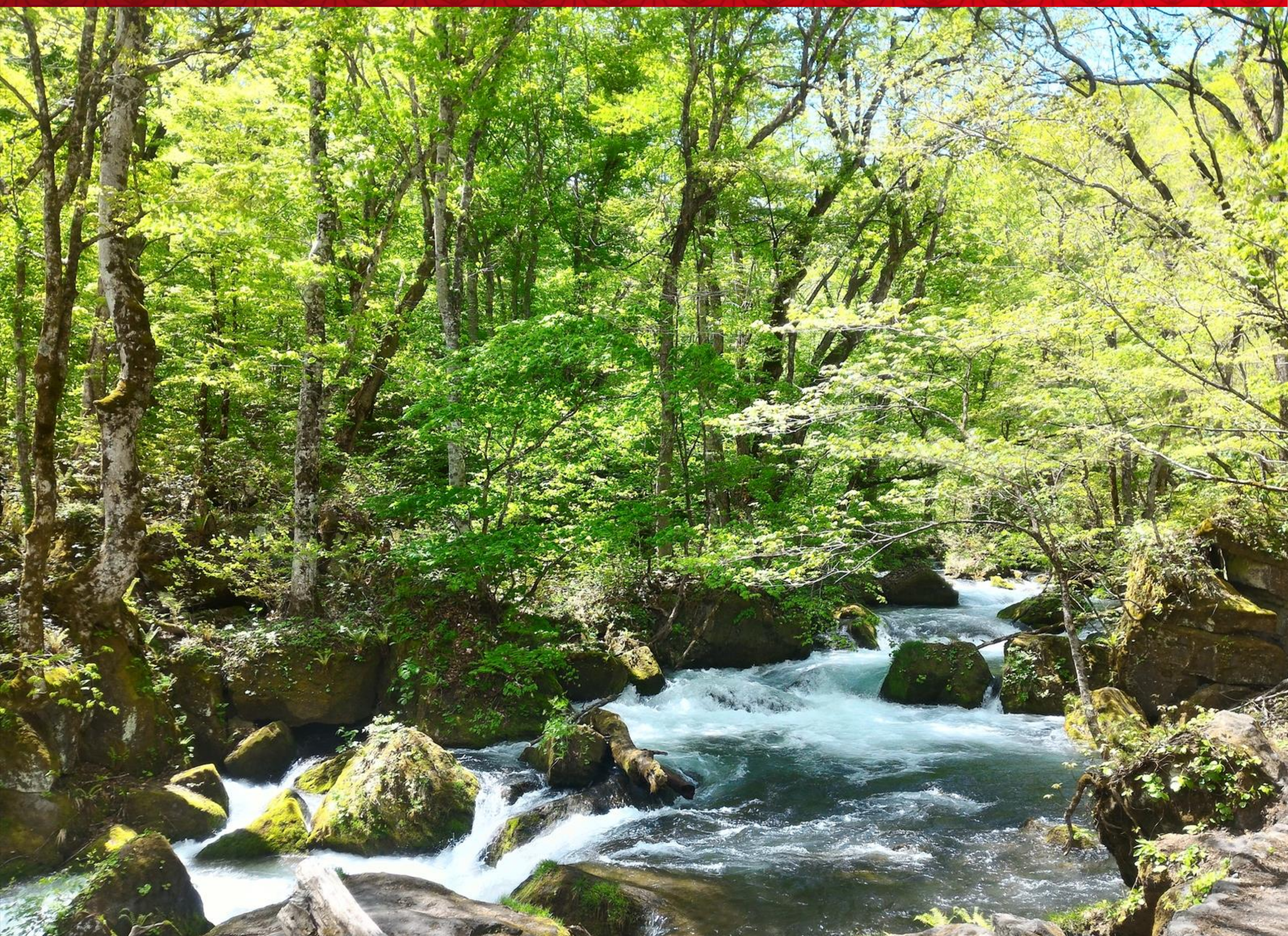
The Government of Japan

Japan's Eighth National Communication and Fifth Biennial Report

under the United Nations Framework Convention on Climate Change

December 2022



Introduction

Prior to the United Nations Framework Convention on Climate Change (UNFCCC) adopted in 1992, Japan formulated the Action Program to Arrest Global Warming in 1990 and has been implementing measures to address climate change issues. Subsequently, the Kyoto Protocol was adopted at the third session of the Conference of the Parties (COP3) in 1997, and Japan established the Global Warming Prevention Headquarters at the Cabinet, and comprehensive and systematic measures have been implemented under the *Act on Promoting Global Warming Countermeasures* and the *Kyoto Protocol Target Achievement Plan*. As a result of the implementation of those measures, the greenhouse gas (GHG) emission reduction target in the first commitment period of the Kyoto Protocol (2008-2012) was achieved. After the first commitment period of the Kyoto Protocol, Japan announced its GHG emission reduction target for FY 2020 at COP19 and continued its efforts to reduce GHG emissions. In addition, Japan ratified the Paris Agreement in 2016 and submitted its Nationally Determined Contribution (NDC), including a mid-term emission reduction target for FY 2030, to the UNFCCC secretariat in March 2020. In November 2020, then Prime Minister Yoshihide Suga declared a goal of achieving carbon neutrality by 2050, and Japan decided and submitted its new NDC consistent with the 2050 carbon neutrality goal to the secretariat in October 2021. At the same time, Japan formulated the *Long-Term Strategy as a Growth Strategy Based on the Paris Agreement,* which presents the basic concept and vision toward carbon neutrality in 2050 and submitted it to the UNFCCC secretariat.

In order to contribute to the achievement of the long-term goal set in the Paris Agreement, which is to hold the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit it to 1.5°C, Japan has been accelerating efforts to reduce greenhouse gas emissions by all entities through the revision of the *Act on Promoting Global Warming Countermeasures* and the *Plan for Global Warming Countermeasures* to achieve the GHG emission reduction target for 2030 indicated in its NDC and carbon neutrality goal by 2050. In addition, Japan has been providing a variety of financial, technological, and capacity-building support to developing countries in order to reduce GHG emissions and improve their adaptive capacity to climate change on a global scale.

Articles 4.1 and 12.1 of the UNFCCC require Parties to submit National Communications (NCs) to the UNFCCC secretariat on a regular basis to confirm the implementation progress of climate change-related commitments made under the Convention. This report is the eighth National Communication (NC8) submitted by Japan under the Convention and related provisions, and it comprehensively describes the climate change policies and related efforts that Japan has implemented and plans to implement in the future.

The structure of this report is consistent with the reporting elements specified in the UNFCCC NC reporting guidelines (Decision 6/CP.25, Annex). Chapter 1, “National Circumstances Relevant to Greenhouse Gas Emissions and Removals”, reports on national circumstances affecting Japan’s GHG emissions and removals. Chapter 2, ”Information on Greenhouse Gas Emissions and Trends”, provides information on GHG emissions and trends between FY 1990 and FY 2020, consistent with Japan’s National Greenhouse Gas Inventory that Japan submits annually to the UNFCCC in accordance with Article 4 and 12 of the UNFCCC. Chapter 3, "Policies and Measures", provides information on Japan's policies and measures to achieve its GHG emission reduction targets. Chapter 4, "Projections", reports on Japan's projected GHG emissions and removals for FY 2030 and their methodologies. Chapter 5, "Vulnerability Assessment, Climate Change Impacts, and Adaptation Measures", provides an overview of policies and measures related to the projected impacts of climate change and adaptation. Chapter 6, "Financial, Technological, and Capacity-Building Support", reports information on financial, technological, and capacity-building support provided by Japan to assist climate change policies and measures in developing countries. Chapter 7, "Research and Systematic Observation", reports information on Japan's research activities and systematic observation of climate change. Chapter 8, "Education, Training and Public Awareness", reports information on environmental education and awareness-raising activities on climate change and support measures for NGOs conducted in Japan.

COP16 decided that developed country parties should submit Biennial Reports (BRs), which include information on the progress of emission reductions achieved and mitigation actions to achieve their quantified economy-wide emission reduction targets, projection of GHG emissions and removals, and the provision of financial, technological, and capacity-building support (Decision 1/CP.16). COP17 decided that developed country parties shall submit the first Biennial Report (BR1) by January 1, 2014, and subsequent BRs every two years, and also adopted the UNFCCC BR reporting guidelines that stipulate the reporting elements to be reported in the BRs (Decision 2/CP.17, Annex I). At COP18 and COP21, the Common Tabular Format (CTF), which developed country parties shall use to report the information required in the BR, was adopted (Decision 19/CP.18, Annex and 9/CP.21, Annex). In accordance with the above provisions, Japan submits its fifth biennial report (BR5) as an annex to this NC8.

The structure of BR5, which is included in Annex I of this report, is consistent with the reporting elements specified in the UNFCCC BR reporting guidelines. Chapter 1 of Annex I, "Information on Greenhouse Gas Emissions and Trends", provides an overview of Japan's GHG emissions and trends between FY 1990 and FY 2020, consistent with Japan’s National Greenhouse Gas Inventory that Japan submits annually to the UNFCCC in accordance with Article 4 and 12 of the UNFCCC. Chapter 2 of Annex I, "Quantified Economy-Wide Emission Reduction Targets", reports Japan's GHG emission reduction targets for FY 2020 and FY 2030. Chapter 3 of Annex I, “Progress in Achievement of Quantified Economy-Wide Emission Reduction Targets and Relevant Information”, presents information on the progress made toward achieving the GHG emission reduction targets and mitigation actions for achieving the targets. Chapter 4 of Annex I, ”Projections”, presents projections of Japan's GHG emissions and removals in FY 2030. Chapter 5 of Annex I, "Financial, Technological, and Capacity-Building Support", reports information on financial, technological, and capacity-building support provided by Japan to assist climate change policies and measures in developing countries.

Table of Contents

Executive Summary

Chapter 1 National Circumstances Relevant to Greenhouse Gas Emissions and Removals

- The population of Japan, as of October 1, 2020, was approximately 126 million. It is predicted that the population of Japan will decline rapidly and reach around 98 to 106 million by 2050.
- As of fiscal year (FY) 2020, Japan's land area equaled 37.80 million hectares, or 0.3% of the total global land area, of which nearly 80% was accounted for as 24.97 million hectares (66.1%) of forests and 4.05 million hectares (10.7%) of agricultural land.
- Japan stretches a great distance from north to south. The southernmost point of the whole land is located at 20 degrees north latitude and the northernmost point at 46 degrees north latitude. With such a structure, various climate zones exist on the islands of Japan, such as subarctic, extratropical, and subtropical zones.
- Japan's GDP for FY 2021 was approximately 541 trillion yen, and GDP per capita was approximately 4.31 million yen.
- The final energy consumption by different sectors in Japan in FY 2020 was 46% for the industrial sector, including non-energy use, 32% for the commercial and residential sector, and 22% for the transport sector.
- The energy mix in electricity generation in FY 2010 was 29.3% for LNG thermal, 28.6% for nuclear, and 25.0% for coal thermal. However, because of the Great East Japan Earthquake in 2011, the nuclear power plants in Japan stopped, and the energy mix in electricity generation has significantly changed after FY 2011. In FY 2020, the energy mix in electricity generation was 39.0% for LNG thermal and 31.0% for coal thermal.
- Japan is one of the most forested countries in the world, and its forested area remains about 25 million hectares, or two-thirds of the country's total land area. Of this, 10 million hectares are planted forests. More than half of them are over 50 years old, and the amount of CO_2 removals is declining because of the maturation of the forests.

Chapter 2 Information on Greenhouse Gas Emissions and Trends

- Total GHG emissions in fiscal year (FY) 2020 (excluding LULUCF, including indirect CO_2) were 1,150 million tonnes CO_2 eq. (Mt CO_2 eq.), which decreased by 9.8% compared to the emissions in FY1990, by 16.8% compared to FY 2005, which is the base year of Japan's emission reduction target for FY 2020, and by 18.4% compared to FY 2013 which is the base year of Japan's emission reduction target for FY 2030.
- Between FY 1990 and FY 2020, CO_2 emissions (excluding LULUCF and indirect CO_2) decreased by 10.0%, CH4 emissions (excluding LULUCF) decreased by 35.6%, and N_2O (excluding LULUCF) decreased by 38.2%.
- Between Calendar Year (CY) 1990 and CY 2020, HFCs emissions increased by 224.7%, PFCs emissions decreased by 46.9%, SF_6 emissions decreased by 84.2%, and NF_3 emissions increased by 785.7%.
- In FY 2020, CO_2 emissions accounted for 90.6% of total GHG emissions. The breakdown of CO_2 emissions shows that emissions from fuel combustion account for 94.7%, followed by industrial processes and product use (4.1%) and waste (1.2%). As for the breakdown of CO_2

emissions within fuel combustion, energy industries accounted for 41.9%, followed by manufacturing industries and construction (22.4%), transport (17.0%), and other sector (13.3%). The main driving factor for the increase in CO_2 emissions since FY 1990 was an increase in solid fuel consumption for electricity power generation.

- Net removals (including CO_2, CH_4 and N_2O emissions) from the LULUCF sector in FY 2020 were 52.0 Mt CO_2 eq. The net removals from the Kyoto Protocol Article 3.3 and 3.4 activities in FY 2020 were 34.5 Mt CO_2 eq.

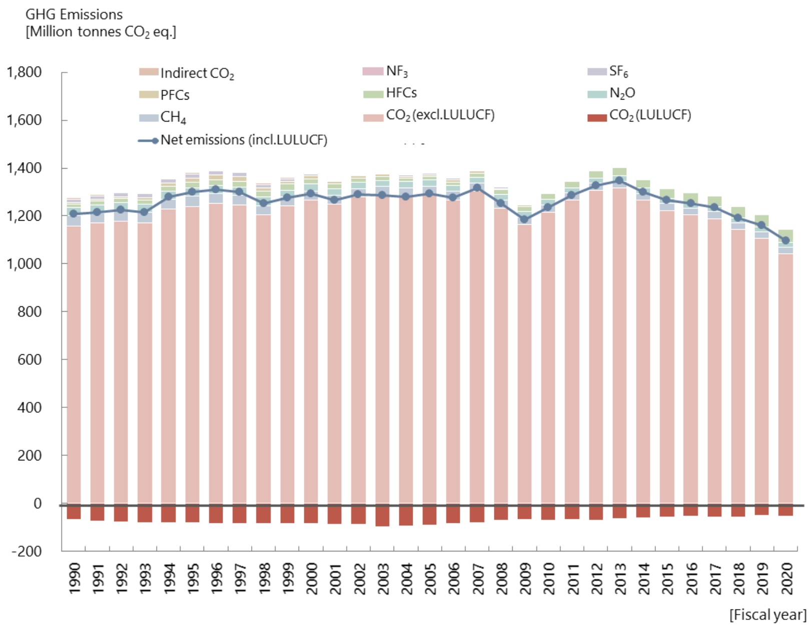


Figure ES-1 Trends in GHG emissions and removals in Japan

Chapter 3 Policies and Measures

(Overall framework of promotion of policies and measures)

- In the *Basic Environment Law* that defines the basic principles regarding environmental conservation in Japan and outlines the basic direction of national policy, the proactive promotion of global environmental conservation is regulated. The government formulates the *Basic Environmental Plan* based on Article 15, paragraph 1, of the Law to comprehensively and strategically promote measures related to environmental conservation. The global warming countermeasure is an important component of the plan.
- Regarding the promotion of global warming countermeasures, there is specific legislation, the *Act on the Promotion of Global Warming Countermeasures*. Article 2.2 of the Act states that global warming countermeasures must be promoted through close cooperation among citizens, the national government, local governments, businesses, and private organizations to realize a decarbonized society by 2050 while integrally promoting environmental conservation and economic and social development. Furthermore, the government established the *Plan for Global Warming Countermeasure* based on Article 8, paragraph 1, of the *Act*. The *Plan for Global Warming Countermeasures* is the only general plan regarding global warming in Japan. This plan sets targets for reducing greenhouse gas (GHG) emissions and removals, basic matters concerning measures that businesses and citizens should

implement, and basic matters concerning measures that the national government and local governments should implement in order to achieve the target.

(Basic concept of global warming countermeasures)

- Integrated improvement of the environment, economy, and society: Japan will promote policies that will help improve the environment, economy, and society on an integrated basis by harnessing local resources, technological innovations, and ingenuity and using AI, the IoT, and other digital technologies in order to stimulate the Japanese economy, create jobs, solve issues plaguing local communities, and enable the achievement of SDGs.
- Green recovery from COVID-19: In recognizing that we stand at a significant crossroads at this time in history, it is necessary to achieve a transformation of the social system into one that is sustainable and resilient rather than return to the society that existed before the emergence of COVID-19. Based on the 2050 declaration of carbon neutrality, Japan will accelerate the three pillars of transition to a decarbonized society, a circular economy, and decentralized society and then redesign in a forceful manner, the economy and society to be sustainable and resilient.
- Transforming the awareness of all actors, changing their behavior, and strengthening their coordination: Knowledge concerning the issue of global warming, which is becoming increasingly serious, and information on what each individual should do and on the state of progress with respect to the implementation of global warming countermeasures should be proactively provided and shared as visibly as possible. Japan will train human resources and develop activities to communicate these ideas and put them into action so as to induce changes in awareness and behavior across all sectors and levels of the nation.
- Contribution to reducing the global GHG emissions by strengthening research and development and spreading superior decarbonization technologies: Japan will strengthen research and development work on innovative technologies that pertain to promising fields based on the *Sixth Basic Plan for Science, Technology, and Innovation* and the *Environment Innovation Strategy*. In addition, Japan will promote the diffusion of leading decarbonization technologies and the implementation of global warming mitigation activities through the Joint Crediting Mechanism (JCM) and other means.
- Response to the Paris Agreement: In order to achieve the goals of the Paris Agreement, Japan will faithfully accommodate the five-year cycle of the communication and update of targets as set forth in the Paris Agreement, as well as the report and review of progress towards the implementation and achievement of the targets. Furthermore, Japan will also proactively contribute to the establishment of detailed international rules for the Paris Agreement.
- Emphasizing the evaluation and review process (PDCA): In order to constantly monitor and ensure the effectiveness of the *Plan for Global Warming Countermeasures*, Japan will strictly check progress with respect to the measures implemented by the government for each countermeasure each year by assessing the emission reductions, the evaluation indicators for countermeasures, and other relevant indicators for greenhouse gas and category, and flexibly review the Plan as required.

(Policies and measures on mitigation actions and their effect)

- For the energy conversion sector of the Energy sector, initiatives such as "Reduction of CO_2 emission intensity in the electric power sector", "Maximum introduction of renewable energy", and "Promotion of the introduction of facilities and equipment with high energy-saving performance in petroleum product manufacturing sector will be promoted.

- For the industry sector, initiatives such as "Promotion of voluntary effort by industry", "Promotion of the introduction of facilities and equipment with high energy-saving performance", "Implementation of thorough energy management", and "Promotion of emissions reductions measures for small and medium businesses" will be promoted.
- For the commercial sector, initiatives such as "Improvement of the energy efficiency of buildings", "Promotion of the introduction of facilities and equipment with high energy-saving performance", "Greening of digital equipment and industry", and "Implementation of thorough energy management" will be promoted.
- For the residential sector, initiatives such as "improvement of energy efficiency of housing", "Promotion of the introduction of facilities and equipment with high energy-saving performance", and "Implementation of thorough energy management" will be promoted.
- For the transport sector, "Diffusion of next-generation vehicles and improvement of fuel efficiency", "measures for road traffic flow", "Promotion of the use of public transportation and bicycles", "Measures for railways, ships and aviation", and "Promotion of decarbonized logistic systems" will be promoted.
- For the industrial processes and product use (IPPU) sector, reduction of fluorinated gases emissions such as "Promotion of non-fluorocarbons and low GWP1 products", "Preventing leakage of fluorocarbons from the use of refrigeration and air-conditioning equipment for business use" and "Recovery and proper disposal of fluorocarbons from refrigeration and air-conditioning equipment", and reduction of CO_2 emissions from cement production by an expansion of the use of blended cement will be promoted.
- For the agriculture sector, measures for CH_4 emission reduction from rice cultivation and N_2O emission reduction associated with fertilizer application will be promoted.
- Regarding forest carbon sink measures in the land use, land use change and forestry (LULUCF) sector, initiatives to be implemented will include "Maintenance of healthy forests", "Promotion of appropriate management and conservation of protection forests and, natural parks", "Fostering efficient and stable forest management", and "People's participation in forest management" and "Promotion of the use of wood and woody biomass". For measures to increase carbon sinks in agricultural soils, carbon sequestration in cropland and grassland soils will be promoted through the continuous application of organic matter, such as compost and green manure to the soil. Also, urban greening and initiatives related to blue carbon will be promoted.
- For the waste sector, initiatives such as "Diffusion of biomass plastics", "Reduction of waste incineration", and "Advancement of incineration at sewage sludge incineration facilities" will be implemented.
- As cross-cutting measures, "Activation of J-Credit scheme," "Promotion of JCM", "Realization of a hydrogen society", "Initiatives based on guidelines for controlling GHG emissions", "GHG emissions accounting, reporting, and disclosure program", and "Pro-Growth Carbon pricing", will be promoted.

Chapter 4 Projections

[1] Global Warming Potential: The degree of effect of each GHG on global warming, expressed as a ratio to the effect of CO_2.

(General)

- The future projections of greenhouse gas (GHG) emissions and removals of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3) for FY 2030 are estimated by gas and sector.
- The projected total GHG emissions (excluding the net GHG removals contribution of the LULUCF sector) in FY 2030 under a *with measures* scenario is approximately 813 Mt CO_2 eq., which is a decrease of 42% from FY 2013. Taking into account the projections for the GHG removals contribution of LULUCF (removals by forest carbon sinks [approximately 38 Mt CO_2], carbon sinks in agricultural soils [approximately 8.5 Mt CO_2] and urban greening [approximately 1.2 Mt CO_2]) and the Joint Crediting Mechanism (JCM) in FY 2030, the projected total GHG emissions for FY 2030 will be a reduction of 46% from FY 2013.

(Projections by gas)

- The projected emissions of energy-related CO_2 in FY 2030 decrease by 45% compared to the emissions in FY 2013 (approximately 677 Mt CO_2). A significant reduction is expected in all sectors, and the reduction rate is particularly large in the residential and commercial sectors.
- The projected emissions of non-energy-related CO_2 (Fugitive emissions from fuels, Industrial Processes and Product Use (IPPU), Agriculture, Waste, and Indirect CO_2) in FY 2030 decrease by 15% compared to FY 2013 (approximately 70.0 Mt CO_2).
- The estimated CH_4 emissions in FY 2030 decrease by 11% compared to FY 2013 (approximately 26.7 Mt CO_2 eq.). The largest reduction rate from FY 2013 is in the waste sector, followed by fugitive emissions from fuels.
- The N_2O projected emissions in FY 2030 decrease by 17% compared to FY 2013 (approximately 17.8 Mt CO_2 eq.). The largest reduction rate from FY 2013 is in the fuel combustion sector, followed by the IPPU sector.
- The projected emissions of fluorinated gases (HFCs, PFCs, SF_6, and NF_3) in CY 2030 decrease by 44% from CY 2013 (approximately 21.8 Mt CO_2 eq.).

(Projections by sector)

- The projected emissions of the energy sector in FY 2030 are a decrease of 45% compared to FY 2013 (approximately 683.3 Mt CO_2 eq.).
- The projected emissions of the IPPU sector in FY 2030 are a decrease of 25% compared to FY 2013 (approximately 65.5 Mt CO_2 eq.). The main factor in the emission decrease in FY 2030 is an emission reduction in the refrigerants sector by leakage prevention of fluorocarbons from the use of refrigerators and air conditioners, promotion of the recovery of fluorocarbons in disposal and promotion of eliminating fluorocarbons, and the lowering of the GWP.
- The projected emissions from the agriculture sector in FY 2030 are a decrease of 3% compared to FY 2013 (approximately 31.7 Mt CO_2 eq.). The main driver of the emission decrease in FY 2030 is the emission reduction from rice cultivation through the implementation of emission reduction measures.
- The estimated net removals of the LULUCF sector in FY 2030 (based on the scope of the national GHG inventory) are approximately 39.8 Mt CO_2.

- The projected emissions from the waste sector in FY 2030 are a decrease of 24% compared to FY 2013 (approximately 30.7 Mt CO_2 eq.). The main drivers of the emission decrease in FY 2030 are a decrease in the amount of waste incineration, final disposal and treated wastewater by depopulation and promotion of 3R (Reduce, Reuse, Recycle), and CO_2 emission reduction in plastics incineration by the introduction of biomass plastics.
- The estimated indirect CO_2 emissions in FY 2030 are a decrease of 11% compared to FY 2013 (approximately 2.1 Mt CO_2 eq.). The main drivers of the emission decrease in FY 2030 are a decrease in the carbon content and the amount of use of solvents such as paint.

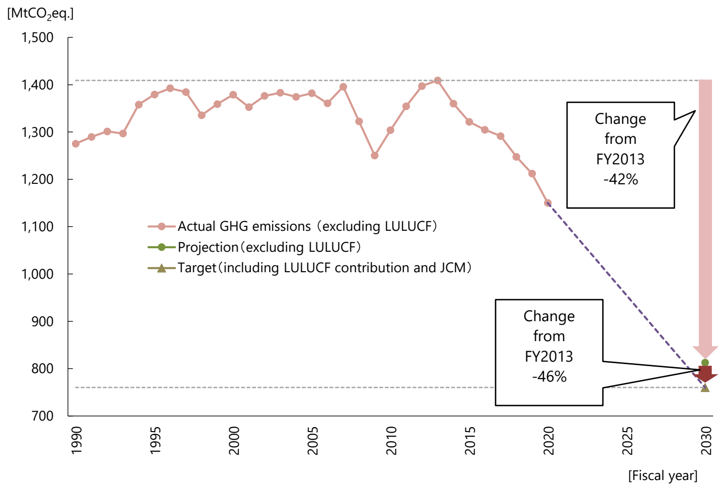


Figure ES-2 GHG emission and removal projections under a *with measures* scenario

Chapter 5 Vulnerability Assessment, Climate Change Impacts, and Adaptation Measures

(Institutional and legal framework for climate change adaptation measures)

- The *National Plan for Adaptation to the Impacts of Climate Change* was established and approved by the Cabinet in November 2015 (final revision: October 2021). Later, in order to define the legal position of climate change adaptation and to promote climate change adaptation more strongly in collaboration with a variety of stakeholders, including the national government, local governments, business operators, and citizens, the *Climate Change Adaptation Act* was promulgated in June 2018 and has been in force since December 2018.

(Objectives and progress management)

- The objectives of Japan's adaptation measures are to prevent and mitigate damage from the impact of climate change; to promote the stable life of citizens, sound development of society and the economy, conservation of the natural environment, and achievement of resilient national land by promoting measures related to climate change adaptation integrally and systematically based on scientific findings; and to build a safe, comfortable, and sustainable society.
- The progress of adaptation measures is to be periodically checked under the Climate Change Adaptation Promotion Council, which is chaired by the Minister of the Environment and

composed of the relevant ministries and agencies.

(Major climate change impacts assessments and adaptation measures on individual sectors)

- In the *Assessment Report on Climate Change Impacts in Japan* that was published in December 2020, the impact that climate change could have on Japan is assessed for 71 categories covering seven sectors (agriculture, forestry, and fisheries; water environment and water resources; natural ecosystems; natural disasters and coastal areas; human health; industrial and economic activities; and life of citizenry and urban life) from three perspectives, including the degree and possibility of the impact (significance), the expression time of the impact, the time when adaptation efforts need to be started, and when an important decision needs to be made (urgency), and the certainty of evidence (confidence). The result of the assessment indicates that the impacts of climate change are significant and urgent.
- The Adaptation Plan that was revised in October 2021 sorted the climate change impacts for each category, and the basic concept of adaptation measures in consideration of the climate change impacts assessment in the aforementioned report.

(Adaptation efforts by local governments)

- In local governments, as of March 2022, 155 local governments have formulated *Local Climate Change Adaptation Plans* and are implementing adaptation measures based on local circumstances in a planned manner. As of March 2022, 47 local governments established Local Climate Change Adaptation Centers that serve as bases to collect, organize, analyze, and provide information related to local climate change impacts and climate change adaptation and to provide technical advice.

(Cross-sectoral efforts and international cooperation)

- Regarding cross-sectoral efforts, the *National Climate Change Adaptation Plan* stipulates basic measures for the enhancement and utilization of scientific knowledge on climate change and other related issues; basic measures related to ensuring the system for collection, organization, analysis, and provision of information related to climate change; basic measures related to the promotion of measures related to climate change adaptation with local governments; basic measures related to the promotion of climate change adaptation by business operators and business activities contributing to climate change adaptation; and basic measures for securing international collaboration and promoting international cooperation related to climate change.
- Concerning international cooperation, the *National Climate Change Adaptation Plan* positions the "contribution to increasing the adaptive capacity of developing countries" as one of its basic strategies, and the national government promotes the enhancement of scientific findings related to climate change risks, the provision of stakeholders' support tools, development of capacities related to the assessment of climate change impacts and climate change adaptations through the Asia-Pacific Climate Change Adaptation Information Platform (AP-PLAT). In addition, the national government promotes technical cooperation in the observation, monitoring, projection, and assessment of climate change and its impacts, as well as DRR, climate change adaptation of agriculture, among others, and the international development of Japanese adaptation businesses using AP-PLAT and DIAS, etc.

(Other basic measures related to promoting adaptation measures)

- In 2020, a new crisis, COVID-19, emerged in addition to climate change. They are deeply connected to each other. Social changes to improve the environment, economy, and society integrally, the conservation of biodiversity, and coexistence with nature are essential to overcoming the crisis. For this reason, it is important to direct environmental policy in Japan through three transitions: the transition to a decarbonized society, the transition to a circular economy, and the transition to a decentralized society in harmony with nature, and then for local governments to develop regions newly based on the concept of a Circular and Ecological Economy, and for citizens to redesign society into one where each person changes their lifestyle. Based on these concepts, Japan is taking on various efforts.

Chapter 6 Financial, Technological, and Capacity-Building Support

(Finance)

- Japan has provided a variety of climate change support through multilateral and bilateral frameworks to support the implementation of the Paris Agreement by developing countries.
- Under the Actions for Cool Earth 2.0 (ACE 2.0) announced at COP21 in 2015, Japan made a commitment to provide approximately 1.3 trillion yen per year of both public and private climate finance to developing countries in 2020. This commitment was achieved in 2020 according to Japan’s latest climate finance figures.
- Japan's climate change support to developing countries during the two-year period from 2019 to 2020 reached to approximately 24.5 billion USD (public finance amounted to approximately USD billion USD, private finance amounted to approximately 3.8 billion USD. Regarding the Green Climate Fund (GCF), Japan, in addition to its contributions of 1.5 billion USD to the GCF for initial resource mobilization (2015-2018), has committed to making contributions of up to 1.5 billion USD for the First Replenishment (2020-2023) of the GCF.
- Based on these achievements, a new climate finance commitment from 2021 was announced by former Prime Minister Suga at the G7 Cornwall Summit in June 2021 to provide climate assistance for developing countries totaling 6.5 trillion yen in public and private over the five years from 2021 to 2025. In addition, at COP26 in November 2021, Prime Minister Kishida announced up to 10 billion USD over the five years from 2021 and 2025 on top the 6.5 trillion yen announced at the G7 Cornwall Summit in order to take the initiative in fulfilling the financial gap in annual 100 billion USD joint mobilization goal of climate finance by developed countries. Furthermore, as part of these financial commitments, Japan announced at COP26 that it would double its support for adaptation, totaling approximately 1.6 trillion yen in public and private financial support for adaptation over the five years from 2021 to 2025.
- As a major developed country, Japan will continue to support actions to address climate change in developing countries by steadily implementing its financial commitments.

(Technology Development and Transfer)

- Japan will contribute to solving the climate change problem all over the world through the development of technologies in the environment and energy fields (Innovation), and by taking a leadership role in the international diffusion of the technologies (Application) based on proactive diplomatic initiatives for countering global warming, which is called the Actions for Cool Earth Japan as announced in November 2013.

- Japan will deepen the discussions for driving innovation through the Innovation for Cool Earth Forum (ICEF), which aims to be the global platform to promote discussions and cooperation on innovation among the worldwide academic, industrial, and public sectors. Also, Japan will promote demonstration projects to create innovations for drastically redeveloping advanced low-carbon technology in accordance with the specific characteristics of developing countries. Japan will also create co-innovation projects by incorporating the needs of developing countries and the seeds provided by Japanese industries, while taking the initiative in dispatching business missions to developing countries and accelerating the collaboration of private companies and local governments on both sides. Furthermore, Japan will foster further innovation by sharing information on the dissemination of innovative technology to developing countries and its effectiveness.
- Regarding the implementation of adaptation projects in developing countries, Japan will support adaptation projects based on the priorities and needs of each country, while diversifying the financial resources, including mobilization of private finance, through collaboration with Japanese cooperation organizations or governmental financial institutions, including the Japan International Cooperation Agency (JICA), Japan Bank for International Cooperation (JBIC), and the Nippon Export and Investment Insurance (NEXI).
- Japan has been promoting the global application of existing low-carbon and decarbonizing technologies. Accelerating the diffusion of such technologies and verifying the reduction effect from the technologies through the Joint Crediting Mechanism (JCM) etc., which has implemented more than 200 GHG emission reduction projects, will realize further emission reductions of greenhouse gases and new economic growth simultaneously.

(Capacity-building)

- To accelerate climate change measures and sustainable development in developing countries, Japan will collaborate with them by utilizing its advanced technology and know-how, create co-innovation that reflects their challenges and needs, and contribute to the global reduction of GHG emissions. Japan will incorporate the needs of each country and the seeds of technology and know-how acquired by private Japanese companies and local governments and promote the creation of specific projects to find solutions that lead to co-innovation among Japan and developing countries.
- Regarding capacity-building support for adaptation, Japan will support the consolidation and dissemination of information on climate risk, the establishment of risk evaluation methods, and the development of national adaptation plans in developing countries.
- Regarding the capacity-building support for mitigation, Japan will support institutional and capacity development to develop concrete plans and measures as well as a review of progress. Japan will provide such support by using its experience and know-how and collaborating with JICA, the National Institute for Environmental Studies (NIES), etc.
  Regarding the capacity-building support for transparency, Japan provides institutional and capacity development to establish policies and systems to achieve the emission reduction target through the Partnership to Strengthen Transparency for Co-Innovation (Partnership to Strengthen Transparency for co-Innovation: PaSTI), and the Workshop on Greenhouse Gas Inventories in Asia (WGIA) to support Asian countries to improve the accuracy of their GHG inventories and to facilitate the enhancement of cooperative relationships.

Chapter 7 Research and Systematic Observation

(General)

- The *Plan for Global Warming Countermeasures* stipulates that Japan promotes research on climate change and strengthens the observation and monitoring system as a fundamental measure for global warming policies and measures.
- The *Plan for Adaptation to the Impacts of Climate Change* stipulates that Japan promotes observation, monitoring, prediction, and assessment, as well as research and studies of climate change and climate change impacts in various fields and develops scientific knowledge on climate change prediction based on the latest research results as a basic strategy.

(Research)

- The *Sixth Science, Technology and Innovation Basic Plan* set the promotion of social transformation and discontinuous innovation toward overcoming global-scale challenges as an initiative to transform Japan into a sustainable and resilient society that ensures the safety and security of the people. Specifically, Japan creates highly accurate climate change prediction information and promotes the accumulation and utilization of global environment big data, such as greenhouse gas observation data and prediction information, in order to contribute to solving climate change.
- Under the *Environment Innovation Strategy*, Japan aims to establish innovative technologies by 2050 that will enable the world to become carbon-neutral and reduce CO_2 emissions in the stock-base.
- Japan participates in and cooperates with international global environmental research programs, such as the World Climate Research Program (WCRP) and Future Earth, and conducts research and studies based upon the appropriate international division of tasks, as well as promotes joint research and other initiatives with overseas research organizations.
- Through the Asia-Pacific Network for Global Change Research (APN), Japan enhances activities related to global change research in the Asia-Pacific region by cooperating with researchers and governmental officers throughout the region.

(Systematic observation)

- Japan promotes comprehensive measures for observation and monitoring of climate change under the "Implementation Policy of Earth Observations for 10 years" based on the "Earth Observation Promotion Strategy" and the "Sixth Science, Technology, and Innovation Basic Plan". In the promotion, bearing in mind Japan's contribution to developing the Global Earth Observation System of Systems (GEOSS), ensure the consistency with international observation and monitoring projects in terms of methods and take care to enable effective data utilization through exchanging outcomes of activities of observation and monitoring organizations each other, such as by utilizing the "Data Integration and Analysis System" (DIAS) connected to GEOSS on behalf of Japan.
- Japan participates in and cooperates with international observation and monitoring programs conducted under the Global Climate Observing System (GCOS), Global Atmosphere Watch (GAW), the Global Ocean Observing System (GOOS), and the Global

Environmental Monitoring System (GEMS), which contribute to the development of GEOSS. Japan also conducts wide-area observation and monitoring based on the appropriate sharing of international tasks. In addition, Japan also facilitates the utilization of observation and monitoring data through joint research and knowledge networks, such as the APN.

- It is important to effectively promote Earth observation by satellites with coordination on a worldwide scale in accordance with Japan’s Basic Plan on Space Policy. Japan actively leads the activities of the Committee on Earth Observation Satellites (CEOS) and other international forums and promotes the development, launch, and operation of satellites in conformity with these activities. Furthermore, through GEOSS, Japan promotes integrated global observations combining satellites, aircraft, ships, and ground-based observation in cooperation with international organizations and research projects.

Chapter 8 Education, Training, and Public Awareness

(General)

- The government of Japan provides opportunities to learn about global warming and energy issues via home education, school education and social education through the operation of the Law for the Promotion of Environmental Conservation Activities through Environmental Education and the promotion of Education for Sustainable Development (ESD). Furthermore, Japan promotes improved awareness through advertising in the mass media, distributing pamphlets, and holding symposiums. Japan is also committed to increasing support for environmental NGOs, which promise to play a leading role as advisors in public efforts to address global warming.
- Japan actively provides and shares knowledge about the global warming issue, the specific actions for which enormous efforts are needed in order to curb GHG emissions, and information about what each individual must do. Japan also carries out public relations and dissemination activities on these topics in order to improve the awareness of households and businesses and to rouse them to take action.

(Education in schools)

- Japan formulated the basic policies for the promotion of environmental education based on the *Law for the Promotion of Environmental Conservation Activities through Environmental Education*, and promotes integrated measures related to environmental education in order to encourage the public, private organizations, and others to address the initiatives of environmental conservation on their own initiative.
- Japan set up the Interministerial Meeting for the Education for Sustainable Development (ESD) and actively promotes the related measures. The implementation plan of ESD in Japan was formulated in May 2021, and efforts are being made for its systematic implementation.

(Public awareness raising and public involvement)

- Japan encourages voluntary actions by each individual citizen by strongly appealing to public awareness. This is done through the appropriate provision of information using diverse methods. In doing so, Japan works to foster a sound sense of crisis, using the latest scientific knowledge, and to provide information and educate the public concerning what specific actions or purchases contribute to the education in greenhouse gas emissions or the promotion of measures for carbon sinks.

(Support for NGOs and other organizations)

- The government of Japan and local governments provide financial support for environmental NGOs which are indispensable for the success of mitigating global warming. Japan continues to strengthen its support to the extent that is does not distort the original objective of their activities.

(Monitoring, review and evaluation of the implementation of Article 6 of the Convention)

- In Japan, there is no formal monitoring, review and evaluation process specific to the implementation of Article 6 of the Convention. However, as described in the relevant chapters of this report, activities related to Article 6 are implemented as a part of Japan's ongoing climate change education, training, and public awareness activities; transparency activities such as the preparation of national greenhouse gas inventories, national communications and biennial reports; implementation of mitigation and adaptation policies; and activities related to supporting developing countries.

Chapter 1

National Circumstances Relevant to Greenhouse Gas Emissions and Removals

1.1 Overview

- The population of Japan, as of October 1, 2020, was approximately 126 million. It is predicted that the population of Japan will decline rapidly and reach around 98 to 106 million by 2050.
- As of fiscal year (FY) 2020, Japan's land area equaled 37.80 million hectares, or 0.3% of the total global land area, of which nearly 80% was accounted for as 24.97 million hectares (66.1%) of forests and 4.05 million hectares (10.7%) of agricultural land.
- Japan stretches a great distance from north to south. The southernmost point of the whole land is located at 20 degrees north latitude and the northernmost point at 46 degrees north latitude. With such a structure, various climate zones exist on the islands of Japan, such as subarctic, extratropical, and subtropical zones.
- Japan's GDP for FY 2021 was approximately 541 trillion yen, and GDP per capita was approximately 4.31 million yen.
- The final energy consumption by different sectors in Japan in FY 2020 was 46% for the industrial sector, including non-energy use, 32% for the commercial and residential sector, and 22% for the transport sector.
- The energy mix in electricity generation in FY 2010 was 29.3% for LNG thermal, 28.6% for nuclear, and 25.0% for coal thermal. However, because of the Great East Japan Earthquake in 2011, the nuclear power plants in Japan stopped, and the energy mix in electricity generation has significantly changed after FY 2011. In FY 2020, the energy mix in electricity generation was 39.0% for LNG thermal and 31.0% for coal thermal.
- Japan is one of the most forested countries in the world, and its forested area remains about 25 million hectares, or two-thirds of the country's total land area. Of this, 10 million hectares are planted forests. More than half of them are over 50 years old, and the amount of CO_2 removals is declining because of the maturation of the forests.

1.2 Government

1.2.1 Administrative organization

The administrative organization of Japan is as shown in Figure 1-1. It consists of 1 Office and 13 Ministries as of August 2022. The roles of each major ministry are as described below.

Principle roles

Cabinet

Cabinet Office	・Assistance of the administrative tasks of the Cabinet on important measures ・Coordination among relevant ministry and governmental institutions on measures of wide range of sectors
Digital Agency	・Support the Council of Ministers to create a digital society ・Prompt and focused execution of administrative tasks related to the formation of a digital society
Reconstruction Agency	・Plan, coordinate, and implement the national policy on reconstruction from the damages of the Great East Japan Earthquake ・Responsible as a unified point of contact, assistance, etc. to local public bodies
Ministry of Internal Affairs and Communications	・Secure total and efficient administerial implementation through management and operation of basic administrative system ・Enhancement of coordination among the central and local government, as well as among the local government
Ministry of Justice	・Sustaining and maintaining basic legislation ・Maintenance of legal orders
Ministry of Foreign Affairs	・Management of peaceful and safe international society ・Management of good international relations
Ministry of Finance	・Secure healthy financial balance ・Appropriate operation of Customs services
Ministry of Education, Culture, Sports, Science and Technology	・Promotion of education and lifelong learning ・Creating necessary frameworks to promote science and technology
Ministry of Health, Labour and Welfare	・Improvement and enhancement of social welfare, social security and public health ・Maintenance of work environment for workers such as work conditions, and job security
Ministry of Agriculture, Forestry and Fisheries	・Securing stable food supply ・Growth of agriculture, forestry and fisheries industries
Ministry of Economy, Trade and Industry	・Secure economic development and industrial growth ・Secure stable and efficient supply of mineral source and energy
Ministry of Land, Infrastructure, Transport and Tourism	・Overall and systematic use, development and maintenance of national land ・Promotion of government transportation policies
Ministry of the Environment	・Maintenance of global environment, preventing pollutions, protection and conservation of natural environment ・Securing safety of nuclear power usage
Ministry of Defense	・Protection of peace and independency, maintenance of national security ・Control and operation of Japan's Ground Self-Defense Force, Maritime Self-Defense Force, and Air Self-Defense Force

Figure 1-1 Administrative organization of Japan (as of August 2022)

Reference: Cabinet Office "Figure of Administrative organization (as of August 2021),"
Act for Establishment of each ministry

1.2.2 Global Warming Prevention Headquarters

The climate change countermeasures in Japan are being promoted by various ministries and agencies under the Global Warming Prevention Headquarters established in the Cabinet. The headquarters was established in 2005 under the *Act on Promotion of Global Warming Countermeasures* (Act No. 117 of 1998). It is headed by the Prime Minister with the Chief Cabinet Secretary, the Minister of the Environment, and the Minister of Economy, Trade and Industry as vice chairmen and all other Ministers as members.

1.2.3 Budget for Global Warming Countermeasures

The plan for global warming countermeasures has been promoted as a plan for the comprehensive and strategic implementation of Japan's global warming countermeasures to build a mid and long-term decarbonized society. In order to assess the overall government initiatives from a budget perspective and to enhance linkage among ministries, the plans for the budget amount related to the global warming countermeasure are collected.

The plan for the budget related to the global warming countermeasures per each measure for FY 2022 is 384.4 billion yen (57%) for "A. Those effective for GHG reduction by 2030," 47.6 billion yen (7%) for "B. Those effective for GHG reduction after 2030," 201.2 billion yen (30%) for "C. Those contributing to GHG reduction as a result," and 40.3 billion yen (6%) for "D. Basic measures etc." (Table 1-1).

Table 1-1 Budget plan for Global Warming Countermeasures related matters in FY 2022

(Unit：million yen)

	A	B	C	D
	Measures effective for GHG reduction by 2030	Measures effective for GHG reduction after 2030	Measures contributing to GHG reduction as a result	Basic measures, etc.
Ministry of Economy, Trade and Industry	95,475	37,094	109,422	5,404
Ministry of the Environment	141,373	7,315	40,556	18,008
Ministry of Agriculture, Forestry and Fisheries	126,687	837	37,220	2,053
Ministry of Land, Infrastructure, Transport and Tourism	14,458	65	11,602	979
Ministry of Education, Culture, Sports, Science and Technology		2,329		8,354
Others	6,422		2,448	5,518
All ministries and offices	**384,416**	**47,640**	**201,248**	**40,315**

Note1: It does not include those that cannot be identified by global warming countermeasures.
Note2: Numbers may not add up due to rounding.

Reference: Ministry of the Environment "Budget plan for Global Warming Countermeasures related matters for FY 2022"

The breakdown of the global warming countermeasures related budget per measure per sector, "Measures for Managing Forest Carbon Sinks and utilization of biomass" is 184.0 billion yen (27%) and is the largest, followed by "Initiatives by Commercial and other sector" as 126.9 billion yen (19%), and "Initiatives by Energy industry sector" as 114.6 billion yen (17%).

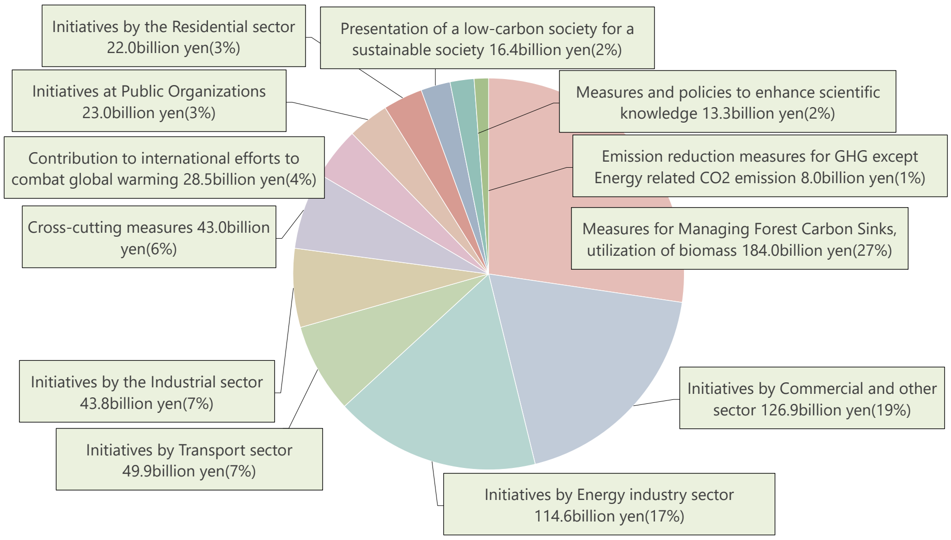


Figure 1-2　Breakdown of the budget plan for Global Warming Countermeasures

Reference: Ministry of the Environment "Budget plan for Global Warming Countermeasures related matters for FY 2022"

1.3 Population and households

1.3.1 Population structure

The population of Japan just after World War II was approximately 72 million, and it had consistently been on an increasing trend during the 20th century, reaching over 100 million in 1967. However, the rate of increase in the population slowed down after the 1980s. After reaching 128 million in 2008, the population has fallen into a decreasing trend. The population of Japan as of October 2020 is approximately 126 million. The population of Japan is expected to decline rapidly in the future, and it is predicted to decrease to approximately 98 million to 106 million by 2050.

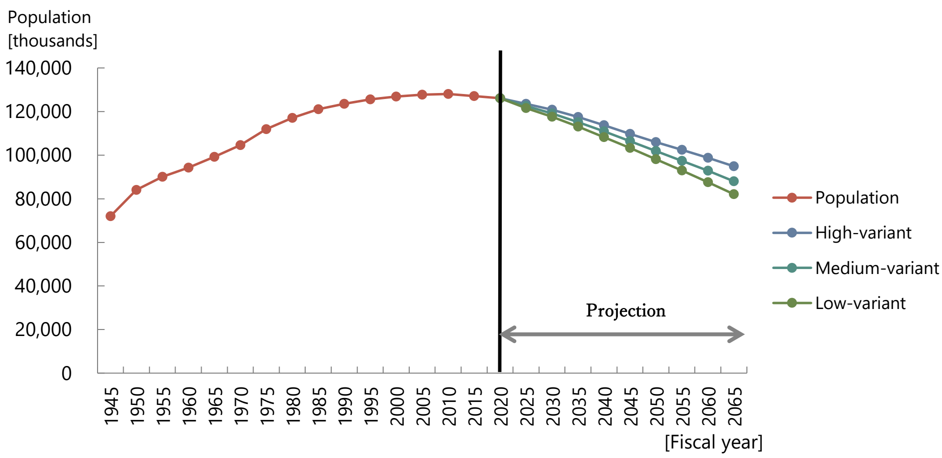


Figure 1-3　Long-term trend in Japan's population (as of October 1 of each year)

Reference: Statistics Bureau, Ministry of Internal Affairs and Communications "Population Census" (1945-2020)
National Institute of Population and Social Security Research "Population Projections for Japan: (medium-mortality)" (after 2021)

Changes in Japan's population structure are shown in Figure 1-4 and Figure 1-5. Japan's population structure is characterized by the peaks seen in the first baby boomer period brought about by the increase in marriages immediately after World War II, and by the second baby boomer period, which was brought about by the birth of children of the first baby boomers, and by the bottom of the pyramid narrowing after that.

When comparing the population structure of 2020 to that of 1990, the population from age 0-64 in 1990 was approximately 90% of the total population with a relatively high portion of the younger generation. On the other hand, in 2020, the population from age 0-64 was approximately 70% of the population, nearly 20 points less compared to that of 1990. It shows the population is aging.

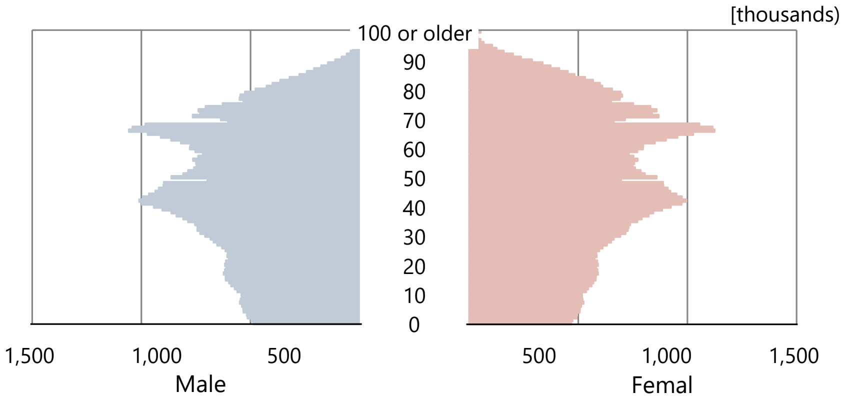


Figure 1-4 Japan's population pyramid (as of October 1, 2020)

Reference: Ministry of Internal Affairs and Communications "2020 Population Census"

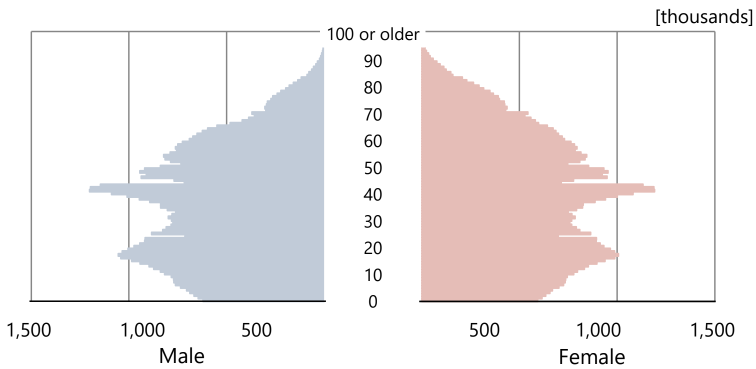


Figure 1-5 Japan's population pyramid (as of October 1, 1990)

Reference: Ministry of Internal Affairs and Communications "1990 Population Census"

One of the major factors behind the aging of the population is the decline in the number of births. The total fertility rate was more than 4.00 immediately after World War II, however, it declined rapidly after that and rated lower than the replacement level[2] for the first time in 1956

[2] Replacement level is the total fertility rate which does not increase or decrease the population.

(2.24 in that year). Since then, the total fertility rate has gradually declined, reaching less than 2.00 after 1975. In recent years, the total fertility rate has been on a gradual upward trend since 2006. However, it began to decline in 2016, with a total fertility rate of 1.33 in 2020.

In the post-war period, average longevity had increased, and as the number of live births was large before the High Economic Growth period as well, natural changes, which is a deduction of the number of deaths from the number of live births, had appeared positive for a long period of time. However, because of the decrease in the number of live births and the increase in the number of deaths, the natural changes turned negative for the first time in 2005. Although it turned positive in 2006 tentatively, the number of natural changes has been on a downward trend since then.

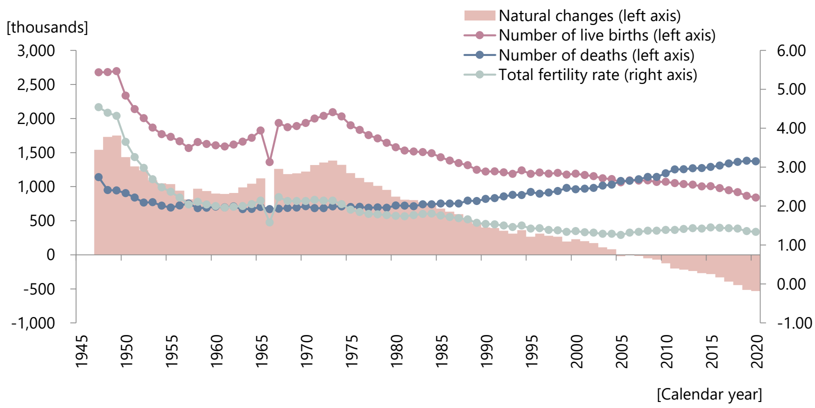
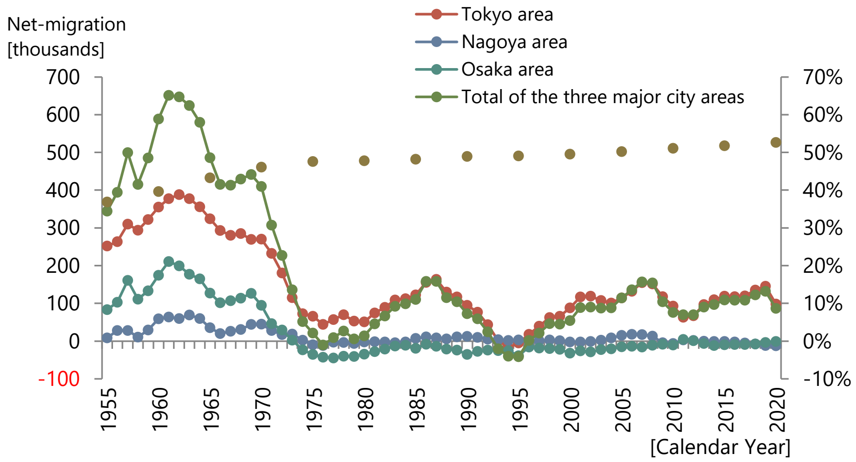


Figure 1-6 Trend in number of live births and deaths, total fertility rate in Japan

Reference: Ministry of Health, Labor and Welfare "Vital Statistics"

1.3.2 Population distribution

Trends in positive and negative net migration to the three metropolitan areas (Tokyo, Nagoya and Osaka) are shown in Figure 1-7. During the 1950s and the 1970s, positive migration to the three metropolitan areas greatly exceeded negative migration as many of those born in the suburban areas moved out for employment and further education. Soon after, in the mid-1970s and onwards, when the Japanese economy entered a period of stable growth, the number of positive migrations to the three metropolitan areas slowed down. When looking at each metropolitan area, for the Nagoya and Osaka areas, the excess of positive net migration is close to zero in the long term, having almost no positive migration of the population. On the other hand, the excess of positive migration has slowed down, and the migration results in excess throughout time, accelerating the centralization of the population to Tokyo.



Note 1: Tokyo area includes Saitama, Chiba, and Kanagawa prefectures and the Tokyo metropolitan area.
Note 2: Nagoya area includes Gifu, Aichi, and Mie prefectures.
Note 3: Osaka area includes Kyoto, Osaka, Hyogo, and Nara prefectures.

Figure 1-7　Area with centralized population

Reference: Ministry of Internal Affairs and Communications “Report on Internal Migration in Japan”

When looking at the portion of the population of the three metropolitan areas against the total population, it was 36.9% in 1955 and increased to 52.6% in 2020. From this data, the population had centralized to metropolitan areas throughout the post-war era. According to the population distribution of Japan as of 2020 (Figure 1-8), centralized population areas with a population more than 5,000 persons per square kilometer are mainly the Tokyo, Nagoya, and Osaka areas. On the other hand, areas with a population of less than 100 persons per square kilometer share much of the land, and there are areas with no residents around the Hokkaido, Tohoku, and Hokuriku areas.

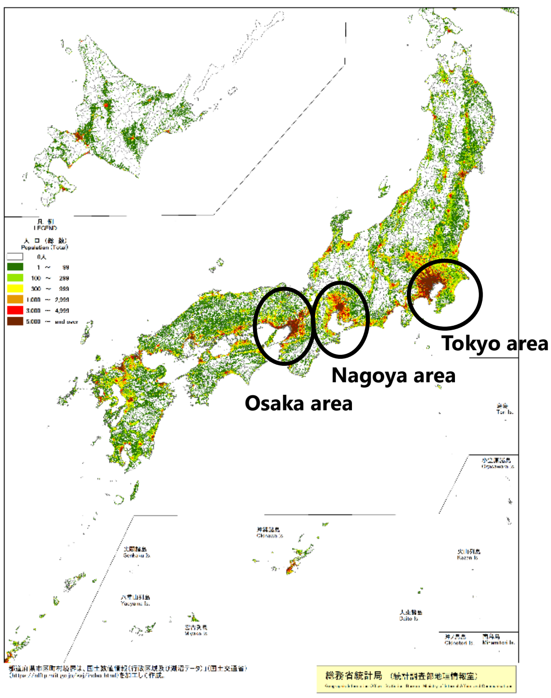


Figure 1-8　Total population (as of October 1, 2020)

Reference: Ministry of Internal Affairs and Communications “Statistical Maps on Grid Square Basis for 2020 Population Census”

1.3.3 Number of households

The number of households in Japan in 2020 was approximately 56 million, an increase of 4.4% compared to 2015. The number of persons per household in 2020 decreased to 2.21 compared to 2.33 in 2015. After 1970, the number of households continued to grow, and the number of persons per household continued to decrease. These changes were due to the changes in the household structure, such as the shift from big families to nuclear families and the increase of one-person households, as well as a decrease in the number of children due to the decrease in the fertility rate.

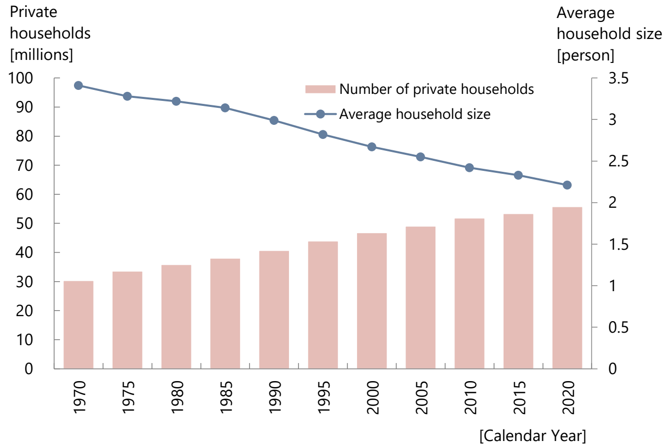


Figure 1-9 Number of households and number of people per household (as of October 1 of each year)

Reference: Ministry of Internal Affairs and Communications "Population Census"

As for the change in the number of households with the number of people per household, the number of households of single and two people is increasing with the increasing rate of households of single people being particularly significant. The household of three people had increased by 2010 but in 2015 turned into a downward trend. Households with more than four people have consistently decreased after 1990.

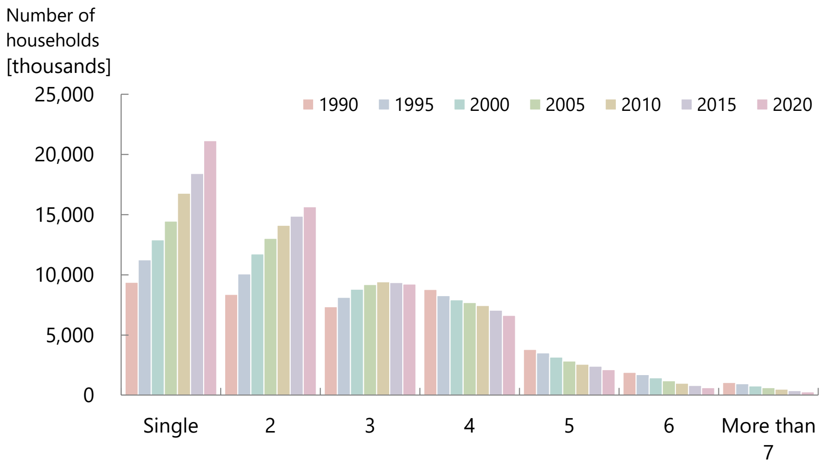


Figure 1-10 Number of households per the number of people per household (as of October 1 of each year)

Reference: Ministry of Internal Affairs and Communications "Population Census"

1.3.4 Impact on greenhouse gases

As described above, since Japan's population is expected to decrease in the future, it is predicted that Japan's energy consumption will decrease as a whole, and energy-related CO_2 emissions will decrease accordingly. On the other hand, since the number of households is increasing because of the increase in the number of single-person households, CO_2 emissions from the residential sector may not trend downward.

In addition, the concentration of the population in the three metropolitan areas may contribute to a decrease in CO_2 emissions from the transport and residential sectors since urban areas have better public transportation systems and a smaller residential area per household than rural areas.

1.4 National land use

Japan, located on the east side of Eurasia, is a long, thin archipelago that lies approximately between latitudes 20 and 46 north and consists of four major islands -(from north to south) Hokkaido, Honshu, Shikoku, and Kyushu- as well as more than 6,800 other islands.

As of FY 2020, Japan’s land area equaled 37.80 million hectares, or 0.3% of the total global land area, of which nearly 80% was accounted for as 24.98 million hectares (66.1%) of forests and 4.05 million hectares (10.7%) of agricultural land. Looking at the changes in land use compared to FY 2015, cropland is decreasing while the forest, wetlands, and settlements are increasing.

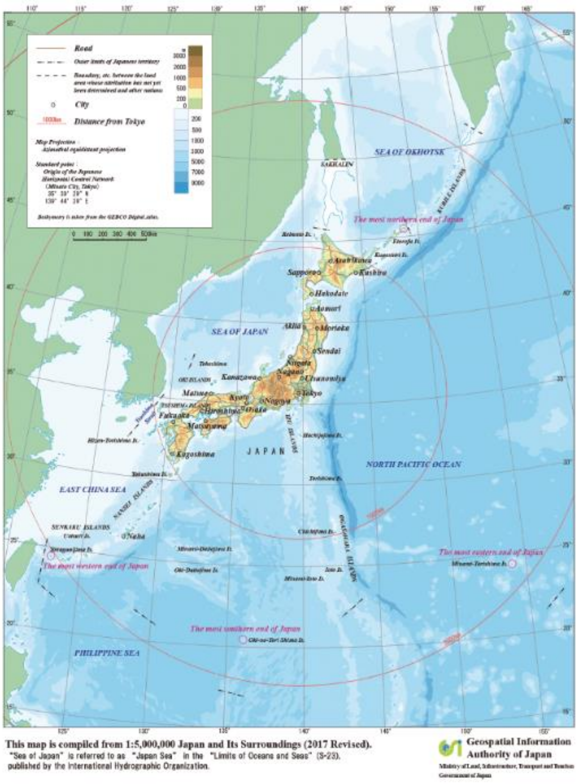


Figure 1-11 Map of Japan

Reference: Ministry of Land, Infrastructure, Transport and Tourism “Map of Japan”

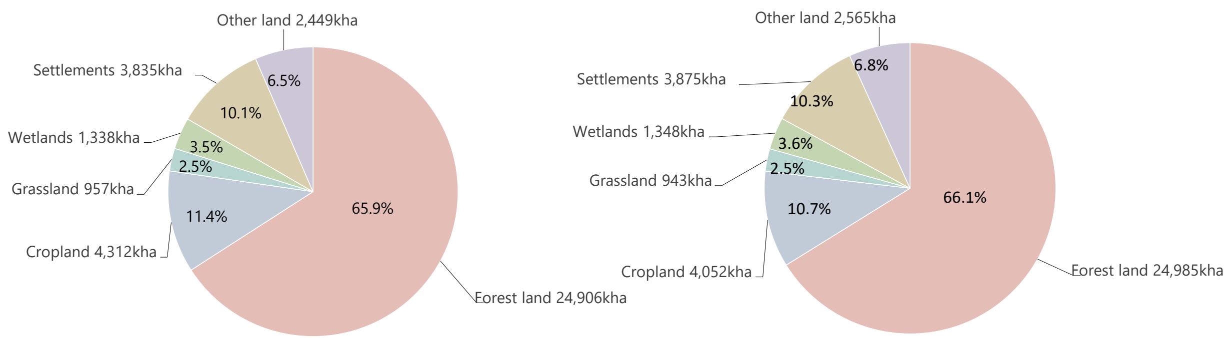


Figure 1-12 Current land use in Japan[3] in FY 2015 (left figure) and in FY 2020 (right figure)

Reference: National Institute for Environmental Studies "National Greenhouse Gas Inventory Report of Japan"

1.5 Climate

1.5.1 Overview of average climate

Japan stretches over a great distance from north to south with its southernmost point of land, including remote islands, located at 20 degrees north latitude, and the northernmost point at 46 degrees north latitude. With such a structure, various climate zones exist on the islands of Japan, such as subarctic, extratropical, and subtropical zones. The difference in climate, when compared to the latitudes, and the difference in temperature are about 10 degrees Celsius or so between the Hokkaido area and the Okinawa area during summer. However, as the seasonal rain front or typhoons often hit the southern part of the country, the precipitation in the southern part of Japan compared to the northern part is remarkably higher. On the other hand, the average temperature in Okinawa during winter is above 15 degrees Celsius most of the time, whereas in Hokkaido, it often falls below zero. Therefore, the temperature gap within the country during winter is significant at more than 20 degrees Celsius. Sixty-one percent of the land of Japan is mountains, and in many areas, the mountain ranges divide the islands of Japan into the coastal areas facing the Pacific Ocean or the Sea of Japan. By orographic rainfall, the climates on the Pacific Ocean side and the Sea of Japan side are significantly different. In winter, seasonal cold winds from Siberia onto the coastal areas facing the Sea of Japan result in having more days of snowfall and, in areas near the mountains, result in a large amount of snowfall that piles up more than three meters high. In the coastal area facing the Pacific Ocean, dry winds blow down along the mountains bringing more clear days.

[3] "Settlements" are urban regions that do not correspond to forests, agricultural land, grasslands, or marshes. Figures are from the National Institute for Environmental Studies and consist of those directly assessed using existing statistics and those estimated for a portion of lands that could not be directly assessed.

Table 1-2 Major Climate Components of Japan[4] (the 1991-2020 average)

		Latitude	Longitude	Elevation (m)	Average Temperature(℃)		Annual Precipitation (mm)	Total Snow Depth (cm)
					August	February		
Northern Japan	Abashiri	44° 01.0'	144° 16.7'	37.6	19.6	-5.4	844.2	312
	Nemuro	43° 19.8'	145° 35.1'	25.2	17.4	-3.8	1,040.4	159
	Suttsu	42° 47.7'	140° 13.4'	33.4	21.2	-1.9	1,250.6	454
	Yamagata	38° 15.3'	140° 20.7'	152.5	25.0	0.4	1,206.7	285
	Ishinomaki	38° 25.6'	141° 17.9'	42.5	23.6	1.6	1,091.3	51
Eastern Japan	Fushiki	36° 47.5'	137° 03.3'	11.6	26.7	3.3	2,281.0	238
	Choshi	35° 44.3'	140° 51.4'	20.1	25.5	6.9	1,712.4	0
	Iida	35° 31.4'	137° 49.3'	516.4	25.4	2.3	1,688.1	61
Western Japan	Sakai	35° 32.6'	133° 14.1'	2.0	27.3	5.3	1,903.3	75
	Hamada	34° 53.8'	132° 04.2'	19.0	26.8	6.5	1,654.6	-
	Hikone	35° 16.5'	136° 14.6'	87.3	27.5	4.2	1,610.0	81
	Miyazaki	31° 56.3'	131° 24.8'	9.2	27.6	8.9	2,625.5	0
	Tadotsu	34° 16.5'	133° 45.1'	3.7	28.3	6.4	1,116.8	-
Okinawa and Amami	Naze	28° 22.7'	129° 29.7'	2.8	28.5	15.3	2,935.7	0
	Ishigakijima	24° 20.2'	124° 09.8'	5.7	29.4	19.4	2,095.5	0

Reference: Japan Meteorological Agency "Table of Monthly Climate Statistics"

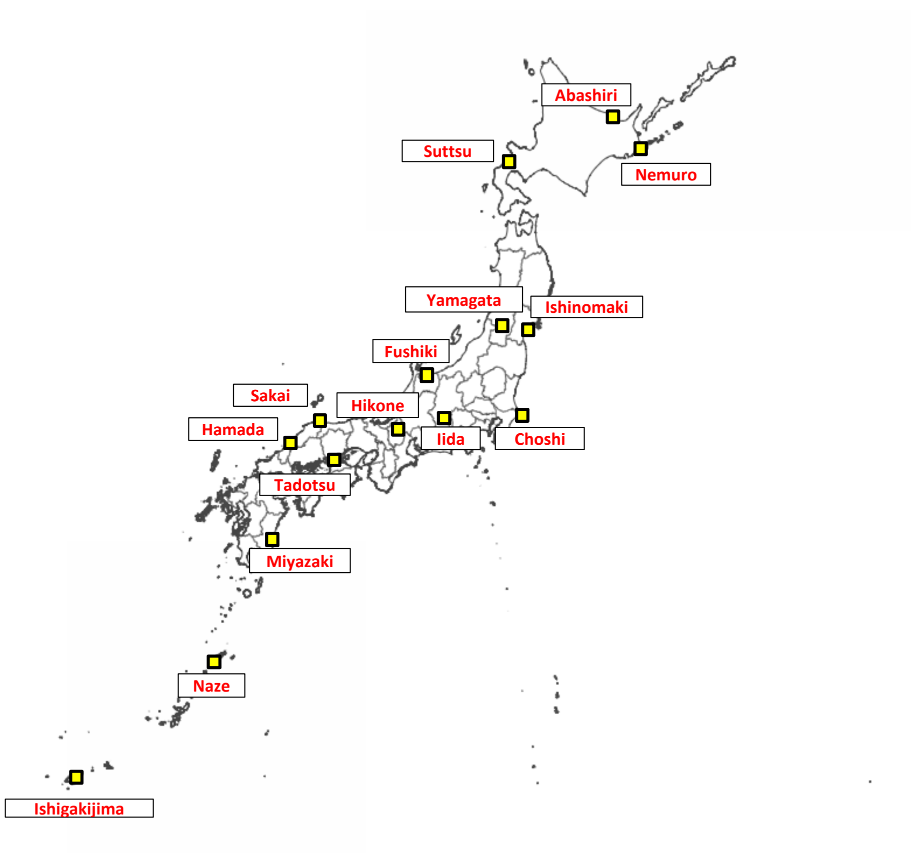


Figure 1-13 Distribution of 15 observation stations in Table 1-2

Reference: Japan Meteorological Agency: "Surface weather observation (as of December 24, 2021)"

[4] Areas with less influence of urbanization and with long-term observations are selected. These 15 observation stations are used to calculate surface temperature anomalies over Japan.

1.5.2 Temperature

Long-term trends of annual mean surface temperature anomalies from 1898 to 2021 in Japan[5] are shown in Figure 1-14.

The annual mean temperature in Japan fluctuates on different time scales ranging from years to decades. On a longer time scale, it is virtually certain that the annual mean surface temperature over Japan has risen at a rate of 1.28°C per century. Similarly, it is virtually certain that the seasonal mean temperatures for winter, spring, summer, and autumn have risen at rates of about 1.20ºC, 1.53ºC, 1.16ºC, and 1.27°C per century, respectively. The temperature anomaly for 2021 is estimated to have been 0.61°C, which is the third highest since statistics began in 1898. The high temperatures seen in recent years in Japan and the rest of the world have been influenced by fluctuations over different time scales ranging from years to decades, as well as by global warming resulting from increased concentrations of greenhouse gases.

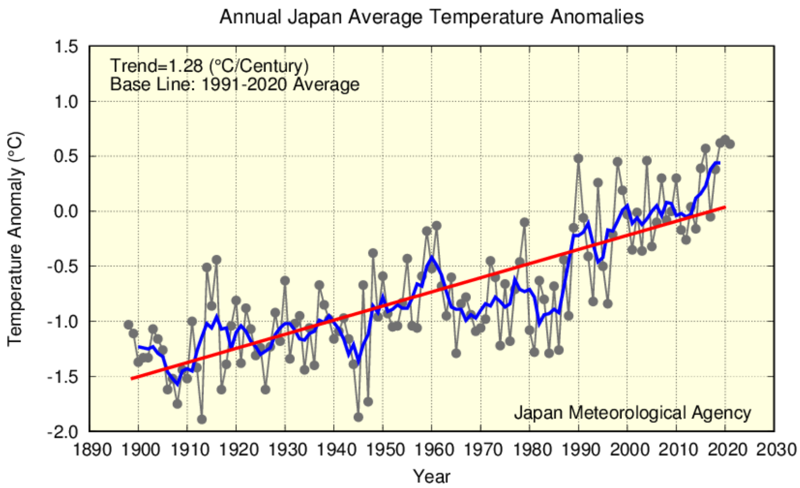


Figure 1-14 Annual surface temperature anomalies in Japan (1898-2021)

The thin gray line indicates surface temperature anomaly calculated by 15 observation stations. The blue line indicates the five-year running mean[6], and the red line indicates the long-term linear trend.

Reference: Japan Meteorological Agency "Climate Change Monitoring Report 2021 "(P48 Figure 2.3-4)

Figure 1-15 and Figure 1-16 show the long-term trends of extremely high/low-temperature events in Japan[7] from 1901 to 2021. The frequency of extremely high temperatures has increased, while that of extremely low temperatures has decreased. These trends are consistent with the rising annual mean temperature shown in Figure 1-14.

[5] Anomalies are deviations from the baseline (the 1991 – 2020 average) in 15 observation stations in Table 1-2. Miyazaki and Iida were relocated in May 2000 and May 2002, respectively, and their temperatures have been adjusted to eliminate the influence of the relocation.

[6] Average value for the total of five years, the corresponding year and two years before and after.

[7] Here, judgment of extremely high/low temperatures is based on the fourth highest/lowest monthly values on record over the 121-year period from 1901 to 2021. The annual occurrences of extremely high/low monthly mean temperatures are derived from an analysis of temperature records from the 15 observation stations in Table 1-2. Monthly mean temperatures of the stations in Miyazaki and Iida have been adjusted to eliminate the influence of their relocation.

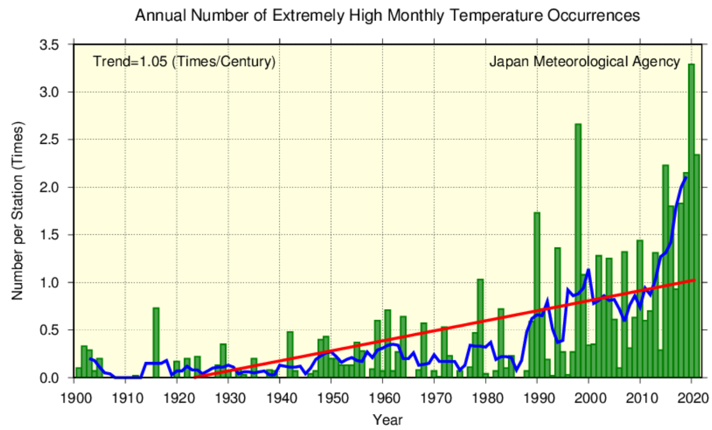


Figure 1-15　Annual number of extremely high monthly mean temperature occurrences (1901–2021)

The green bars indicate annual occurrences of extremely high monthly mean temperatures per station. The blue line indicates the five-year running mean, and the straight red line indicates the long-term linear trend.

Reference：Japan Meteorological Agency "Climate Change Monitoring Report 2021" (P49 Fig. 2.3-5）

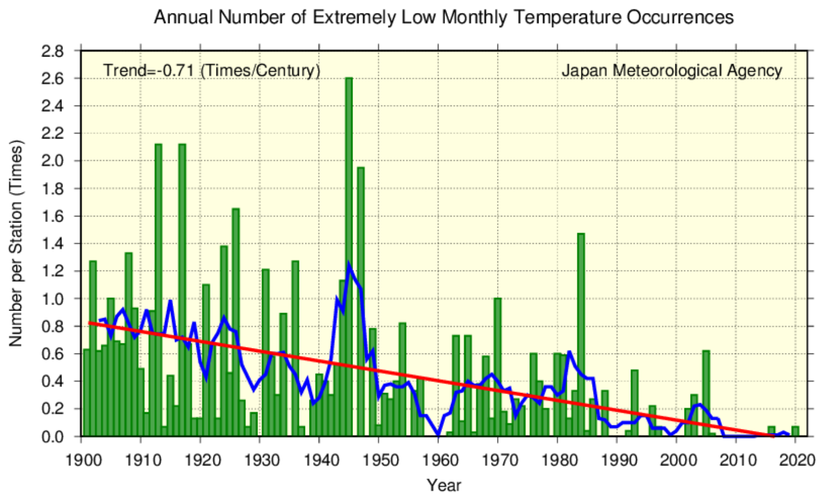


Figure 1-16　Annual number of extremely low monthly mean temperature occurrences (1901–2021)

The green bars indicate annual occurrences of extremely low monthly mean temperatures per station. The blue line indicates the five-year running mean, and the straight red line indicates the long-term linear trend.

Reference：Japan Meteorological Agency "Climate Change Monitoring Report 2021" (P49 Fig. 2.3-5)

1.5.3　Precipitation

Figure 1-17 shows the annual precipitation anomalies from 1898 to 2021.[8] There is no obvious long-term trend in the annual precipitation in Japan. Japan experienced relatively large amounts

[8] In order to analyze the long-term trends of precipitation, more observation stations are needed compared to that of temperature because there are large variances in each area. Precipitation anomalies in Japan are calculated using 51 observation stations whose observation data homogeneity continues for the long term.
Asahikawa, Abashiri, Sapporo, Obihiro, Nemuro, Suttsu, Akita, Miyako, Yamagata, Ishinomaki, Fukushima, Fushiki, Nagano, Utsunomiya, Fukui, Takayama, Matsumoto, Maebashi, Kumagaya, Mito, Tsuruga, Gifu, Nagoya, Iida, Kofu, Tsu, Hamamatsu, Tokyo, Yokohama, Sakai, Hamada, Kyoto, Hikone, Shimonoseki, Kure, Kobe, Osaka, Wakayama, Fukuoka, Oita, Nagasaki, Kumamoto, Kagoshima, Miyazaki, Matsuyama, Tadotsu, Kochi, Tokushima, Naze, Ishigakijima, Naha.
Anomalies are deviations from the baseline (the 1991 to 2020 average) at the 51 observation stations described above.

of rainfall until the mid-1920s, around the 1950s and after the 2010s. The annual figure was more variable for the period from the 1970s to the 2000s.

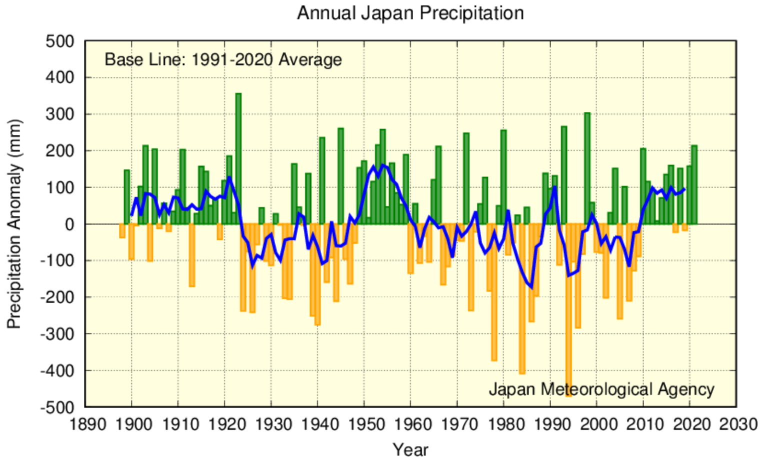


Figure 1-17 Annual anomalies in precipitation in Japan (1898–2021)

The bars indicate the average precipitation anomaly for each year at 51 observation stations. The blue line indicates the five-year running mean.

Reference: Japan Meteorological Agency "Climate Change Monitoring Report 2021" (P54, Fig.2.4-2)

The trends of occurrence of extreme precipitation events in Japan, the number of days with daily precipitation ≥ 200 mm and the number of days with daily precipitation ≥ 1.0 mm[9] (Figure 1-18 and Figure 1-19) indicate that the annual number of days with precipitation over 200 mm is extremely likely to have increased, whereas the annual number of days with precipitation ≥ 1.0 mm is virtually certain to have decreased. These results suggest a decrease in the annual number of wet days including light precipitation and in contrast, an increase in extremely wet days.

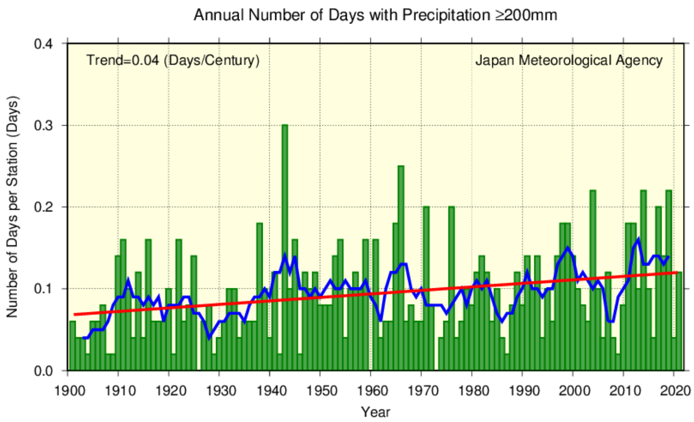


Figure 1-18 Annual number of days with precipitation ≥ 200 mm (1901–2021)

The green bars indicate the annual number of days per station. The blue line indicates the five-year running mean, and the straight red line indicates the long-term linear trend.

Reference：Japan Meteorological Agency "Climate Change Monitoring Report 2021" (P55 Fig. 2.4-4)

[9] The number of days with daily precipitation ≥ 200 mm and the number of days with daily precipitation ≥ 1.0 mm shows the total number of days with daily precipitation at the above 51 observation stations divided by the available observation stations number and annual number of days per station.

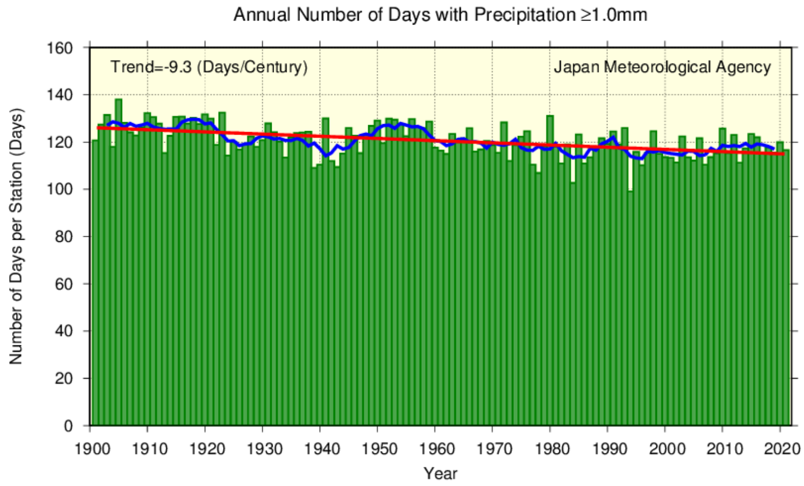


Figure 1-19 Annual number of days with precipitation ≥ 1.0 mm (1901–2021)

The green bars indicate the annual number of days per station. The blue line indicates the five-year running mean, and the straight red line indicates the long-term linear trend.

Reference : Japan Meteorological Agency "Climate Change Monitoring Report 2021" (P55 Fig. 2.4-5)

1.6 Economy

1.6.1 Gross Domestic Production

Japan's economy grew extremely rapidly in the 1960s, resulting in the significant development of heavy industry and producing essential material products such as steel and petrochemical materials. In the 1970s, the oil shock induced the shift of the industrial structure from the basic materials to manufacturing and assembly. In the latter half of the 1980s, the so-called Bubble Economy[10] started and was triggered by the domestic demand expansion attributed to the increased number of public projects supported by fiscal measures or to the increased money supply by the expansionary monetary policy. In 1990s land prices and stock values crashed, and so did the Bubble Economy. Since then, Japan's economy entered a long period of a low growth rate. Japan's economy in the 1990s continued to stagnate from the lingering impact of the crash of the Bubble Economy, including a negative growth rate of the real gross domestic product (GDP)[11] to the previous year in FY 1993. In FY 1995, the growth rate of the real GDP reached over 3%, and again in FY 1997 turned negative due to the influence of the financial crisis in 1997 and 1998.

In the 2000s, the economy gradually recovered as exports grew from the depreciation of the yen and global economic recovery. The length of economic expansion marked the longest in the post-war era, exceeding the Izanagi boom.[12] In FY 2007, the financial insecurity and economic slowdown in the United States with the inflation of petroleum and materials gradually slowed Japan's economy. The growth rate of the real GDP turned negative compared to the

[10] Asset price movement away from the theory of price. It indicates Japan's 11th business cycle.

[11] GDP by chain-linked method (Benchmark year = 2015). GDP for 1980-1993 are reference values based on a simplified retrospective methods.

[12] It indicates Japan's 6th business cycle.

previous year for two consecutive periods after the global financial crisis in 2008.

With the financial crisis remaining, the Great East Japan Earthquake made the economic situation difficult in the early 2010s.After the economy hit the trough in November 2012, the gradual recovery continued through 2018 as a steadily positive economic cycle started with increased corporate earnings leading to higher wages and employment growth, which in turn led to further corporate earnings growth through increased consumption and investment. However, with the global outbreak of COVID-19 from 2020 onward, the declaration of the states of emergency and other factors put downward pressure on consumer spending and external demand. The real GDP growth in FY 2020 marked a 4.1% decline from the previous year, the largest drop since 1980, when comparable figures were available. While there are risks such as a downturn in overseas economies due to global monetary policy tightening and other factors, the impact of a high inflation rate on households and businesses, and supply-side constraints, efforts to normalize economic and social activities have progressed amid the increase of vaccination rate, and a gradual recovery has continued since the end of 2020.

Japan's real GDP in FY 2021 was approximately 541 trillion yen, and GDP per capita was approximately 4.31 million yen.

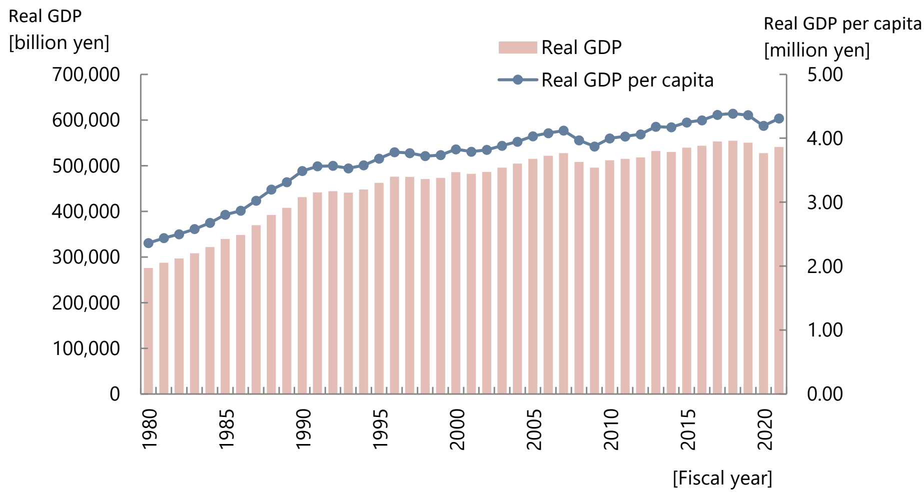


Figure 1-20 Trend of Real GDP[13]

Reference: Cabinet Office "Provisional estimates of GDP (Benchmark year = 2015)" (FY 1980-FY 1993)

Cabinet Office "Quarterly Estimates of GDP for Jul. to Sep. 2022 (The Second Preliminary) (Benchmark year=2015)" (FY 1994-FY 2021)

Ministry of Internal Affairs and Communications, "Monthly Report on Population Estimates"

[13] Real GDP per capita is obtained by dividing the country's gross domestic product by the total population computed by averaging the population figures for each month.

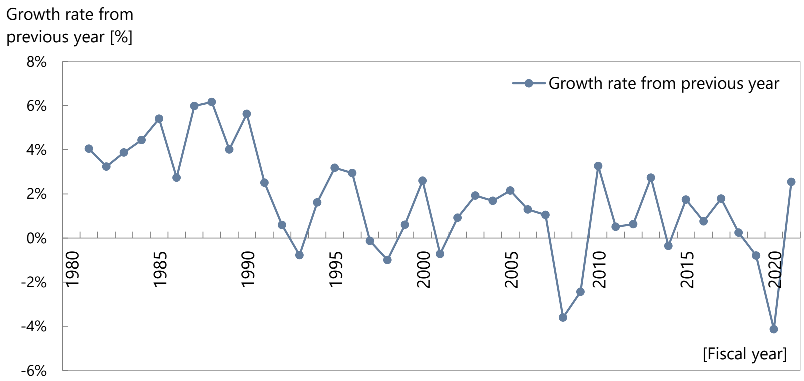


Figure 1-21 Trend in Real GDP growth rate from previous year

Reference: Cabinet Office "Provisional estimates of GDP (Benchmark year = 2015)" (FY 1981-FY 1994)
Cabinet Office "Quarterly Estimates of GDP for Jul. to Sep. 2022 (The Second Preliminary) (Benchmark year = 2015)" (FY 1995-FY 2021)

Table 1-3 Japan's Business Cycle

Cycle	Trough	Peak	Trough	Term		
				Expansion	Recession	Total
1st Cycle		Jun.1951	Oct.1951		4 months	
2nd Cycle	Oct.1951	Jan.1954	Nov.1954	27 months	10 months	37 months
3rd Cycle	Nov.1954	Jun.1957	Jun.1958	31 months	12 months	43 months
4th Cycle	Jun.1958	Dec.1961	Oct.1962	42 months	10 months	52 months
5th Cycle	Oct.1962	Oct.1964	Oct.1965	24 months	12 months	36 months
6th Cycle	Oct.1965	Jul.1970	Dec.1971	57 months	17 months	74 months
7th Cycle	Dec.1971	Nov.1973	Mar.1975	23 months	16 months	39 months
8th Cycle	Mar.1975	Jan.1977	Oct.1977	22 months	9 months	31 months
9th Cycle	Oct.1977	Feb.1980	Feb.1983	28 months	36 months	64 months
10th Cycle	Feb.1983	Jun.1985	Nov.1986	28 months	17 months	45 months
11th Cycle	Nov.1986	Feb.1991	Oct.1993	51 months	32 months	83 months
12th Cycle	Oct.1993	May.1997	Jan.1999	43 months	20 months	63 months
13th Cycle	Jan.1999	Nov.2000	Jan.2002	22 months	14 months	36 months
14th Cycle	Jan.2002	Feb.2008	Mar.2009	73 months	13 months	86 months
15th Cycle	Mar.2009	Mar.2012	Nov.2012	36 months	8 months	44 months
16th Cycle	Nov.2012	Oct.2018	May.2020	71 months	19 months	90 months

Reference: Cabinet Office "Business-Cycle Peak and Trough"

1.6.2 Trade structure

Japan's trade balance was at a surplus from the 1990s to 2010 but turned into a deficit in 2011 because of the influences of the Great East Japan Earthquake, a major flood in Thailand, yen appreciation, and the European debt problem. The trade surplus has decreased since then, marking the highest record for a trade deficit in 2014 by 10.4653 trillion yen. The balance turned into a surplus in 2016, not due to the increase in the export amount but the decrease in import amount. In 2018, the trade balance turned into a deficit again, affected by the slowdown of the Chinese economy. In 2020, both exports and imports declined from the previous year because of the impact of the COVID-19 pandemic, but the decline in imports exceeded the decline in exports, resulting in the first trade balance surplus in three years.

Looking at Japan's imports by major commodity in 2021, mineral fuels accounted for the largest share, followed by electrical equipment. On the other hand, exports are dominated by machinery, transportation equipment, and electrical machinery. Compared to 1990, the value of imports has increased by about 2.5 times, and the value of exports has doubled, indicating that globalization has increased trade with other countries.

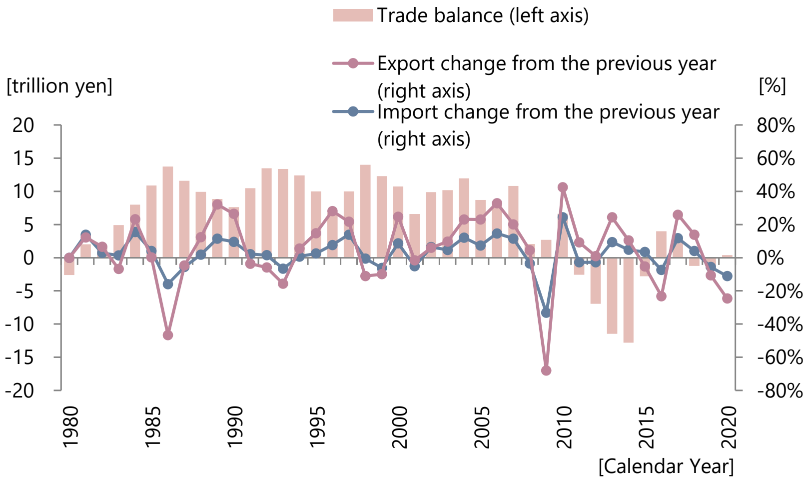


Figure 1-22 Japan's Trade Trend (Calendar year)

Reference: Ministry of Finance "Trade Statistics"

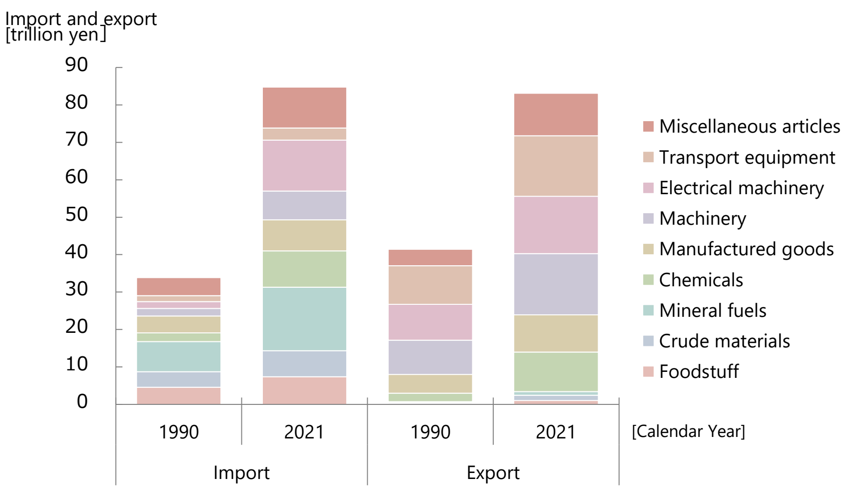


Figure 1-23 Japan's imports and exports by main goods (Calendar year)

Reference: Ministry of Finance "Trade Statistics"

1.6.3 Labor force

Japan's labor force in 2020, which was approximately 68.7 million, decreased by approximately 200,000 compared to the previous year. According to the breakdown per age group, the labor force of age 15 to 64, which was approximately 59 million, decreased by approximately 300,000 compared to the previous year. On the other hand, the labor force for ages over 65 reached approximately 9.2 million, which was an increase of 150,000 compared to the previous year; the growth of the labor force of age over 65 was contributing to the increase of the total labor force.

Comparing the ratio of the labor force per age group, in 1975 the ratio of the labor force for ages over 65 accounted for 4.6% and increased to 13.4% in 2020. The labor force structure indicates a trend in aging as similarly indicated in the population structure.

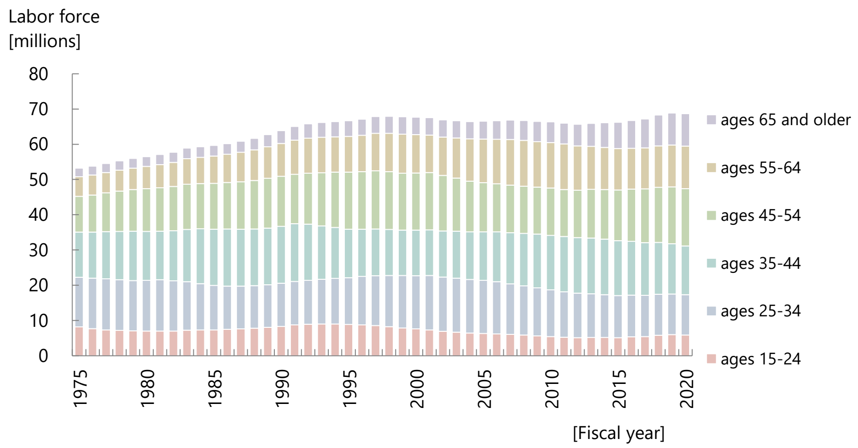


Figure 1-24 Trends in Labor Force (annual mean)

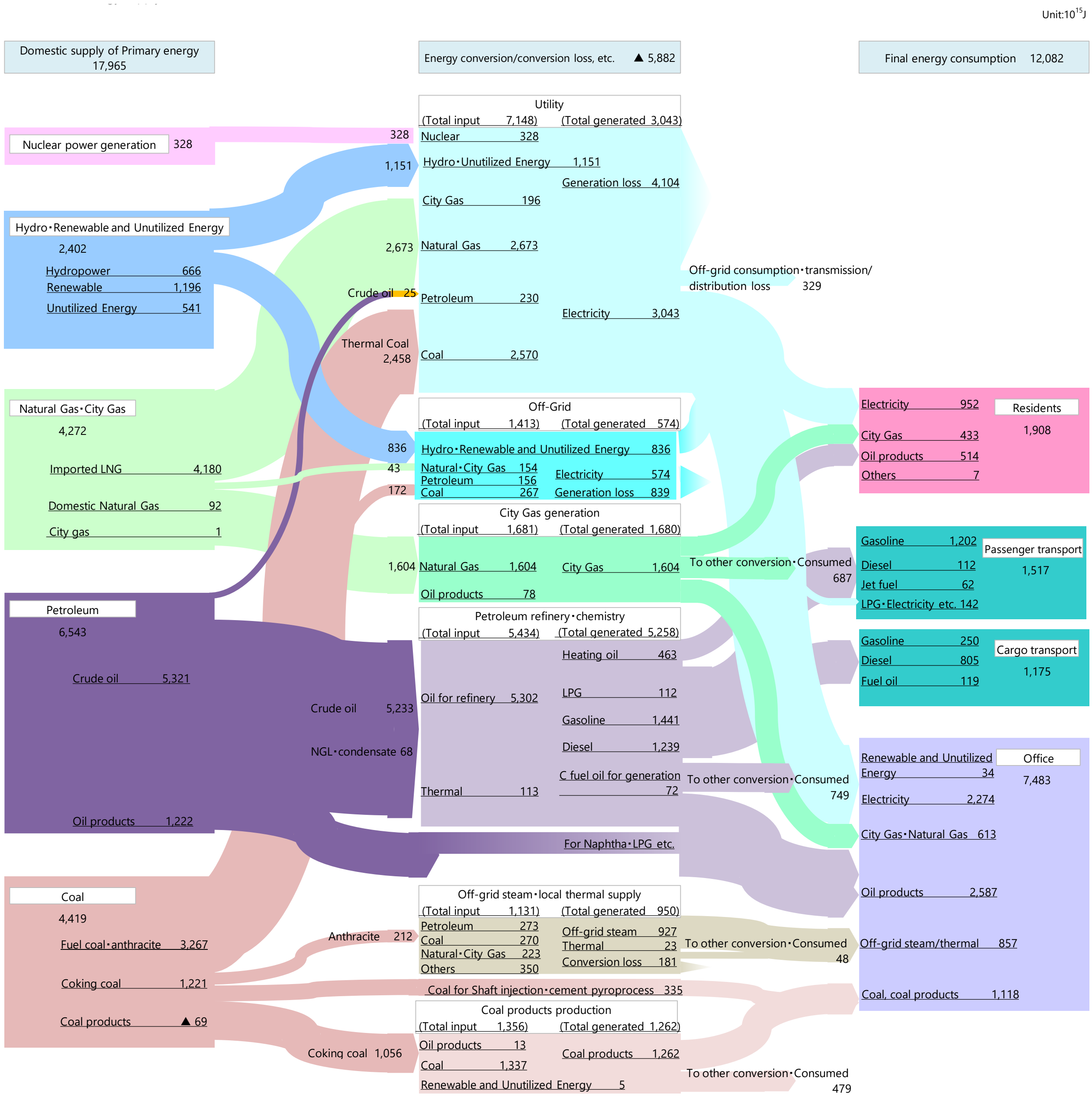
Reference: Ministry of Internal Affairs and Communications "2020 Labour Force Survey"

1.7 Energy

1.7.1 Energy balance flow

The energy balance flow of Japan in FY 2020 is shown in Figure 1-25. The primary energy supply in Japan was 18,000 PJ in FY 2020. The loss in energy conversion or during transport and consumption in the energy conversion sector was 5,900 PJ. Deducting the energy conversion/conversion loss from the primary energy supply, the final energy consumption of Japan in FY 2020 was 12,100 PJ.

The flow of each primary energy indicates that most nuclear and renewable energy is converted and consumed for electricity. On the other hand, natural gas is converted to electricity, and a large portion is converted to city gas by adjusting the calorific value. A relatively small portion of petroleum is converted to electricity; instead, a majority is consumed as transport fuel such as gasoline and diesel, oil products such as kerosene and heavy oil, and as a petrochemical raw material such as naphtha. A majority of the uses of coal are converted to electricity and as a raw material for coke for steel manufacturing.



(1) This flow diagram shows overview of Japan's energy flow and does not cover details.
(2) "Petroleum" includes oil products as well as crude oil and NGL/condensates.
(3) "Coal" includes coal products as well as anthracite and coking coal.
Reference: "Total energy statistics", Agency for Natural Resources and Energy

Figure 1-25 Overview of Japan's Energy Balance Flow (FY 2020)[14]

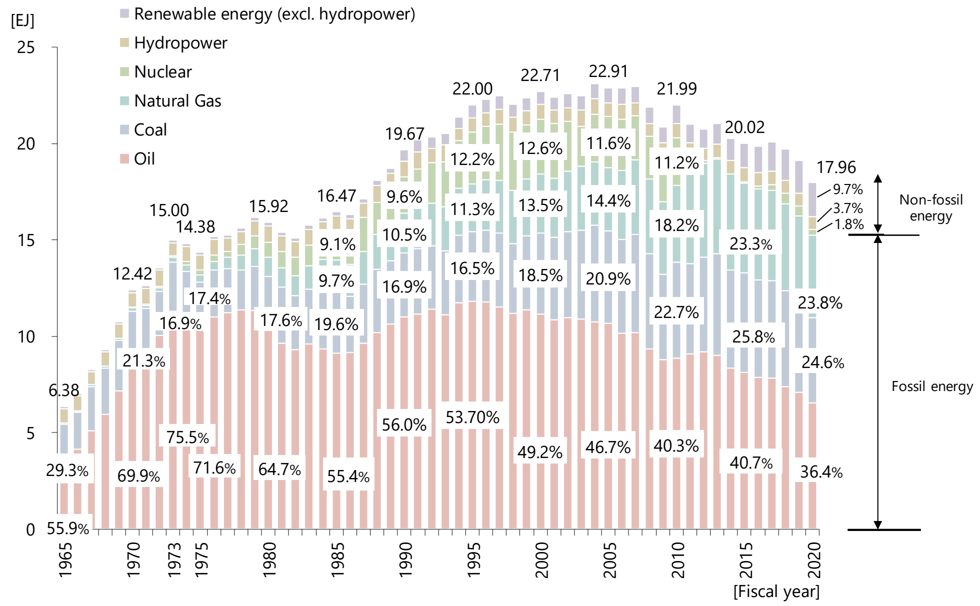
Reference: Agency for Natural Resource and Energy "Energy White Paper 2022"

1.7.2 Primary energy supply

The volume of the primary energy supply by fuel is shown in Figure 1-26. Before the 1960s, domestic coal was main Japan's main primary energy supply. Soon after, domestic coal lost price competitiveness. Therefore, Japan started to rely heavily on cheaper oil from the Middle East. However, when the second oil crisis hit in the 1970s, the oil-dependent policy and

[14] "Unutilized energy" refers to energy sources such as waste-to-energy and waste-to-energy recovery that make effective use of parts of energy sources that are normally discarded or dissipated after they have been used.

measures were replaced with the promoted introduction of nuclear power, natural gas and coal, accelerating the development of new energy. Consequently, the portion of oil in the domestic primary supply, which was 75.5% in 1973 when the oil crisis occurred, had declined to 36.4% by FY 2020.



Note1: Calculation method has been changed after FY1990.
Note2: Renewable energy (excl. hydropower) includes solar power, wind power, biomass, geothermal etc.

Figure 1-26 Primary Energy Supply

Reference : Agency for Natural Resource and Energy "Energy White Paper 2022"

■ Oil

The share of oil in Japan's primary energy supply decreased because of the promotion of oil substitution and energy conservation policies triggered by the oil crisis but turned to an increase in the late 1980s with the implementation of a whole range of energy conservation measures that were easy to implement and the decline in oil prices. Since the mid-1990s, the supply has been on a downward trend again due to progress in the use of petroleum alternative energy and the improved fuel efficiency of cars, and the supply in FY 2020 was 6,543 PJ. Japan's crude oil self-sufficiency ratio has been continuously below 0.5% from around the 1970s to FY 2020.

■ Natural Gas

Starting with the import of LNG from the United States in 1969, the import of LNG from Southeast Asia and the Middle East started, which led to the expansion of LNG use in Japan. The share of natural gas in the primary energy supply reached a record high of 24.5% in FY 2014 and 23.8% in FY 2020. The import share of the natural gas supply in FY 2020 was extremely high at 97.9% with all natural gas being imported as LNG. The domestic natural gas production in FY 2020 was 2.1% of our country's consumption.

■ Coal

Domestic coal production declined in the 1960s from the impact of the shift to oil and in the 1980s and later from the impact of cheap imported coal. Since the 2000s, domestic coal production had remained at 1.2 to 1.3 million tonnes per year, but by FY 2020, it had declined to 750,000 tonnes. In FY 2020, Japan imported almost all of its domestic supply of coal from abroad.

The energy self-sufficiency of Japan (Figure 1-27) in FY 1960 was 58.1%, mainly using plenty of domestic natural resources such as coal or hydropower. Entering the high economic growth period, self-sufficiency dropped to approximately 10% as energy demand in Japan increased and as energy supply efficiency decreased significantly as influenced by the change of fuels from coal to oil. After that, supply efficiency increased with the operation of nuclear power plants; however, because of the Great East Japan Earthquake in 2011, the nuclear power plants in Japan stopped operating. Consequently, the energy self-sufficiency had dropped to 6.0%. Soon after, by FY 2020 the self-sufficiency recovered to 14.8% with the introduction of new energy and the restart of nuclear power plants.

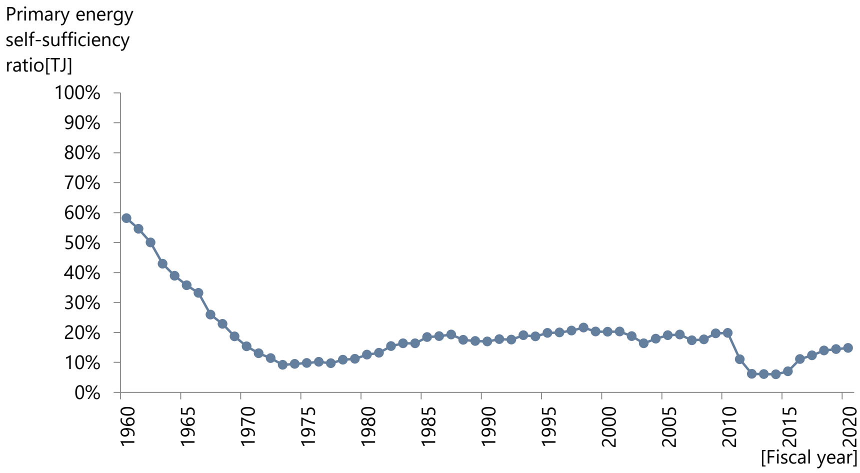


Figure 1-27 Primary Self-Sufficiency

Reference: IEA, Agency for Natural Resource and Energy "Energy White Paper 2022", Agency for Natural Resources and Energy "General Energy Statistics"

1.7.3 Energy mix

For the energy mix of power of power generation in FY 1990, oil-fired thermal power accounted for the largest share of Japan's total power supply at 28.7%, followed by nuclear power at 27.3%. Since then, the share of oil thermal has decreased while the share of coal-fired and nuclear power has increased, mainly due to the breakaway from the dependence on oil from the Middle East. In FY 2010, LNG-fired power accounted for 29.3%, nuclear power 28.6%, and coal-fired power 25.0%, and these three power sources accounted for more than 80% of total power generation. However, because of the shutdown of nuclear power plants in Japan after the Great East Japan Earthquake in 2011, the share of these three power sources in total power generation changed significantly since FY 2011. In FY 2020, LNG-fired and coal-fired power accounted for 39.0% and 31.0%, respectively.

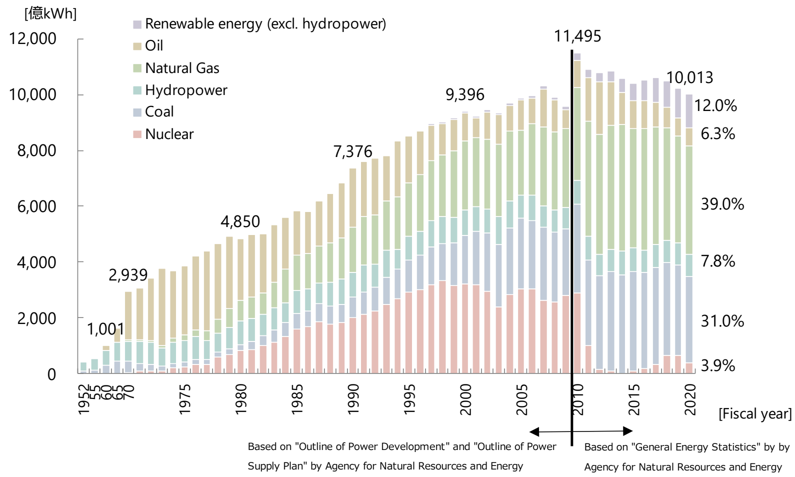


Figure 1-28 Power generation by energy source[15]

Reference: Agency for Natural Resources and Energy "Outline of Power Development" and "Outline of Power Supply Plan" (FY 1990-FY 2009)
Agency for Natural Resources and Energy "General Energy Statistics" (FY 2010-)

With the shutdown of nuclear power plants in Japan due to the Great East Japan Earthquake in 2011, the ratio of fossil power sources, mainly coal-fired thermal power, increased, leading to an increase in energy-related CO_2 emissions from the power generation sector. On the other hand, the share of new energy sources has gradually been increasing because of measures to introduce solar power and wind power generation, contributing to a decrease in energy-related CO_2 emissions.

1.7.4 Energy consumption

Final energy consumption in Japan continued to increase significantly with the Japanese economy's rapid growth until the 1970s. It then levelled off following the two oil shocks of the 1970s, followed by a period represented by a downward trend. In the late 1980s, it began to increase again amid a strong economy and relatively lower crude oil prices. However, final energy consumption has been on a downward trend since peaking in FY 2005, partly due to the rise in crude oil prices after mid-FY 2000.

These trends can be summarized for different consumption sectors as follows. Until the first oil shock in 1973, energy consumption in the industrial, commercial and residential, and transport sectors grew rapidly. From FY 1973 until FY 1986, energy consumption in the commercial and residential sector and transport sector continued to grow, but industrial energy consumption began to decrease because of the efforts for energy saving from the viewpoint of reducing production costs. From FY 1986 until FY 2000, the strong economy and drop in crude oil prices in the latter half of the 1980s boosted energy consumption in all four sectors. From FY 2001 onward, energy consumption in the industrial and transport sectors has decreased overall as a

[15] Since electricity retailing was fully deregulated in FY 2016, "General Energy Statistics" is used, which covers all power generation, including auto producer generation. However, the data in "General Energy Statistics" are available only for FY 2010 and later. Thus the figures for FY 2009 and earlier are based on "Outline of Power Development" and "Outline of Power Supply Plan". The figures are excluding Okinawa Electric Power until FY 1971."

result of raising environmental awareness, but energy consumption in the commercial and residential sector has continued to increase. However, after the Great East Japan Earthquake in 2011, energy consumption in the industrial, commercial, and residential sectors decreased because of the further implementation of energy-saving efforts. In FY 2020, final energy consumption decreased significantly because of the impact of the suppression of human flows and the decline in production activities caused by the COVID-19 pandemic.

By sector in FY 2020, the proportion of final energy consumption was 46% for the industrial sector, including non-energy use, 32% for the commercial and residential sector, and 22% for the transport sector.

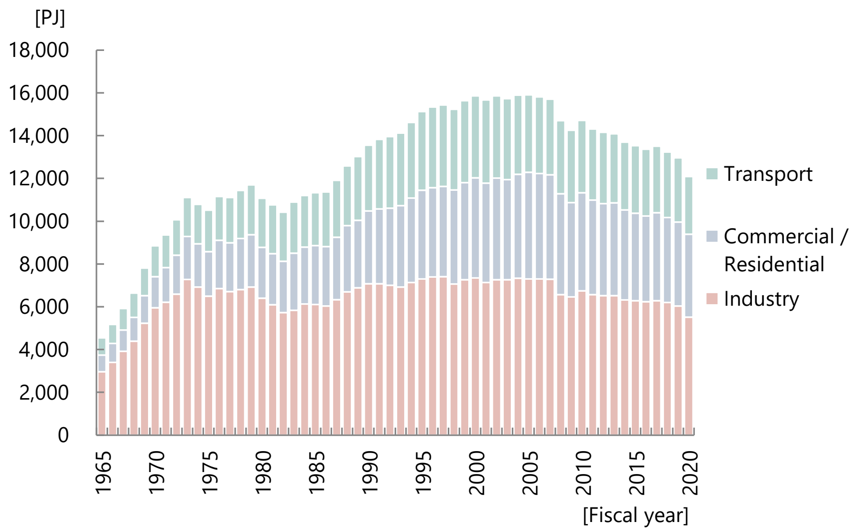


Figure 1-29 Trends in final energy consumption

Reference: Agency for Natural Resource and Energy "General Energy Statistics"

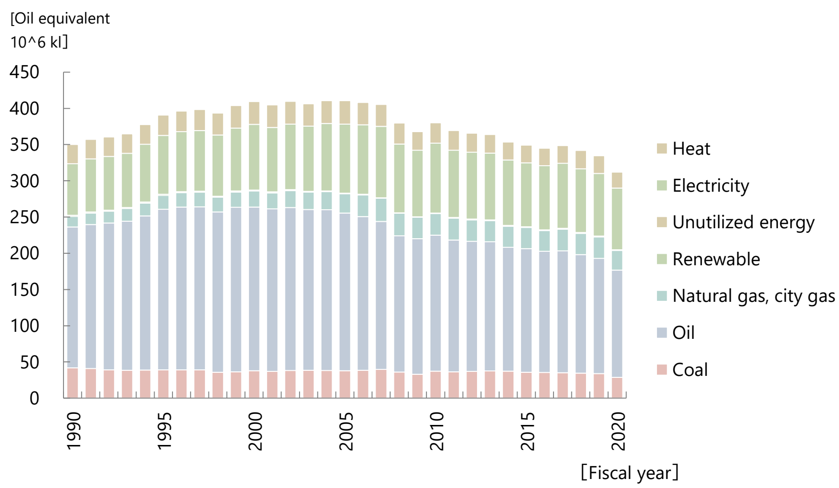
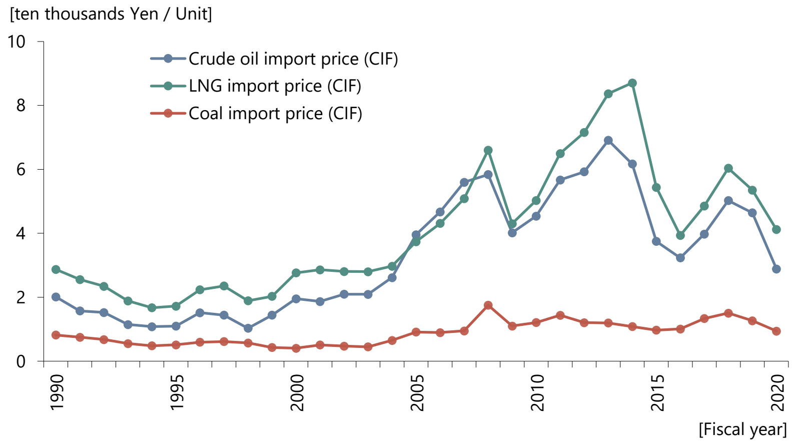


Figure 1-30 Trends in final energy consumption by energy source

Reference: Agency for Natural Resource and Energy "General Energy Statistics"

1.7.5 Energy prices

Crude oil import prices (CIF) shifted to being stable in the 1990s, but the prices skyrocketed in the 2000s because of the strong growth in oil demand in developing countries and the increasing geopolitical risks in the Middle East. Soon after, the prices continued to rise until 2013, temporarily falling because of the slowdown in oil demand from the worldwide financial crisis in 2009. In 2014, crude oil prices fell dramatically from the excess supply caused by the slowdown in oil demand in developing countries, increased oil production by oil countries motivated by the high oil price, and steady growth of shale oil production. After oil countries agreed to reduce production in 2016, oil prices began to rise again and remained on an upward trend until 2018. However, the oil supply-demand balance loosened because of increased shale oil production and other factors, and they turned downward again. Furthermore, the impact of the COVID-19 pandemic in 2020 led to a significant decline in oil demand and a sharp drop in oil prices. Japan's LNG import prices (CIF) are linked to crude oil prices; therefore, the trend resembles that of crude oil prices. The level of coal import prices (CIF) remains lower than crude oil and LNG, which steadily grew after the 2000s.

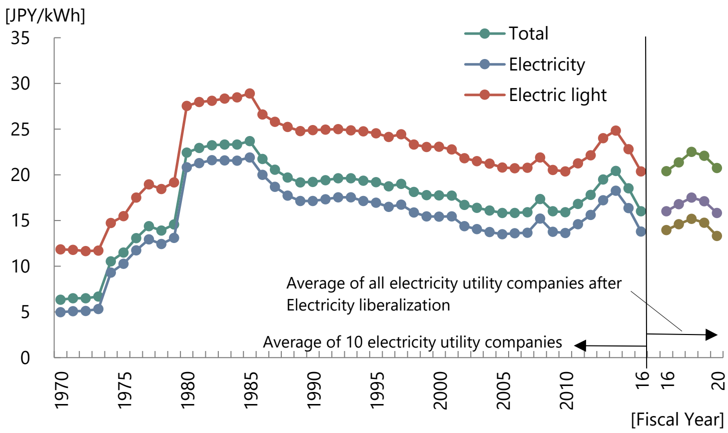


Note: Unit of crude oil is ten thousand Yen / kL and the units of LNG and Coal are ten thousand Yen / kt.

Figure 1-31 Fuel import price (CIF)

Reference: Agency for Natural Resource and Energy "Energy White Paper 2016"

Electricity prices rose sharply after the oil crisis, partly because oil-fired thermal power was the mainstream power source at the time but subsequently began to decline. Since FY 2015, electricity prices have been linked to fluctuations in the cost of thermal power generation due to the rise and fall of fuel prices and have repeatedly fallen and risen. Since FY 2015, electricity prices have repeatedly declined and risen in tandem with changes in thermal power generation costs associated with higher and lower fuel prices.



Note: Prior to FY 2016, 10 former electric utilities were covered; after FY2016, all electric utilities were covered.

Figure 1-32 Electricity price

Reference: Agency for Natural Resource and Energy "Energy White Paper 2016"

1.8 Industry

Japan's GDP in 2020 consisted of approximately 1% of the primary industry, 26% of the secondary industry, and 73% of the tertiary industry. The tertiary industry, which includes wholesale and retail trade, professional, scientific and technical activities, and medical, health care and welfare, is a major industry. In the early 1990s, secondary industries accounted for about 40% of the total, but the appreciation of the Japanese yen from the spring of 1990 to the spring of 1995 affected the processing and assembly-type manufacturing industry, leading to the overseas expansion of the manufacturing industry. The share of the primary industry, which includes agriculture, forestry, and fisheries, had been on a decreasing trend until 2004, but since then it has remained at around 1.0%.

Improvement of energy efficiency in the secondary industry, which accounts for about 40% of total final energy consumption, can contribute significantly to the reduction of greenhouse gas emissions. In addition, since the tertiary industry accounts for about 70% of the industrial structure, energy efficiency improvements in companies and offices, such as promotion of energy conservation, improvement of heating and cooling efficiency, and more efficient lighting equipment, are also important for reducing greenhouse gas emissions.

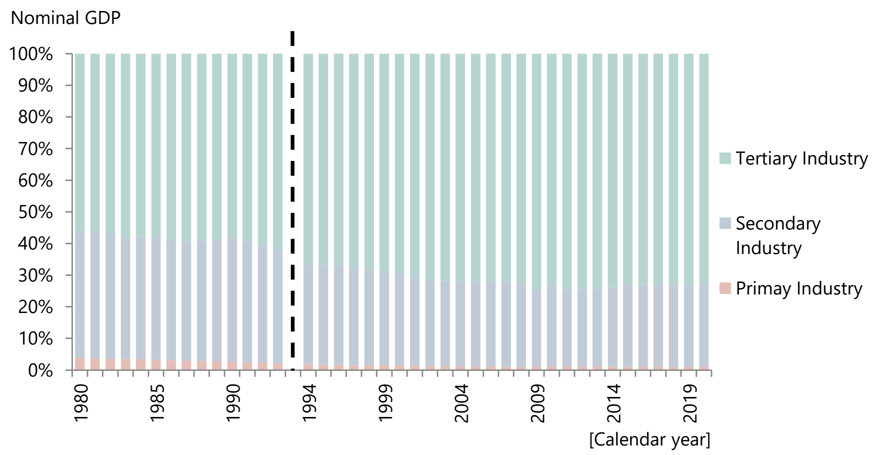


Figure 1-33 Trend in nominal GDP composition by industry[16]

Reference: Cabinet Office "National Accounts for 2009 (Benchmark year = 2000)" (CY 1980-CY 1993)
Cabinet Office "National Accounts for 2020 (Benchmark year = 2015)" (CY 1994-CY 2020)

1.9 Transport

1.9.1 Passenger transport

Domestic passenger traffic in Japan grew significantly throughout the period of rapid economic growth as a result of the popularization of cars, improvements in the transport system and network expansion. Growth during the Bubble Economy was prominent, recording a 42.4% increase in FY 1989 against FY 1980.

Passenger traffic, mainly buses, railways, and passenger ships, declined or remained steady during the 1990s after the Bubble Economy crashed. On the other hand, passenger cars and aircraft constantly grew at a slower rate, contributing to the overall growth of domestic passenger traffic.

In the 2000s, the passenger traffic growth flattened as passenger cars became popular for short-distance activities such as shopping and other daily activities. After FY2006, the passenger traffic continued to decline for four consecutive fiscal years as a consequence of the global financial crisis in 2008 and the Great East Japan Earthquake in 2011. However, it stopped declining and had been gradually increasing after FY 2012 as the aircraft traffic grew with the introduction of low-cost carrier (LCC) services.

In FY2020, passenger traffic declined significantly from the impact of the COVID-19 pandemic. Passenger cars and railways accounted for 68.8% and 24.7% of the total passenger traffic in FY 2020, respectively, with these two transportation modes accounting for more than 90% of the total.

CO_2 emissions per unit of transportation differ by transportation mode. In FY 2020, buses emitted about 2.9 times more CO_2, airplanes emitted about 4.7 times more CO_2, and private passenger cars emitted about 4.1 times more CO_2 than railways. Shifting from passenger cars

[16] Nominal GDP up to CY 1993 and on and after CY 1994 cannot be connected because the benchmark year of the calculation is different.

to public transportation such as railways and buses, enabled a reduction in CO_2 emissions.

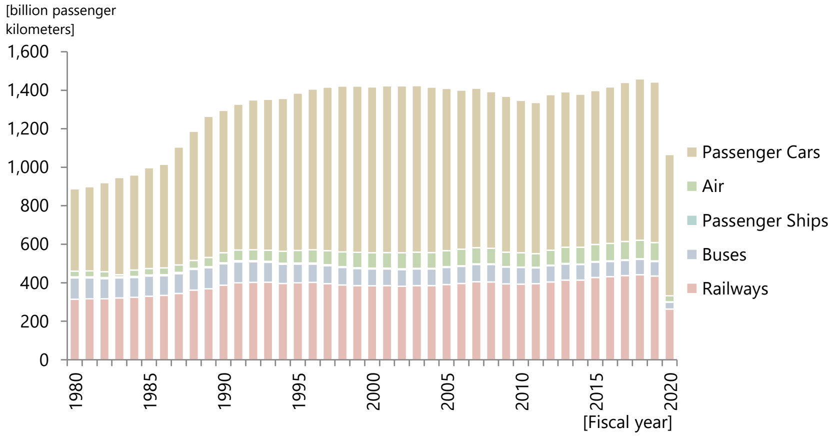


Figure 1-34 Trend in Passenger Traffic

Reference: Ministry of Land, Infrastructure, Transport and Tourism "Motor Vehicle Transport Statistics", "Statistical Yearbook of Railway Statistics", "Collection of Transport Statistics", "Annual Statistical Report on Air Transport", and "Annual Statistical Report on Shipping"

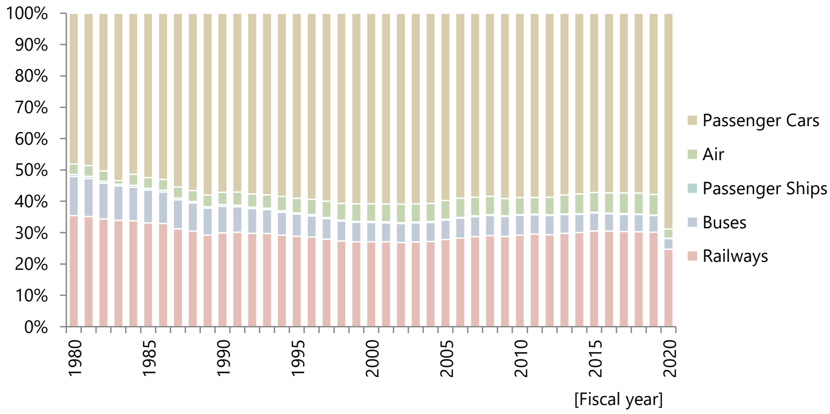


Figure 1-35 Modal shares of domestic passenger traffic

Reference: Ministry of Land, Infrastructure, Transport and Tourism "Motor Vehicle Transport Statistics", "Statistical Yearbook Railway Statistics", "Collection of Transport Statistics", "Annual Statistical Report on Air Transport", and "Annual Report on Shipping"

1.9.2 Freight transport

Since the prewar time, domestic freight traffic in Japan depended on railways and shipping. In 1980 or so, roads developed to increase the dependency on motor vehicles. During the former part of the 1980s, industrial structures shifted from massive and heavy to small and light, moving on to a service-oriented economy and reducing the domestic freight traffic. In the latter half of the 1980s, freight traffic shot up as the economy grew during the bubble period.

In the 1990s, after the Bubble Economy crashed, domestic freight traffic, mainly railways, coastal shipping and air, turned generally flat or declined. In total, freight traffic growth remained steady with the contribution of an increase in car traffic.

In the first half of the 2000s, the trend in growth had not changed dramatically, however, in FY 2008, the growth dropped significantly for two consecutive fiscal years as a consequence of the global financial crisis. In FY 2010, freight traffic increased as the economy recovered temporarily, and from FY 2011 to FY 2012, car freight traffic was reduced by the Great East Japan Earthquake along with a lack of truck drivers. Freight traffic continued to decrease until FY 2012, hitting the lowest level ever, and continues to remain so since then.

In FY 2020, freight traffic decreased from the impact of the COVID-19 pandemic. The share of freight traffic in FY 2020 was 55.4% for cars, 39.7% for coastal shipping, 4.7% for railways, and 0.1% for air. Cars and coastal shipping accounted for more than 95% of total freight traffic.

CO_2 emissions per tonne-km transported in FY 2020 were 216 g for commercial freight vehicles, compared to 21 g for railways and 43 g for ships.

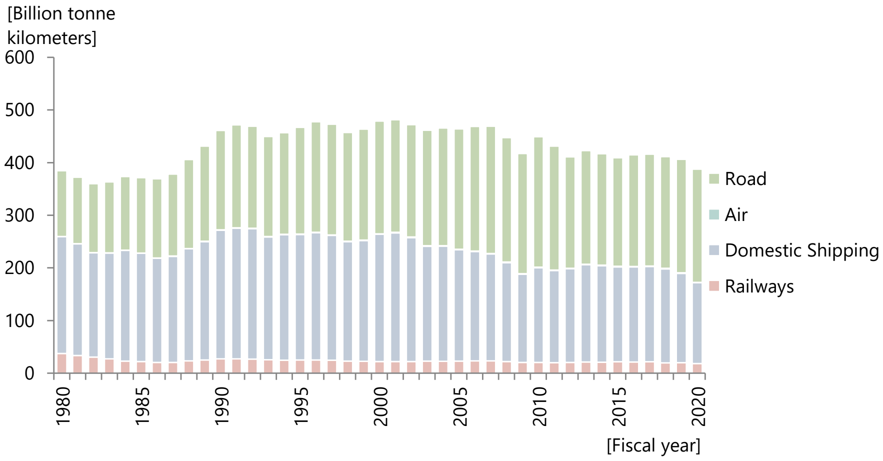


Figure 1-36 Trend in domestic freight traffic

Reference: Ministry of Land, Infrastructure, Transport and Tourism "Motor Vehicle Transport Statistics", "Statistical Yearbook Railway Statistics", "Collection of Transport Statistics", "Annual Statistical Report on Air Transport", and "Annual Report on Shipping"

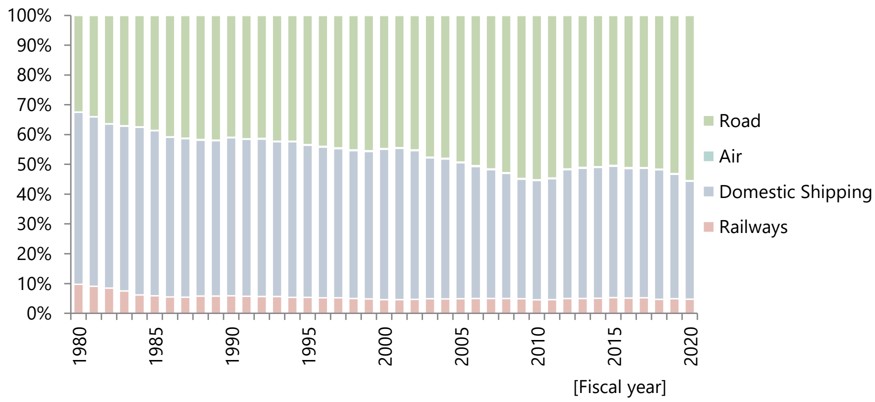


Figure 1-37 Trend in domestic freight modal share

Reference: Ministry of Land, Infrastructure, Transport and Tourism "Motor Vehicle Transport Statistics", "Statistical Yearbook Railway Statistics", "Collection of Transport Statistics", "Annual Statistical Report on Air Transport", and "Annual Report on Shipping"

1.9.3 Car traffic

This section focuses on the trend in the number of cars, car traffic, and fuel consumption because cars account for a significant share of passenger and freight traffic.

The number of cars was increasing as a total during the 1990s, specifically with passenger cars as motorization advanced. The number of small trucks owned, on the other hand, turned into a declining trend upon the abolishment of the preferential taxation against freight vehicles in 1989 when the consumption tax was introduced. In the 2000s, the growth in the number of passenger cars slowed down and remained steady because of the increased population of seniors and as a consequence of the migration of the population to urban areas where passenger cars were relatively low. However, since 2010, the number of cars, mainly passenger cars, has shown a gradual upward trend due to the impact of the eco-car tax reductions and subsidies.

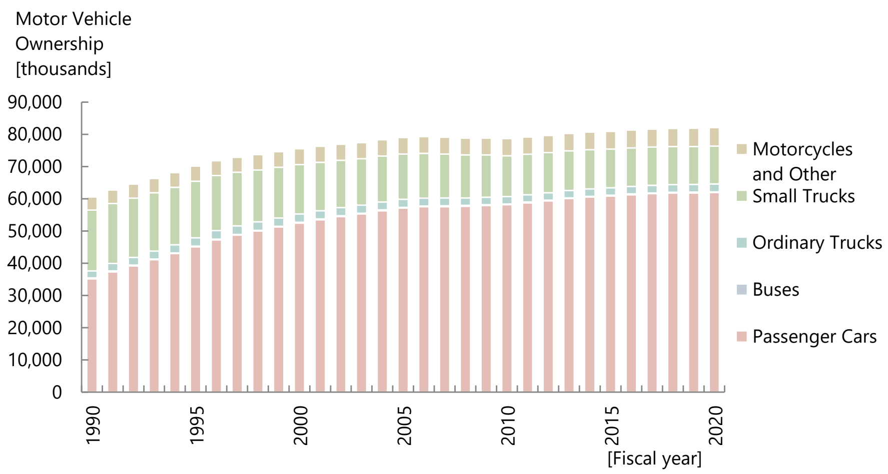


Figure 1-38 Trend in the number of cars[17]

Reference: Ministry of Land, Infrastructure, Transport and Tourism “Motor Vehicle Transport Statistics”, Automobile Inspection & Registration Information Association, “Statistical Data for Motor Vehicle Ownership”

Car traffic was constantly increasing until FY 2003 but turned into a declining trend as of FY 2004 as freight traffic declined, and around the same period, the traffic of private cars started to decline. Since FY 2014, car traffic has again shown an increasing trend, but in FY 2020, it decreased significantly from the impact of the COVID-19 pandemic.

[17] “Passenger cars” include lightweight cars. “Small trucks” include lightweight trucks. Special categories of small-size vehicles, Type I motorcycles (up to 50 cc), and Type II motorcycles (up to 125 cc) are not included.

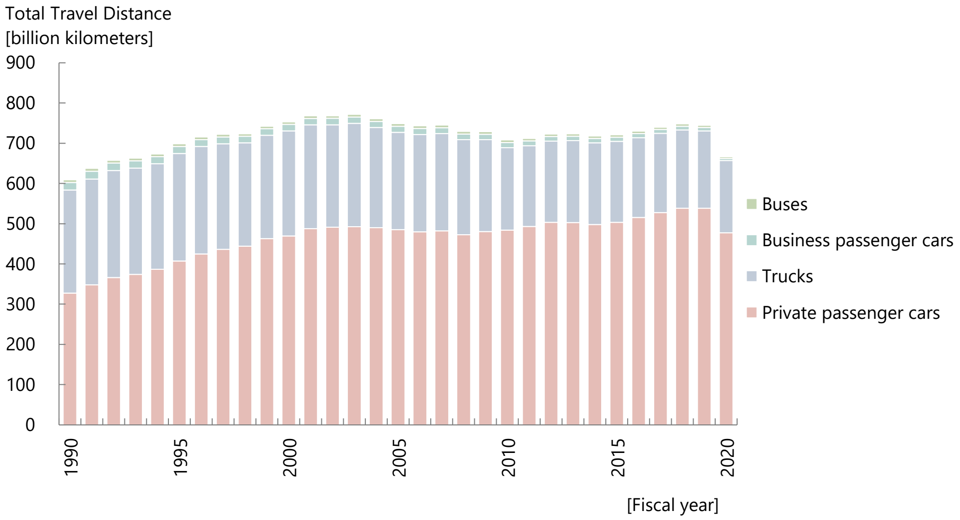


Figure 1-39 Trend in cars total travel distance

※1: Since the survey and counting methods used in the "Annual Statistical Report on Automobile Transport" changed in October 2010, the data up to FY 2009 has a gap compared to the data after FY 2010. Therefore, the data after FY 2010 uses figures from the "Annual Report on Fuel Consumption of Automobiles." It must be noted that continuity of the data is not necessarily ensured.
※2: "Other" is the total of "other LPG automobiles" and "CNG automobiles" in the "Annual Report on Fuel Consumption of Automobiles."

Reference: Ministry of Land, Infrastructure and Transportation, "Annual Statistical Report on Automobile Transport" and "Annual Report on Fuel Consumption of Automobiles"

The trend of private cars that account for a major share among the number of cars, almost no growth, or even declines are observed, except for minicars. The number of minicars is rapidly growing, indicating the miniaturization of the size of cars caused by the growing demand for low-priced and cost-effective cars.

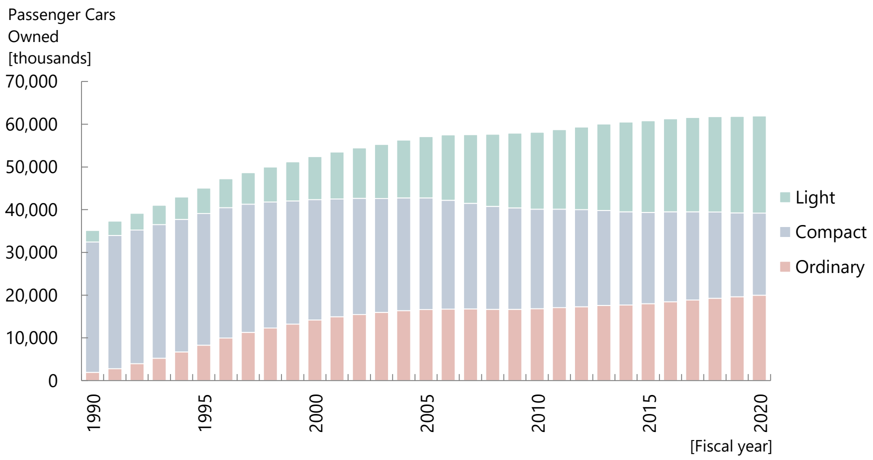
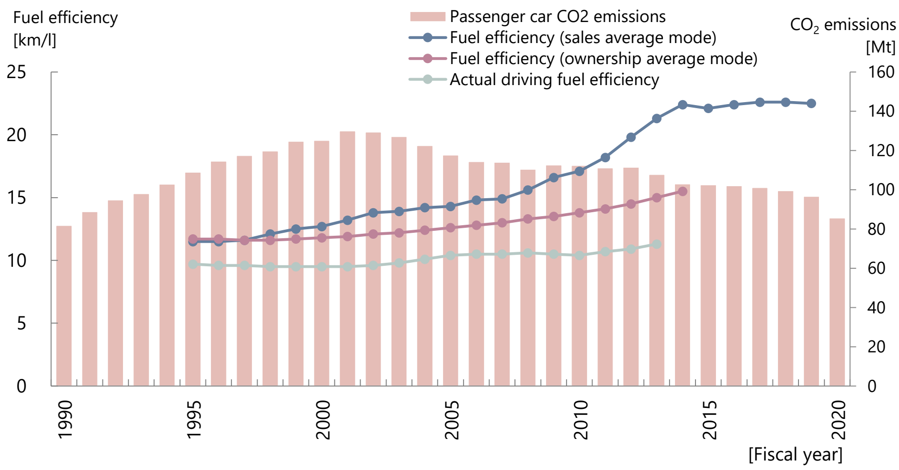


Figure 1-40 The number of passenger cars (Ordinary, Compact, and Light Cars)

Reference: Automobile Inspection and Registration Association, "Car ownership by type of vehicle (in detail)"

Until the latter half of the 1990s, the average mode fuel efficiency and actual fuel efficiency of cars tended to level off or worsen because of the increasing size of cars and other factors. However, since the early 2000s, fuel efficiency has been improving because of improvements in car performance by the Top Runner Program and an increase in the share of light vehicles. In recent years, the number of eco-cars sold has increased rapidly because of eco-car tax reductions and subsidies, resulting in a rapid improvement in average sales mode fuel efficiency, which has remained almost flat since FY 2015.



Note: Data of fuel efficiency (average sales mode) and fuel efficiency (average ownership mode) are only published up to 2014 and 2013, respectively.

Figure 1-41 Actual fuel efficiency of passenger cars

Reference: Japan's Automotive Industry, Environmental Report (Japan Automobile Manufacturers Association), Greenhouse Gas Inventory

1.10 Houses and commercial facilities

1.10.1 Houses

As of October 1, 2018, the total number of houses had reached 62.41 million (53.62 million residing) for a total of 54.00 million households. The number of houses per household continued to rise, but the trend has slowed in recent years with the number of houses per household in 2018 at 1.16, the same level as in 2013. When houses are counted by age, the housing stock built before the 1980s is 12.01 million, accounting for approximately 25% of the total.[18] The housing stock built after 2000 is 16.99 million and is approximately 35% of the total. By type of construction and ownership, for houses built before the 1970s, houses account for 75.8%, and rentals (apartments) account for 13.2%. For houses built after 2011, the ratio of houses decreased to 48.9%, and rentals (apartment) increased to 36.4%.

[18] "Total" refers to the number of houses, excluding those of unknown construction age.

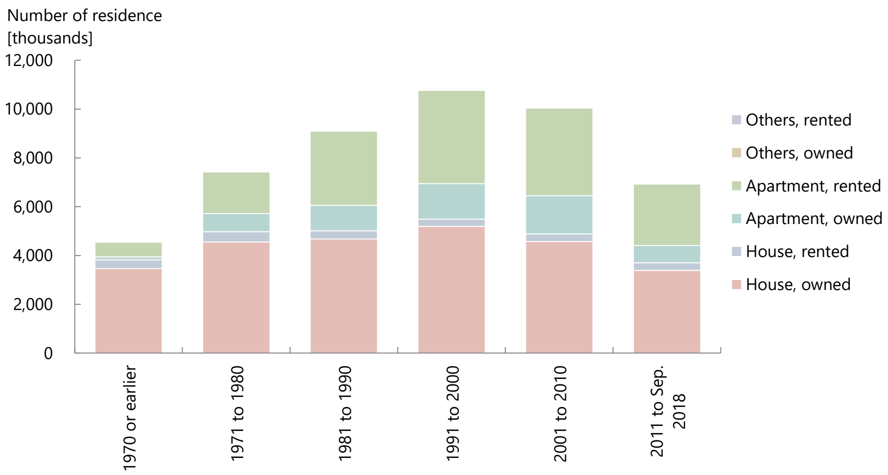


Figure 1-42 Housing stock per age as of FY 2018

Reference: Ministry of Internal Affairs and Communications "2018 Housing and Land Survey"

The average floor space per household is demonstrating a steady improvement overall to 93.04 m^2 in 2018 compared to that of 77.14 m^2 in 1973. But when the details are analyzed, though the floor space per household increased compared to 1973 for both owned and rented, a stark contrast can be seen between owned houses (119.91 m^2) and rented houses (46.79 m^2), illustrating the prominence of small rented houses.

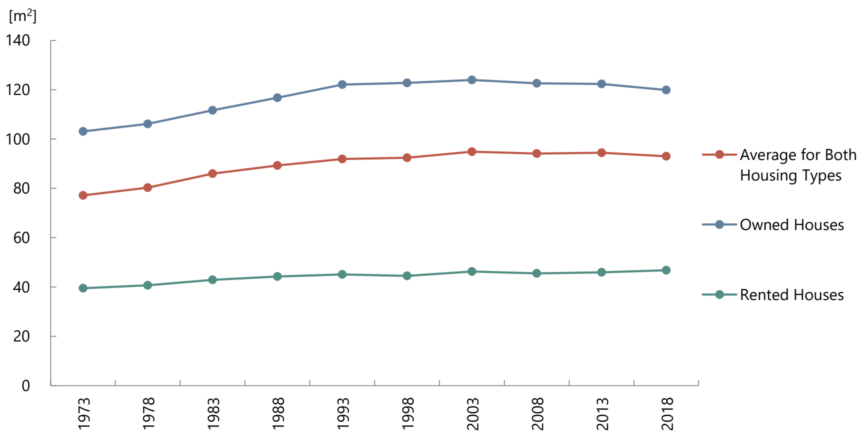


Figure 1-43 Floor Space per Household in Japan

Reference: Ministry of Internal Affairs and Communications, "2018 Housing and Land Survey of Japan"

A wide variety of home appliances are used in residences, and these indirectly contribute to greenhouse gas emissions through the consumption of electricity. The penetration rate of room air conditioners, which consume relatively large amounts of electricity, has been continuously increasing since the 1980s and exceeded 90% in 2012. The penetration rate of flat-screen TVs also exceeded 90% in 2012. In addition, the penetration rates of personal computers and warm water washing toilets seat are gradually increasing.

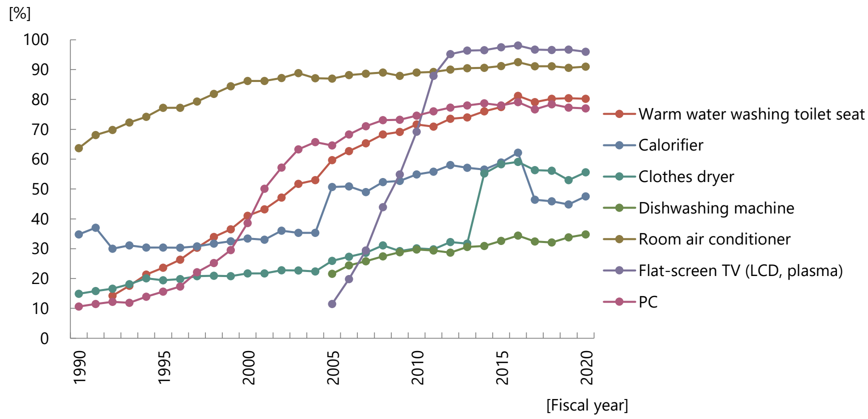


Figure 1-44 Trends in penetration rate of home appliances

Reference: Cabinet Office, "2021 Survey of consumption trends"

Energy consumption by use in the residential sector in recent years has been dominated by lighting and home appliances (including general home appliances other than air conditioners, such as refrigerators and televisions), followed by hot water supply and heating.

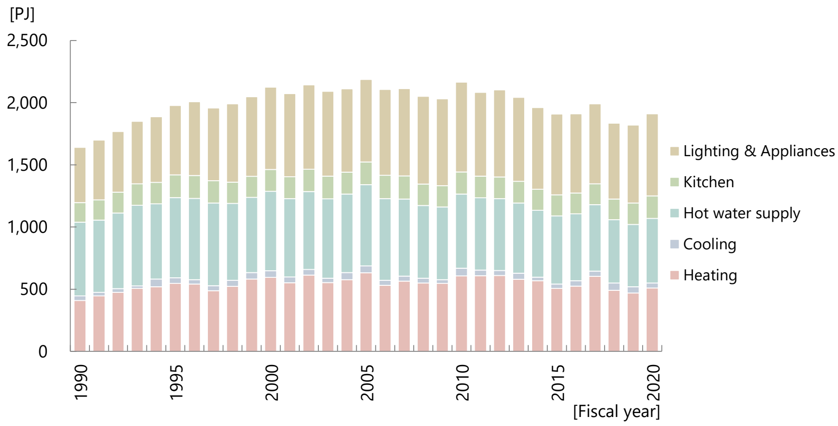


Figure 1-45 Energy consumption by use in the residential sector

Reference: Agency for Natural Resources and Energy, "General energy statistics", The Institute of Energy Economics, Japan, "Handbook of Energy & Economic Statistics in Japan"

1.10.2 Commercial facilities

Since the period of rapid economic growth, the ratio of tertiary industries in Japan has increased in terms of the industrial structure and particularly with regard to the employment structure. The importance of "soft" work, including technology, information, planning, and design, has also increased in each industry, and the weight of indirect sectors has increased. In line with this shift towards service and other tertiary industries, the amount of floor space devoted to the commercial sector has steadily increased. Since FY 1965, it has increased at an average of 4.1% annually until FY 1999. However, between FY 2000 and FY 2020 the annual rate of increase has been in decline with an annual mean of 0.8%.

An increase in total floor space in the commercial sector can lead to an increase in air conditioning, lighting, and other equipment, as well as an increase in energy consumption, which can lead to an increase in greenhouse gas emissions.

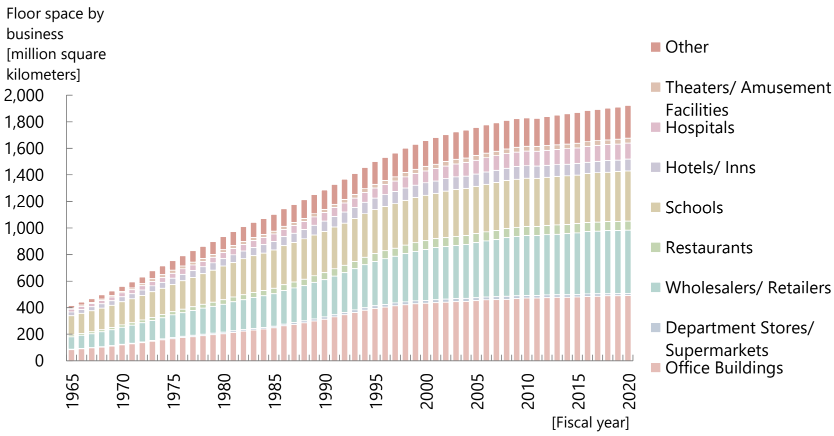


Figure 1-46 Change in the amount of floor space in the commercial sector by business type

Reference: The Institute of Energy Economics, Japan, "Handbook of Energy & Economic Statistics in Japan"

1.11 Waste

1.11.1 Sound Material-Cycle Society

From 1960s to around 1990, Japan faced many issues, such as the increasing amount of waste along with increased income and pollution from rapid industrialization. Despite such measures as building basic systems for waste processing or an emission control strategy for hazardous substances that took in place, the amount of waste continued to increase even after 1990. The land of Japan is small, and the insufficiency of landfill space has become a major issue. As a solution, the *Revision of the Waste Management Act* in 1991 included waste generation controls and waste separation/recycling, and the *Act on the Promotion of Effective Utilization of Resources* defined consideration for the environment in the product design and production process, the voluntary collection of waste by business operators, and the building of the recycling process. In the 2000s, the *Basic Act for Establishing a Sound Material-Cycle Society* was formulated to develop a sound material-cycle society with the firm realization of the 3Rs (Reduce, Reuse, Recycle) and proper waste processing.

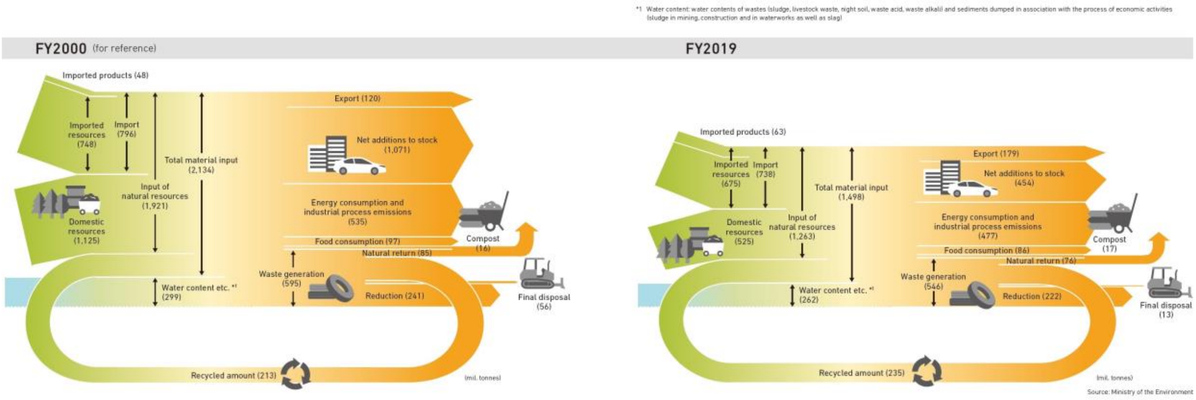


Figure 1-47 Material flow in Japan

Reference: Ministry of the Environment "Annual Report on the environment in Japan 2022"

Quantitative targets by FY 2025 for resource productivity[19] (input), cyclical use rate at the inlet[20] (recycling), cyclical use rate at the outlet[21] (recycling), and final disposal amount (output)[22] are set in the Fundamental Plan for Establishing a Sound Material-Cycle Society. The target for resource productivity is 490,000 yen/tonne by FY 2025, and 436,000 yen/tonne in FY 2019, which is approximately a 72% increase compared to FY 2000 (Figure 1-48). Cyclical use rates at inlet and outlet are targeted as 18% and 47% in FY 2025, respectively, and for FY 2019, they showed an increase by 6 points and 7 points compared to FY 2000, respectively (Figure 1-49, Figure 1-50). The final disposal amount is targeted as 13 million tonnes in FY 2025, and in FY 2019 it was 77% less than FY 2000 (Figure 1-51).

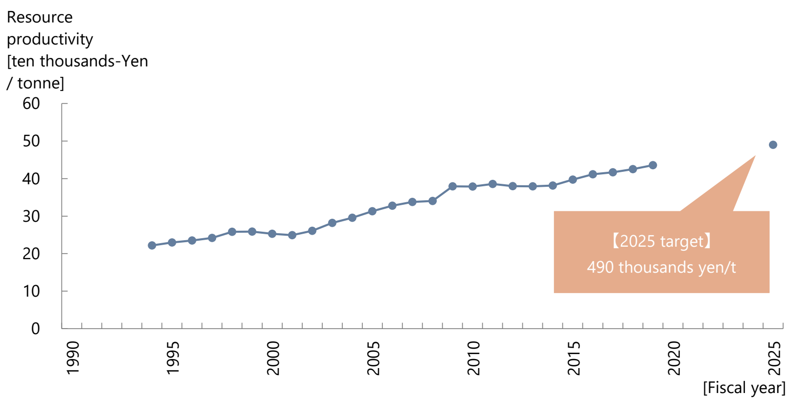


Figure 1-48 Resource productivity

Reference: Ministry of the Environment "Annual White Paper on the Environment in Japan 2022"

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[19] Resource productivity = GDP per resource-input. Resource-input refers to the total amount of domestically produced and imported natural resources and imported products.
[20] Recycling utilization rate at inlet = circulation usage / (circulation usage + resource-input)
[21] Recycling utilization rate at outlet = circulation usage / waste generated
[22] Final disposal amount = Landfill waste

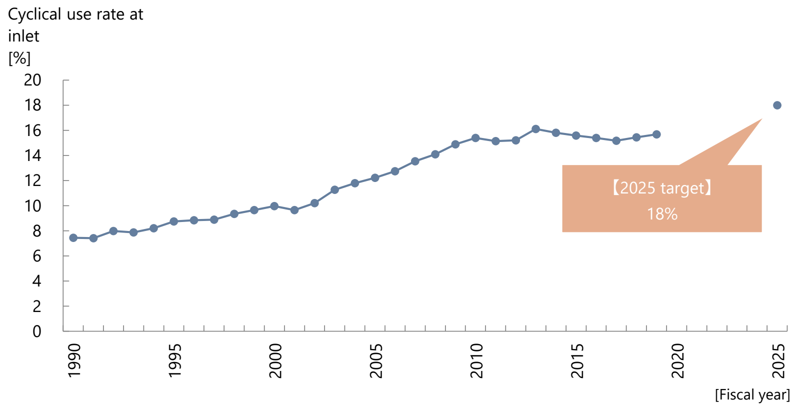

Figure 1-49 Cyclical use rate at inlet

Reference: Ministry of the Environment "Annual White Paper on the Environment in Japan 2022"

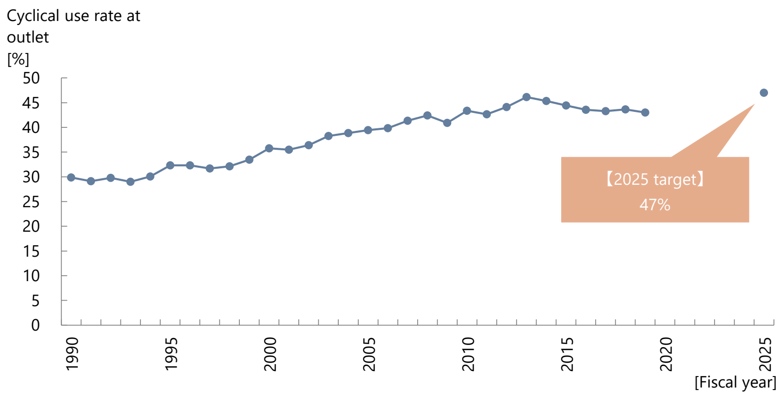

Figure 1-50 Cyclical use rate at outlet

Reference: Ministry of the Environment "Annual White Paper on the Environment in Japan 2022"

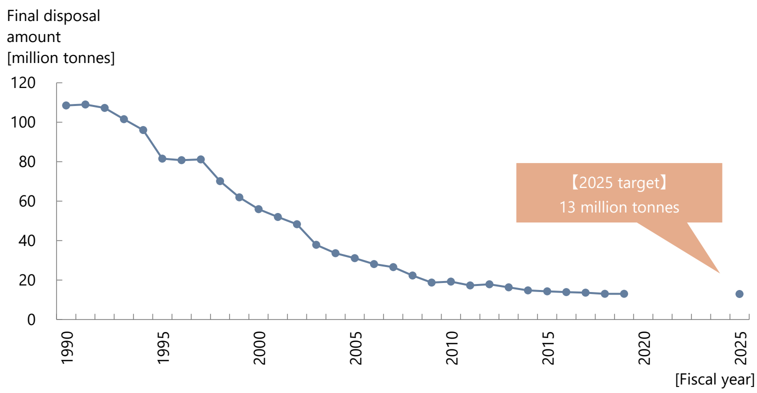

Figure 1-51 Final disposal amount

Reference: Ministry of the Environment "Annual White Paper on the Environment in Japan 2022"

1.11.2 Municipal Solid Waste

The volume of total and per person per day rapidly increased from around 1985 along with the economic rise during the bubble period. In the 1990s, after the Bubble Economy crashed, the increase continued mildly and turned into a downward trend after 2001 as the sound material-cycle society with the separated collection and varied recycling saturated socially, as well as by the influences from changes in the industrial structure and economic fluctuations. Waste volume per person per day in FY2020 was 901g/person/day, marking the lowest number.

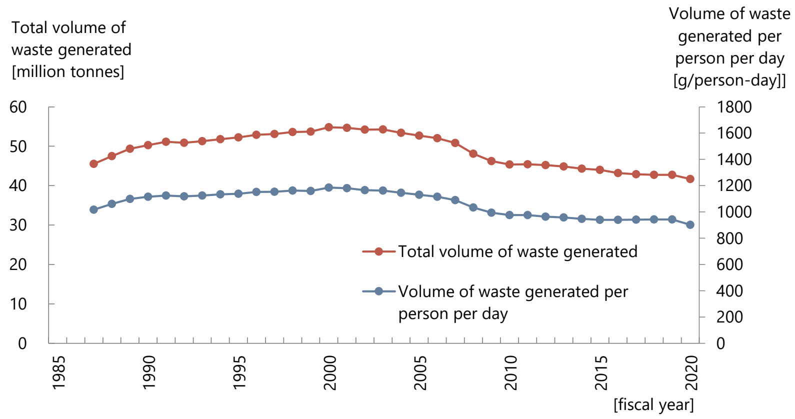

Figure 1-52 Final disposal amount and final disposal amount per person per day

Reference: Ministry of the Environment "Current status of municipal waste treatment"

Japan has promoted emission control and recycling, volume reduction, and acting against increasing waste. After 2000, the target volume of disposal is set in the Basic Environment Plan. Reduction of disposals is promoted systematically and effectively. As a result, the disposal amount of municipal solid waste is significantly decreasing. In FY 2020, the amount of disposal was 3.64 million tonnes.

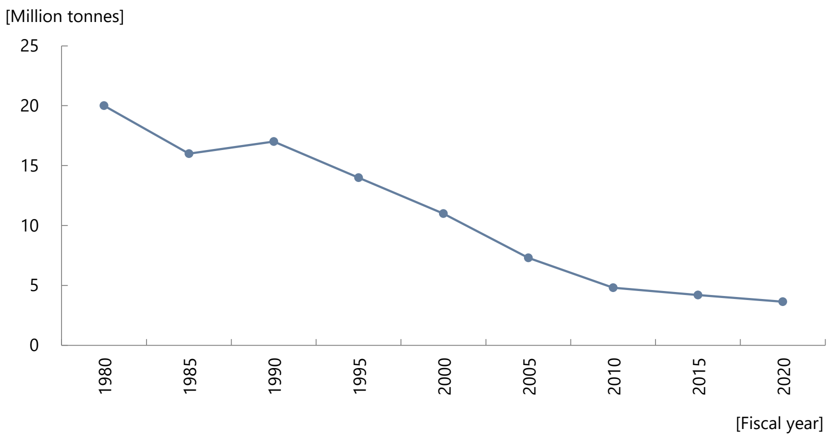

Figure 1-53 Disposal of municipal waste

Reference: Ministry of the Environment "Current status of municipal waste treatment"

1.11.3 Industrial Waste

The volume of Industrial waste in Japan is shown in Figure 1-54. Since 1990, the volume of Japan's industrial waste has not shown any major changes and has remained at the same level. Total industrial waste in FY 2020 was 393 million tonnes, an increase of 7 million tonnes compared to FY 2019.

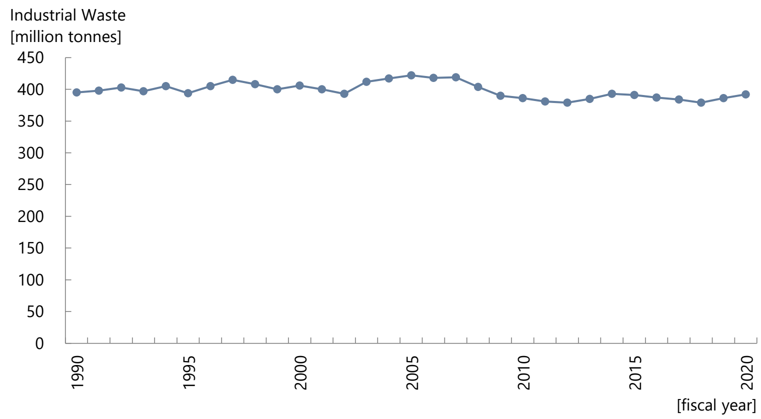

Figure 1-54 Volume of industrial waste

Reference: Ministry of the Environment "Current status of industrial waste treatment"

Similar to the trend of municipal solid waste, disposal of industrial waste has been significantly reduced as the volume of waste reduction increased (Figure 1-55). Disposal of industrial waste in FY 2020 was 9 million tonnes, achieving an 87% reduction compared to FY 1980.

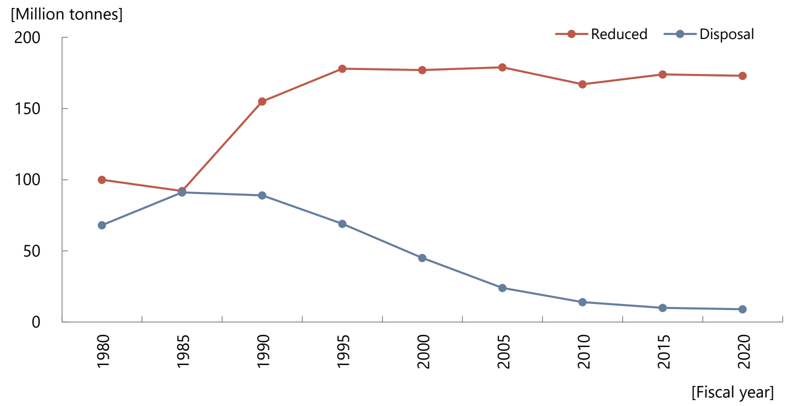

Figure 1-55 Industrial waste disposal and reduction

Reference: Ministry of the Environment "Current status of industrial waste treatment"

1.12 Agriculture

In Japan, which falls within the Asian monsoon region, rice cultivation in paddy fields has long formed part of the agricultural system suited to the humid and rainy summer conditions. In order to develop paddy field cultivation, measures to improve irrigation have been implemented, and as a result, the ratio of irrigated paddy fields out of the total agricultural area in Japan (54.4%) is quite high compared to other countries.

However, as Japan is mountainous and does not have much flat land (mountainous areas account for 61% of the national land area), there is intense competition over land use. The ratio of the national land area used for agriculture is about 12%, and the cultivated fields per agriculture management entity are small (approximately 2.7 hectares). Furthermore, the cultivated area has been decreasing each year, and in 2020, it had fallen about 17% from the 1990 level to 4.37 million hectares. Aging of farmers and the lack of a labor force resulted in uncultivated lands. This trend remains current.

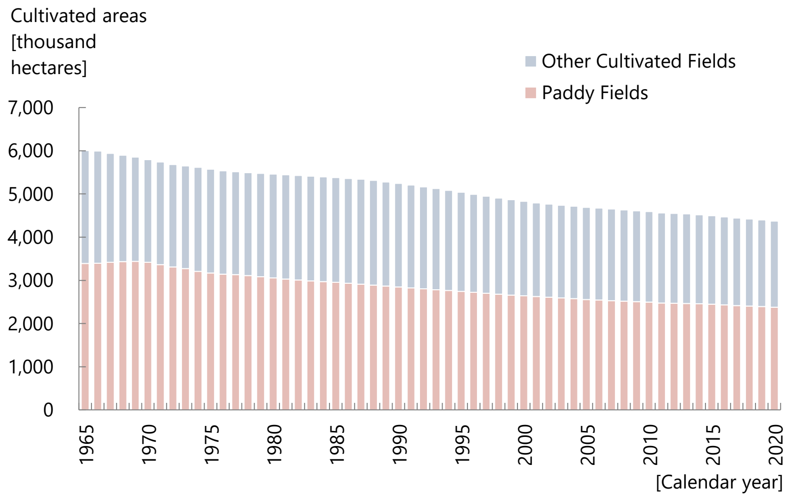

Figure 1-56 Changes in cultivated areas

Reference: Ministry of Agriculture, Forestry and Fisheries of Japan, "Statistics on Cultivated Land and Planted Areas, 2020"

Livestock production in Japan accounts for about 36% of total agricultural output (in 2020), and the main livestock species are cattle (dairy cattle, beef cattle), swine, and chickens. Although a certain number of dairy and livestock farmers are leaving the industry every year because of the aging of the workforce and the lack of successors, the number of livestock per farmer has been increasing, and the trend toward large-scale production has been progressing. In recent years, the number of cattle, swine, and chickens kept has been on a gradual upward trend.

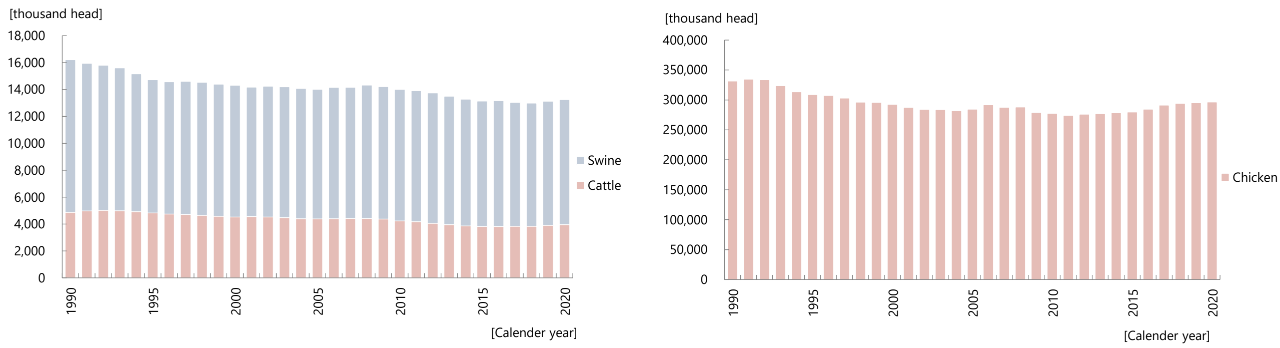

Figure 1-57 Changes in livestock population

Reference: Cattle: Ministry of Agriculture, Forestry and Fisheries of Japan, "Livestock Statistics"
Swine: "Livestock Statistics" (Estimates for 2004, 2009, 2014, and 2019 due to missing data.)
Broiler: 1990-2008, Ministry of Agriculture, Forestry and Fisheries of Japan, "Livestock Products Distribution Statistics", Number of young chickens for meat
2009-2020, Estimated based on the number of broilers shipped from "Livestock Products Distribution Statistics"
Hen: "Livestock Statistics" (Estimates for 2004, 2009, 2014, and 2019 due to missing data.)
Note: The number of chickens is the total number of broilers and hens.

1.13 Forestry

Forestry plays an important role in Japan in maintaining and fulfilling multiple functions of forests. This includes national land conservation through forestry activities, including thinning and tending, as well as providing products such as timber.

Forest cover remains about 25 million hectares, or about 70%, of Japan's national land area for years. It comprises national forests (approximately 30%) and non-national forests (approximately 70%). In Japan, trees were planted on over 300,000 hectares of land each year between the 1950s and the early 1970s, and at the peak of these efforts, over 400,000 hectares were planted in a single year. This active effort contributed to establishing over 10 million hectares of planted forests. As a result of the growth of these planted forests, the growing stock of Japan's forests[23] amounted to approximately 5.2 billion cubic meters in 2017, which is more than double compared to the level in 1966. More than half of the planted forest area is over 50 years old and has matured enough to be used as timber. The growth rate of planted forests declines after peaking at around the 4-5 age classes. The CO_2 removals of Japan's planted forests as a whole is also declining because of the maturation of the forests.

The demand for wood in Japan had been on a long-term downward trend, but in recent years, it has hovered at around 80 million m^3 per year. Meanwhile, the supply of domestic wood is on an increasing trend, representing approximately 41% of the total wood demand in 2021.

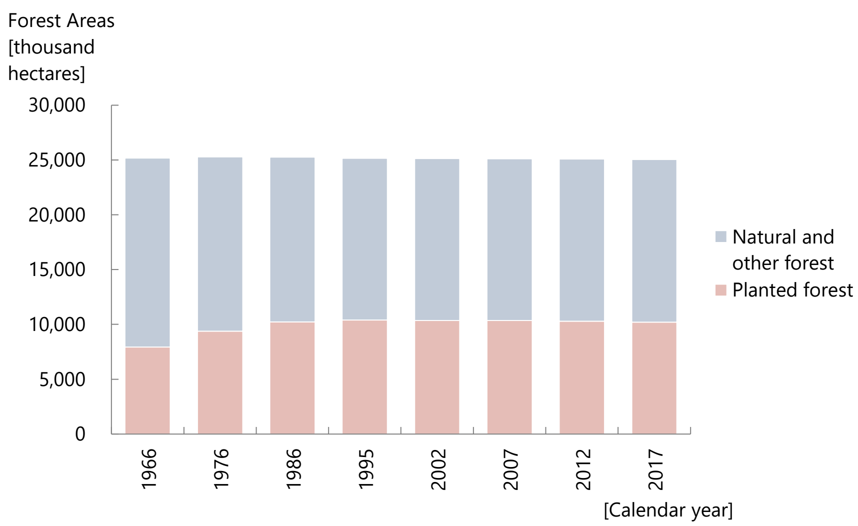

Figure 1-58 Trends in forested area

Reference: Forestry Agency "State of Forest Resources"

[23] Total Volume of the trunk.

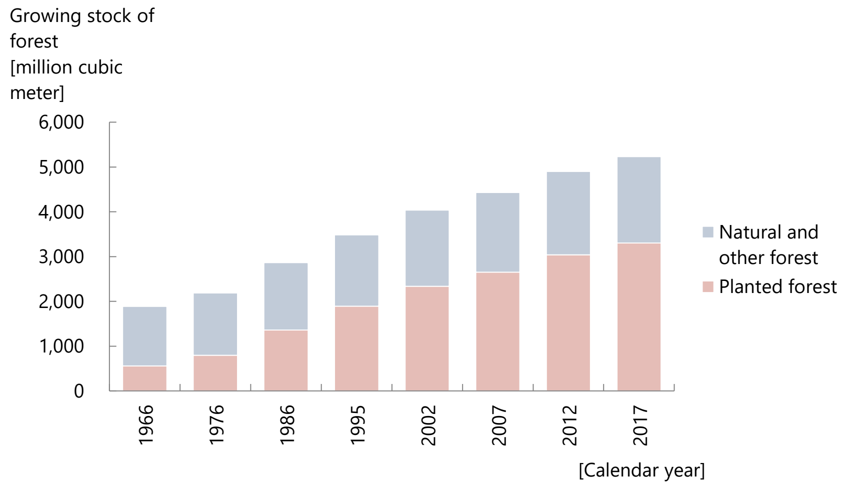

Figure 1-59 Trends in growing stock of forest

Reference: Forestry Agency "State of Forest Resources"

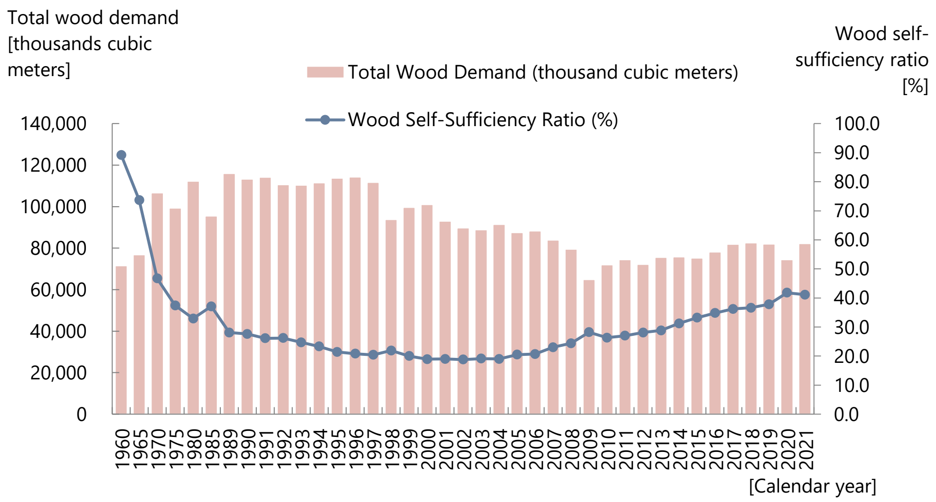

Figure 1-60 Trends in wood demand and wood self-sufficiency ratio

Reference: Forestry Agency "Demand and Supply of Woods"

Chapter 2

Information on Greenhouse Gas Emissions and Trends

2.1 Overview

- Total GHG emissions in fiscal year (FY) 2020 (excluding LULUCF, including indirect CO_2) were 1,150 million tonnes CO_2 eq. (Mt CO_2 eq.), which decreased by 9.8% compared to the emissions in FY1990, by 16.8% compared to FY 2005, which is the base year of Japan's emission reduction target for FY 2020, and by 18.4% compared to FY 2013 which is the base year of Japan's emission reduction target for FY 2030.
- Between FY 1990 and FY 2020, CO_2 emissions (excluding LULUCF and indirect CO_2) decreased by 10.0%, CH_4 emissions (excluding LULUCF) decreased by 35.6%, and N_2O (excluding LULUCF) decreased by 38.2%.
- Between Calendar Year (CY) 1990 and CY 2020, **HFCs** emissions increased by 224.7%, PFCs emissions decreased by 46.9%, SF_6 emissions decreased by 84.2%, and NF_3 emissions increased by 785.7%.
- In FY 2020, CO_2 emissions accounted for 90.6% of total GHG emissions. The breakdown of CO_2 emissions shows that emissions from fuel combustion account for 94.7%, followed by industrial processes and product use (4.1%) and waste (1.2%). As for the breakdown of CO_2 emissions within fuel combustion, energy industries accounted for 41.9%, followed by manufacturing industries and construction (22.4%), transport (17.0%), and other sector (13.3%). The main driving factor for the increase in CO_2 emissions since FY 1990 was an increase in solid fuel consumption for electricity power generation.
- Net removals (including CO_2, CH_4 and N_2O emissions) from the LULUCF sector in FY 2020 were 52.0 Mt CO_2 eq. The net removals from the Kyoto Protocol Article 3.3 and 3.4 activities in FY 2020 were 34.5 Mt CO_2 eq.

2.2 Description of GHG emissions and removals

2.2.1 Overview of greenhouse gas inventory

■ Background information on Japan's greenhouse gas inventory

Japan reported greenhouse gas (GHG) inventories in April 2022, which contain information on emissions and removals of GHGs, including precursors (nitrogen oxides [NO_X], carbon monoxide [CO], non-methane volatile organic compounds [NMVOC]), and sulfur oxides [SO_X] in Japan from FY 1990 to FY 2020[24] based on Article 4 and 12 of the United Nations Framework Convention on Climate Change (UNFCCC) and Decision 2/CMP.8.

Estimation methodologies for the GHG inventories are required to be in line with the *2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines)*, which were made by the Intergovernmental Panel on Climate Change (IPCC), and Japan's estimation methodologies are basically in line with these guidelines. In order to enhance transparency, consistency, comparability, completeness, and accuracy of the inventory, Japan also applies the *2013 Supplement to the 2006 IPCC Guidelines: Wetlands (Wetlands Guidelines)*, the *2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (KP Supplement [2013])* and the*2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2019 Refinement)*.

Japan's national inventory was reported in accordance with the *UNFCCC Reporting Guidelines on*

24 The fiscal year (FY) from April of the reporting year through March of the next year is used because CO_2 is the primary GHGs emission and estimated on a fiscal year basis. "CY" stands for calendar year.

Annual Greenhouse Gas Inventories (Decision 24/CP.19 Annex I, hereinafter referred to as the *UNFCCC Inventory Reporting Guidelines*) decided by the Conference of the Parties.

■ Brief general description of methodologies

The methodology used in the estimation of GHG emissions or removals is in accordance with the *2006 IPCC Guidelines*. The country-specific methodologies are also used for some source/sink categories in order to more accurately reflect the actual emission status in Japan.

The results of the actual measurements or estimates based on research conducted in Japan are used to determine the EFs (country-specific emission factors). The default values given in the *2006 IPCC Guidelines* are used for the estimation of emissions, which are assumed to be quite low and are not investigated well.

■ Sectors

Japan's national GHG inventory is composed of GHG emissions and removals (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, and NF_3) and precursors (NO_x, CO, NMVOC and SO_x). These emissions are estimated by five sectors (Energy; Industrial Processes and Product Use (IPPU); Agriculture; Land Use, Land-Use Change and Forestry (LULUCF); and Waste).

(1) Energy

Emissions from the energy sector consist of two main categories: fuel combustion (1.A) and fugitive emissions (1.B) from fuels. Fuel combustion (1.A) includes emissions released into the atmosphere when fossil fuels (e.g., coal, oil products, and natural gas) are combusted. Fugitive emissions are intentional or unintentional releases of gases from fossil fuels by anthropogenic activities. In particular, the emissions from fuel combustion (1.A) are a significant emission source accounting for nearly 90% of total GHG emissions (excluding LULUCF). It is composed of five subcategories, Energy industries (1.A.1), including emissions from mainly public electricity and heat production; Manufacturing industries and construction (1.A.2), including emissions from the manufacturing and construction industries; Transport (1.A.3), including emissions from the transport of passengers and freight; Other sectors (1.A.4), including commercial/institutional, residential, agriculture/forestry/fishing; and Other (1.A.5).

In Japan, fossil fuels are used to produce energy for a wide variety of purposes (e.g., production, transportation, and consumption of energy products), and CO_2, CH_4, N_2O, NOx, CO, and NMVOC are emitted in the process.

(2) Industrial Processes and Product Use (IPPU)

The Industrial Processes and Product Use (IPPU) sector deals with GHG emissions resulting from chemical and physical transformations in the industrial processes. Specially, CO_2, CH_4, and N_2O emissions from mineral products (e.g., cement production), the chemical industry (e.g., ammonia production), metal production (e.g., iron and steel production), non-energy products from fuels and solvent use, and HFCs, PFCs, SF_6, and NF_3 emissions at the stage of production, use, and discharge are estimated. It also deals with N_2O emissions resulting from the use of anesthetics (e.g., laughing gas) and NMVOC emissions from solvent production, and such uses as paint, metal cleansing, and dry cleaning are estimated.

(3) Agriculture

The agriculture sector deals with GHG emissions resulting from agricultural activities. In particular, CH_4 as the result of enteric fermentation, CH_4 and N_2O generated in the treatment of manure excreted by cattle etc., CH_4 emitted from paddy fields cultivated for rice production, N_2O emitted from agricultural soil, and CH_4 and N_2O from field burning of agricultural waste, CO_2 from application of limestone, and urea into the soil etc. are estimated.

(4) Land Use, Land-Use Change and Forestry (LULUCF)

The land use, land-use change, and forestry (LULUCF) sector deals with GHG emissions and removals resulting from land use, such as forestry activities and land-use change. Japan classifies its national land into six categories—forestland, cropland, grassland, wetlands, settlements, and other land—and subdivides each of them into two subcategories by distinguishing them on the basis of whether or not land conversion has occurred in accordance with the *2006 IPCC Guidelines*; a default value of 20 years was used when distinguishing land conversion. GHG emissions and removals in this sector consist of carbon stock changes in five carbon pools (aboveground biomass, belowground biomass, dead wood, litter and soil), carbon stock changes in harvested wood products (HWP) from forestland, direct N_2O emissions from N fertilization in forestland, CH_4 and N_2O emissions from drainage of organic soils, N_2O emissions from nitrogen mineralization resulting from the change of land use or management of mineral soils, indirect N_2O emissions from managed soils, and non-CO_2 emissions from biomass burning.

(5) Waste

In the waste sector, GHG emissions from the treatment and disposal of waste are estimated for solid waste disposal, biological treatment of solid waste, incineration and open burning of waste, wastewater treatment and discharge, and others[25] in accordance with treatment processes. The "waste" to be covered in this sector is waste as defined under the *2006 IPCC Guidelines*. The waste sector estimates GHG emissions from not only incineration and disposal of municipal and industrial waste, which are defined by the *Waste Management and Public Cleansing Act* (Act No. 137, 1970) but also energy or material use of recycled materials.

2.2.2 Trends in GHG emissions and removals

Total GHG emissions in FY 2020[26] (excluding LULUCF, including indirect CO_2[27]) were 1,150 Mt

25 Data for some emission source categories in the waste sector are complemented by estimations when statistical data or related data are not available. The methodologies for this estimation are not described in this chapter. For details, refer to the Report of *the Waste Panel on Greenhouse Gas Emission Estimate* (2006) and the website of the Ministry of the Environment, Review of Greenhouse Gases Emissions Estimation Methods (http://www.env.go.jp/earth/ondanka/santeiho/kento/index.html).

26 The sum of CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, and NF_3 emissions converted to CO_2 equivalents multiplied by their respective global warming potential (GWP). The GWP is a coefficient by means of which greenhouse gas effects of a given gas are made relative to those of an equivalent amount of CO_2. The coefficients are subjected to the *Fourth Assessment Report* (2007) issued by the IPCC.

27 Carbon monoxide (CO), methane (CH_4) and non-methane volatile organic compounds (NMVOC) are oxidized in the atmosphere in the long term and converted to CO_2. Indirect CO_2 means the value in CO_2 equivalent of these emissions. However, emissions derived from combustion origin and biomass origin of CO, CH_4, and NMVOC are excluded to avoid double counting and/or by the concept of carbon neutral.

CO_2 eq. They decreased by 9.8% compared to FY 1990, decreased by 16.8% compared to FY 2005, and decreased by 18.4% compared to FY 2013. The main driving factor for the decrease in GHG emissions compared to FY 2005, which is the base year of the emission reduction target for the year 2020, is decreasing energy-related CO_2 by the decrease in energy consumption due to energy savings, while the HFC_S emissions increased as a result of substitution from ozone-depleting substance (ODS) in the refrigeration and air conditioning sector.

Net removals[28] (including CO_2, CH_4, and N_2O emissions) from the LULUCF sector in FY 2020 were 52.0 $MtCO_2$ eq.), which accounted for 4.5% of total GHG emissions. They decreased by 20.4% compared to FY 1990, by 41.4% compared to FY 2005, and by 17.4% compared to FY 2013. The long-term declining trend in removals from 2003 is mainly due to progression in the maturity of Japanese forests.

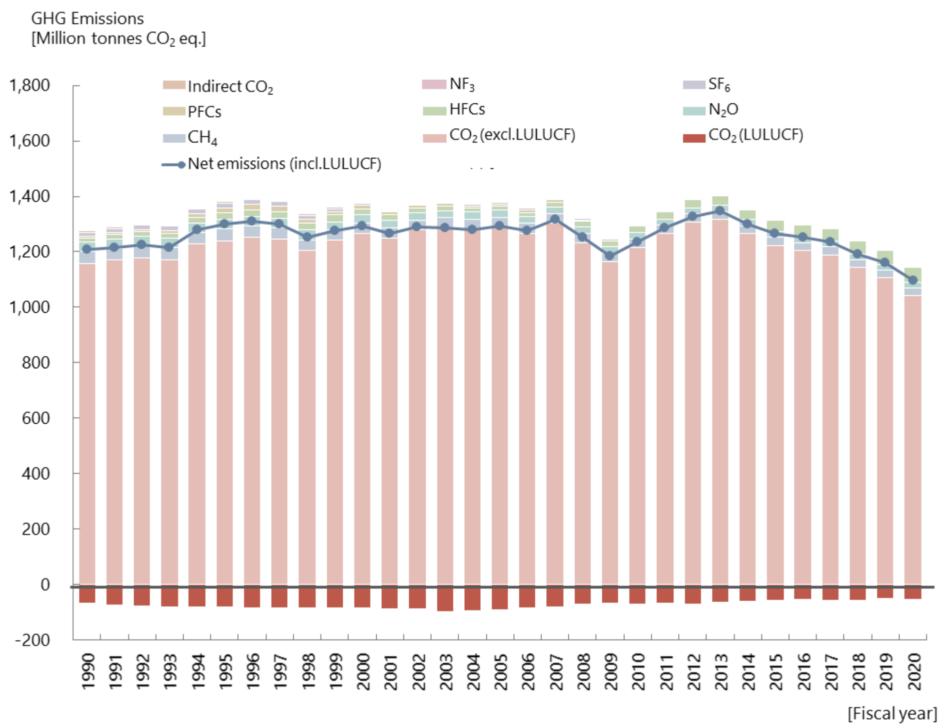

Figure 2-1 Trends in GHG emissions and removals in Japan

2.2.3 Trends in GHG emissions and removals by gas

In FY 2020, CO_2 emissions (excluding indirect CO_2) were 1,042 Mt CO_2, accounting for 90.6% of total GHG emissions (excluding LULUCF). CH_4 emissions (excluding LULUCF) were 28.4 Mt CO_2 eq. (2.5%), N_2O emissions (excluding LULUCF) were 20.0 $MtCO_2$ eq. (1.7%), indirect CO_2 emissions were 2.0 Mt CO_2 eq. (0.2%), and total emissions of HFC_S, PFC_S, SF_6, and NF_3 in CY 2020 were 57.5 Mt CO_2 eq. (5.0%).

28 Note: Since the national GHG inventory submitted under the UNFCCC reports all GHG emissions and removals from the LULUCF sector, these values do not correspond to emissions and removals reported under the Kyoto Protocol.

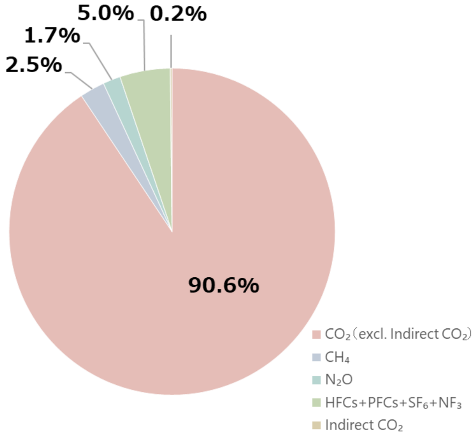

Figure 2-2 Proportion of GHGs emissions (FY 2020, excluding LULUCF)

Table 2-1 Trends in GHGs emissions (excluding LULUCF)

GHGs	GHG emissions [Mt CO_2 eq.]								Changes [Mt CO_2 eq.]	Changes [%]	Changes [Mt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
CO_2 (excluding indirect CO_2)	1,158.1	1,239.9	1,264.6	1,290.6	1,215.1	1,315.6	1,223.6	1,042.2	-248.4	-19.2%	-273.3	-20.8%
CH_4	44.1	41.7	37.6	34.7	32.0	30.1	29.3	28.4	-6.3	-18.3%	-1.7	-5.6%
N_2O	32.4	33.6	30.3	25.5	22.8	22.0	21.3	20.0	-5.5	-21.6%	-2.1	-9.4%
HFCs	15.9	25.2	22.9	12.8	23.3	32.1	39.3	51.7	38.9	+304.6%	19.6	+61.0%
PFCs	6.5	17.7	11.9	8.6	4.3	3.3	3.3	3.5	-5.2	-59.8%	0.2	+5.7%
SF_6	12.9	16.4	7.0	5.0	2.4	2.1	2.1	2.0	-3.0	-59.7%	0.0	-2.3%
NF_3	0.0	0.2	0.3	1.5	1.5	1.6	0.6	0.3	-1.2	-80.4%	-1.3	-82.1%
Indirect CO_2	5.5	4.8	4.3	3.3	2.5	2.3	2.2	2.0	-1.3	-39.7%	-0.3	-14.8%
Total	1,275.4	1,379.5	1,378.9	1,382.0	1,303.9	1,409.1	1,321.6	1,150.1	-231.9	-16.8%	-259.0	-18.4%

■ CO_2

(1) Trends in CO_2 emissions

CO_2 emissions in FY 2020 were 1,042 Mt CO_2, accounting for 90.6% of total GHG emissions. They decreased by 10.0% compared to FY 1990, decreased by 19.2% compared to FY 2005, and decreased by 20.8% compared to FY 2013.

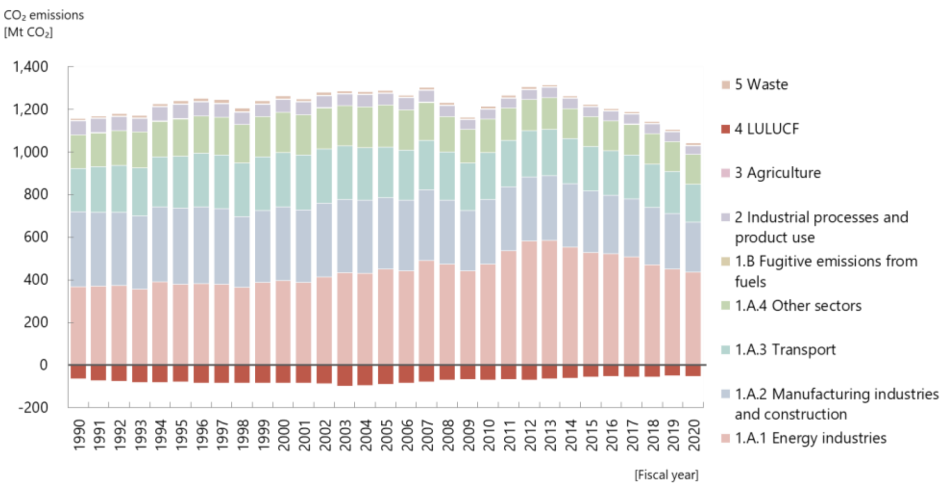

Figure 2-3 Trends in CO_2 emissions

The breakdown of CO_2 emissions in FY 2020 showed that fuel combustion (1.A) accounted for 94.7% and was followed by industrial processes and product use (4.1%) and waste (1.2%). As for the breakdown of CO_2 emissions within the fuel combustion category, energy industries (1.A.1) accounted for 41.9%, followed by manufacturing industries and construction (1.A.2) at 22.4%, transport (1.A.3) at 17.0%, and other sector[29] (1.A.4) at 13.3%.

By looking at the changes in emissions by sector, emissions from fuel combustion in the energy industries increased by 18.4% compared to FY 1990, decreased by 3.0% compared to FY 2005, and decreased by 25.2% compared to FY 2013. The main driving factor for the increase compared to the emissions in FY 1990 was the increased emissions from solid and gaseous fuel consumption for electricity power generation, despite the decreased emissions from liquid fuel consumption. Emissions from manufacturing industries and construction decreased by 33.2% compared to FY 1990, by 30.1% compared to FY 2005, and by 23.3% compared to FY 2013. The main driving factor for the decrease compared to the emissions in FY 1990 is the decreased emissions from solid fuel consumption for the iron and steel industry. Emissions from transport decreased by 12.1% compared to FY 1990, decreased by 25.4% compared to FY 2005, and decreased by 17.4% compared to FY 2013. The main driving factor for the decrease compared to the emissions in FY 1990 was the decrease in emissions from diesel fuel in road transportation. Emissions from other sectors decreased by 12.2% compared to FY 1990, by 29.2% compared to FY 2005, and by 7.0% compared to FY 2013. The main driving factor for the decrease compared to the emissions in FY 1990 was the decreased emissions from the liquid fuel consumption for the commercial/institutional sub-sectors.

CO_2 removals in FY 2020 were 52.3 Mt CO_2, which were equivalent to 4.5% of total GHG emissions. They decreased by 20.4% compared to FY 1990, by 41.2% compared to FY 2005, and by 17.3% compared to FY 2013.

Table 2-2 Trends in CO_2 emissions and removals in each sector

Category	GHG emissions [Mt CO_2]								Changes [Mt CO_2]	Changes [%]	Changes [Mt CO_2]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
1 Energy	1,078.9	1,155.4	1,186.3	1,218.8	1,154.3	1,253.2	1,163.9	987.0	-231.9	-19.0%	-266.2	-21.2%
1.A Fuel combustion	1,078.7	1,154.8	1,185.8	1,218.3	1,153.8	1,252.8	1,163.5	986.6	-231.7	-19.0%	-266.1	-21.2%
1.A.1 Energy industries	368.5	378.9	395.5	449.7	473.8	583.5	527.3	436.3	-13.3	-3.0%	-147.1	-25.2%
1.A.2 Manufacturing industries and construction	349.8	357.7	346.9	334.6	301.1	304.9	288.1	233.8	-100.7	-30.1%	-71.0	-23.3%
1.A.3 Transport	202.1	242.8	253.1	238.1	222.0	215.1	208.9	177.6	-60.4	-25.4%	-37.5	-17.4%
1.A.4 Other sectors	158.2	175.4	190.3	196.0	156.9	149.3	139.2	138.8	-57.2	-29.2%	-10.5	-7.0%
1.B Fugitive emissions from fuels	0.2	0.5	0.5	0.5	0.5	0.4	0.4	0.3	-0.2	-32.2%	-0.1	-21.5%
2 Industrial processes and product use	65.6	67.5	60.3	56.7	47.3	49.0	47.0	42.7	-13.9	-24.5%	-6.2	-12.7%
3 Agriculture	0.6	0.4	0.4	0.4	0.4	0.6	0.5	0.4	0.0	+3.6%	-0.2	-26.4%
4 LULUCF	-65.7	-79.5	-85.0	-89.0	-70.2	-63.2	-56.7	-52.3	36.7	-41.2%	10.9	-17.3%
5 Waste	13.0	16.7	17.5	14.7	13.0	12.8	12.3	12.1	-2.6	-17.8%	-0.7	-5.6%
Total (including LULUCF)	1,158.1	1,239.9	1,264.6	1,290.6	1,215.1	1,315.6	1,223.6	1,042.2	-248.4	-19.2%	-273.3	-20.8%

(2) CO_2 emissions per capita, CO_2 emissions per unit of GDP

CO_2 emissions per capita in FY 2020 were 8.26 t CO_2/capita. They decreased by 11.8% compared to FY 1990, decreased by 18.2% compared to FY 2005, and decreased by 20.0% compared to FY 2013.

29 It covers emissions from commercial/institutional, residential and agriculture/forestry/fishing.

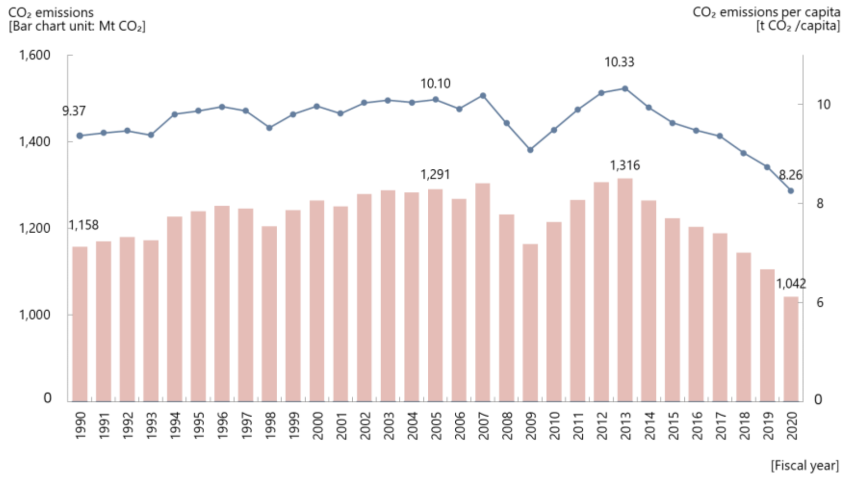

Figure 2-4 Trends in total CO_2 emissions and CO_2 emissions per capita

Source of population data: Ministry of Internal Affairs and Communications, Population Estimates (The data for the years the census was conducted are based on the census population.)

CO_2 emissions per unit of real GDP (million yen) in FY 2020 were 1.98 t CO_2/million yen. They decreased by 26.2% compared to FY 1990, by 20.9% compared to FY 2005, and by 19.8% compared to FY 2013.

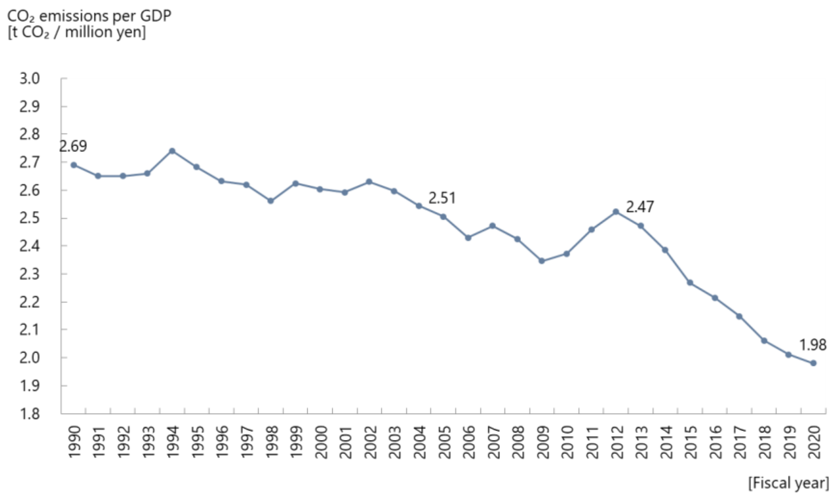

Figure 2-5 Trend in CO_2 emissions per unit of GDP

Source of GDP data: Cabinet Office, Government of Japan, Annual Report on National Accounts

■ CH_4

CH_4 emissions in FY 2020 were 28.5 Mt CO_2 eq. (including LULUCF), accounting for 2.5% of total GHG emissions. They decreased by 35.6% compared to FY 1990, by 18.3% compared to FY 2005, and by 5.6% compared to FY 2013. Their decrease since FY 1990 was mainly a result of a 65.5% decrease in emissions from the waste sector (solid waste disposal).

The breakdown of the CH_4 emissions in FY 2020 showed that the largest source was the agriculture sector accounting for 77.6%, followed by the waste sector (15.2%). In the agriculture sector, rice cultivation (3.C) was the largest source accounting for 42.2% of total CH_4 emissions and followed by enteric fermentation (3.A) (26.8%). In the waste sector, solid waste disposal (5.A) was the largest source accounting for 9.3% of total CH_4 emissions.

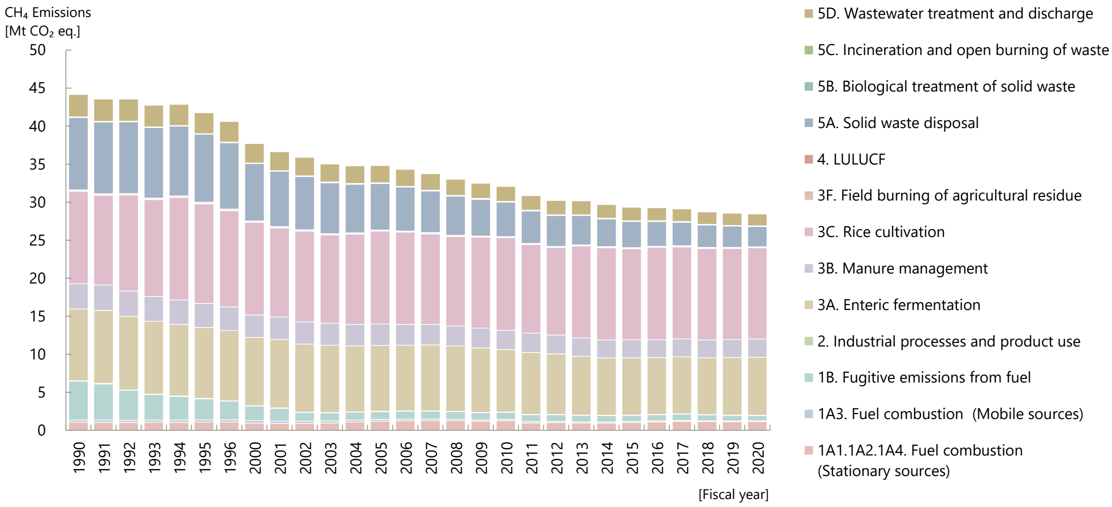

Figure 2-6 Trends in CH_4 emissions

Table 2-3 Trends in CH_4 emissions

Category	Emissions [Mt CO_2 eq.]								Changes [Mt CO_2 eq.]	Changes [%]	Changes [Mt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
1 Energy	6.5	4.2	3.2	2.5	2.4	2.0	2.0	1.9	-0.5	-21.0%	0.0	-0.8%
1.A Fuel combustion	1.3	1.4	1.3	1.4	1.4	1.1	1.1	1.3	-0.2	-12.7%	0.1	+12.7%
1.A.1 Energy industries	0.5	0.4	0.3	0.2	0.3	0.2	0.3	0.4	0.2	+61.7%	0.2	+68.0%
1.A.2 Manufacturing industries and construction	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.1	+21.6%	0.0	+8.5%
1.A.3 Transport	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	-0.1	-57.4%	0.0	-30.1%
1.A.4 Other sectors	0.2	0.3	0.3	0.5	0.5	0.2	0.2	0.2	-0.3	-58.2%	0.0	-8.0%
1.B Fugitive emissions from fuels	5.1	2.8	1.9	1.0	0.9	0.8	0.8	0.7	-0.3	-32.5%	-0.2	-18.4%
2 Industrial processes and product use	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	-29.2%	0.0	-17.8%
3 Agriculture	25.0	25.7	24.2	23.8	23.0	22.3	21.9	22.1	-1.7	-7.0%	-0.2	-1.0%
4 LULUCF	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	-21.8%	0.0	-7.6%
5 Waste	12.5	11.8	10.2	8.5	6.6	5.8	5.3	4.3	-4.1	-49.0%	-1.5	-25.1%
Total (including LULUCF)	44.2	41.8	37.7	34.8	32.1	30.2	29.3	28.5	-6.4	-18.3%	-1.7	-5.7%

■ N_2O

N_2O emissions in FY 2020 were 20.2 Mt CO_2 eq. (including LULUCF), accounting for 1.8% of total GHG emissions. They decreased by 38.0% compared to FY 1990, by 21.4% compared to FY 2005, and by 9.2% compared to FY 2013. Their decrease since FY 1990 was mainly a result of an 89.0% decrease in emissions from industrial processes and product use (e.g., adipic acid production in the chemical industry). There was a sharp decline in emissions from the industrial processes and product use from FY 1998 to 1999 as N_2O abatement equipment came on stream in the adipic acid production plant in March 1999. However, the N_2O emissions increased in FY 2000 because of a decrease in the equipment's operation rate due to mechanical failure; the emissions decreased again in FY 2001 with the resumption of normal operation.

The breakdown of the N_2O emissions in FY 2020 showed that the largest source was the agriculture sector accounting for 47.9% of total N_2O emissions, followed by fuel combustion (27.0%). In the agriculture sector, agricultural soils (3.D) was the largest source accounting for 28.8% of total N_2O emissions and followed by enteric fermentation (3.A) (19.0%). In the fuel combustion sector, energy industries (1.A.1) was the largest source accounting for 9.2% of total N_2O emissions.

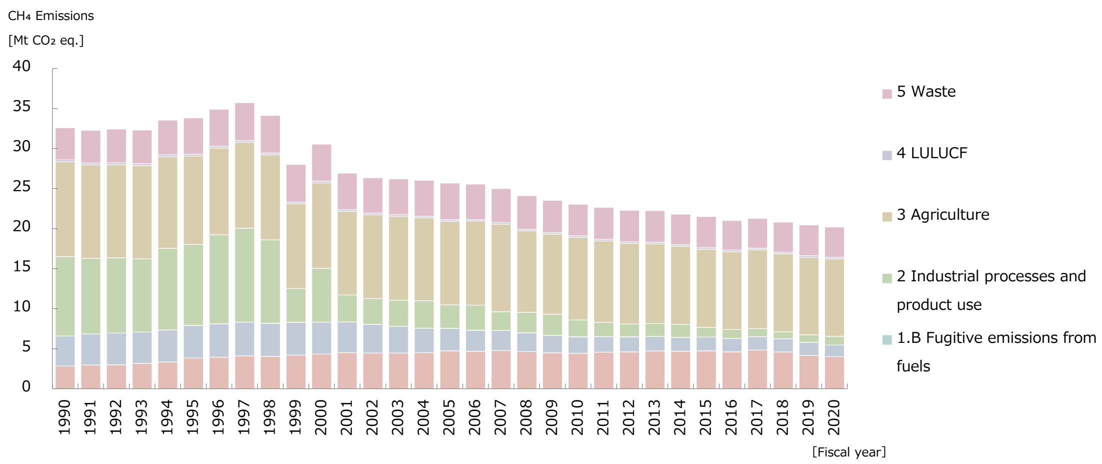

Figure 2-7 Trends in N_2O emissions

Table 2-4 Trends in N_2O emissions

Category	Emissions [Mt CO2 eq.]								Changes [Mt CO_2 eq.]	Changes [%]	Changes [Mt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
1 Energy	6.6	7.9	8.3	7.5	6.5	6.5	6.5	5.5	-2.1	-27.7%	-1.1	-16.4%
1.A Fuel combustion	6.6	7.9	8.3	7.5	6.5	6.5	6.5	5.5	-2.1	-27.7%	-1.1	-16.4%
1.A.1 Energy industries	0.9	1.4	1.6	2.1	2.1	2.4	2.4	1.9	-0.3	-12.0%	-0.5	-21.0%
1.A.2 Manufacturing industries and construction	1.3	1.7	1.9	1.9	1.7	1.8	1.7	1.5	-0.4	-20.7%	-0.3	-15.9%
1.A.3 Transport	3.7	4.1	4.0	2.8	2.1	1.8	1.7	1.5	-1.4	-48.5%	-0.4	-19.5%
1.A.4 Other sectors	0.7	0.8	0.8	0.7	0.6	0.6	0.6	0.7	-0.1	-10.8%	0.1	+10.0%
1.B Fugitive emissions from fuels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-53.5%	0.0	-30.9%
2 Industrial processes and product use	9.9	10.1	6.7	2.9	2.1	1.6	1.2	1.1	-1.8	-62.9%	-0.5	-32.8%
3 Agriculture	11.9	11.0	10.7	10.5	10.3	10.0	9.8	9.7	-0.8	-7.5%	-0.3	-2.8%
4 LULUCF	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	+3.4%	0.0	+6.2%
5 Waste	4.0	4.5	4.6	4.6	3.9	4.0	3.9	3.8	-0.8	-17.4%	-0.2	-4.6%
Total (including LULUCF)	32.6	33.8	30.6	25.7	23.0	22.2	21.5	20.2	-5.5	-21.4%	-2.0	-9.2%

■ HFCs

HFCs emissions in CY 2020[30] were 51.7 Mt CO_2 eq., accounting for 4.5% of total GHG emissions. They increased by 224.7% compared to CY 1990, by 304.6% compared to CY 2005, and by 61.0% compared to CY 2013. Their increase since CY 1990 was mainly a result of an increase in emissions from refrigeration and air conditioning (+47.7 MtCO_2 eq. compared to CY1990) substituting for HCFC (an ozone-depleting substance), despite a decrease in emissions of HFC-23 (-99.1% compared to CY1990) produced as a by-product of HCFC-22 production due to regulation under the *Act on the Protection of the Ozone Layer Through the Control of Specified Substances and Other Measures*. (Act No.53, 1988)

The breakdown of the HFCs emissions in CY 2020 showed that the largest source was refrigerants of refrigeration and air conditioning equipment (2.F.1), accounting for 92.2% of total HFCs emissions.

30 Emissions of HFCs, PFCs, SF_6, and NF_3 are estimated on a calendar year (CY) basis.

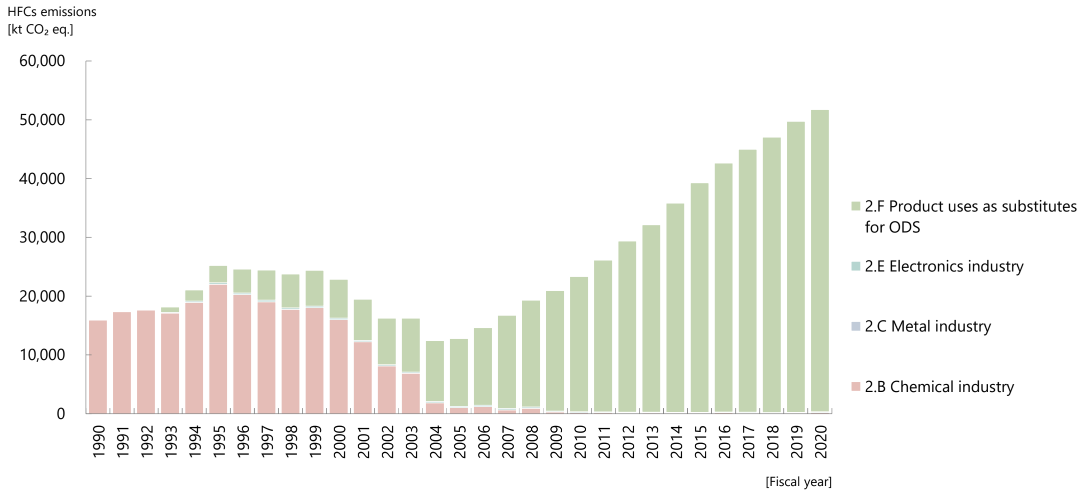

Figure 2-8 Trends in HFCs emissions

Table 2-5 Trends in HFCs emissions

Category	Emissions [kt CO_2 eq.]								Changes [kt CO_2 eq.]	Changes [%]	Changes [kt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
2.B Chemical industry	15,930	22,019	15,984	1,035	181	147	113	216	-819.0	-79.1%	69.0	+46.8%
2.C Metal industry	NO	NO	NO	NO	NO	1.3	0.9	1.3	-	-	0.0	0.0%
2.E Electronics industry	0.7	271	285	227	168	112	115	109	-117.5	-51.8%	-2.2	-1.9%
2.F Product uses as substitutes for ODS	1.3	2,923	6,582	11,521	22,977	31,860	39,052	51,398	39877.0	+346.1%	19,537.8	+61.3%
Total	15,932	25,213	22,851	12,784	23,327	32,121	39,281	51,725	38941.8	+304.6%	19,604.7	+61.0%

PFCs

PFCs emissions in CY 2020 were 3.5 Mt CO_2 eq., accounting for 0.3% of total GHG emissions. They decreased by 46.9% compared to CY 1990, decreased by 59.8% compared to CY 2005 and increased by 5.7% compared to CY 2013. Their decrease since CY 1990 was mainly the result of a decrease in emissions from the solvents (-68.0%).

The breakdown of the PFCs emissions in CY 2020 showed that the largest source was semiconductor manufacture (2.E.1), accounting for 52.1% of total PFCs emissions, followed by solvents, such as those for washing metals (2.F.5) (41.9%).

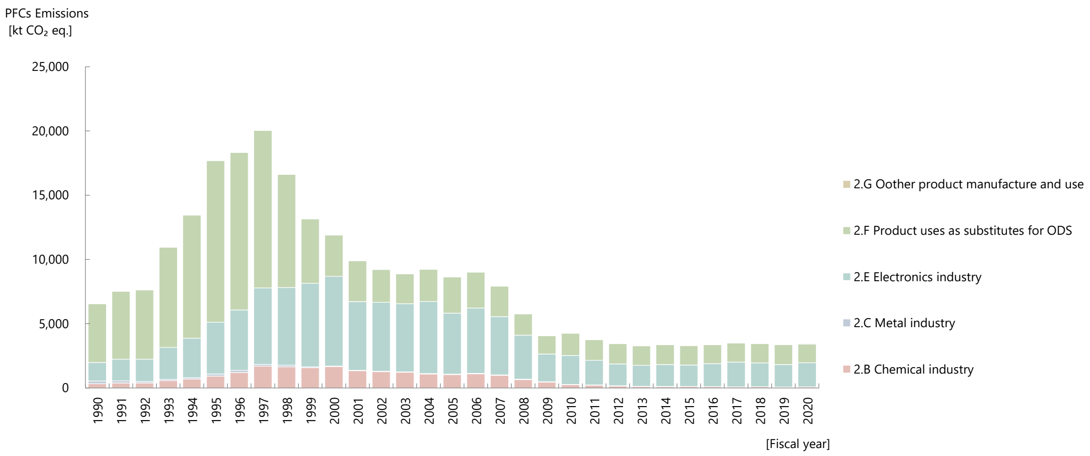

Figure 2-9 Trends in PFCs emissions

Table 2-6 Trends in PFCs emissions

Category	Emissions [kt CO_2 eq.]								Changes [kt CO_2 eq.]	Changes [%]	Changes [kt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
2.B Chemical industry	330.9	914.4	1,661.3	1,040.6	248.4	110.8	114.6	73.8	-966.8	-92.9%	-37.0	-33.4%
2.C Metal industry	203.7	170.6	43.5	35.8	25.2	15.8	0.0	0.0	-35.8	-100.0%	-15.8	-100.0%
2.E Electronics industry	1,454.8	4,019.8	6,985.6	4,746.1	2,260.8	1,631.4	1,668.7	1,887.8	-2858.4	-60.2%	256.4	+15.7%
2.F Product uses as substitutes for ODS	4,549.9	12,572.2	3,199.8	2,814.6	1,720.7	1,517.9	1,517.0	1,456.6	-1358.0	-48.2%	-61.4	-4.0%
2.G Oother product manufacture and use	NO	NO	NO	0.3	4.3	10.4	7.8	56.5	56.2	+19448.6%	46.1	+445.0%
Total	6,539.3	17,677.0	11,890.2	8,637.4	4,259.4	3,286.3	3,308.1	3,474.5	-5162.9	-59.8%	188.3	+5.7%

■ SF_6

SF_6 emissions in CY 2020 were 2.0 Mt CO_2 eq., accounting for 0.2% of total GHG emissions. They decreased by 84.2% compared to CY 1990, decreased by 59.7% compared to CY 2005, and decreased by 2.3% compared to CY 2013. Their decrease since CY 1990 was mainly a result of a decrease from electrical equipment due to an enhancement of gas management system, such as gas recovery largely in electric power companies. (-93.0%)

The breakdown of the SF_6 emissions in CY 2020 showed that the largest source was other product use (e.g., accelerators) (2.G.2), accounting for 38.7% of total SF_6 emissions, followed by electrical equipment (2.G.1) (28.2%) and magnesium production (2.C.3) (14.6%).

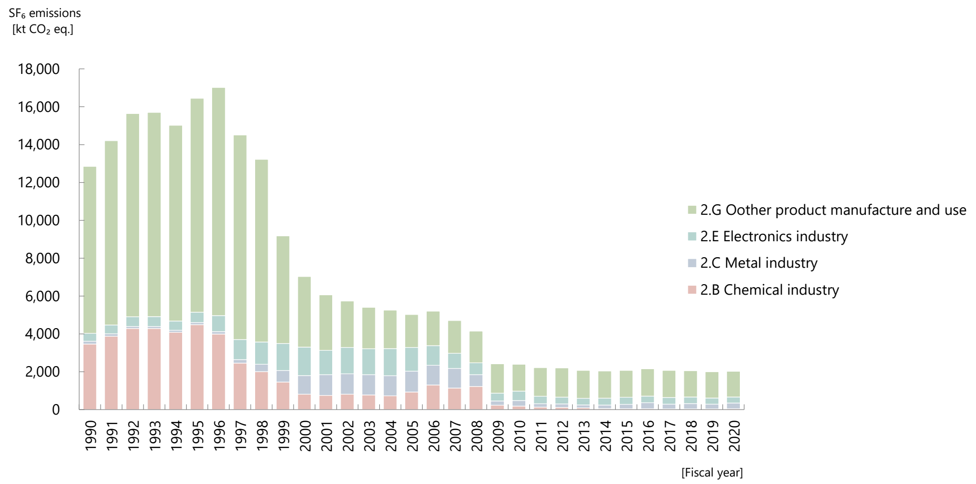

Figure 2-10 Trends in SF_6 emissions

Table 2-7 Trends in SF_6 emissions

Category	Emissions [kt CO_2 eq.]								Changes [kt CO_2 eq.]	Changes [%]	Changes [kt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
2.B Chemical industry	330.9	914.4	1,661.3	1,040.6	248.4	110.8	114.6	73.8	-966.8	-92.9%	-37.0	-33.4%
2.C Metal industry	203.7	170.6	43.5	35.8	25.2	15.8	0.0	0.0	-35.8	-100.0%	-15.8	-100.0%
2.E Electronics industry	1,454.8	4,019.8	6,985.6	4,746.1	2,260.8	1,631.4	1,668.7	1,887.8	-2858.4	-60.2%	256.4	+15.7%
2.F Product uses as substitutes for ODS	4,549.9	12,572.2	3,199.8	2,814.6	1,720.7	1,517.9	1,517.0	1,456.6	-1358.0	-48.2%	-61.4	-4.0%
2.G Oother product manufacture and use	NO	NO	NO	0.3	4.3	10.4	7.8	56.5	56.2	+19448.6%	46.1	+445.0%
Total	6,539.3	17,677.0	11,890.2	8,637.4	4,259.4	3,286.3	3,308.1	3,474.5	-5162.9	-59.8%	188.3	+5.7%

■ NF_3

NF_3 emissions in CY 2020 were 0.3 Mt CO_2 eq., accounting for 0.03% of total GHG emissions. They increased by 785.7% compared to CY 1990, decreased by 80.4% compared to CY 2005, and decreased by 82.1% compared to CY 2013. The increase since CY 1990 was mainly a result of an increase in fugitives from fluorochemical production (NF_3) (+833.5%).

The breakdown of the CY 2020 emissions showed that the largest source was semiconductor manufacture (2.E.1), accounting for 88.2%. It was followed by liquid crystal manufacture (2.E.2) (6.6%) and fluorochemical production (2.B.9) (5.2%).

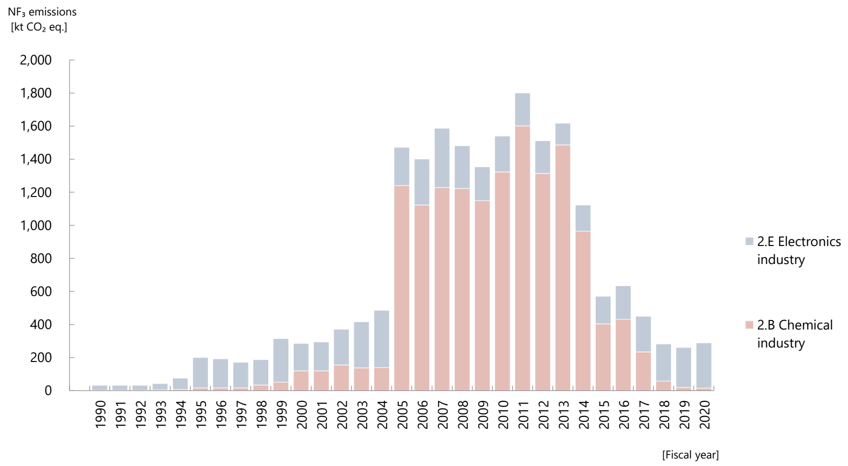

Figure 2-11 Trends in NF_3 emissions

Table 2-8 Trends in NF_3 emissions

Category	Emissions [kt CO_2 eq.]								Changes [kt CO_2 eq.]	Changes [%]	Changes [kt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
2.B Chemical industry	2.8	17.2	120.4	1,240.1	1,322.7	1,486.1	404.2	15.1	**-1225.0**	**-98.8%**	**-1,471.0**	**-99.0%**
2.E Electronics industry	29.8	183.9	165.4	231.6	217.1	131.2	166.8	273.7	**42.1**	**+18.2%**	**142.6**	**+108.7%**
総計	32.6	201.1	285.8	1,471.8	1,539.7	1,617.2	571.0	288.8	**-1182.9**	**-80.4%**	**-1,328.4**	**-82.1%**

■ Indirect CO_2

Indirect CO_2[31] emissions in FY 2020 were 2.0 Mt CO_2 eq., accounting for 0.2% of total GHG emissions. They decreased by 64.6% compared to FY 1990, by 39.7% compared to FY 2005, and by 14.8% compared to FY 2013. Their decrease since FY 1990 was due to the decrease in indirect CO_2 emissions from the use of paint through the wider use of low VOC paint and VOC removal by adsorption devices.

31 Emissions derived from combustion-origin and biomass-origin CO, CH_4, and NMVOC are excluded to avoid double counting and/or by concept of carbon neutrality.

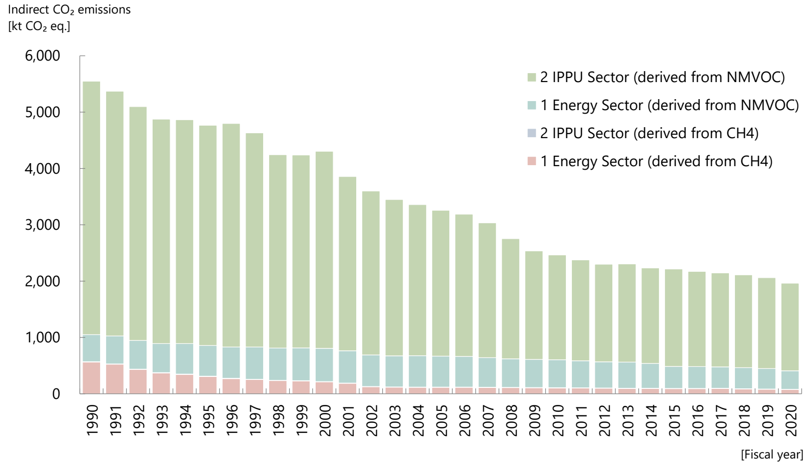

Figure 2-12 Trends in Indirect CO_2 emissions

Table 2-9 Trends in Indirect CO_2 emissions

Emission Source	Emissions [kt CO_2 eq.]								Changes [kt CO_2 eq.]	Changes [%]	Changes [kt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
Derived from CH_4	568.5	311.4	217.4	118.7	107.2	98.4	95.0	80.3	-38.4	-32.4%	-18.1	-18.4%
1. Energy Sector	561.8	305.0	211.5	112.8	101.2	93.3	89.7	76.1	-36.7	-32.5%	-17.2	-18.4%
2. IPPU Sector	6.7	6.4	6.0	5.9	5.9	5.1	5.3	4.2	-1.7	-29.2%	-0.9	-17.8%
Derived from NMVOC	4,979.9	4,456.1	4,088.4	3,137.5	2,357.7	2,206.9	2,118.3	1,883.2	-1254.3	-40.0%	-323.8	-14.7%
1. Energy Sector	480.5	545.0	589.8	548.0	497.2	463.6	390.1	326.7	-221.3	-40.4%	-137.0	-29.5%
2. IPPU Sector	4,499.5	3,911.1	3,498.6	2,589.5	1,860.5	1,743.3	1,728.2	1,556.5	-1033.0	-39.9%	-186.8	-10.7%
Total	5,548.4	4,767.5	4,305.8	3,256.2	2,464.9	2,305.3	2,213.4	1,963.4	-1292.7	-39.7%	-341.8	-14.8%

2.2.4 Trends in GHG emissions and removals by sector

The breakdown of GHG emissions and removals in FY 2020 by sector[32] showed that energy sector (excluding indirect CO_2) accounted for 86.5% of total GHG emissions, followed by industrial processes and product use (8.8%), agriculture (2.8%), waste (1.8%) sectors, and indirect CO_2 emissions (0.2%).

Removals by LULUCF in FY 2020 were equivalent to 4.5% of total GHG emissions.

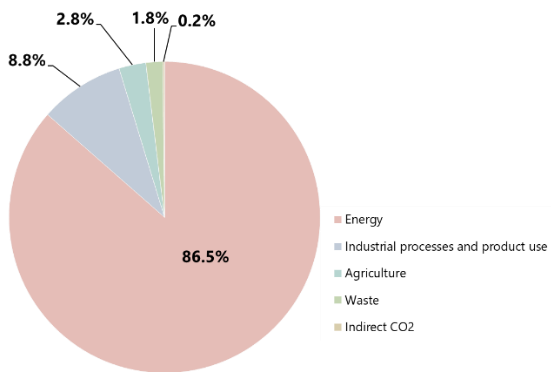

Figure 2-13 Share of GHG emissions by sector (FY 2020, excluding LULUCF)

32 As indicated in the 2006 IPCC Guidelines and the CRF.

Table 2-10 Trends in GHG emissions and removals by sector

GHGs	Emissions [Mt CO_2 eq.]								Changes [Mt CO_2 eq.]	Changes [%]	Changes [Mt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
1 Energy	1,091.9	1,167.4	1,197.8	1,228.8	1,163.1	1,261.7	1,172.3	994.4	-234.5	-19.1%	-267.3	-21.2%
1.A Fuel combustion	1,086.6	1,164.1	1,195.4	1,227.3	1,161.7	1,260.4	1,171.1	993.3	-234.0	-19.1%	-267.1	-21.2%
1.A.1 Energy industries	369.9	380.7	397.4	452.0	476.2	586.1	530.0	438.6	-13.4	-3.0%	-147.5	-25.2%
1.A.2 Manufacturing industries and construction	351.4	359.8	349.2	336.9	303.3	307.1	290.3	235.9	-101.0	-30.0%	-71.3	-23.2%
1.A.3 Transport	206.2	247.2	257.4	241.1	224.2	217.1	210.7	179.2	-61.9	-25.7%	-37.9	-17.4%
1.A.4 Other sectors	159.1	176.5	191.4	197.3	158.0	150.1	140.0	139.7	-57.6	-29.2%	-10.5	-7.0%
1.B Fugitive emissions from fuels	5.3	3.3	2.4	1.5	1.4	1.3	1.2	1.0	-0.5	-32.4%	-0.3	-19.5%
2 Industrial processes and product use	111.0	137.2	109.1	87.6	81.0	89.8	93.5	101.4	13.8	+15.8%	11.6	+13.0%
3 Agriculture	37.5	37.1	35.3	34.6	33.7	32.8	32.2	32.2	-2.4	-7.0%	-0.7	-2.0%
4 LULUCF	-65.3	-79.2	-84.7	-88.7	-69.9	-63.0	-56.4	-52.0	36.7	-41.4%	10.9	-17.4%
5 Waste	29.6	33.0	32.4	27.7	23.5	22.5	21.5	20.2	-7.6	-27.3%	-2.3	-10.4%
Indirect CO_2	5.5	4.8	4.3	3.3	2.5	2.3	2.2	2.0	-1.3	-39.7%	-0.3	-14.8%
Gross Total (excluding LULUCF, including Indirect CO_2)	1,275.4	1,379.5	1,378.9	1,382.0	1,303.9	1,409.1	1,321.6	1,150.1	-231.9	-16.8%	-259.0	-18.4%

Energy

Emissions from the energy sector in FY 2020 were 994 Mt CO_2 eq. They decreased by 8.9% compared to FY 1990, decreased by 19.1% compared to FY 2005, and decreased by 21.2% compared to FY 2013.

The breakdown of the GHG emissions from the energy sector in FY 2020 showed that emissions from fuel combustion (1.A) accounted for 99.9%. The emissions from energy industries (1.A.1) were the largest source accounting for 44.1% of total emissions from the energy sector, followed by manufacturing industries and construction (1.A.2) (23.7%), and transport (1.A.3) (18.0%).

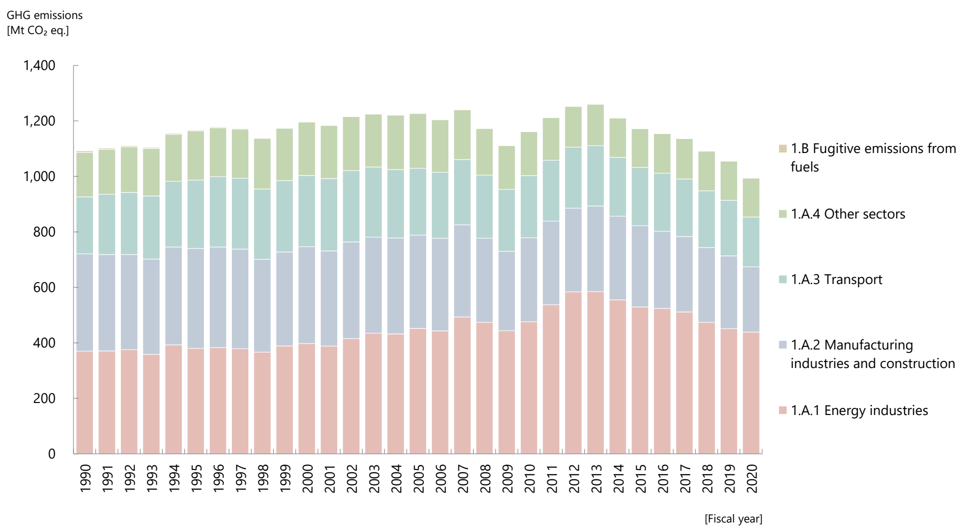

Figure 2-14 Trends in GHG emissions from the energy sector

Table 2-11 Trends in GHG emissions from the energy sector

GHGs	Emissions [Mt CO_2 eq.]								Changes [Mt CO_2 eq.]	Changes [%]	Changes [Mt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
1.A Fuel Combustion	1,086.6	1,164.1	1,195.4	1,227.3	1,161.7	1,260.4	1,171.1	993.3	-234.0	-19.1%	-267.1	-21.2%
1.A.1 Energy industries	369.9	380.7	397.4	452.0	476.2	586.1	530.0	438.6	-13.4	-3.0%	-147.5	-25.2%
1.A.2 Manufacturing industries and construction	351.4	359.8	349.2	336.9	303.3	307.1	290.3	235.9	-101.0	-30.0%	-71.3	-23.2%
1.A.3 Transport	206.2	247.2	257.4	241.1	224.2	217.1	210.7	179.2	-61.9	-25.7%	-37.9	-17.4%
1.A.4 Other sectors	159.1	176.5	191.4	197.3	158.0	150.1	140.0	139.7	-57.6	-29.2%	-10.5	-7.0%
1.B Fugitive emissions from fuels	5.3	3.3	2.4	1.5	1.4	1.3	1.2	1.0	-0.5	-32.4%	-0.3	-19.5%
1.C CO_2 transport and storage	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	-	-	-	-
Total	1,091.9	1,167.4	1,197.8	1,228.8	1,163.1	1,261.7	1,172.3	994.4	-234.5	-19.1%	-267.3	-21.2%

Industrial Processes and Product Use

Emissions from the industrial processes and product use (IPPU) sector in FY 2020 were 101.4 Mt CO_2 eq. They decreased by 8.6% compared to FY 1990, increased by 15.8% compared to FY 2005, and increased by 13.0% compared to FY 2013.

The breakdown of GHG emissions from the IPPU sector in FY 2020 showed that the largest source was HFCs emissions from product uses as ODS substitutes (2.F), accounting for 50.7% of total emissions from the IPPU sector, followed by the mineral industry (2.A), such as CO_2 emissions from cement production (30.8%) and CO_2 emission from the metal industry (2.C) (5.7%).

Despite the increase in HFCs emissions from product uses as substitutes for ODS compared to FY 1990, emissions from the IPPU sector decreased in the same period. The main driving factors for the decrease in emissions since FY 1990 were the decrease in emissions of HFC-23 produced as a by-product of HCFC-22 production due to regulation under the *Act on the Protection of the Ozone Layer Through the Control of Specified Substances and Other Measures* (chemical industry), the decrease in CO_2 emissions from cement production (mineral industry) as clinker production declined, and the decrease in N_2O emissions from adipic acid production (chemical industry) as the N_2O abatement equipment came on stream.

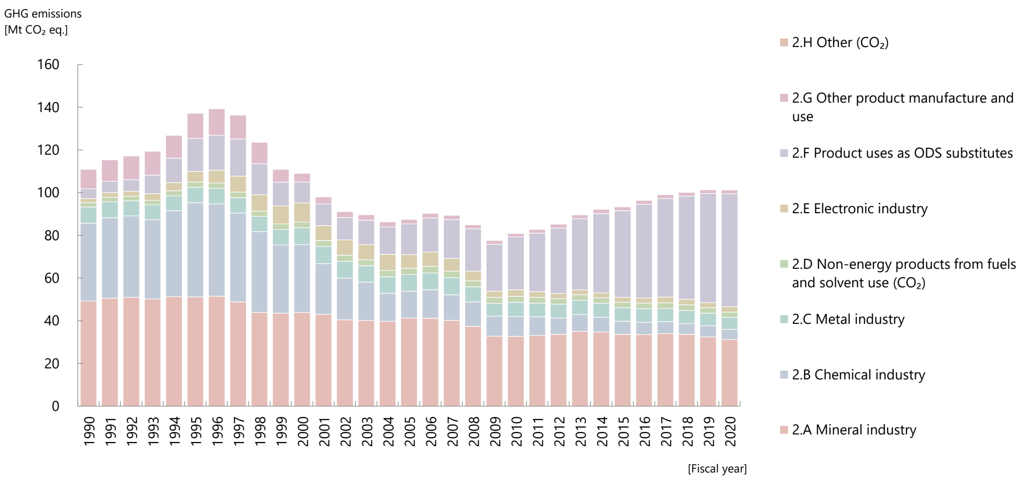

Figure 2-15 Trends in GHG emissions from the industrial processes sector

Table 2-12 Trends in GHG emissions from the industrial processes sector

GHGs	Emissions [Mt CO_2 eq.]								Changes [Mt CO_2 eq.]	Changes [%]	Changes [Mt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
2.A Mineral industry	49.2	51.1	43.9	41.2	32.8	35.0	33.7	31.2	-10.01	-24.3%	-3.79	-10.8%
2.B Chemical industry	36.4	44.2	31.8	12.6	9.2	7.9	6.1	4.7	-7.92	-62.7%	-3.20	-40.4%
2.C Metal industry	7.6	7.2	7.9	7.8	6.7	6.6	6.4	5.7	-2.09	-26.7%	-0.87	-13.2%
2.D Non-energy products from fuels and solvent use (CO_2)	2.0	2.4	2.7	2.9	2.7	2.7	2.5	2.3	-0.52	-18.2%	-0.34	-12.7%
2.E Electronic industry	1.9	5.0	8.9	6.5	3.1	2.2	2.3	2.6	-3.86	-59.8%	0.37	+16.6%
2.F Product uses as ODS substitutes	4.6	15.5	9.8	14.3	24.7	33.4	40.6	52.9	38.52	+268.7%	19.48	+58.4%
2.G Other product manufacture and use	9.1	11.7	4.1	2.1	1.7	1.8	1.8	1.8	-0.27	-12.9%	0.00	-0.3%
2.H Other (CO_2)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.00	-3.9%	-0.01	-7.3%
Total	111.0	137.2	109.1	87.6	81.0	89.8	93.5	101.4	13.84	+15.8%	11.64	+13.0%

Agriculture

Emissions from the agriculture sector in FY 2020 were 32.2 Mt CO_2 eq. They decreased by 14.1% compared to FY 1990, by 7.0% compared to FY 2005, and by 2.0% compared to FY 2013.

The breakdown of the GHG emissions from the agriculture sector in FY 2020 showed that the largest source was the CH_4 emissions from rice cultivation (3.C), accounting for 37.3% of total emissions from this sector. It was followed by CH_4 emission from enteric fermentation (3.A) (23.7%), and by N_2O emission from the agricultural soils (3.D) (18.0%), such as N_2O emissions from nitrogen-based fertilizer applications.

The main driving factor for the decrease in emissions since FY 1990 was the decrease in N_2O emissions from agricultural soils due to the decrease in the amount of inorganic nitrogen fertilizers applied and organic fertilizers from livestock manure applied, and the decrease in CH_4 emissions from enteric fermentation due to the decrease in the number of cattle.

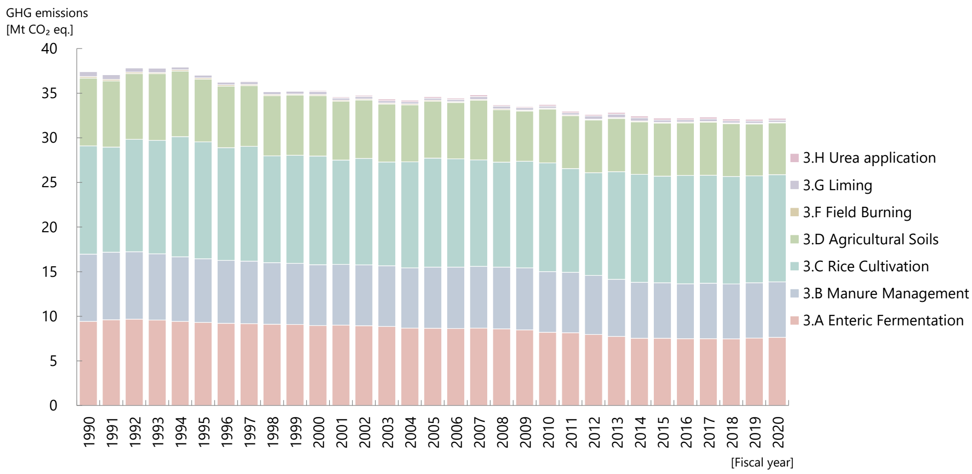

Figure 2-16 Trends in GHG emissions from the agriculture sector

Table 2-13 Trends in GHG emissions from the agriculture sector

GHGs	Emissions [Mt CO_2 eq.]								Changes [Mt CO_2 eq.]	Changes [%]	Changes [Mt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
3.A Enteric Fermentation	9.4	9.3	9.0	8.7	8.2	7.7	7.5	7.6	-1.02	-11.8%	-0.10	-1.3%
3.B Manure Management	7.5	7.1	6.8	6.9	6.8	6.4	6.2	6.2	-0.63	-9.1%	-0.17	-2.6%
3.C Rice Cultivation	12.1	13.1	12.2	12.2	12.2	12.1	12.0	12.0	-0.21	-1.7%	-0.07	-0.6%
3.D Agricultural Soils	7.6	7.0	6.8	6.4	6.0	6.0	5.9	5.8	-0.56	-8.8%	-0.15	-2.6%
3.F Field Burning	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.03	-25.4%	-0.01	-11.3%
3.G Liming	0.6	0.3	0.3	0.2	0.2	0.4	0.3	0.2	0.00	+0.5%	-0.15	-38.7%
3.H Urea application	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.01	+7.6%	-0.01	-2.7%
Total	37.5	37.1	35.3	34.6	33.7	32.8	32.2	32.2	-2.43	-7.0%	-0.66	-2.0%

■ Land Use, Land Use Change and Forestry (LULUCF)

Net removals (including CO_2, CH_4 and N_2O emissions) from the LULUCF sector in FY 2020 were 52.01 Mt CO_2 eq. They decreased by 20.4% compared to FY 1990, by 41.4% compared to FY 2005 and by 17.4% compared to FY 2013.

The breakdown of the GHG emissions and removals from this sector in FY 2020 showed that the largest was CO_2 removals by Forest land (4.A), 57.00 Mt, accounting for 109.6% of net total emissions and removals of this sector.

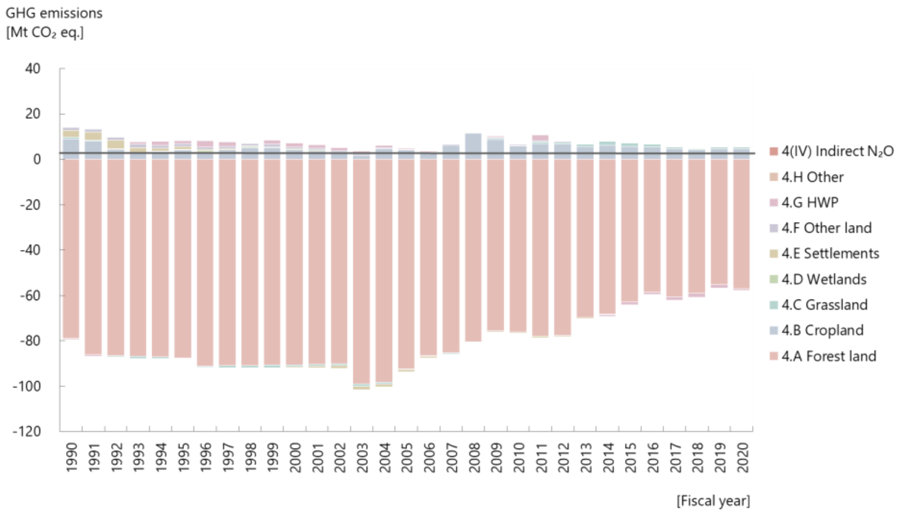

Figure 2-17 Trends in GHG emissions and removals from the LULUCF sector

Table 2-14 Trends in GHG emissions and removals from the LULUCF sector

GHGs	Emissions [Mt CO_2 eq.]								Changes [Mt CO_2 eq.]	Changes [%]	Changes [Mt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
4.A Forest land	-78.93	-87.47	-90.51	-92.50	-76.22	-69.84	-62.96	-57.00	35.50	-38.4%	12.84	-18.4%
4.B Cropland	9.04	3.99	4.09	4.00	5.93	5.54	5.76	4.71	0.70	17.6%	-0.83	-15.0%
4.C Grassland	0.69	0.09	-0.87	-0.25	0.21	1.13	1.40	0.58	0.83	-328.9%	-0.55	-48.5%
4.D Wetlands	0.09	0.36	0.43	0.05	0.11	0.02	0.07	0.03	-0.02	-42.2%	0.00	13.9%
4.E Settlements	2.87	1.29	-0.43	-0.94	-0.38	-0.42	0.15	0.18	1.11	-119.0%	0.60	-142.0%
4.F Other land	1.29	1.06	0.77	0.27	0.31	0.26	0.28	0.25	-0.01	-5.1%	-0.01	-2.2%
4.G HWP	-0.45	1.40	1.77	0.62	0.10	0.30	-1.21	-0.81	-1.42	-230.8%	-1.11	-365.1%
4.H Other	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.01	-0.01	-32.1%	0.00	-12.2%
4(IV) Indirect N_2O	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.00	7.0%	0.00	8.9%
Total	-65.32	-79.20	-84.68	-88.70	-69.89	-62.96	-56.44	-52.01	12.32	-41.4%	10.95	-17.4%

Waste

Emissions from the waste sector in FY 2020 were 20.2 Mt CO_2 eq. They decreased by 31.7% compared to FY 1990, by 27.3% compared to FY 2005, and by 10.4% compared to FY 2013.

The breakdown of the GHG emissions from this sector in FY 2020 showed that the largest source was CO_2 emissions from waste incineration (5.C) associated with waste derived from fossil fuels such as waste plastic and waste oil, accounting for 56.9% of total emissions from this sector. It was followed by CH_4 emission from solid waste disposal (5.A) (13.1%) and N_2O emission from wastewater treatment and discharge (5.D) (10.4%).

The main driving factor for the decrease in emissions since FY 1990 was the decrease in CH_4 emissions from solid waste disposal on land as a result of a decrease in the amount of disposal of biodegradable waste due to improvements in the volume reduction ratio by intermediate treatment under the *Waste Management and Public Cleansing Act* and the *Basic Law for Establishing the Recycling-based Society* (Act No.110, 2000), and other recycling laws.

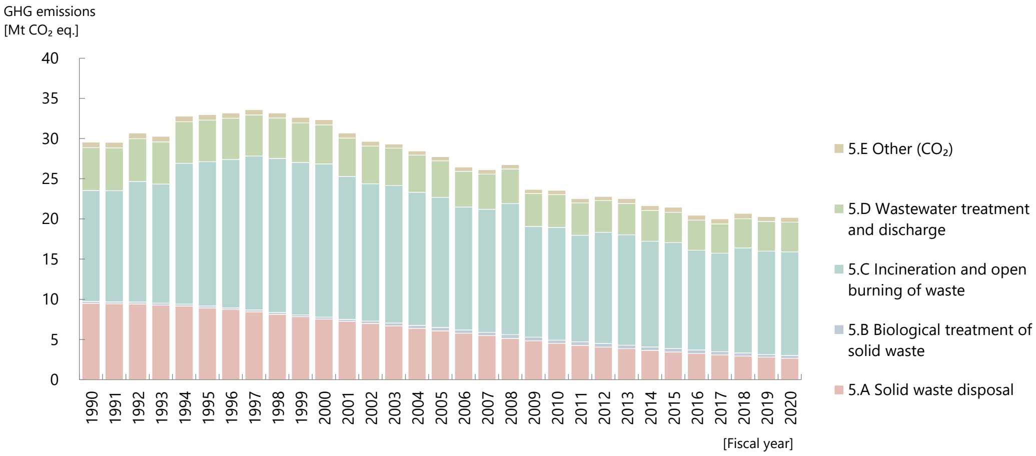

Figure 2-18　Trends in GHG emissions from the waste sector

Table 2-15　Trends in GHG emissions from the waste sector

GHGs	Emissions [Mt CO_2 eq.]								Changes [Mt CO_2 eq.]	Changes [%]	Changes [Mt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
5.A Solid waste disposal	9.5	8.9	7.5	6.1	4.5	3.9	3.4	2.7	-3.43	-56.3%	-1.20	-31.1%
5.B Biological treatment of solid waste	0.2	0.2	0.2	0.4	0.4	0.4	0.4	0.4	-0.06	-14.6%	-0.08	-18.6%
5.C Incineration and open burning of waste	13.8	17.9	19.1	16.2	14.0	13.7	13.2	12.9	-3.28	-20.3%	-0.84	-6.1%
5.D Wastewater treatment and discharge	5.3	5.2	4.9	4.6	4.1	3.9	3.8	3.7	-0.89	-19.5%	-0.22	-5.8%
5.E Other（CO_2）	0.7	0.7	0.7	0.5	0.5	0.6	0.6	0.6	0.09	+18.5%	0.00	-0.7%
Total	29.6	33.0	32.4	27.7	23.5	22.5	21.5	20.2	-7.56	-27.3%	-2.34	-10.4%

2.2.5　Factor analysis of trend of energy-related CO_2[33] emissions

Since about 90% of Japan's greenhouse gas emissions are CO_2 from fuel combustion (energy-related CO_2), changes in energy-related CO_2 emissions have a major impact on total GHG emissions. Japan conducts a factor analysis of the trend of energy-related CO_2 regarding the contribution of each factor to changes in emissions and utilizes it for planning and implementation of mitigation policies and measures.

Specifically, CO_2 emissions could be divided into three factors: the factor of carbon intensity, the factor of energy intensity, and the factor of activity. Emissions are shown as the product of several factors in each sector, and changes in emissions caused by changes in each factor are calculated in a quantitative manner (Figure 2-19). Energy-related CO_2 emissions by sector (excluding the energy transformation sector) used in this analysis are CO_2 emissions with electricity and heat allocated to each end-use sector in line with domestic mitigation measures, so it is not consistent with emissions by sector in the GHG Inventory, and this BR submitted to the UNFCCC secretariat. CO_2 emissions with electricity and heat allocated to each end-use sector are shown in Table 2-16.

This section shows the summary of the results of the factor analysis of energy-related CO_2 for the period from FY 2005 to FY 2020.

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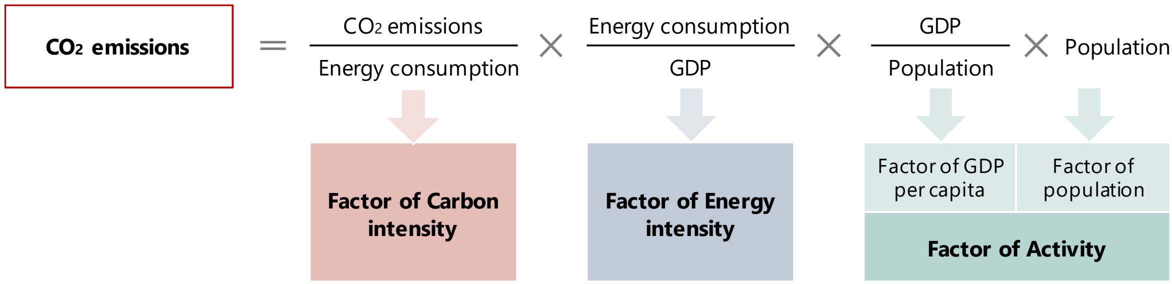
33 It is defined as CO_2 emissions from fossil fuel combustion, except for CO_2 emissions from the oxidation of lubricants, waste burnt for energy, and CO_2 recovery by CCS in accordance with the domestic definition of energy-related CO_2.



$$CO2 = \frac{CO2}{E} \times \frac{E}{GDP} \times \frac{GDP}{P} \times P = U_{CO2} \times U_E \times U_G \times P$$

Factor of Carbon intensity

$$\begin{aligned}\Delta CO2 = \; & \Delta U_{CO2} \times U_E \times U_G \times P \\ & + \Delta U_{CO2} \times \Delta U_E \times U_G \times P/2 \\ & + \Delta U_{CO2} \times U_E \times \Delta U_G \times P/2 \\ & + \Delta U_{CO2} \times U_E \times U_G \times \Delta P/2 \\ & + \Delta U_{CO2} \times \Delta U_E \times \Delta U_G \times P/3 \\ & + \Delta U_{CO2} \times U_E \times \Delta U_G \times \Delta P/3 \\ & + \Delta U_{CO2} \times \Delta U_E \times U_G \times \Delta P/3 \\ & + \Delta U_{CO2} \times \Delta U_E \times \Delta U_G \times \Delta P/4\end{aligned}$$

Factor of Energy intensity

$$\begin{aligned} & + U_{CO2} \times \Delta U_E \times U_G \times P \\ & + \Delta U_{CO2} \times \Delta U_E \times U_G \times P/2 \\ & + U_{CO2} \times \Delta U_E \times \Delta U_G \times P/2 \\ & + U_{CO2} \times \Delta U_E \times U_G \times \Delta P/2 \\ & + \Delta U_{CO2} \times \Delta U_E \times \Delta U_G \times P/3 \\ & + \Delta U_{CO2} \times \Delta U_E \times U_G \times \Delta P/3 \\ & + U_{CO2} \times \Delta U_E \times \Delta U_G \times \Delta P/3 \\ & + \Delta U_{CO2} \times \Delta U_E \times \Delta U_G \times \Delta P/4\end{aligned}$$

Factor of GDP per capita

$$\begin{aligned} & + U_{CO2} \times U_E \times \Delta U_G \times P \\ & + \Delta U_{CO2} \times U_E \times \Delta U_G \times P/2 \\ & + U_{CO2} \times \Delta U_E \times \Delta U_G \times P/2 \\ & + U_{CO2} \times U_E \times \Delta U_G \times \Delta P/2 \\ & + \Delta U_{CO2} \times \Delta U_E \times \Delta U_G \times P/3 \\ & + \Delta U_{CO2} \times U_E \times \Delta U_G \times \Delta P/3 \\ & + U_{CO2} \times \Delta U_E \times \Delta U_G \times \Delta P/3 \\ & + \Delta U_{CO2} \times \Delta U_E \times \Delta U_G \times \Delta P/4\end{aligned}$$

Factor of population

$$\begin{aligned} & + U_{CO2} \times U_E \times U_G \times \Delta P \\ & + \Delta U_{CO2} \times U_E \times U_G \times \Delta P/2 \\ & + U_{CO2} \times \Delta U_E \times U_G \times \Delta P/2 \\ & + U_{CO2} \times U_E \times \Delta U_G \times \Delta P/2 \\ & + \Delta U_{CO2} \times \Delta U_E \times U_G \times \Delta P/3 \\ & + \Delta U_{CO2} \times U_E \times \Delta U_G \times \Delta P/3 \\ & + U_{CO2} \times \Delta U_E \times \Delta U_G \times \Delta P/3 \\ & + \Delta U_{CO2} \times \Delta U_E \times \Delta U_G \times \Delta P/4\end{aligned}$$

CO_2: CO_2 emissions
E: Energy consumption
GDP: Gross Domestic Product
P: Population
U_{CO2} : CO_2 emission intensity
U_E : Energy consumption intensity
U_G : GDP per capita

Figure 2-19 Equation for factor analysis of energy-related CO_2

Table 2-16 Energy-related CO_2 emissions with electricity and heat allocated by sector

	Energy-related CO_2 emissions [Mt CO_2 eq.]								Changes [Mt CO_2 eq.]	Changes [%]	Changes [Mt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
Industries (factories, etc.)	503.4	489.3	477.4	467.4	431.0	463.6	430.4	355.5	**-111.9**	**-23.9%**	**-108.1**	**-23.3%**
Transport (cars, etc.)	208.4	249.2	258.8	244.4	228.8	224.2	217.4	184.8	**-59.7**	**-24.4%**	**-39.5**	**-17.6%**
Commercial and other (commerce, service, office, etc.)	130.8	161.9	189.5	220.1	199.9	237.3	217.9	182.2	**-37.9**	**-17.2%**	**-55.1**	**-23.2%**
Residential	128.7	150.3	155.8	170.5	178.4	207.6	186.7	166.5	**-4.0**	**-2.4%**	**-41.1**	**-19.8%**
Energy Transformation(power plants, etc.)	96.2	91.4	88.9	98.0	99.0	102.7	93.5	78.4	**-19.6**	**-20.0%**	**-24.2**	**-23.6%**
Total	1,067.6	1,142.1	1,170.3	1,200.5	1,137.0	1,235.4	1,145.9	967.4	**-233.1**	**-19.4%**	**-268.0**	**-21.7%**

■ Total energy-related CO_2 emissions

Energy-related CO_2 emissions in FY 2020 were 967.4 Mt CO_2, which decreased by 19.4% compared to FY 2005 and by 21.7% compared to FY 2013.

The largest decrease factor from FY 2005 was the decrease in the energy intensity. On the other hand, the largest increase factor was the factor of carbon intensity (electricity) due to the increase in the CO_2 emission factor by changing the energy mix and the factor of GDP per capita by economic development (Figure 2-20). Particularly after FY 2011, the temporary suspension of all nuclear power plants in Japan due to the Fukushima Daiichi nuclear power plant accident caused by the Great East Japan Earthquake on March 11, 2011, led to an increase in fossil fuel-fired power generation and an increase in the factor of carbon intensity.

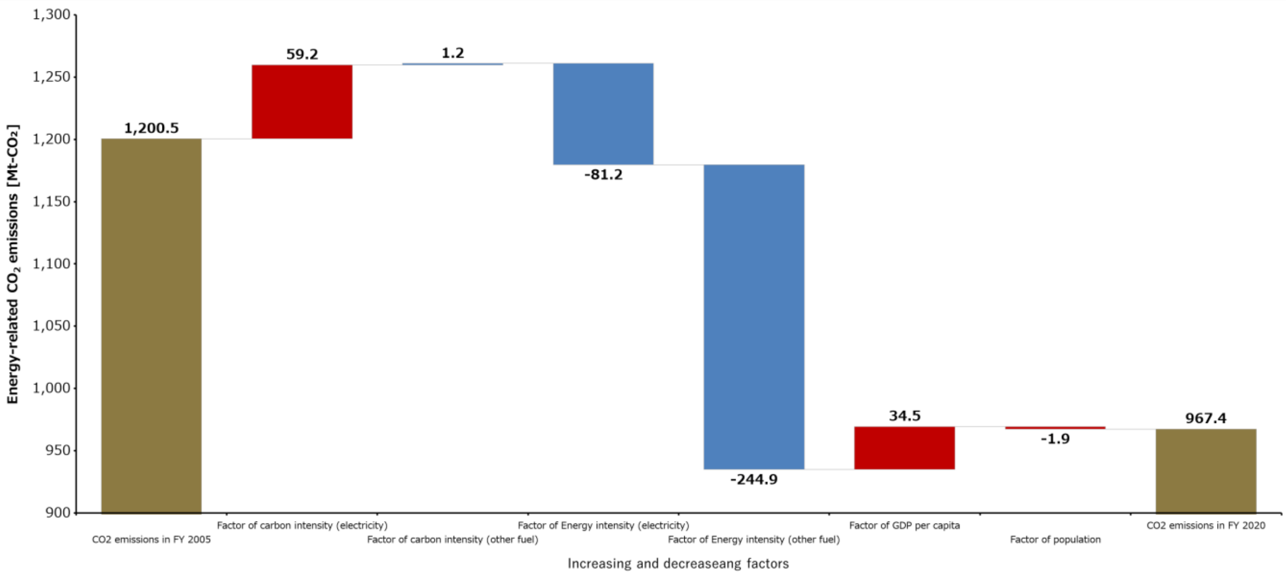


Figure 2-20 Changes in energy-related CO_2 emissions and factors since FY 2005

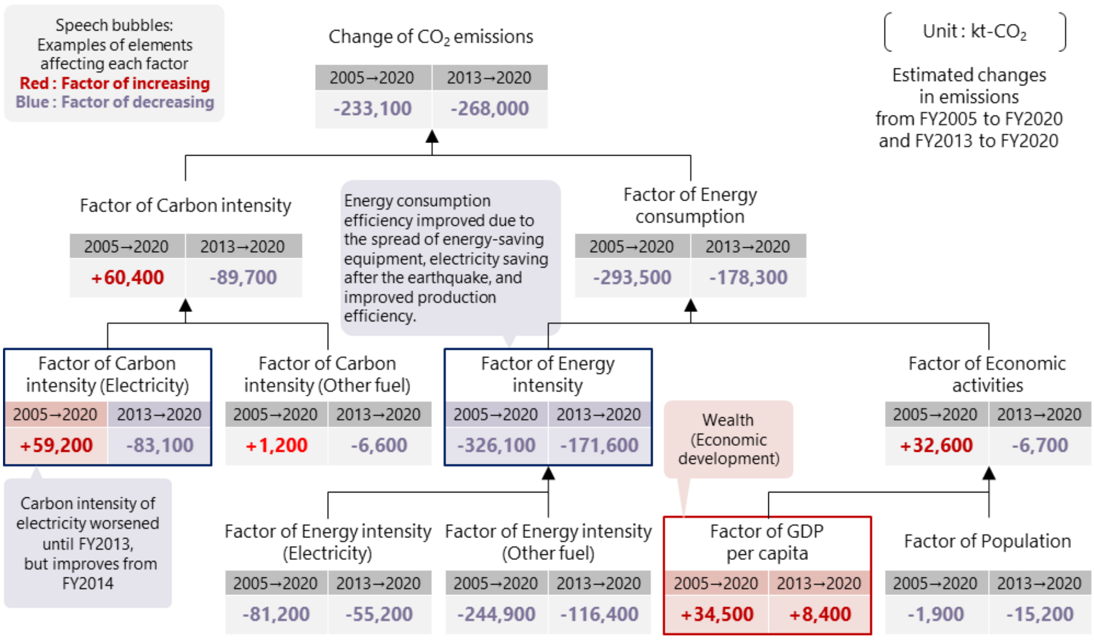


Figure 2-21 Factor of change of energy-related CO_2 emissions in FY 2020

Trends in an increase or decrease in factors of GHG emissions each year from the previous year between FY 2005 and FY 2020 are shown in Figure 2-22. Though the emissions in FY 2008 and FY 2009 decreased significantly due to the effects of the global economic crisis, the emissions in FY 2010 reversed significantly after the recovery of the economy. In FY 2011 and FY 2012, the emissions increased significantly from the increase in thermal power generation because of the shutdown of the nuclear power plant after the Great East Japan Earthquake. On the other hand, the emissions have been declining since FY 014 because of the progress in energy-saving after the Great East

Japan Earthquake, increases in the introduction of renewable energy, and the restart of nuclear power plants. In addition, electrification, which has progressed over time, increased electricity consumption and reduced energy consumption other than electricity, affecting the factor of energy intensity.

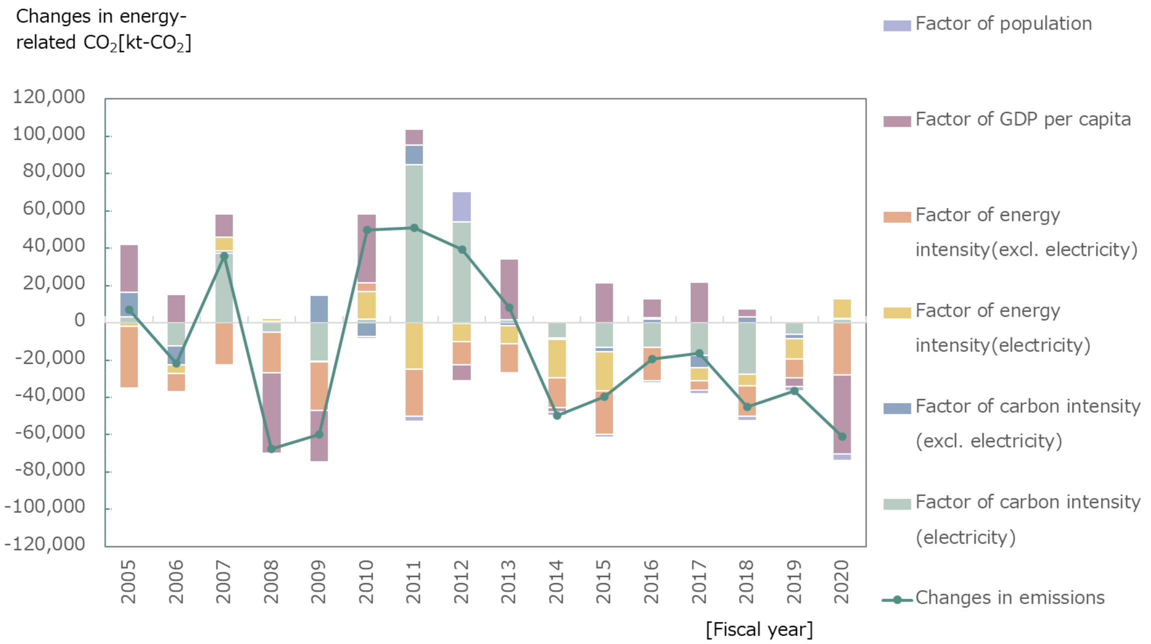


Figure 2-22 Trends of Factor of change of energy-related CO_2 emissions

■ Energy transformation sector (without electricity and heat allocated)[34]

CO_2 emissions (without electricity and heat allocated) in the energy transformation sector in FY 2020 were 432 Mt CO_2, which decreased by 1.5% compared to FY 2005 and decreased by 24.6% compared to FY 2013.

The largest decrease factor from FY 2013 was the factor of energy mix that was due to the decrease in the share of fossil fuel power generation in total power generation caused by the increase in renewable energy and the restart of nuclear power plants, followed by the factor of power generation amount due to energy saving activities. The largest increase factor was the factor of fuel mix due to the change in fuel type consumed for power generation. There is no information disclosure on the amount of generated electricity before FY 2009, which is consistent with the scope of the survey after FY 2010, and the factor analysis in the energy transformation sector focuses on the comparison FY 2013 with FY 2020.

34 The sum of commercial power generation and in-house power generation

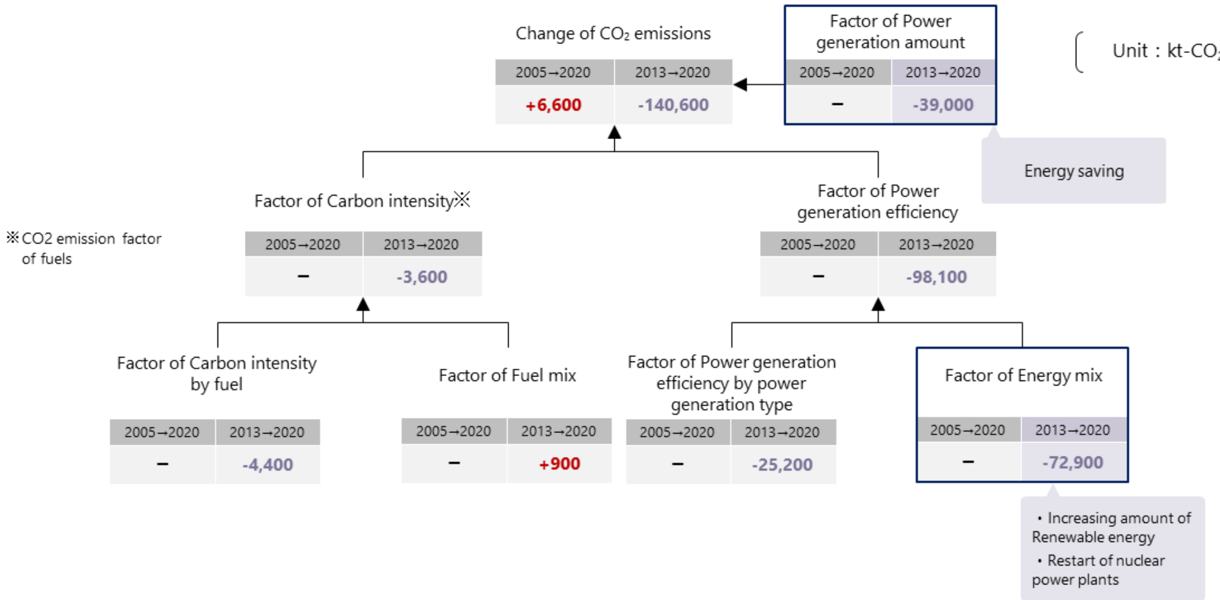


Figure 2-23 Factor of change of CO_2 emissions from the energy transformation sector (Commercial and auto power generation) in FY 2020

■ Industrial sector

(1) Manufacturing industry

CO_2 emissions in the manufacturing industries sector in FY 2020 were 329.0 Mt CO_2, which decreased by 24.7% compared to FY 2005 and by 25.0% compared to FY 2013.

The largest decrease factor from FY 2005 was the factor of added value, which was due to the recovery of added value (GDP) in the manufacturing industry and the increase of added value per product, followed by the factor of energy intensity due to the expansion of energy and power saving activities in factories. The largest increase factor was the factor of economic activity, which was due to the increase in GDP in the manufacturing industry, followed by the factor of carbon intensity (purchased electricity), which was due to the increase in the carbon intensity of electricity.

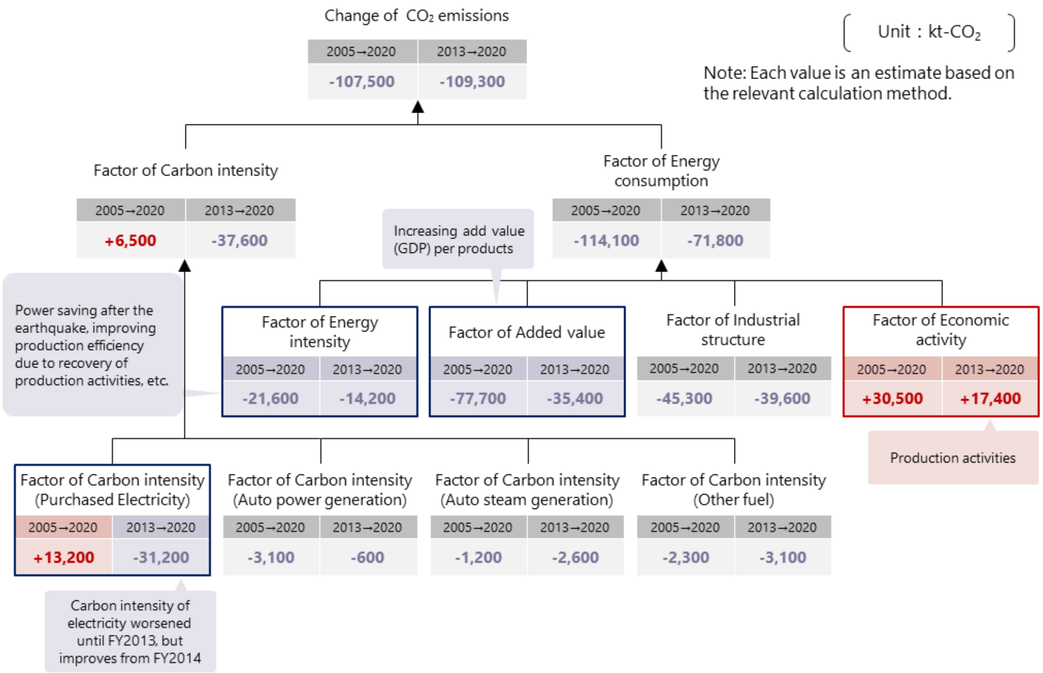


Figure 2-24 Factor of change of CO_2 emissions from the manufacturing industry sector (with electricity and heat allocated) in FY 2020

(2) Non-manufacturing industry

CO_2 emissions in the non-manufacturing industries sector in FY 2020 were 27.0 Mt CO_2, which decreased by 13.9% compared to FY 2005, and increased by 4.9% compared to FY 2013.

The largest decrease factor from FY 2005 was the factor of industrial structure. On the other hand, the largest increase factor was the factor of energy intensity.

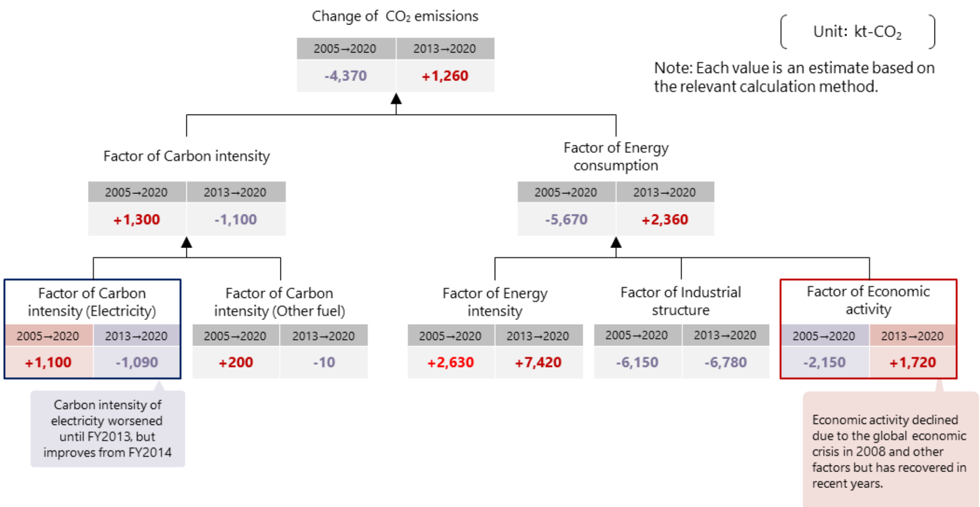


Figure 2-25 Factor of change of CO_2 emissions from the non-manufacturing industry sector (with electricity and heat allocated) in FY 2020

Transportation sector

(1) Passenger

CO_2 emissions in the transportation sector (passenger) in FY 2020 were 104.3 Mt CO_2, which decreased by 27.8% compared to FY 2005 and by 22.6% compared to FY 2013.

The largest decrease factor from FY 2005 was the factor of traffic volume, which was due to the drastic decrease in passenger traffic volume resulting from the COVID-19 pandemic, followed by the factor of energy intensity, which was due to the improved fuel efficiency of transport. On the other hand, the largest increase factor was the factor of carbon intensity, followed by the factor of modal shifts, which was due to the increase in the proportion of cars in the traffic volume.

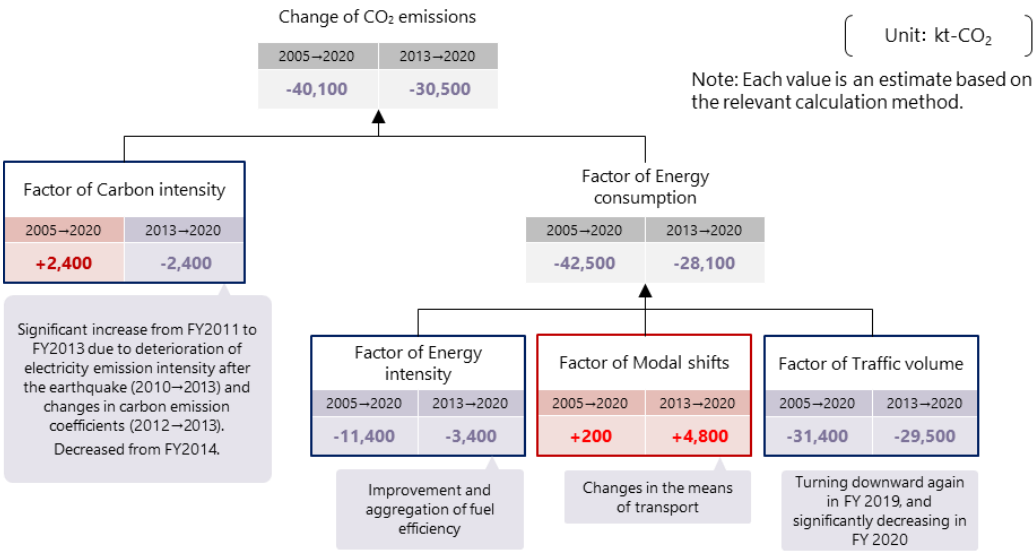


Figure 2-26 Factor of change of CO_2 emissions from the passenger sector (transportation) (with electricity and heat allocated) in FY 2020

(2) Freight

CO_2 emissions in the transportation sector (freight) in FY 2020 were 80.5 Mt CO_2, which decreased by 19.6% compared to FY 2005 and by 0.1% compared to FY 2013.

The largest decrease factor from FY 2005 was the factor of traffic volume, which was due to the decrease in the traffic volume by the continuous effect of the global economic crisis after 2008 and the impact of the COVID-19 pandemic. On the other hand, the largest increase factor was the factor of modal shifts, which was due to the increase in the share of cargo trucks in the traffic volume.

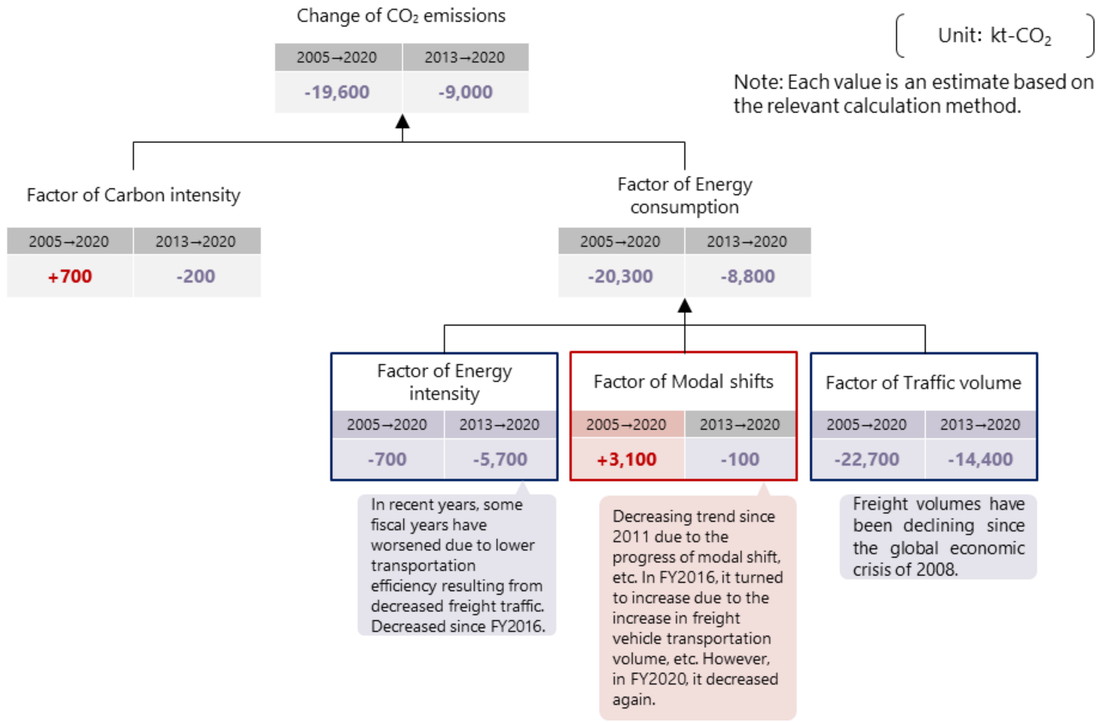


Figure 2-27　Factor of change of CO_2 emissions from the freight sector (transportation) (with electricity and heat allocated) in FY 2020

■ Residential sector

CO_2 emissions in the residential sector in FY 2020 were 166.5 Mt CO_2, which decreased by 2.4% compared to FY 2005 and decreased by 19.8% compared to FY 2013.

The largest increase factor from FY 2005 was the factor of number of households, which was due to an increase in the number of households, followed by the factor of carbon intensity, which was due to the increase in the carbon intensity of electricity. On the other hand, the largest decrease factor from FY 2005 was the factor of number per household, which was due to the decrease in the size of households, followed by the factor of energy intensity, which was due to the improvement of home appliances and expansion of energy and power saving activities after the Great East Japan Earthquake.

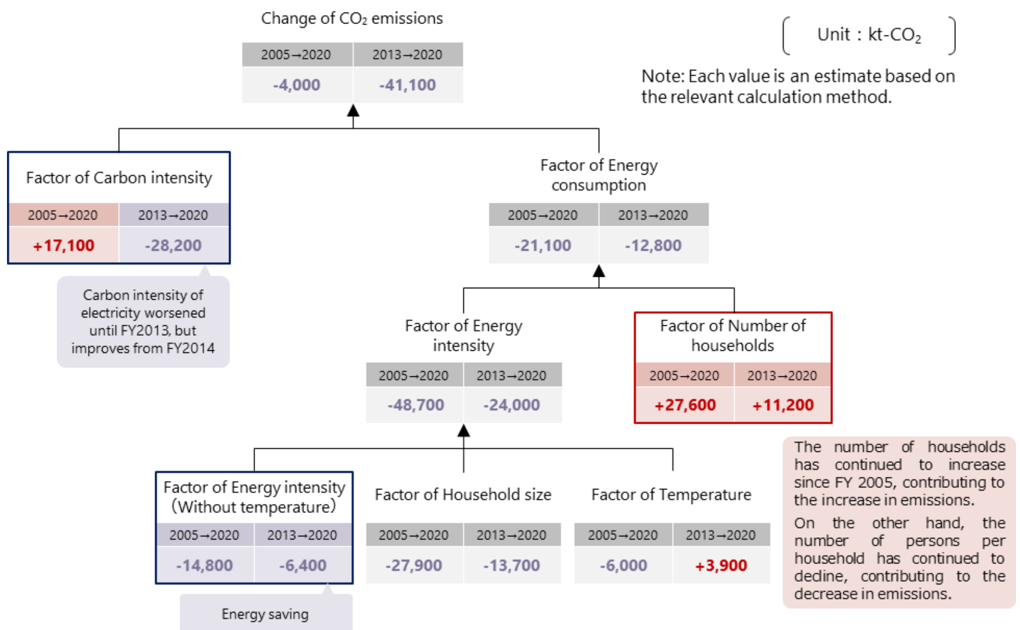


Figure 2-28 Factor of change of CO_2 emissions from the residential sector (with electricity and heat allocated) in FY 2020

Commercial and other sector

CO_2 emissions in the commercial and other sector in FY 2020 were 182 Mt CO_2, which decreased by 17.2% compared to FY 2005 and by 23.2% compared to FY 2013.

The largest decrease factor from FY 2005 was the factor of energy intensity, which was due to the expansion of energy and power saving activities after the Great East Japan Earthquake, followed by the factor of economic activity, which was due to the decrease in industrial activity affected by the global recession and the COVID-19 pandemic. On the other hand, the increase factors were the factor of floor space, which was due to the increase in floor space, followed by the factor of carbon intensity, which was due to the increase in the carbon intensity of electricity.

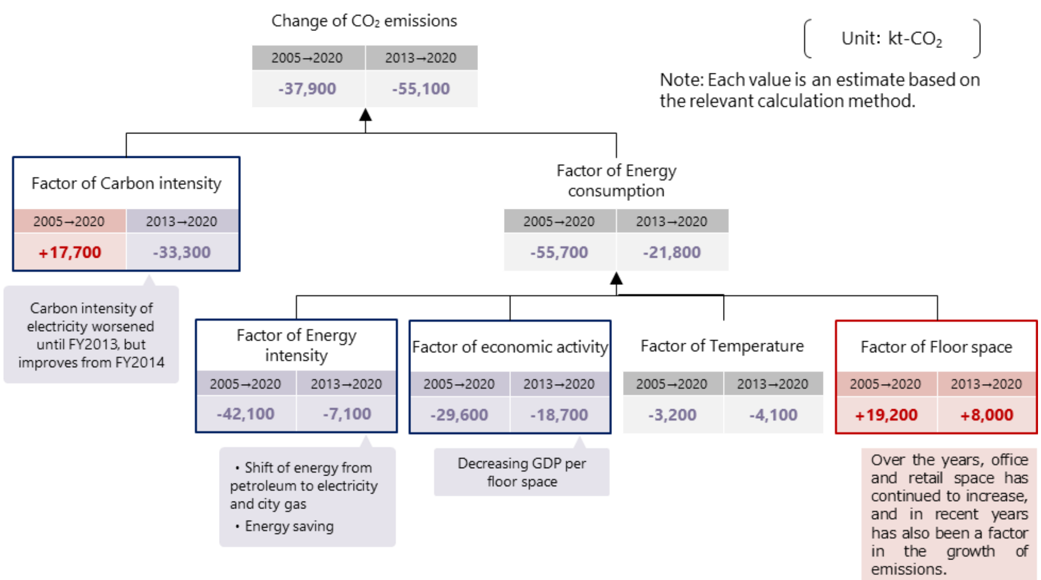


Figure 2-29 Factor of change of CO_2 emissions from the commercial and other sector (with electricity and heat allocated) in FY 2020

■ Summary

A Summary of factor analysis of energy-related CO_2 emissions by sector from FY 2005 to FY 2020 is shown in Table 2-17.

Table 2-17 Summary of factor analysis of energy-related CO_2 emissions by sector from FY 2005 to FY 2020

(Unit : kt-CO_2)

Sector		Factor of Activity		Factor of intensity				Factor of Temperature	Total Change of CO_2 Emissions
		Activity data	Changes in CO_2 emissions		Factor of Carbon intensity (excluding Electricity)	Factor of Carbon intensity (Electricity)	Factor of Energy intensity		
Total		GDP	+32,600	-265,700	-1,200	+59,200	-326,100	-	-233,100
Industries (factories, etc.)		GDP in industries	+28,300 Increase of production	-140,300	-6,400	+14,300	-148,100	-	-111,900
Transport	Passenger	Traffic volume	-31,400	-8,600	+1,300	+1,100	-11,100 Energy saving	-	-40,100
	Freight	Traffic volume	-22,700 Decrease of traffic volume	+3,100	+700	+100	+2,400	-	-19,600
Commercial and other (commerce, service, office, etc.)		Floor area	+19,200 Increase of floor space	-54,000	+1,600	+16,100	-71,700	-3,200	-37,900
Residential		Number per household	+27,600 Increase of number of households	-25,700	-2,100	+19,200 Increase of carbon intensity	-42,700	-6,000	-4,000
Energy transformation (power plnats)		Power generation amount	-	-	-	-	-	-	+6,600

Note: Balloons are the main factors that may have affected the increase or decrease.
The total and breakdown may not match due to rounding.
The total is the result of the direct factorization of energy-related CO_2, and it does not match the sum of the factors of each sector.
The factor of carbon intensity (electricity) is covering only purchased electricity, and private power generation is included in the factor of carbon intensity (excluding electricity) (except energy transformation sector（Commercial and auto power generation）).

2.2.6 Trends in precursors and SO_X emissions

Under the revised UNFCCC reporting guidelines on annual inventories for the Parties included in Annex I to the Convention, it is necessary to report emissions not only of the seven types of GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, and NF_3), but also emissions of precursors (NO_X, CO, and NMVOC) as well as SO_X. Their emission trends are indicated below.

Nitrogen oxide (NO_X) emissions in FY 2020 were 1.1 Mt. They decreased by 41.9% compared to FY 1990, by 41.2% compared to FY 2005, and by 17.6% compared to FY 2013.

Carbon monoxide (CO) emissions in FY 2020 were 2.8 Mt. They decreased by 35.6% compared to FY 1990, by 5.4% compared to FY 2005, and increased by 2.8% compared to FY 2013.[35]

Non-methane volatile organic compounds (NMVOC) emissions in FY 2020 were 0.8 Mt. They decreased by 61.7% compared to FY 1990, by 40.0% compared to FY 2005, and by 14.3%

35 The reason for the increase of CO emissions in FY 2010 compared to the previous year was the change in the EF for road transportation, and the reason for the decrease in CO emissions in FY 2011 compared to the previous year was the change in the share of furnace types in the iron and steel industry.

compared to FY 2013.

Sulfur oxide (SO_X)[36] emissions in FY 2020 were 0.6 Mt. They decreased by 54.4% compared to FY 1990, by 43.5% compared to FY 2005, and by 20.1% compared to FY 2013.

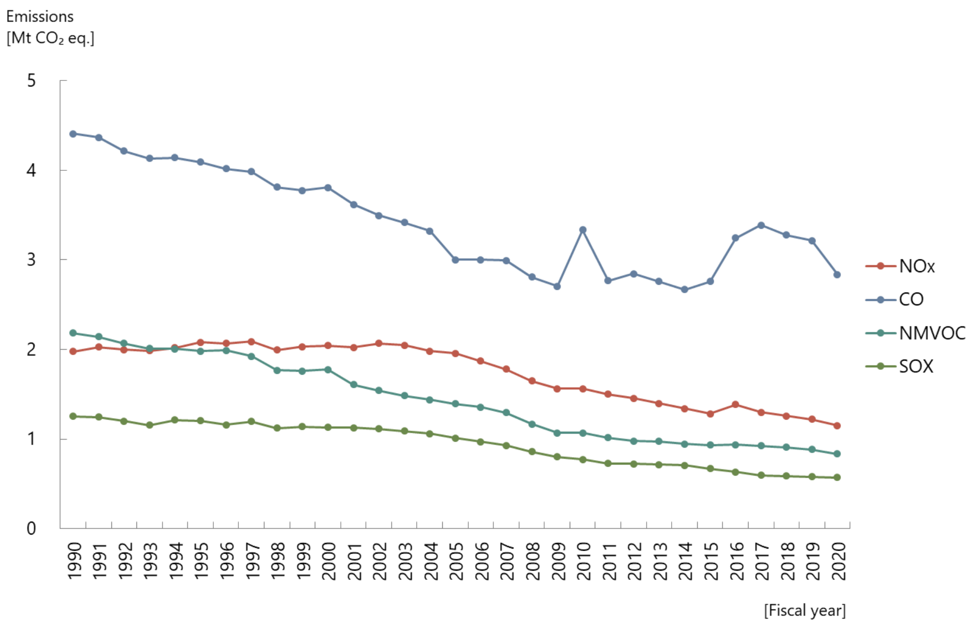


Figure 2-30　Trends in emissions of precursors and SO_X

Table 2-18　Trends in emissions of precursors and SO_X

Indirect GHGs	Emissions [Mt CO_2 eq.]								Changes [Mt CO_2 eq.]	Changes [%]	Changes [Mt CO_2 eq.]	Changes [%]
	1990	1995	2000	2005	2010	2013	2015	2020	2005-2020		2013-2020	
NOx	2.0	2.1	2.0	2.0	1.6	1.4	1.3	1.1	-0.81	-41.2%	-0.25	-17.6%
CO	4.4	4.1	3.8	3.0	3.3	2.8	2.8	2.8	-0.16	-5.4%	0.08	+2.8%
NMVOC	2.2	2.0	1.8	1.4	1.1	1.0	0.9	0.8	-0.56	-40.0%	-0.14	-14.3%
SOx	1.3	1.2	1.1	1.0	0.8	0.7	0.7	0.6	-0.44	-43.5%	-0.14	-20.1%

2.2.7 Emissions and removals from activities under Article 3.3 and 3.4 of the Kyoto Protocol (KP-LULUCF)

The net removals from Kyoto Protocol Article 3.3 and 3.4 activities in FY 2020 were 34.5 Mt CO_2 eq. The breakdown of emissions and removals by each activity is shown in Table 2-19.

36 Most SO_X consists of SO_2. For major sources, SO_2 emissions are estimated.

Table 2-19 Accounting summary for activities under articles 3.3 and 3.4 of the Kyoto Protocol (CRF Accounting table)

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	Base Year (1990)	NET EMISSIONS/REMOVALS [kt CO_2 eq.]									Accounting parameters	Accounting quantity (4)
		2013	2014	2015	2016	2017	2018	2019	2020	Total(3)		
A. Article 3.3 activities												
A.1. Afforestation/reforestation		-1,478	-1,483	-1,486	-1,488	-1,465	-1,375	-1,316	-1,245	-11,336		-11,336
Excluded emissions from natural disturbances		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
Excluded subsequent removals from land subject to		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
A.2. Deforestation		2,005	2,007	2,317	2,316	1,827	1,819	1,683	1,696	15,669		15,669
B. Article 3.4 activities												
B.1. Forest management										-382,808		-382,808
Net emissions/removals		-51,174	-51,512	-49,255	-46,642	-46,353	-45,229	-41,259	-38,939	-370,363		
Excluded emissions from natural disturbances		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
Excluded subsequent removals from land subject to		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
Any debits from newly established forest (CEF-ne)		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
Forest management reference level (FMRL)		0	0	0	0	0	0	0	0	0	0	
Technical corrections to FMRL		1,044	1,220	1,366	1,499	1,635	1,762	1,899	2,019	12,446	1,556	
Forest management cap											355,669	-355,669
B.2. Cropland management (if elected)	7,561	5,490	6,230	5,749	5,525	4,712	4,130	4,747	4,759	41,341		-19,147
B.3. Grazing land management (if elected)	443	966	1,582	1,291	1,008	855	622	751	617	7,692		4,151
B.4. Revegetation (if elected)	-80	-1,230	-1,249	-1,270	-1,287	-1,310	-1,325	-1,350	-1,360	-10,381		-9,743
B.5. Wetland drainage and rewetting (not elected)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
Sum of emissions and removals from Article 3.3 and 3.4 activities for each year		-45,421	-44,425	-42,654	-40,570	-41,734	-41,357	-36,745	-34,472			
Sum of the accounting quantity for Article 3.3 and 3.4 activities of the Kyoto Protocol for the second												**-376,076**

Note:The total values and results of summing up each figure are not always the same because of the difference in display digit.

2.2.8 Key category analysis

A key category is one that is prioritized in improving methodologies for estimating emissions and removals because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level, the trend, or the uncertainty in emissions and removals.

The key category analysis in FY 2020 and the base year of the UNFCCC (FY 1990), which were carried out in accordance with the *2006 IPCC Guidelines* (Approach 1 level assessment[37] and trend assessment,[38] Approach 2 level assessment and trend assessment) are shown in Table 2-20 and Table 2-21. A total of 42 sources and sinks were identified as Japan's key categories in FY 2020, and 40 sources and sinks were identified in FY 1990.

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37 The calculated values for the proportion are added from the category that accounts for the largest proportion until the sum reaches 95% for Approach 1 and 90% for Approach 2. Approach 1 level assessment uses emissions and removals from each category directly and Approach 2 level assessment analyzes the emissions and removals of each category, multiplied by the uncertainty of each category.

38 The calculated results, regarded as trend assessment values, are added from the category whose proportion to the total of trend assessment values is the largest until the total reaches 95% for Approach 1 and 90% for Approach 2. Approach 1 level assessment uses emissions and removals from each category directly, and Approach 2 level assessment analyzes the emissions and removals of each category multiplied by the uncertainty of each category.

Table 2-20 Japan's key categories in FY 2020

	A IPCC Code	B IPCC Category		C GHGs	Ap1-L	Ap1-T	Ap2-L	Ap2-T
#1	1.A.1.	Energy Industries	Solid Fuels	CO_2	#1	#1	#1	#1
#2	1.A.3.	Transport	b. Road Transportation	CO_2	#2		#3	
#3	1.A.1.	Energy Industries	Gaseous Fuels	CO_2	#3	#3	#7	#9
#4	1.A.2.	Manufacturing Industries and Construction	Solid Fuels	CO_2	#4	#6	#2	#8
#5	1.A.4.	Other Sectors	Liquid Fuels	CO_2	#5	#7	#5	#10
#6	4.A	Forest Land	1. Forest Land remaining Forest Land	CO_2	#6	#8	#4	#6
#7	1.A.2.	Manufacturing Industries and Construction	Liquid Fuels	CO_2	#7	#4	#10	#4
#8	2.F	Product uses as substitutes for ODS	1. Refrigeration and Air conditioning	HFCs	#8	#5	#9	#5
#9	1.A.1.	Energy Industries	Liquid Fuels	CO_2	#9	#2	#11	#2
#10	1.A.4.	Other Sectors	Gaseous Fuels	CO_2	#10	#9	#23	#22
#11	1.A.2.	Manufacturing Industries and Construction	Gaseous Fuels	CO_2	#11	#10		#26
#12	2.A	Mineral Product	1. Cement Production	CO_2	#12	#12	#22	#24
#13	3.C	Rice Cultivation		CH_4	#13		#29	
#14	5.C	Incineration and Open Burning of Waste		CO_2	#14		#14	
#15	1.A.2.	Manufacturing Industries and Construction	Other Fossil Fuels	CO_2	#15	#13	#12	#15
#16	1.A.3.	Transport	d. Domestic Navigation	CO_2	#16			
#17	1.A.4.	Other Sectors	Other Fossil Fuels	CO_2	#17		#15	#27
#18	3.A	Enteric Fermentation		CH_4	#18		#13	
#19	1.A.4.	Other Sectors	Solid Fuels	CO_2	#19	#17		
#20	2.A	Mineral Product	2. Lime Production	CO_2	#20			
#21	4.B	Cropland	1. Cropland remaining Cropland	CO_2			#24	#23
#22	3.B	Manure Management		N_2O			#8	
#23	3.D	Agricultural Soils	1. Direct Emissions	N_2O			#27	
#24	2.F	Product uses as substitutes for ODS	2. Foam Blowing Agents	HFCs		#21	#17	#11
#25	5.A	Solid Waste Disposal		CH_4		#18		#14
#26	2.D	Non-energy Products from Fuels and Solvent Use		CO_2			#18	
#27	3.D	Agricultural Soils	2. Indirect Emissions	N_2O			#6	#18
#28	2.B	Chemical Industry	Other products except Anmonia	CO_2			#19	#19
#29	5.D	Wastewater Treatment and Discharge		N_2O			#28	
#30	2.E	Electronics Industry		PFCs			#16	#25
#31		Indirect CO_2	from IPPU sector	Ind CO_2			#30	#16
#32	4.E	Settlements	2. Land converted to Settlements	CO_2				#21
#33	5.C	Incineration and Open Burning of Waste		N_2O			#21	
#34	2.G	Other Product Manufacture and Use		SF_6		#14	#20	#3
#35	1.A.3.	Transport	b. Road Transportation	N_2O			#26	#13
#36	4.A	Forest Land	2. Land converted to Forest Land	CO_2		#15		#17
#37	1.B	Fugitive Emission from Fuel	1.Fugitive emissions from Solid Fuels	CH_4		#19		#7
#38	2.B	Chemical Industry	3. Adipic Acid Production	N_2O		#16		#20
#39	2.E	Electronics Industry		SF_6			#25	
#40	2.B	Chemical Industry	9. Fluorochemical Production (Fugitive Emissions)	HFCs		#11		
#41	2.B	Chemical Industry	4. Caprolactam, Glyoxal and Glyoxylic Acid Production	N_2O				#12
#42	2.B	Chemical Industry	9. Fluorochemical Production (Fugitive Emissions)	SF_6		#20		

N.B.1) Ap1-L: Approach 1-Level Assessment, Ap1-T: Approach 1-Trend Assessment,
Ap2-L: Approach 2-Level Assessment, Ap2-T: Approach 2-Trend Assessment
N.B.2) Figures recorded in the Level and Trend columns indicate the ranking in each assessment.

Table 2-21 Japan's key categories in FY 1990

	A IPCC Code	B IPCC Category		C GHGs	Ap1-L	Ap2-L
#1	1.A.2.	Manufacturing Industries and Construction	Solid Fuels	CO_2	#1	#1
#2	1.A.3.	Transport	b. Road Transportation	CO_2	#2	#3
#3	1.A.1.	Energy Industries	Liquid Fuels	CO_2	#3	#4
#4	1.A.2.	Manufacturing Industries and Construction	Liquid Fuels	CO_2	#4	#6
#5	1.A.4.	Other Sectors	Liquid Fuels	CO_2	#5	#8
#6	1.A.1.	Energy Industries	Solid Fuels	CO_2	#6	#7
#7	1.A.1.	Energy Industries	Gaseous Fuels	CO_2	#7	#18
#8	4.A	Forest Land	1. Forest Land remaining Forest Land	CO_2	#8	#2
#9	2.A	Mineral Product	1. Cement Production	CO_2	#9	#21
#10	1.A.4.	Other Sectors	Gaseous Fuels	CO_2	#10	
#11	2.B	Chemical Industry	9. Fluorochemical Production (Fugitive Emissions)	HFCs	#11	
#12	1.A.3.	Transport	d. Domestic Navigation	CO_2	#12	
#13	5.C	Incineration and Open Burning of Waste		CO_2	#13	#17
#14	3.C	Rice Cultivation		CH_4	#14	
#15	1.A.2.	Manufacturing Industries and Construction	Gaseous Fuels	CO_2	#15	
#16	5.A	Solid Waste Disposal		CH_4	#16	#14
#17	3.A	Enteric Fermentation		CH_4	#17	#13
#18	2.G	Other Product Manufacture and Use		SF_6	#18	#5
#19	4.B	Cropland	1. Cropland remaining Cropland	CO_2	#19	#20
#20	2.C	Metal Production	1 Iron and Steel Production	CO_2	#20	
#21	2.B	Chemical Industry	3. Adipic Acid Production	N_2O	#21	
#22	1.A.3.	Transport	a. Domestic Aviation	CO_2	#22	
#23	2.A	Mineral Product	2. Lime Production	CO_2	#23	
#24	4.A	Forest Land	2. Land converted to Forest Land	CO_2	#24	#30
#25	1.A.4.	Other Sectors	Other Fossil Fuels	CO_2	#25	#23
#26	1.B	Fugitive Emission from Fuel	1.Fugitive emissions from Solid Fuels	CH_4	#26	#11
#27	3.D	Agricultural Soils	1. Direct Emissions	N_2O	#27	#24
#28		Indirect CO_2	from IPPU sector	Ind CO_2		#15
#29	4.E	Settlements	2. Land converted to Settlements	CO_2		#29
#30	3.B	Manure Management		N_2O		#10
#31	1.A.2.	Manufacturing Industries and Construction	Other Fossil Fuels	CO_2		#31
#32	2.B	Chemical Industry	Other products except Anmonia	CO_2		#16
#33	1.A.3.	Transport	b. Road Transportation	N_2O		#12
#34	3.D	Agricultural Soils	2. Indirect Emissions	N_2O		#9
#35	5.D	Wastewater Treatment and Discharge		N_2O		#28
#36	2.D	Non-energy Products from Fuels and Solvent Use		CO_2		#27
#37	2.B	Chemical Industry	4. Caprolactam, Glyoxal and Glyoxylic Acid Production	N_2O		#19
#38	2.E	Electronics Industry		PFCs		#25
#39	5.C	Incineration and Open Burning of Waste		N_2O		#26
#40	2.E	Electronics Industry		SF_6		#22

N.B.1) Ap1-L: Approach 1-Level Assessment, Ap2-L: Approach 2-Level Assessment

N.B.2) Figures recorded in the Level and Trend columns indicate the ranking in each assessment.

2.3 Brief description of national inventory arrangements

2.3.1 Description of Japan's institutional arrangement for GHG inventory preparation

The government of Japan is to calculate the emissions and removals of GHGs for Japan and disclose the results every year in accordance with Article 7 of Chapter 1 "General Provisions," the *Act on Promotion of Global Warming Countermeasures*,[39] which determines the domestic measures for the UNFCCC and the Kyoto Protocol. The Ministry of the Environment (MOE) with the cooperation of relevant ministries, agencies, and organizations prepares Japan's national inventory and compiles the supplementary information required under Decision 2/CMP.8, which is annually submitted in accordance with the UNFCCC and the Kyoto Protocol.

The MOE assumes overall responsibilities for the national inventory and organizes the Committee for the Greenhouse Gas Emission Estimation Methods (Committee) in order to integrate the latest scientific knowledge into the inventory and to modify it to meet international requirements. The estimation of GHG emissions and removals are then carried out by taking the decisions of the Committee into consideration. Substantial activities, such as the estimation of emissions and removals and the preparation of the Common Reporting Format (CRF) tables and National Inventory Report (NIR), are done by the Greenhouse Gas Inventory Office of Japan (GIO), which belongs to the Center for Global Environmental Research, Earth System Division of the National Institute for Environmental Studies. The relevant ministries, agencies, and organizations provide the GIO with the appropriate data (e.g., activity data, emission factors, and GHG emissions and removals) by compiling various statistics and provide relevant information on supplementary information required under Decision 2/CMP.8. The relevant ministries and agencies check the inventories (i.e., CRF, NIR), including the spreadsheets that are actually utilized for the estimation (Japan National Greenhouse gas Inventory files, hereinafter referred to as "JNGI files"), as a part of the Quality Control (QC) activities.

The checked inventories are determined as Japan's official GHG emission/removal values. The inventories are then published by the MOE and are submitted to the UNFCCC secretariat.

Figure 2-31 shows the overall institutional arrangement for Japan's inventory preparation. More detailed information on the roles and responsibilities of the relevant ministries, agencies, and organizations in the inventory preparation process is described below.

[39] Enacted in October 1998. The latest amendment was made on May 26, 2021.

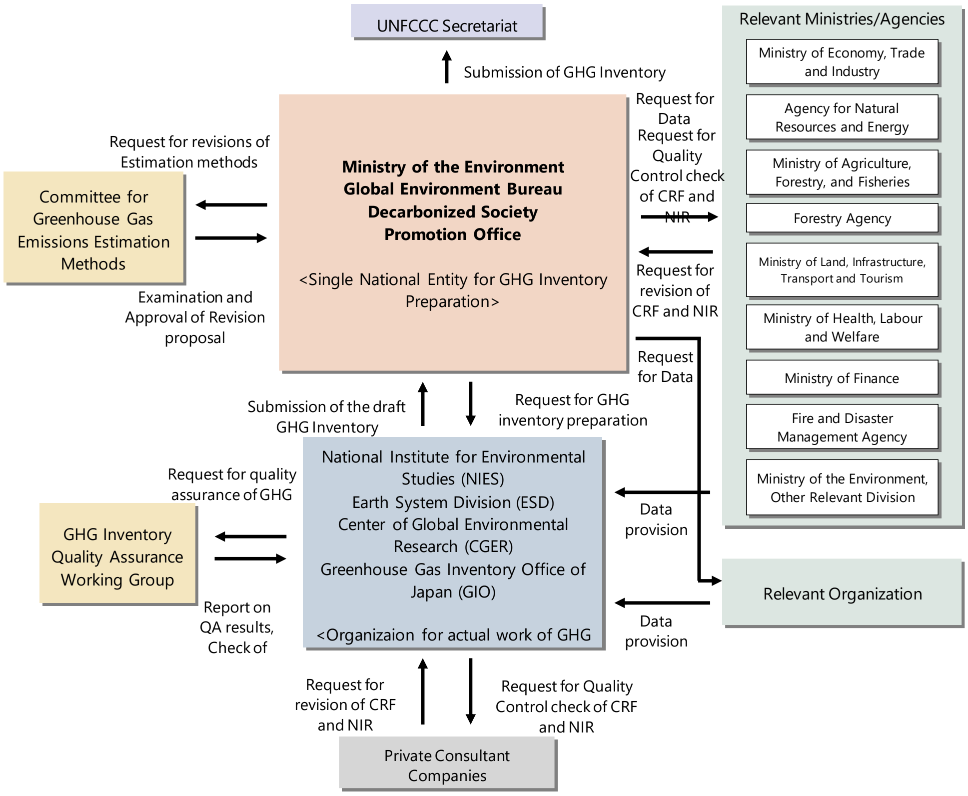

Figure 2-31 Japan's Institutional Arrangements for the National Inventory Preparation

2.3.2 Roles and responsibilities of each entity involved in the inventory preparation process

The following are the agencies involved in the inventory compilation process, and the roles of those agencies.

(1) Ministry of the Environment (Global Environment Bureau, Decarbonized Society Promotion Office,)

- The single national agency responsible for preparing Japan's inventory, which was designated pursuant to the UNFCCC Inventory Reporting Guidelines and the Kyoto Protocol Article 5.1.
- It is responsible for editing and submitting the inventory.
- It coordinates the Quality Assurance and Quality Control (QA/QC) activities for the inventory.
- It checks and approves the QA/QC plan.
- It checks and approves the inventory improvement plan.

【Contact information】

Global Environment Bureau, Decarbonized Society Promotion Office
TEL: +81-3-5521-8244
E-mail: CHIKYU-TEITANSO@env.go.jp

(2) Greenhouse Gas Inventory Office of Japan (GIO), Center for Global Environmental

Research, Earth System Division, National Institute for Environmental Studies

- Performs the actual work of inventory compilation. Responsible for inventory calculations, editing, and the archiving and management of all data.
- Prepares the revised draft of the QA/QC plan.
- Prepares the draft of the inventory improvement plan.

(3) Relevant ministries/agencies

The relevant ministries and agencies have the following roles and responsibilities regarding inventory compilation.

- Preparation and provision of data such as activity data and the emission factors required for the preparation of the inventory
- Confirmation of data provided for the preparation of the inventory
- Confirmation of the inventory (CRF, NIR, JNGI files, and other information) prepared by the GIO (Category-specific QC)
- (When necessary) responding to questions from expert review teams (ERTs) about the statistics controlled by relevant ministries and agencies, or about certain data they have prepared, and preparing comments on draft reviews
- (When necessary) responding to in-country review by ERTs

(4) Relevant organizations

Relevant organizations have the following roles and responsibilities regarding inventory compilation.

- Preparation and provision of data such as activity data and emission factors required for the preparation of the inventory
- Confirmation of data provided for the preparation of the inventory
- (When necessary) responding to questions from ERTs about the statistics controlled by relevant organizations or about certain data they have prepared, and preparing comments on draft reviews

(5) Committee for the Greenhouse Gas Emissions Estimation Methods

The Committee for the Greenhouse Gas Emissions Estimation Methods (the Committee) is a committee created and ran by the MOE. Its role is to consider the methods for calculating inventory emissions and removals and consider the selection of parameters, such as activity data (AD) and emission factors (EFs).

Under the Committee, the inventory working group (WG) that examines cross-cutting issues, and the breakout groups that consider sector-specific problems (Breakout group on Energy and Industrial Processes, Breakout group on Transport, Breakout group on F-gases [HFCs, PFCs, SF_6, and NF_3], Breakout group on Agriculture, Breakout group on Waste, Breakout group on LULUCF, Breakout group on NMVOC, and sub-breakout group on CCU [CO_2 Capture and Utilization]) are set up.

The inventory WG and the breakout groups comprise experts in a variety of fields and consider suggestions for inventory improvements.

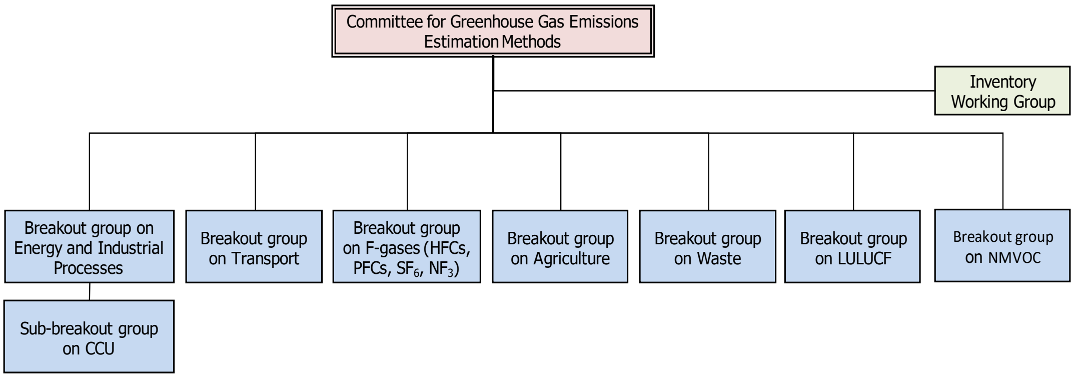

Figure 2-32 Structure of the Committee for the Greenhouse Gas Emissions Estimation Methods

(6) Private consulting companies

Private consultant companies that are contracted by the MOE to perform tasks related to inventory compilation play the following roles in inventory compilation based on their contracts.

- Quality Control (QC) of the inventory (CRF, NIR, JNGI files) compiled by the MOE and the GIO
- (When necessary) providing support for responding to questions from ERTs and for preparing comments on draft reviews
- (When necessary) providing support for responding to in-country review by ERTs

(7) GHG Inventory Quality Assurance Working Group (Expert peer review) (QAWG)

The GHG Inventory Quality Assurance Working Group (the QAWG) is an organization for QA activities and comprises experts who are not directly involved in inventory compilation. Its role is to assure inventory quality and to identify places that need improvement by conducting detailed reviews of each emission source and sink in the inventory.

2.3.3 Brief Description of the Inventory Preparation Process

■ Annual inventory preparation cycle

Table 2-22 shows the annual cycle of inventory preparation. The inventory preparation cycle is set in conjunction with Japan's fiscal year calendar (starting April 1 and ending March 31 of the next year). In Japan, in advance of the estimation of national inventory submitted to the UNFCCC (submission deadline: April 15), preliminary figures are estimated and published as a document for an official announcement. (In preliminary figures, only GHG emissions excluding removals are estimated.)

Table 2-22　Annual Inventory Preparation Cycle

※Inventory preparation in fiscal year "n"

	Process	Relevant Entities	Calender Year n+1								CY n+2			
			Fiscal Year n+1											FY n+2
			May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Holding the meeting of the QAWG	MOE, GIO	→	→	→	→								
2	Discussion on the inventry improvement	MOE, GIO		→	→	→	→							
3	Holdong the meeting of the Committee	MOE, (GIO, Private consultant)		→	→	→	→	→	→	→	→			
4	Collection of data for the national inventory	MOE,GIO,Relevant Ministries/Agencies, Relevant organization, Private consultant								→	→	→	→	
5	Preparation of a draft of CRF	GIO, Private consultant									→	→	→	
6	Preparation of a draft of NIR	GIO, Private consultant									→	→	→	
7	Implementation of the exterior QC and the coordination with the relevant ministries and agencies	MOE, GIO, Relevant Ministries/Agencies, Private consultant										→	→	→
8	Correction of the drafts of CRF and NIR	MOE, GIO, Private consultant											→	→
9	Submission and official announcement of the national inventory	MOE, GIO												★

MOE: Ministry of the Environment

GIO: Greenhouse Gas Inventory Office of Japan

Committee: Committee for the Greenhouse Gas Emission Estimation Methods

QAWG: Inventory Quality Assurance Working Group

■ Process of the inventory preparation

(1) Holding the meeting of the Greenhouse Gas Inventory Quality Assurance Working Group (QAWG) (Step 1)

The QAWG, which is composed of experts who are not directly involved in nor related to the inventory preparation process, is organized in order to conduct peer reviews and assure the inventory’s quality and to find possible improvements.

This QAWG reviews the appropriateness of the estimation methodologies, AD, EFs, and the contents of the CRF and NIR. The GIO integrates the items identified for improvement by the QAWG into the inventory improvement plan and utilizes them in discussions on the inventory estimation methods and in subsequent inventory preparation.

(2) Discussion on the inventory improvement (Step 2)

The MOE and the GIO identify the items that need to be addressed by the Committee based on the results of the previous inventory review of the UNFCCC, the recommendations of the QAWG, the items needing improvement as identified at former Committee’s meetings, and any other items requiring revision as determined during previous inventory preparations. The schedule for the expert evaluation (step 3) is developed by taking the above-mentioned information into account.

(3) Holding meetings of the Committee for the Greenhouse Gas Emission Estimation Methods [evaluation and examination of estimation methods by experts] (Step 3)

The MOE holds meetings of the Committee in which estimation methodologies for an annual inventory and the issues that require technical reviews are discussed by experts with different scientific backgrounds.

(4) Collection of data for the national inventory (Step 4)

The data required for preparing the national inventory and the supplementary information required under Decision 2/CMP.8 are collected. For details on the process of collecting activity data, see "1.4.1. Collection Process of Activity Data" in the *National Greenhouse Gas Inventory Report of Japan, 2022*.

(5) Preparation of a draft of CRF [including the implementation of the key category analysis and the uncertainty assessment] (Step 5)

The data input and estimation of emissions and removals are carried out simultaneously by utilizing JNGI files, which have interconnecting links based on the calculation formulas for emissions and removals. Subsequently, the key category analysis and the uncertainty assessment are also carried out.

(6) Preparation of a draft of NIR (Step 6)

The draft of the NIR is prepared by following the general guidelines made by the MOE and the GIO. The MOE and the GIO identify the points that need to be revised or that require an additional description by taking the discussion in step 2 into account. The GIO prepares the new NIR by updating the data and by adding and revising descriptions in the previous NIR.

(7) Implementation of the external QC and the coordination with the relevant ministries and agencies (Step 7)

As a QC activity, the selected private consulting companies check the JNGI files and the initial draft of the CRF (the 0th draft) prepared by the GIO (external QC). The companies not only check the input data and the calculation formulas in the files but also check the estimations by recalculating the total amounts of GHG emissions and removals determined by utilizing the same files. Because of this crosscheck, any possible data input and emission estimation mistakes are avoided. They also check the content and descriptions of the initial draft of the NIR (the 0th draft) prepared by the GIO. JNGI files, draft CRF and draft NIR, which have been checked by the private consulting companies, are regarded as the primary drafts of inventories.

Subsequently, the GIO sends out the primary drafts of the inventories and official announcements as electronic computer files to the MOE and the relevant ministries and agencies and asks them to check the contents of the primary drafts. The data, which are estimated based on confidential data, are only sent out for confirmation to the ministry and/or agency that provided the confidential data.

(8) Correction of the drafts of CRF and NIR (Step 8)

When revisions are requested as a result of the check of the primary drafts of the inventories and official announcements by the relevant ministries and agencies (step 7), the MOE, GIO, and relevant ministries and/or agencies that submit requests for a revision then coordinate the details of any revision, revise the primary drafts, and prepare the secondary drafts. The secondary drafts are sent out again to the relevant ministries and/or agencies for conclusive confirmation. If there is no additional request for revision, the secondary drafts are considered the final versions.

(9) Submission and official announcement of the national inventory (Step 9)

The MOE submits the completed inventory to the UNFCCC Secretariat. At the same time as the submission, information on the estimated GHG emissions and removals are officially announced and published on the MOE website (https://www.env.go.jp/) with additional relevant information. The inventory is also published on the GIO website (https://www.nies.go.jp/gio/index.html).

2.3.4 Process for the inventory recalculations

In accordance with the UNFCCC Reporting Guidelines and the *2006 IPCC Guidelines*, Annex I Parties should recalculate their inventories for the base year and all subsequent years of the time series in the cases of 1) application of new estimation methods, 2) addition of new categories for emissions and removals, and 3) data refinement.

In Japan, improvements in the calculation methods are considered in accordance with necessity whenever an inventory item requiring improvement is identified because of, for example, a UNFCCC review or an observation by the QAWG, progress in international negotiations such as the creation of new guidelines, progress or changes in scientific research or in the compilation of statistics, or the acquisition of new information by the system for calculating, reporting, and publishing GHG emissions. Proposals for improving the estimation of emissions and removals are considered by scientific research or the Committee, and the results are incorporated into the inventory. Figure 2-33 is a diagram of the inventory improvement process.

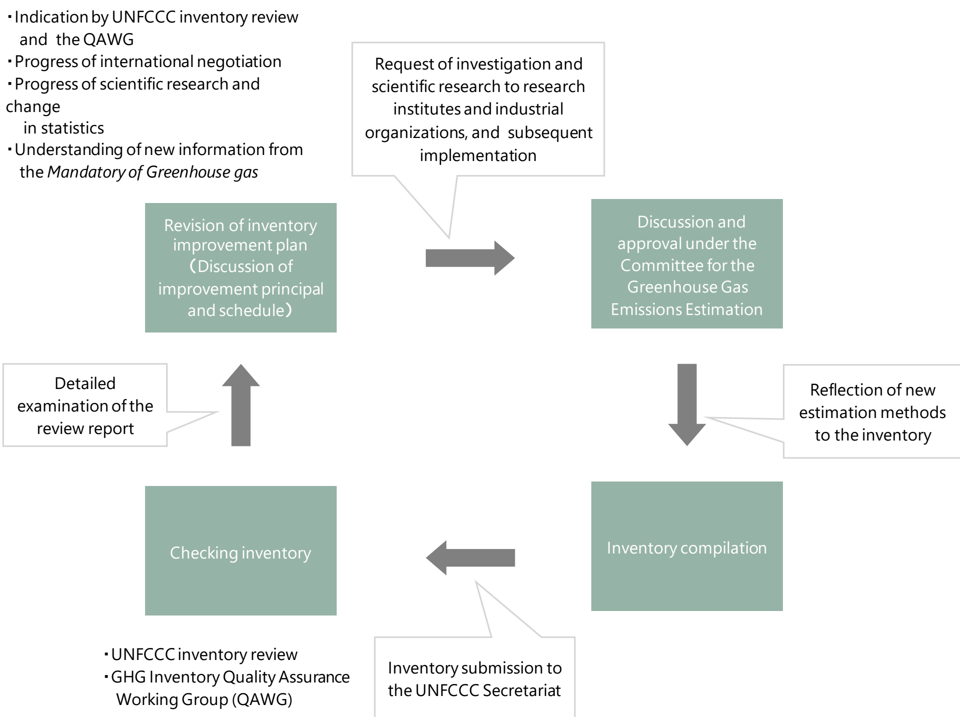

Figure 2-33 Diagram of the inventory improvement process

2.3.5 Information on the QA/QC process

When compiling the inventory in Japan, inventory quality is controlled by performing QC activities (such as checking the correctness of calculations and archive of documents) at each step in accordance with the *2006 IPCC Guidelines*. In Japan, the QC activities related to inventory compilation performed by personnel belonging to the agencies involved in inventory compilation—that is, the MOE (including the GIO and private consultant companies), relevant ministries and agencies—are considered to be QC. External reviews by experts who are outside the inventory compilation system are considered to be QA. They assess data quality from the perspectives of scientific knowledge and data availability with respect to current calculation methods. Table 2-23 sketches Japan's QA/QC activities.

Table 2-23　Summary of Japan's QA/QC activity

	Implementing entity	Main contents of activity
QC (Quality Control)	Ministry of the Environment (Decarbonized Society Promotion Office, Global Environment Bureau)	・Coordinating QA/QC activities for inventory preparation ・Checking and approving the QA/QC plan ・Checking and approving the inventory improvement plan
	Greenhouse Gas Inventory Office of Japan, Center for Global Environmental Research, Earth System Division, National Institute for Environmental Studies (GIO)	・Conducting general QC check ・Archiving QA/QC activity records and relevant data and documents ・Revising the QA/QC plan ・Developing the inventory improvement plan
	Relevant Ministry and Agencies	・Checking data necessary for inventory preparation ・Checking JNGI files and inventory prepared by GIO (Category-specific QC)
	Committee for the Greenhouse Gas Emissions Estimation Methods	・Discussing and assessing estimation methods, EFs, and AD (Category-specific QC)
	Private Consultant Companies	・Checking JNGI files and inventory prepared by GIO (Category-specific QC)
QA (Quality Assurance)	Inventory Quality Assurance Working Group (QAWG)	・Conducting expert peer review of inventory

2.3.6　Changes in national inventory arrangements since BR4

The following changes have been implemented since the national inventory arrangements described in the fourth biennial report (BR4) submitted in December 2019

- Change of name from the "Law-carbon Society Promotion Office" to "Decarbonized Society Promotion Office" of the Ministry of the Environment, which is the single national entity for GHG inventory preparation.
- Addition of sub-breakout group on CCU to the Committee for the Greenhouse Gas Emissions Estimation Methods.

2.4 National registry

This table describes the national registry that provides supplementary information as stated in Article 7.2 of the Kyoto Protocol. The following information is based on Decision 13/CP.10 ANNEX II para. 1.

Item	Content
(a) The name and contact information of the registry administrator designated by the Party to maintain the national registry.	[Contact information] • Mr. Kazuhisa Koakutsu, Office of Director for International Cooperation for Transition to Decarbonization and Sustainable Infrastructure, Global Environmental Bureau, Ministry of the Environment (TEL:+81-3-5521-8246, E-mail: kyomecha-registry@env.go.jp)
(b) The names of other Parties with which the Party cooperates by maintaining their national registries in a consolidated system.	None are relevant.
(c) Description of the database structure and capacity of the national registry.	[Database structure] A server equipped with disk array storage from Fujitsu, is used as the database server. Disk array storage is a mirroring framework that allows for replacing a failed hard disk without stopping operations. The software of the database server is implemented using an Oracle relational database management system. [Capacity] The database server possesses sufficient data capacity based on the forecasted workload during the first and second commitment periods. In the event of an increase in the necessary capacity, additional hard disks could be attached to the database server.
(d) A description of how the national registry conforms to technical standards for data exchange between registry systems for the purpose of ensuring the accurate, highly transparent, and efficient exchange of data between national registries, the CDM registry, and the transaction log.	• In 2006, certain Data Exchange Standards (DES) prepared by the UNFCCC Secretariat were updated four times (versions 1.1a, 1.1b, 1.1c, and 1.1 Final). The national registry was revamped to comply with the new version, including correcting response codes and the WSDL. • In October 2007, DES annex E (list of checks to be undertaken by the ITL, version 1.1.001) was released, and the internal checks for the national registry were changed in order to be consistent with the updated Annex E • In August 2008, part of the DES was updated as new checks were added relating to the commitment period reserve associated with the "joint achievement," which is defined in Article 4 of the Kyoto Protocol. DES Annex E (version 1.1.2) was released, and the internal checks of the national registry were updated in order to be consistent with the updated DES. • In March 2009, version 1.4 of the technical specifications for the standard electronic format (SEF) was released. A function was therefore added to output XML files containing information on unit holdings and transactions undertaken, which allows the registry administrators to generate the SEF. • In May 2010, part of the DES was updated as a transaction message flow was changed. DES (version 1.1.6) was released, and the new transaction message flow was implemented in the registry in order to be consistent with the updated DES. • In September 2010, part of the DES was updated as the heartbeat connection health monitoring between the Community Independent Transaction Log (CITL) and the ITL was added. DES annex E (list of checks to be undertaken by the ITL, version 1.1.10) was released, and response codes were changed in order to be consistent with the updated Annex E. • In December 2010, DES annex E (list of checks to be undertaken by the ITL, version 1.1.10) was released, and response codes were changed in order to be consistent with the updated Annex E. • In April 2013, The DES annex G (List of Codes, version 1.1.3) was released. The new LULUCF activity code, wetland drainage and rewetting, was added to the

Item	Content
	database of Japan's national registry in order to be consistent with the updated Annex G.
(e) A description of the procedures employed in the national registry to minimize discrepancies in the issuance, transfer, acquisition, cancellation, and retirement of ERUs, CERs, tCERs, lCERs, AAUs and/or RMUs, as well as in the supplementing of tCERs and 1CERs. In addition, the procedure taken to forcefully terminate transactions when a discrepancy is notified and to correct problems in the event of a failure to terminate the transactions.	[Means to minimize discrepancies] The following are some of the checks implemented in the registry to minimize discrepancies. (1) Data type validity for information input manually (e.g., numbers, alphanumeric characters) (2) Data value validity for complying with Kyoto unit types. (e.g., whether an expiry date is set for tCERs). (3) The existence validity of corresponding Kyoto units in transferring accounts at the time of transaction. [Procedures for forced termination of discrepant transactions] Transactions are automatically terminated when discrepancies regarding them have been identified. [Procedure in the event of a failure to terminate discrepant transactions] The registry logs information on failed transactions for which discrepancies were identified and forced terminations subsequently failed. The system administrator periodically checks the archive logs to resolve problems. In addition, in the event of a failure to terminate a discrepant transaction, the monitoring system automatically detects the failure and notifies the system administrator of it via email.
(f) An overview of security measures employed to prevent unauthorized tampering and operator errors, and to update methods oversight.	・VPN communication and SSL encryption were selected for use in accordance with the DES (Version 1.0). ・Fingerprint authentication was introduced to limit users that can operate the terminals of the registry administrators, and access was restricted by IP address and digital certificate . ・The information security of the current national registry was audited by a corporation that had acquired BS7799/ISMS certification, which is an international standard for security management. ・The servers of the national registry system are established in an Internet data center (IDC) with a 24-hour surveillance system. ・All PCs and servers used for the national registry have virus detection software installed and virus pattern files are automatically updated on a regular basis.
(g) A list of information publicly assessable through the user interface of the national registry.	・Account information and a list of authorized legal entities (up-to-date information and by account type). ・Total amount of Kyoto units held and issued for each calendar year (by unit type, by account type). ・Total amount of Kyoto units held for each calendar year at the beginning and end of each year (by unit type, by account type). ・ Total amount of Kyoto units subject to external transfers for each calendar year (by unit type, by partner party). ・Total amount of expired, canceled, and replaced Kyoto units for each calendar year (by unit type, by transaction type). ・Summary information on transactions undertaken for each calendar year (by unit type). ・Information on corrected transactions (by unit type).
(h) The Internet address of the national registry's interface.	http://www.registry.go.jp/index_e.html
(i) A description of measures taken to safeguard, maintain, and recover data in order to ensure that data storage is preserved and registry services are recovered in the event of a disaster.	[Data protection] The national registry is established at an Internet data center (IDC) with the following characteristics. ・An anti-seismic building with high aseismic capacity. ・Electrical facilities that guarantee over 24 hours of continuous operation in the event of a power failure. ・Fire-resistant construction possessing a gas-type fire extinguishing system. [Data management] Online backup as well as redundant configuration of duplicates is implemented. [Data recovery] Separate system recovery manuals have been created for both hardware and software failure. In addition, disaster recovery exercises are conducted regularly, and procedures are checked in order to recover the system promptly and infallibly in the event of a failure.

Item	Content
(j) The results of tests developed for testing the performance, procedures, and security measures of the national registry conducted in accordance with the provisions of Decision 19/CP.7 relating to technical standards for data exchange between registry systems.	In July 2007, a test was conducted between the ITL and the national registry of Japan based on DES annex H Version 1.1.002. The test was a success as the anticipated results were achieved in each of the test areas. In addition, the following tests were conducted between the ITL and the national registry before and after the go-live. -Go-live test In November 2007, a test was conducted in preparation for the Japanese registry connecting to the ITL for live operation. The test was completed without any problems and the live operation commenced. -ETS go-live test In October 2008, a test was conducted in accordance with the CITL and national registries of the EU connecting to the ITL for live operation. The test was completed without any problems. -SEF coordinated testing In December 2008, predefined test transactions were conducted in a test environment. SEF results were output by the national registry of Japan and consistency was confirmed between the SEF generated by the registry and one generated by the ITL. -Annex H testing for CP2 In September 2012, Annex H testing for CP2 was added in DES (version 1.1.9). In November 2012, the interoperability test for CP2 was conducted between the national registry of Japan and the ITL in a test environment. - Testing for Changes to CP2 end dates in the registry systems network In February 2013, Testing for Changes to CP2 end dates in the registry systems network was completed without any problems. - Annex H testing for post CP1 true-up and CP2 In January 2017, Annex H testing for post CP1 true-up and CP2 was completed without any problems. -Developer test Tests using the developer environment and registry environment provided by the UNFCCC are conducted as necessary. Before conducting the tests listed above, internal tests were conducted to check the functionality, operability, performance, security, and reliability of the registry system.

Chapter 3

Policies and Measures

3.1 Overview

(Overall framework of promotion of policies and measures)

- In the *Basic Environment Law* that defines the basic principles regarding environmental conservation in Japan and outlines the basic direction of national policy, the proactive promotion of global environmental conservation is regulated. The government formulates the *Basic Environmental Plan* based on Article 15, paragraph 1, of the Law to comprehensively and strategically promote measures related to environmental conservation. The global warming countermeasure is an important component of the plan.
- Regarding the promotion of global warming countermeasures, there is specific legislation, the *Act on the Promotion of Global Warming Countermeasures*. Article 2.2 of the Act states that global warming countermeasures must be promoted through close cooperation among citizens, the national government, local governments, businesses, and private organizations to realize a decarbonized society by 2050 while integrally promoting environmental conservation and economic and social development. Furthermore, the government established the *Plan for Global Warming Countermeasure* based on Article 8, paragraph 1, of the *Act*. The *Plan for Global Warming Countermeasures* is the only general plan regarding global warming in Japan. This plan sets targets for reducing greenhouse gas (GHG) emissions and removals, basic matters concerning measures that businesses and citizens should implement, and basic matters concerning measures that the national government and local governments should implement in order to achieve the target.

(Basic concept of global warming countermeasures)

- Integrated improvement of the environment, economy, and society: Japan will promote policies that will help improve the environment, economy, and society on an integrated basis by harnessing local resources, technological innovations, and ingenuity and using AI, the IoT, and other digital technologies in order to stimulate the Japanese economy, create jobs, solve issues plaguing local communities, and enable the achievement of SDGs.
- Green recovery from COVID-19: In recognizing that we stand at a significant crossroads at this time in history, it is necessary to achieve a transformation of the social system into one that is sustainable and resilient rather than return to the society that existed before the emergence of COVID-19. Based on the 2050 declaration of carbon neutrality, Japan will accelerate the three pillars of transition to a decarbonized society, circular economy, and decentralized society and then redesign in a forceful manner, the economy and society to be sustainable and resilient.
- Transforming the awareness of all actors, changing their behavior, and strengthening their coordination: Knowledge concerning the issue of global warming, which is becoming increasingly serious, and information on what each individual should do and on the state of progress with respect to the implementation of global warming countermeasures should be proactively provided and shared as visibly as possible. Japan will train human resources and develop activities to communicate these ideas and put them into action so as to induce changes in awareness and behavior across all sectors and levels of the nation.
- Contribution to reducing the global GHG emissions by strengthening research and development and spreading superior decarbonization technologies: Japan will strengthen research and development work on innovative technologies that pertain to promising fields

based on the *Sixth Basic Plan for Science, Technology, and Innovation* and the *Environment Innovation Strategy*. In addition, Japan will promote the diffusion of leading decarbonization technologies and the implementation of global warming mitigation activities through the Joint Crediting Mechanism (JCM) and other means.

- Response to the Paris Agreement: In order to achieve the goals of the Paris Agreement, Japan will faithfully accommodate the five-year cycle of the communication and update of targets as set forth in the Paris Agreement, as well as the report and review of progress towards the implementation and achievement of the targets. Furthermore, Japan will also proactively contribute to the establishment of detailed international rules for the Paris Agreement.
- Emphasizing the evaluation and review process (PDCA): In order to constantly monitor and ensure the effectiveness of the *Plan for Global Warming Countermeasures*, Japan will strictly check progress with respect to the measures implemented by the government for each countermeasure each year by assessing the emission reductions, the evaluation indicators for countermeasures, and other relevant indicators for greenhouse gas and category, and flexibly review the Plan as required.

(Policies and measures on mitigation actions and their effect)

- For the energy conversion sector of the energy sector, initiatives such as "Reduction of CO_2 emission intensity in the electric power sector", "Maximum introduction of renewable energy", and "Promotion of the introduction of facilities and equipment with high energy-saving performance in petroleum product manufacturing sector will be promoted.
- For the industry sector, initiatives such as "Promotion of voluntary effort by industry", "Promotion of the introduction of facilities and equipment with high energy-saving performance", "Implementation of thorough energy management", and "Promotion of emissions reductions measures for small and medium businesses" will be promoted.
- For the commercial sector, initiatives such as "Improvement of the energy efficiency of buildings", "Promotion of the introduction of facilities and equipment with high energy-saving performance", "Greening of digital equipment and industry", and "Implementation of thorough energy management" will be promoted.
- For the residential sector, initiatives such as "improvement of energy efficiency of housing", "Promotion of the introduction of facilities and equipment with high energy-saving performance", and "Implementation of thorough energy management" will be promoted.
- For the transport sector, "Diffusion of next-generation vehicles and improvement of fuel efficiency", "measures for road traffic flow", "Promotion of the use of public transportation and bicycles", "Measures for railways, ships and aviation", and "Promotion of decarbonized logistic systems" will be promoted.
- For the Industrial processes and product use (IPPU) sector, reduction of fluorinated gases emissions such as "promotion of non-fluorocarbons and low GWP[40] products", "Preventing leakage of fluorocarbons from the use of refrigeration and air-conditioning equipment for business use" and "Recovery and proper disposal of fluorocarbons from refrigeration and air-conditioning equipment", and reduction of CO_2 emissions from cement production by an expansion of the use of blended cement will be promoted.
- For the agriculture sector, measures for CH_4 emission reduction from rice cultivation and N_2O emission reduction associated with fertilizer application will be promoted.

[40] Global Warming Potential: The degree of effect of each GHG on global warming, expressed as a ratio to the effect of CO_2.

- Regarding forest carbon sink measures in the land use, land use change and forestry (LULUCF) sector, initiatives to be implemented will include “Maintenance of healthy forests”, “Promotion of appropriate management and conservation of protection forests and natural parks”, “Fostering efficient and stable forest management”, and “People’s participation in forest management” and “Promotion of the use of wood and woody biomass”. For measures to increase carbon sinks in agricultural soils, carbon sequestration in cropland and grassland soils will be promoted through the continuous application of organic matter, such as compost and green manure to the soil. Also, urban greening and initiatives related to blue carbon will be promoted.
- For the waste sector, initiatives such as “Diffusion of biomass plastics”, “Reduction of waste incineration”, and “Advancement of incineration at sewage sludge incineration facilities” will be implemented.
- As cross-cutting measures, “Activation of J-Credit scheme,” “Promotion of JCM”, “Realization of a hydrogen society”, “Initiatives based on guidelines for controlling GHG emissions”, “GHG emissions accounting, reporting, and disclosure program”, and “Pro-Growth Carbon pricing”, etc. will be promoted.

3.2 Policymaking process

3.2.1 Overall framework of promotion of policies and measures

In the *Basic Environment Law* (November 19, 1993, Act No. 91) that defines the basic principles regarding environmental conservation in Japan and outlines the basic direction of national policy, proactive promotion of global environmental conservation is regulated. The government formulates the *Basic Environmental Plan* [41] based on Article 15, paragraph 1, of the Law to comprehensively and strategically promote measures related to environmental conservation. The global warming countermeasure is an important component of the plan.

Additionally, regarding the promotion of global warming countermeasures, there is specific legislation, the *Act on the Promotion of Global Warming Countermeasures* (1998, Act No. 117). Article 2, paragraph 2 of the Act states that global warming countermeasures must be promoted through close cooperation among citizens, the national government, local governments, businesses, and private organizations, to realize a decarbonized society by 2050 while integrally promoting environmental conservation and economic and social development. Furthermore, the government established the *Plan for Global Warming Countermeasures* (Cabinet Decision on October 22, 2021) based on Article 8, paragraph 1, of the Act. The *Plan for Global Warming Countermeasures* is the only general plan regarding global warming in Japan. This plan sets targets for reducing GHG emissions and removals, basic matters concerning measures that businesses and citizens should implement, and basic matters concerning measures that the national government and local governments should implement in order to achieve the target.

3.2.2 Direction of global warming countermeasures in Japan

Japan will take the initiative in implementing global warming countermeasures under an international collaboration and based on scientific knowledge.

[41] Currently, the Fifth Basic Environmental Plan, approved by the Cabinet on April 17, 2018, is the latest.

Mid- and long-term strategic initiatives for achieving carbon neutrality by 2050

The Paris Agreement aims to hold the increase in the global average temperature to well below 2℃ and pursue efforts to limit the global average temperature to 1.5℃. Also, the Paris Agreement aims to have global emissions reach their peak as early as possible in order to realize early reductions in accordance with the latest science in order to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century.

As indicated in the *IPCC Special Report on Global Warming of 1.5°C*, it is globally urgent that we recognize that there are meaningful differences in the impact that might occur between a 1.5°C increase and a 2°C increase in temperature and that we pursue efforts to limit the increases in the global average temperature to 1.5°C above preindustrial levels.

Japan aims to reduce national total GHG emissions to zero by 2050, in other words, to realize carbon neutrality by 2050 in accordance with the notion that industrial structures and economic society can be transformed by proactively implementing global warming countermeasures that no longer act as a constraint on economic growth and that can instead lead to significant growth. *The Act to Partially Amend the Act on the Promotion of Global Warming Countermeasures* (Act no. 54 of 2021; the amended *Act on the Promotion of Global Warming Countermeasures* shall hereinafter be referred to as the "*Amended Global Warming Countermeasures Promotion Act*"), which was passed by the 204th session of the Diet, enshrined the goal of carbon neutrality by 2050 into law. Accordingly, Japan will not just attain our medium-term emission reduction targets but also work to enhance the continuity and predictability of policies for realizing a decarbonized society and accelerate initiatives, investments, and innovations for the sake of decarbonization.

In addition, Japan aims to reduce its GHG emissions by 46% in fiscal year (FY) 2030 from its FY 2013 level, setting an ambitious target that is aligned with the long-term goal of achieving net-zero by 2050 and continue strenuous efforts in its challenge to meet the lofty goal of cutting its emission by 50%. In order to give rise to a virtuous cycle for the economy and the environment and achieve strong growth towards our ambitious target for FY 2030, Japan will promote as many initiatives as possible in all areas, such as thorough energy conservation, the introduction of renewable energy sources to the maximum extent possible, and decarbonization of the public sector and regions. In the food, agriculture, forestry, and fisheries sectors, Japan aims to achieve both increased productivity and sustainability through innovations in accordance with the *Green Food System Strategy* (as determined by the Ministry of Agriculture, Forestry and Fisheries on May 12, 2021). Moreover, Japan steadily implements cross-sectoral decarbonization and other such initiatives on national land and in our urban and regional spaces in accordance with the *Green Challenge for Land, Infrastructure, Transport, and Tourism* (as determined by the Ministry of Land, Infrastructure, Transport and Tourism on July 6, 2021). Japan also creates new industries and jobs by promoting a strategic shift to a circular economy, which is needed for decarbonization, and nature-based solutions (NbS[42]).

Japan will continue to take on challenges towards 2030 and 2050. The realization of carbon neutrality by 2050 and a 46% reduction target by FY 2030 will certainly not be easy, but the decarbonization of all socioeconomic activities is positioned as a key challenge, and the pursuit of a shift to a sustainable and strong socioeconomic system is crucial. Japan will promote growth-contributing

[42] Nature-based Solutions. Initiatives to solve social issues by taking advantage of the functions of healthy natural ecosystems.

policies centered around decarbonization in order to realize our targets.

■ Initiatives for reducing global GHG emissions

Japan will demonstrate global leadership in terms of spearheading global decarbonization. Japan will continue to expand cooperation based on ties of collaboration with partner countries on the basis of relationships of trust that have been established to date and promote the business-led international development of technologies and products that offer high levels of environmental performance by leveraging our technological strengths and making further improvements to the environment, such as by creating markets, developing human resources, and building systems in order to make maximum contributions to the efforts to reduce global emissions.

3.2.3 Basic concept of global warming countermeasures

■ Integrated improvement of the environment, economy, and society

In promoting global warming countermeasures, Japan will promote policies that will help improve the environment, economy, and society on an integrated basis by harnessing local resources, technological innovations, and ingenuity and utilizing AI, the IoT, and other digital technologies in order to stimulate the Japanese economy, create jobs, solve issues plaguing local communities, and enable the achievement of SDGs.

Specifically, in order to promote economic development, the realization of high standards of living for citizens, the revitalization of communities, and reductions in GHG emissions, and while Japan strives to live in a state of harmony with nature, Japan will boldly shift to a nature-symbiotic society through the thorough promotion of energy conservation, the introduction of renewable energy to the maximum extent possible, the further acceleration of technological development, the reformation of social implementation and approaches to living and work, the promotion of a circular economy built around the 3Rs (reduce the generation of waste and reuse and recycle recyclable resources)+ Renewable (biomass and the use of recyclable materials), and the long-term demonstration of ecosystem services consisting of carbon removals and storage by natural ecosystems, as well as facilitate the aggressive transformation of business towards decarbonization and support labor movements caused by this transformation without allowing for unemployment to result. The Paris Agreement stipulates that the just transition of the workforce" is indispensable, such that it is important to proceed while working to ensure the creation of decent, rewarding jobs and improve labor productivity. In addition, the existence of many companies rooted in local communities in Japan means that Japan will need to study, in addition to the workforce, matters concerning transitions affecting local economies and local companies in an integrated manner.

It is exceedingly important that all entities, including citizens, the national government, local governments, and business enterprises, are aligned when it comes to improving the environment, the economy, and society on an integrated basis and that Japan cooperates in taking actual action towards making concrete progress in this regard.

■ Green recovery from COVID-19

It is said that COVID-19 and other emerging infectious diseases are deeply connected to global environmental changes, such as the loss of biodiversity and climate change[43] and are forcing us to rethink the future of human activities and the way we coexist with nature. At the G7 Cornwall Summit, attendees shared the view that "(t)he unprecedented and interdependent crises of climate change and biodiversity loss pose an existential threat to people, prosperity, security, and nature." Urgent and specific actions are needed to move towards global sustainability, further mitigate and adapt to climate change, and halt and restore the loss of biodiversity and environmental degradation.

Around the globe, green recovery efforts are underway to increase the ambition with respect to climate change countermeasures and achieve a sustainable economy and society as these matters relate to economic recovery in the wake of COVID-19. The new crisis brought about by COVID-19 has substantially altered the global socioeconomic framework, such that climate change countermeasures will also need to be promoted as an integral part of the way we will respond to these changes. In recognizing that we stand at a significant crossroads at this time in history, it is necessary to achieve a transformation of the social system into one that is sustainable and resilient rather than return to the society that existed before the emergence of COVID-19. Based on the 2050 declaration of carbon neutrality, Japan will accelerate the three pillars of transition to a decarbonized society, circular economy, and decentralized society and then redesign in a forceful manner the economy and society to be sustainable and resilient.

■ Transforming the awareness of all actors, changing their behavior, and strengthening their coordination

The issue of global warming is strongly linked to socioeconomic activities, local communities, and the lives of people in general and will have a major impact on future generations, which means that the people, the national government, local governments, business enterprises, and other actors will all need to address this issue in a participatory and coordinated way.

To this end, knowledge concerning the issue of global warming, which is becoming increasingly serious, and information on what each individual should do and on the state of progress with respect to the implementation of global warming countermeasures should be proactively provided and shared as visibly as possible. Japan will train human resources and develop activities to communicate these ideas and put them into action so as to induce changes in awareness and behavior across all sectors and levels of the nation.

■ Contribution to reducing the global GHG emissions by strengthening research and development and spreading superior decarbonization technologies

In order to confront the global challenge of climate change and realize a decarbonized society, we must carry out innovations that do not constitute a mere extrapolation of the conventional path on which we are currently treading. The realization of a decarbonized society requires that we correct the singular understanding that innovation means just innovation of technology and that we promote innovation for practical applications and dissemination with a view to promoting the social implementation of technologies, including by way of spreading existing superior technologies along

[43] In the *Workshop Report on Biodiversity and Pandemics of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services* (2020) The underlying causes of the pandemic are the same global environmental changes that cause biodiversity loss and climate change, including land use change, agricultural expansion and intensification, wildlife trade and consumption, etc. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBE) was established in April 2012 as an intergovernmental organization to make policy recommendations based on research findings on biodiversity and ecosystem services worldwide. It was established in April 2012.

with innovation entailing the creation of cutting-edge technologies. From this perspective, performance and efficiency are also important, but so is innovation conceived through a consideration of needs and a conception of what our future society should look like since performance, no matter how advanced, cannot be demonstrated if a technology is not selected by users.

Japan will strengthen research and development work on innovative technologies that pertain to promising fields based on the *Sixth Basic Plan for Science, Technology, and Innovation* (Cabinet Decision made on March 26, 2021) *Environment Innovation Strategy* (decision made by the Integrated Innovation Strategy Promotion Council on January 21, 2020). In addition, Japan will promote the diffusion of leading decarbonization technologies and the implementation of global warming mitigation activities through the JCM and other means.

■ Response to the Paris Agreement

In order to achieve the goals of the Paris Agreement, Japan will faithfully accommodate the five-year cycle of the communication and update of targets as set forth in the Paris Agreement, as well as the report and review of progress towards the implementation and achievement of the targets. Furthermore, Japan will also proactively contribute to the establishment of detailed international rules for the Paris Agreement. Japan will also steadily respond to the reporting and reviews of activities made by other Parties under the Paris Agreement.

■ Emphasizing the evaluation and review process (PDCA)

In order to constantly monitor and ensure the effectiveness of the Plan, Japan will strictly check progress with respect to measures implemented by the government for each countermeasure each year by assessing the emission reductions, the evaluation indicators for countermeasures, and other relevant indicators (hereinafter referred to as "measure evaluation indicators") for greenhouse gas and category, and flexibly review the Plan as required.

3.2.4 Promotion system of the global warming countermeasures

In order for each actor to continuously promote policies and measures and build a sustainable, decarbonized society, it is important to establish a systematic promotion system.

In the government, the Global Warming Prevention Headquarters, which is headed by the Prime Minister and includes all cabinet ministers as members, and the Executive Committee of the Global Warming Prevention Headquarters, which is a committee of the director-general level of each ministry and agency, shall play a central role in close coordination with the relevant ministries and agencies. In doing so, the opinions of experts and others shall be heard by the relevant councils in a timely and appropriate manner and shall maintain cooperation with related organizations.

In the regions, the Regional Energy and Global Warming Mitigation Councils established in each regional block will be utilized in cooperation with local governments and regional councils for global warming countermeasures in order to back up regional efforts for global warming countermeasures in cooperation with relevant government agencies.

3.2.5 Progress management of the Plan for Global Warming Countermeasures

The Global Warming Prevention Headquarters strictly reviews the achievement status of targets by types of GHGs and other categories, relevant indicators, the progress of each policy and measure, etc., every year, taking into account the periodic reviews and examinations by the relevant councils. As it is necessary to grasp the latest status for an accurate review, the relevant government ministries and agencies strive to quickly calculate the actual figures required for reviewing measure evaluation indicators.

Specifically, the Global Warming Prevention Headquarters or the Executive Committee of the Global Warming Prevention Headquarters clarifies the actual figures of all the measure evaluation indicators for the fiscal year before the review (or actual figures for two fiscal years prior if it is difficult to provide actual figures for the previous fiscal year), as well as the outlooks of each measure evaluation indicator from the fiscal year of the progress review through to FY 2030 (the outlook in each fiscal year if the data is available) once every year. In addition, they clarify the implementation status of policies and measures in the previous fiscal year that supports the outlooks of the measure evaluation indicators and the contents of ongoing policies and measures in the current fiscal year, along with policies and measures that are going to be implemented in the next fiscal year or later, including budget proposals, tax reform plans, and bills that will be implemented as well.

Based on the above, each policy and measure will be evaluated to identify those that are slow to progress, and consideration will be made for the enhancement and strengthening of those policies and measures. In doing so, not only the enhancement of policies and measures that have already been included in the Plan but also new policies and measures will be explored. In reviewing the progress, an examination of the relationship between the evaluation indicators of each policy and measure and the emission reductions as the effects of implementing the corresponding policies and measures, as well as cost performance, are implemented when necessary. For the areas where evaluation methodology, like measures evaluation indicators, has not been fully established at this point, such as policies and measures that lead to the transformation of a socioeconomic system, proper evaluation methodology will be quickly established.

Furthermore, the evidence of the estimated emission reductions by each policy and measure and the results of progress reviews will be made public via the Internet so that the public can access the details of policies and measures and their progress appropriately.

In addition to such annual progress reviews, the targets, policies and measures set in the Plan are examined at least every three years based on the annual GHG emissions and removals and other circumstances, taking account of the reports submitted by the Japanese government to the Secretariat of the United Nations Framework Convention on Climate Change, including the to the Secretariat of the United Nations Framework Convention on Climate Change, including the annual GHG inventory, the biennial report and the national communication. Then, the Plan shall be revised as necessary based on the results of the examination, and the revision shall be decided by the Cabinet.

For the revision, the rules, including the five-year cycle of communicating and updating targets according to the Paris Agreement and decisions at COP21, shall be followed. In the future, the implementation status will be reported and reviewed internationally in accordance with the transparency framework under the Paris Agreement.

3.2.6 Information on changes in domestic institutional arrangements

Since December 2019, when the BR4 was submitted, there have been no changes regarding domestic institutional arrangements for promoting global warming countermeasures and reporting to the UNFCCC.

3.3 Policies and measures on mitigation actions and their effects

3.3.1 Introduction

An overview of the specific policies and measures stipulated in the *Plan for Global Warming Countermeasures* is outlined by sector.

For major policies and measures with large expected emission reductions, in addition to the outline of the policies and measures, the results of the progress evaluation of the policies and measures in the progress review described in Section 3.2.5 are also included as examples[44]. The progress of emission reductions is evaluated on a five-point scale from A to E below, based on the estimates and outlooks of the measure evaluation indicators up to FY 2030 and based on the actual values up to FY 2020.

1. Steady Implementation, evaluation and verification of Industry's Action Plans for a Low-Carbon Society (Number of industries: 115)

A : Actual results exceed the target level
B : Actual results are reduced from the base year/BAU (Business As Usual) but below the target level.
C : Actual results are below the target level and increased from the base year/BAU
D : Data not yet collected (Newly formulation or change of target level, review of data collection etc.)
E : Target not yet established

2. Policies and measures other than 1 (Number of policies and measures: 115)

A : Policy and measure for which the measure evaluation indicator is expected to exceed the target level if current efforts continue and for which the actual results have already exceeded the target level
B : Policy and measure for which the measure evaluation indicator is expected to exceed the target level if current efforts continue (excluding A).
C : Policy and measure for which the measure evaluation indicator is expected to be equivalent to the target level if current efforts continue.
D : Policy and measure for which the measure evaluation indicator is expected to fall below the target level if current efforts continue.
E : Other policies and measures for which quantitative data cannot be obtained

[44] The progress status of all policies and measures can be found in "Progress of the Plan for Global Warming Countermeasures in FY2020" (June 17, 2022) (Global Warming Prevention Headquarters) (*only in Japanese) <https://www.env.go.jp/content/000040099.pdf>.

Evaluation results on the progress of policies and measures implemented in FY 2020 are shown in Table 3-1.

In order to achieve the targets of the Plan, the policies and measures set forth in the Plan will be further promoted, taking into account annual GHG emissions and evaluation results.

In particular, for those industries (58 industries) rated as "A. Actual results exceed target level" in "1. A. Steady Implementation, evaluation and verification of Industry's Action Plans for a Low-Carbon Society," the government will encourage constant review and promotion of further measures, including consideration of raising the target. B. For those industries (42 industries) rated as "B. Actual results are reduced from the base year/BAU, but below target level", "C. Actual results are below the target level, and increased from the base year/BAU" (eight industries), and "E. Target not yet established" (three industries), the government will encourage them to enhance and strengthen their efforts and set the target level.

Furthermore, for those industries that have not yet formulated a low-carbon society action plan, the government will focus on encouraging them to consider formulating their action plans.

For the policies and measures rated as " Policy and measure for which the measure evaluation indicator is expected to fall below the target level if current efforts continue" (21 cases) in " Policies and measures other than 1", the government will proceed to consider enhancement and reinforcement them, and if necessary, consider new policies and measures as well. In addition, policies and measures other than "D." will also be considered for further emission reductions.

Table 3-1 Results of progress evaluation of policies and measures implemented in FY 2020

Category	Evaluation	Number of industries/policies and measures
Steady Implementation, evaluation and verification of Industry's Action Plans for a Low-Carbon Society	A	58
	B	42
	C	8
	D	4
	E	3
Policies and measures other than the above	A	6
	B	15
	C	66
	D	21
	E	7

A summary of each policy and measure and details of emission reductions (achieved and expected) are shown in Table 3-3 (p.182). Note that for some policies and measures, expected emission reductions (estimated mitigation impacts) are not reported because quantitative data and necessary statistical information are not available.

3.3.2 Energy sector

Energy conversion

(1) Reduction of CO_2 emission intensity in power sectors

(Decarbonization of the electric power sector)

Under the energy policy principle of S+3E (Safety, Energy security, Economic efficiency, and Environment), to decarbonize the electric power sector, the use of renewable energy as the main source of power will be thoroughly promoted while working on renewable energies as the highest priority, aiming to realize their maximum utilization while reducing the burden on citizens and coexisting with local communities. Review of siting regulations, overcoming grid constraints, ensuring flexibility in the power system through the use of storage batteries and demand response, including EVs etc., and drastic reform of the electricity market system will be promoted.

Steady investment in the necessary power transmission and distribution networks and power sources, as well as the improvement of cost efficiency and true local production for local consumption, such as distributed energy systems, will also be encouraged.

With regard to nuclear energy, while reducing dependence on nuclear power as much as possible, nuclear power plants will be restarted with the highest priority on safety. At the same time, the establishment of a nuclear emergency preparedness system, including effective nuclear regulations and the securing of evacuation routes through road construction and other measures, will be steadily promoted. Also, research and development and human resource development for the future will be conducted, including the pursuit of reactors with superior safety features.

For thermal power, CO_2 emissions from thermal power generation will be reduced in a consistent manner with the long-term goals of the Paris Agreement in order to achieve a decarbonized society. Therefore, by fading out inefficient coal-fired thermal power generation etc., dependence on thermal power generation will be reduced as much as possible on the basic premise of ensuring a stable supply. In addition, the use of thermal power generation with a premise of using CCUS[45]/carbon recycling and the option of generating power using hydrogen or ammonia will also be pursued to the maximum extent.

A. Reduction of CO_2 emission intensity in the electric power sector

[Outline of policies and measures]

In July 2015, a voluntary framework for the electric power sector and the *Industry's Action Plans Toward a Low-Carbon Society* involving major business operators (the target is to achieve about 0.37 kg-CO_2 kWh, which is consistent with the national energy mix and CO_2 reduction target at the time) was announced. In February 2016, the Electric Power Council for a Low-Carbon Society was established and announced mechanisms and rules for individual companies to develop their own reduction plans and implement PDCA cycles as a whole industry.

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[45] Abbreviation for Carbon dioxide capture, utilization, and storage. A technology for separating and recovering CO_2 contained in exhaust gases from thermal power plants, factories etc., and in the atmosphere, and effectively utilizing it as a resource in the manufacture of minerals, chemicals, and fuels, or storing it in stable underground formations.

To encourage such voluntary initiatives by implementing policies in accordance with the *Act on the Rational Use of Energy (Act No. 49 of 1979, hereinafter referred to as the "Energy Conservation Act")* and *the Act on the Promotion of the Use of Non-fossil Energy Sources and the Effective Use of Fossil Energy Raw Materials by Energy Suppliers* (2009, Act No. 72, hereinafter referred to as the "*the Advancement Act*"), the effectiveness of the efforts of the entire power sector will be ensured under electricity deregulation.

Specifically, the effective measures, including the following items, will be implemented to be consistent with Japan's new CO_2 emission reduction target and energy mix[46], and the future global warming countermeasures in the electric power sector will be considered continuously.

<Voluntary framework>

- The review of emission factor targets consistent with national CO_2 emissions reduction targets and the energy mix and the improvement of the effectiveness and transparency of efforts by the electric power sector as a whole will be promoted. Also, sincere commitment to achieving the stated targets will be encouraged.
- The national council (Resources and Energy Working Group of Industrial Science and Technology Policy and Environment Meeting of Industrial Structure Council and Global Environment Subcommittee) will also follow up on initiatives under the voluntary framework of the electric power sector.

<Policy responses>

- In accordance with the *Energy Conservation Act*, power generators are required to meet power generation efficiency standards for newly constructed power generation facilities on a per facility basis. In addition, power generators are also required to meet the power generation efficiency standards for existing power generation facilities on a per generator basis.
- Furthermore, in order to steadily fade out inefficient coal-fired thermal power generation by 2030, the benchmark target for power generators with coal-fired power generation facilities requires power generation efficiency (on a per generator basis) that is at the same level as state-of-the-art USC (ultra-supercritical) plants. In doing so, the introduction of technologies for decarbonization will be promoted by allowing the subtraction of co-firing hydrogen, ammonia, etc., in the calculation of power generation efficiency.
- Based on the *Advancement Act*, retail electric utilities are required to ensure that the percentage of non-fossil power sources in the electricity they sell is above the standard.
- With a view to 2030 and beyond, CCS[47] will be addressed based on the Strategic Energy Plan and the Long-Term Strategy as a Growth Strategy Based on the Paris Agreement (Cabinet decision on October 22, 2021).

In introducing power generation facilities through competition, Japan believes that constant promotion of the advancement of power generation technologies that contribute to the realization of decarbonization as well as maintenance and improvement of Japan's technological superiority in the power generation business will lead to increased international

[46] The energy mix for FY 2030 is expected to be about 8.8% to 9.2% for hydro, about 7.0% for solar, about 1.7% for wind, about 1.0% to 1.1% for geothermal, and about 3.7% to 4.6% for biomass.

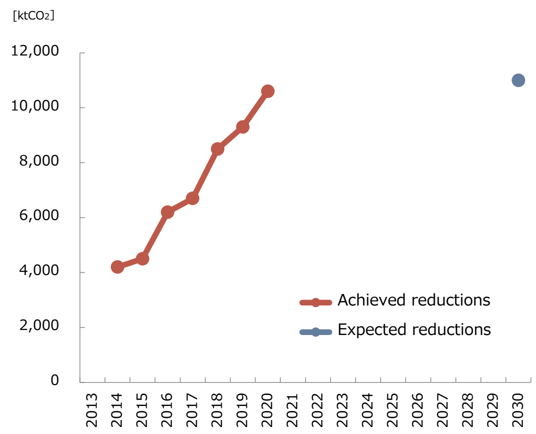
[47] Abbreviation for Carbon dioxide Capture and Storage.

competitiveness and the decarbonization of the world. Based on this concept and taking into account future trends in the development of power generation technology, the adoption of BAT will be encouraged.

The effectiveness and transparency of the entire electric power industry will be ensured by addressing the above. In addition, the implementation status, including an assessment of whether these initiatives continue to be effective, will be evaluated to ensure that emission factor targets are met and reviewed.

If it is determined that the revised emission factor target cannot be achieved based on the assessment of emissions from the power generation sector and the status of the emission factor, the enhancement of measures will be considered with stable supply as a major premise.

<Progress assessment of policies and measures>

Name of policy and measure	Improving the efficiency of thermal power generation
Measure evaluation indicator	CO_2 emission reductions by using BAT
Progress in the emission reductions	C. Expected to be equivalent to the target level in FY 2030
Supplement to the progress assessment and reasons	For the improving efficiency of thermal power generation, it is necessary to replace old thermal power generation facilities with high-efficiency facilities or to introduce high-efficiency facilities when a thermal power generation plant is newly built. These lead-times are not continuous since their period and timing vary depending on businesses in light of a stable supply of electricity and the understanding of the local people. Therefore, it is difficult to appropriately evaluate the probability of achieving the target level based on single-year figures alone. However, since the single-year progress toward the target for FY 2020 based on the voluntary framework of the electric power sector has reached 80%, it can be evaluated that the measure is on track.
Emission reductions ($ktCO_2$)	

(2) Maximum introduction of renewable energy

A. Maximum introduction of renewable energy

[Renewable electricity generation]

Renewable energy does not emit greenhouse gases in its generation, so its increased introduction is essential for mitigating global warming in the energy conversion sector. It is also a promising, diverse, and important domestic energy source that can contribute to energy security because it can be produced domestically. Under the concept of S+3E, the highest priority will be placed on renewable energy, and its maximum introduction will be encouraged while reducing the burden on the citizens and coexisting with local communities. Specific initiatives include the following:

- Appropriate operation and revision of the Feed-in Tariff (FIT) scheme

The FIT scheme, based on the *Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electricity Utilities* (Act No. 108 of 2011), is a measure to reduce the cost of renewable energies by allowing the purchase of renewable energy at a fixed price over a long period of time, increasing investment incentives, and promoting the spread of renewable energy. In the future, efforts to reduce costs by power generation companies will be promoted through the use of a bidding system and the setting of mid- to long-term price targets. From FY 2022 onwards, the FIP scheme was introduced under which power producers sell electricity on the wholesale electricity trading market or in relative transactions, as with other power sources, and receive a certain premium calculated on the basis of the market price. This would encourage the trading of electricity according to supply and demand conditions and market prices and promote the integration of renewable energy into the electricity market.

In order to continue to promote the maximum use of renewable energy while reducing the burden on the citizens, the FIT and FIP[48] schemes will be appropriately operated, and the systems will be appropriately revised as necessary.

- Expansion of use, development of a business environment for long-term stable power generation

In order to maximize the use of renewable electricity and achieve long-term stable use with the understanding of local communities and society, the business environment will be improved through the following initiatives: the development of rules for grid maintenance and grid operation, the development of technologies for higher efficiency and lower cost of power generation facilities and advanced grid operation, rationalization of related regulations as necessary, and establishment of a business discipline for coexistence with the local community.

- Expansion of renewable energy in consumers and communities

The use of solar power generation at factories, offices, housing, and buildings will be promoted while facilitating proactive initiatives in the public sector, such as the installation of solar power generation systems in public buildings. For houses and buildings, the target is to have 60% of newly built houses equipped with photovoltaic power generation systems by 2030. In addition, efforts will be made to publicize and disseminate the PPA model[49] and other information to

[48] Feed-in Premium: A scheme in which a certain amount of subsidy is added to the sales price of electricity generated from renewable energy sources when the electricity is sold.

[49] PPA (Power Purchase Agreement) model: A contract method in which a power generation business supplies electricity generated by the business to specific consumers, etc. This model assumes a business model in which a business operator installs and operates a solar power generation system etc. on a customer's roof or site free of charge, the customer purchases the electricity generated by the system from the business operator who installed it and pays the PPA business operator for its use. This model has advantages in terms of

facilitate a smooth introduction to such customers. Also, the *Act on Promotion of Global Warming Countermeasures* and other relevant measures, will be utilized to promote the introduction of renewable energy with proper environmental consideration and benefits to local communities.

Furthermore, the optimal environmental assessment system will be examined based on the characteristics of offshore wind power generation, such as location and environmental impact, in cooperation with relevant government ministries and agencies, local governments, and business operators. At the same time, continued efforts will be made to improve the efficiency of onshore wind and other types of power generation, as well as to accelerate the development of geothermal power generation through the implementation of scientific studies in coexistence with local communities. Unused hydroelectric energy will be utilized, such as by installing power generation facilities in existing dams that are not being used for power generation and by examining the feasibility of improving dam operations using the latest weather forecasting technology.

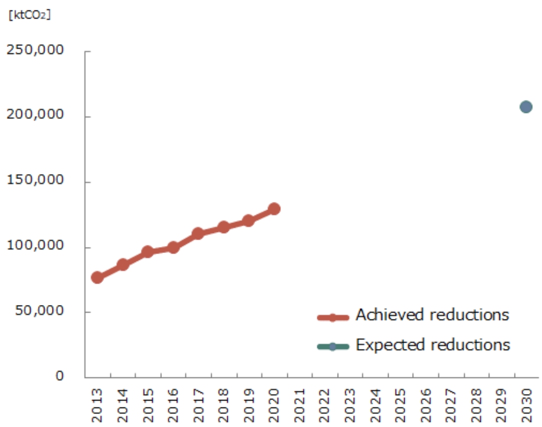
[Renewable heat energy]

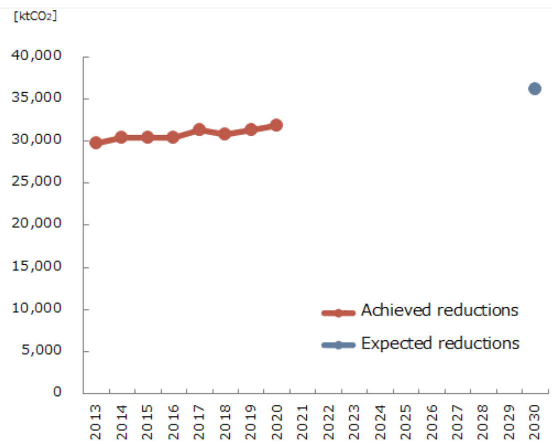
Focusing on renewable heat energy (solar heat, geothermal heat, snow and ice heat, hot spring heat, seawater heat, river heat, sewage heat, etc.), which is a highly local energy source, the use of biomass heat from sewage sludge, waste wood, and unused materials, and the use of unused heat, such as waste heat from waste treatment, will be promoted according to economic efficiency and regional characteristics. Meanwhile, the use of biofuels, hydrogen and other decarbonized fuels that can partially replace petroleum products as fuels in the transport sector is also important. The aim is to expand the use of renewable energy and heat by supporting the introduction of facilities that supply renewable energy and heat and by demonstrating and building models for the effective use of a variety of different types of heat energy in the region.

<Progress assessment of policies and measures>

Name of policy and measure	Expand use of renewable electricity
Measure evaluation indicator	Amount of electricity generated
Progress in the emission reductions	C. Expected to be equivalent to the target level in FY 2030
Supplement to the progress assessment and reasons	As a result of the launch of the FIT scheme in July 2012 based on the *Act on Special Measures concerning the Procurement of Renewable Electricity by Electric Utilities*, the amount of renewable energy introduced has expanded significantly compared to that before the start of the FIT. Steady progress is expected to be made toward achieving the target by continuing to promote efforts to expand the use of renewable electricity while curbing the burden on the public and coexisting in harmony with local communities. Since the energy mix does not specify a target for each fiscal year, it is difficult to properly evaluate the achievement of the target only by the single-year figure. However, as a result of the launch of the FIT scheme in July 2012, based on the Act above, the amount of renewable energy introduced has expanded significantly compared to that before the start of the FIT.

reducing the burden on consumers, such as the fact that the initial cost of installing solar power generation equipment may be zero, but it should be noted that this does not mean that consumers do not bear the cost of the equipment, as the cost is paid through electricity usage fees.

	Although it is difficult to predict the future growth of renewable energy introduction, the amount of electricity generated and emission reductions, which are the measure evaluation indicators, are 198.3 TWh and 129 Mt-CO_2, respectively, in FY 2020. Based on the trend of the certified amount under the *Act on Special Measures concerning the Procurement of Renewable Electricity by Electric Utilities*, at this point, it is evaluated that the measure is ranked "C".
Emission reductions ($ktCO_2$)	

Name of policy and measure	Expand use of renewable heat energy
Measure evaluation indicator	Heat supply
Progress in the emission reductions	C. Expected to be equivalent to the target level in FY 2030
Supplement to the progress assessment and reasons	Since the energy mix does not specify a target for each fiscal year, it is difficult to properly evaluate the achievement status of the target only by the single-year figure. Steady progress is expected to be made toward achieving the target in the future by promoting measures through the development of low-cost technologies and other measures. Although it is difficult to predict the future heat supply and emission reductions, the heat supply and emission reductions, which are the measure evaluation indicators, are $1,175 \times 10^4$ kL and 31.87 Mt-CO_2 in FY 2020, respectively, and assuming that they will continue linearly until FY 2030, it is evaluated that the measure is rank "C" at this time.
Emission reductions ($ktCO_2$)	

(3) Promotion of energy-saving measures in the petroleum product manufacturing sector

A. Promotion of the introduction of facilities and equipment with high energy-saving performance (petroleum product manufacturing sector)

Efforts to achieve energy reductions equivalent to 1 million kL in crude oil equivalent from BAU by (1) effective use of heat, (2) introduction of advanced control and high-efficiency equipment, (3) improvement of power system operations, and (4) large-scale improvements and upgrade of processes, based on the Industry's Action Plans for a Low-Carbon Society in the petroleum product manufacturing sector by petroleum refiners.

■ Industry sector

(1) Promotion of voluntary effort by industry

A. Steady Implementation, evaluation and verification of Industry's Action Plans for a Low-Carbon Society

<Outline of policies and measures >

The Keidanren and industries have been working to reduce emissions by formulating voluntary action plans and have achieved good results so far. Based on the fact that *Industry's Action Plans for a Low-Carbon Society* have led to steady reductions in GHG emissions while maintaining economic competitiveness in many industries, Japan will continue to promote voluntary efforts by the industry as a central part of the measures implemented by the industry sector to steadily implement emission reductions toward achieving the reduction targets in the Plan.

Such a voluntary approach requires a certain level of government involvement in terms of transparency, reliability, and probability of achieving the target. Meanwhile, it has the advantages of allowing each entity to select superior measures based on its originality and ingenuity and of providing incentives to work toward higher targets. It is thus extremely important that industries continue to employ these advantages and promote efforts to reduce GHG emissions. For this reason, while taking into account the advantages of leaving the targets and contents of the Industry's Action Plans for a Low-Carbon Society to the autonomy of the industry, in order to respond to social demands, the industry shall formulate and implement the plan while paying attention to the following points and review it from time to time based on periodic evaluations and verifications:

(i) For industries that have not yet formulated the Industry's Action Plans for a Low-Carbon Society, the number of industries that have formulated targets increased from 87 in FY 2013 to 114 in FY 2018 as a result of active encouragement of the formulation of new voluntary action plans not only for industries that have been participating in the Kyoto Protocol Target Achievement Plan but also for those have not been participating in that plan. Continued efforts will be made to increase the coverage rate within the industry, including SMEs.

(ii) In setting targets in the Industry's Action Plans for a Low-Carbon Society, from the perspective of reducing GHG emissions, CO_2 reduction targets are established based on the maximum introduction of the best available technology (BAT: Best Available Technology) and proactive energy saving efforts. The targets are explained to the public as being the maximum target level that can be achieved. It is important to collect data that will enable a comparison of energy efficiency and CO_2 emissions between Japan and other countries so that the severity of the target level set and the degree of effort made by the industry can be evaluated. In addition, by clearly indicating BAT and best practices in advance, it will be possible to evaluate not only the achievement of the target level but also the efforts made by each industry. Furthermore, while respecting the voluntary targets, the committee will also consider the consistency with the government's 2030 target, the setting of the 2030 target with a view to the ideal state in 2050, and a unified presentation of the CO_2 emission reduction rate compared to the FY 2013 level as a common indicator. In the event that technological developments enable the diffusion of new BAT, the targets will be flexibly raised on a constant basis.

※For the target indicators, each industry makes an independent judgment and mainly selects either energy consumption intensity, energy consumption, CO_2 emission intensity, CO_2 emission, or reduction from Business As Usual (BAU)[50]. It is important to continue to examine the nature of the target setting, including consistency with the government's 2030 target.

(iii) Under the *Industry's Action Plans for a Low-Carbon Society*, the PDCA cycle will be promoted as before to ensure effectiveness, transparency, and reliability. In doing so, taking into account the fact that the plan for 2030 is a long-term initiative, various factors, such as changes in the structure of society and industry and progress in technological innovation, will be considered while clarifying the preconditions and ensuring transparency so that the 2030 target can be easily compared among industries.

(iv) In addition to the emission reduction targets (commitments) set out in (ii) above, the reduction of CO_2 emissions throughout the supply chain by supplying decarbonized products and services in cooperation with related industries. Efforts will also be made to raise public awareness and improve the knowledge of global warming prevention.

(v) From the perspective of contributing to global warming countermeasures on a global scale, each industry will actively work on reducing emissions globally through the overseas deployment of decarbonized products and services etc., transferring technology and know-how based on international rules to developing countries that are willing to improvement measures to prevent global warming, and strengthening private-sector based international collaborative activities. At the same time, contributions to reducing emissions through specific initiatives of the business fields of each industry will be presented.

(vi) Each industry will actively work on the development and practical application of innovative technologies to achieve carbon neutrality in 2050 from a medium- to long-term perspective that looks beyond 2030.

(vii) In addition, in order to disseminate easy-to-understand information on initiatives based on the *Industry's Action Plans for a Low-Carbon Society* to foreign countries and consumers, each industry will make international comparisons based on reliable data and actively disseminate such information to the outside world.

(viii) The effectiveness of the plan will be examined in light of progress on the 2050 carbon neutrality and FY 2030 emission reduction targets, and the survey design will be simplified to make it easier for the industry to participate.

Based on the perspectives of (i) to (viii) above, the government will conduct rigorous and

[50] Reduction from BAU" refers to the targeted reduction in CO_2 emissions, etc., achieved through maximum introduction of BAT, etc., based on the assumed emissions (BAU emissions) in the target year when no additional measures are taken, in other words, when the technology level (intensity) is fixed in a given year.

periodic evaluation and verification by relevant councils of the *Industry's Action Plans for a Low-Carbon Society* formulated by each industry sector and the initiatives to be implemented based on the action plans, as well as the review of how to proceed with the *Industry's Action Plans for a Low-Carbon Society*.

In addition, the industry will contribute to CO_2 reductions in the commercial and institution sector and transport sector by making materials and other products lighter and more functional, developing and providing energy-efficient decarbonized products and services, improving the efficiency of logistics through modal shifts and other means, and promoting the use of next-generation vehicles and public transportation.

<Progress assessment of policies and measures>

The progress assessment results against the targets for FY 2030 of each industry in the *Industry's Action Plans for a Low-Carbon Society* are shown in Table 3-2.

Table 3-2 Target indicators, target levels, and progress evaluation results for each industry in the Low Carbon Society Action Plan

Type of industry	Upper row：CO_2 emissions Middle and lower rows：Target indicators	Base year/BAU	Actual performance								Target Level	Assessment of progress
			2013	2014	2015	2016	2017	2018	2019	2020	2030	
Industry sector												
Industry under Ministry of Finance												
Brewers Association of Japan	CO_2 emissions	$ktCO_2$	546	528	512	499	488	466	450	402		A
	CO_2 emissions	FY 2013	-	-16%	-17%	-18%	-19%	-21%	-23%	-31%	-26.0%	
Japan Tobacco Inc.	CO_2 emissions	$ktCO_2$	950	920	915	850	805	778	734	666		B
	CO_2 emissions	FY 2015	-	-	-0%	-6%	-12%	-13%	-15%	-24%	-32.0%	
Industry under Ministry of Health, Labor and Welfare												
The Federation of Pharmaceutical Manufacturers' Associations of Japan	CO_2 emissions	$ktCO_2$	2,565	2,469	2,409	2,431	2,348	2,197	2,133	2,062		B
	CO_2 emissions	FY 2013	-25%	-28%	-28%	-26%	-27%	-29%	-29%	-31%	-46.0%	
Industry under Ministry of Fisheries, Forestry and Agriculture												
Japan Starch & Sweeteners Industry Association	CO_2 emissions	$ktCO_2$	1,148	1,180	1,255	1,139	1,122	1,078	1,037	860		B
	CO_2 emission intensity	FY 2013	+0%	+3%	+9%	-1%	-2%	-6%	-10%	-25%	-30.3%	
Japan Dairy Industry Association	CO_2 emissions	$ktCO_2$	1,195	1,155	1,160	1,117	1,035	977	958	941		B
	CO_2 emission intensity	FY 2013	-	-3%	-10%	-13%	-19%	-22%	-24%	-23%	-28.0%	
Japan Soft Drink Association	CO_2 emissions	$ktCO_2$	1,220	1,156	1,150	1,140	1,106	1,178	1,161	1,052		A
	CO_2 emission intensity	FY 2012	+2%	-3%	-7%	-10%	-15%	-12%	-19%	-19%	-18.0%	
Japan Baking Industry Association	CO_2 emissions	$ktCO_2$	1,085	1,091	1,070	1,047	1,020	995	979	923		A
	CO_2 emission intensity	FY 2013	-	-6%	-8%	-11%	-15%	-16%	-18%	-20%	-13.0%	
Japan Canners Association	CO_2 emissions	$ktCO_2$	755	679	634	788	1,062	616	628	640		B
	Energy intensity	FY 2009	-5%	-15%	-9%	-13%	-7%	-29%	-26%	-15%	-19.0%	
Japan Beet Sugar Association	CO_2 emissions	$ktCO_2$	638	653	704	601	661	648	692	666		A
	Energy intensity	FY 2010	-15%	-19%	-21%	-12%	-17%	-25%	-17%	-18%	-15.0%	

Type of industry	Upper row：CO_2 emissions Middle and lower rows：Target indicators	Base year/BAU	Actual performance								Target Level	Assessment of progress
			2013	2014	2015	2016	2017	2018	2019	2020	2030	
Japan Oilseed Processors Association	CO_2 emissions	$ktCO_2$	610	607	612	624	635	616	593	585		B
	CO_2 emission intensity	FY 2013	-	-2%	-2%	-2%	-0%	-4%	-7%	-4%	-6.5%	
	CO_2 emissions	FY 2013	-	-0%	+0%	+2%	+4%	+1%	-3%	-4%	-6.5%	
All Nippon Kashi Association	CO_2 emissions	$ktCO_2$	974	973	960	916	943	863	830	858		A
	CO_2 emissions	FY 2013	-	-0%	-1%	-6%	-3%	-11%	-15%	-12%	-17.0%	
	CO_2 emission intensity	FY 2013	-	-7%	-18%	-25%	-25%	-32%	-35%	-33%	-17.0%	
Japan Sugar Refiners' Association	CO_2 emissions	$ktCO_2$	390	376	365	358	345	324	303	278		A
	CO_2 emissions	FY 1990	-33%	-35%	-37%	-38%	-40%	-44%	-48%	-52%	-33.0%	
Japan Frozen Food Association	CO_2 emissions	$ktCO_2$	437	403	419	514	499	528	678	654		B
	Energy intensity	FY 2013	-	-3%	-5%	-6%	-9%	-8%	-4%	-6%	-15.7%	
Japan Ham & Sausage Processors Cooperative Association	CO_2 emissions	$ktCO_2$	569	569	561	550	547	514	511	482		B
	Energy intensity	FY 2011	-6%	-4%	-6%	-6%	-8%	-4%	-3%	-7%	-17.0%	
Flour Millers Association	CO_2 emissions	$ktCO_2$	305	303	286	275	268	242	232	226		B
	CO_2 emission intensity	FY 2013	-	-1%	-7%	-11%	-14%	-21%	-24%	-24%	-32.1%	
All Japan Coffee Association	CO_2 emissions	$ktCO_2$	118	116	120	136	126	127	127	126		A
	CO_2 emission intensity	FY 2005	-33%	-38%	-41%	-44%	-49%	-52%	-53%	-49%	-25.0%	
Japan Soy-sauce Association	CO_2 emissions	$ktCO_2$	198	182	174	170	166	161	154	145		A
	CO_2 emissions	FY 1990	-5%	-12%	-16%	-18%	-20%	-22%	-25%	-30%	-23.0%	
Japan Convenience Foods Industry Association	CO_2 emissions	$ktCO_2$	234	251	254	255	262	260	263	267		E
	-	-	-	-	-	-	-	-	-	-	-	
Nihon Hamburg & Hamburger Association	CO_2 emissions	$ktCO_2$	110	106	105	105	102	98	94	96		C
	Energy intensity	FY 2013	-	+1%	+7%	+3%	+6%	+6%	+9%	+10%	-16.0%	
Japan Association of Mayonnaise ＆ Dressings	CO_2 emissions	$ktCO_2$	62	60	58	57	55	53	50	44		A
	CO_2 emissions	FY 2012	+1%	-1%	-6%	-7%	-11%	-14%	-19%	-28%	-21.7%	

Type of industry	Upper row：CO_2 emissions Middle and lower rows：Target indicators	Base year/BAU	Actual performance								Target Level	Assessment of progress
			2013	2014	2015	2016	2017	2018	2019	2020	2030	
Japan Rice Millers Association	CO_2 emission intensity	FY 2012	-1%	-3%	-9%	-11%	-15%	-18%	-24%	-30%	-17.9%	A
	CO_2 emissions	$ktCO_2$	70	70	70	86	87	77	71	71		
	Energy intensity	FY 2005	-3%	-7%	-3%	-10%	-9%	-6%	-12%	-13%	-12.0%	
Industry under Ministry of Economy, Trade and Industry												
The Japan Iron and Steel Federation	CO_2 emissions	$ktCO_2$	194,408	191,803	184,085	182,643	181,200	177,385	172,613	145,932		B
	CO_2 emissions	FY 2013	-	-1%	-5%	-6%	-7%	-9%	-11%	-25%	-30.0%	
Japan Chemical Industry Association	CO_2 emissions	$ktCO_2$	63,636	62,642	61,207	59,612	60,193	58,577	57,767	54,894		A
	CO_2 emissions	BAU	+0%	+1%	-1%	-2%	-5%	-5%	-4%	+1%	-6.5Mt-CO_2	
	CO_2 emissions	FY 2013	-	-2%	-4%	-6%	-5%	-8%	-9%	-14%	-6.79Mt-CO_2 (-10.7%)	
Japan Paper Association	CO_2 emissions	$ktCO_2$	18,800	18,130	17,893	18,035	17,796	17,418	16,570	15,602		B
	CO_2 emissions	BAU	-14%	-16%	-17%	-17%	-18%	-20%	-20%	-17%	-4.66Mt-CO_2	
Japan Cement Association	CO_2 emissions	$ktCO_2$	18,065	17,744	17,177	16,957	17,319	16,857	16,138	15,513		A
	Energy intensity	FY 2010	-1%	-1%	-2%	-3%	-2%	-4%	-5%	-5%	-3.6%	
Liaison Group of Japanese Electrical and Electronics Industries for Global Warming Prevention	CO_2 emissions	$ktCO_2$	13,018	12,471	13,067	13,819	13,284	14,534	16,985	17,300		D
	Improvement rate of energy intensity	FY 2020	-	-	-	-	-	-	-	-	-9.6%	
Japan Auto Parts Industries Association	CO_2 emissions	$ktCO_2$	7,681	7,414	6,837	6,954	6,986	6,527	6,188	5,694		B
	CO_2 emissions	FY 2007	-2%	-6%	-13%	-12%	-11%	-17%	-21%	-28%	-28.6%	
Japan Automobile Manufacturers Association / Japan Auto-Body Industries Association	CO_2 emissions	$ktCO_2$	7,473	7,150	6,633	6,694	6,606	6,242	5,827	5,223		A
	CO_2 emissions	FY 1990	-25%	-28%	-33%	-32%	-33%	-37%	-41%	-48%	-38.0%	
Japan Mining Industry Association	CO_2 emissions	$ktCO_2$	4,489	4,407	4,040	3,684	3,614	3,410	3,306	3,200		A
	CO_2 emission intensity	FY 1990	-13%	-16%	-18%	-23%	-23%	-25%	-25%	-26%	-26.0%	
Lime Manufacture Association	CO_2 emissions	$ktCO_2$	2,463	2,460	2,226	2,246	2,267	2,230	2,100	1,760		B
	CO_2 emissions	FY 2013	-	-0%	-10%	-9%	-8%	-10%	-15%	-29%	-29.0%	

Type of industry	Upper row：CO_2 emissions Middle and lower rows：Target indicators	Base year/BAU	Actual performance								Target Level	Assessment of progress
			2013	2014	2015	2016	2017	2018	2019	2020	2030	
The Japan Rubber Manufacturers Association	CO_2 emissions	ktCO_2	2,103	2,033	1,899	1,817	1,739	1,615	1,462	1,378		B
	CO_2 emissions	FY 2013	-	-20%	-23%	-25%	-26%	-28%	-33%	-36%	-46.0%	
Japan Textile Finishers' Association	CO_2 emissions	ktCO_2	1,165	1,154	1,123	1,097	1,039	982	879	788		B
	CO_2 emissions	FY 2013	-	-1%	-4%	-6%	-11%	-16%	-25%	-32%	-38.0%	
Japan Aluminum Association	CO_2 emissions	ktCO_2	1,462	1,490	1,442	1,449	1,419	1,344	1,270	1,173		A
	Energy intensity	FY 2005	-4%	-7%	-7%	-5%	-4%	-4%	-5%	-8%	-1.2GJ	
Japan Federation of Printing Industries	CO_2 emissions	ktCO_2	1,443	1,381	1,363	1,324	1,200	1,099	1,011	945		B
	CO_2 emissions	FY 2010	-12%	-14%	-12%	-13%	-19%	-22%	-26%	-30%	-30.9%	
Flat Glass Manufacturers Association of Japan	CO_2 emissions	ktCO_2	1,171	1,102	1,062	1,060	1,088	1,098	1,114	941		B
	CO_2 emissions	FY 2005	-13%	-18%	-21%	-21%	-19%	-18%	-17%	-30%	-32.0%	
Japan Glass Bottle Association	CO_2 emissions	ktCO_2	894	848	852	838	809	768	731	685		B
	CO_2 emissions	FY 2013	-	-5%	-5%	-6%	-9%	-14%	-18%	-23%	-21.3%	
	Energy consumption	FY 2013	-	-5%	-5%	-5%	-7%	-10%	-12%	-17%	-19.6%	
The Japanese Electric Wire & Cable Makers' Association	CO_2 emissions	ktCO_2	961	914	881	853	825	786	717	657		A
	Energy consumption	FY 2005	-17%	-19%	-20%	-20%	-20%	-20%	-24%	-30%	-23.0%	
The Japan Bearing Industry Association	CO_2 emissions	ktCO_2	846	836	788	781	784	744	677	594		B
	CO_2 emission intensity	FY 1997	-21%	-25%	-24%	-23%	-28%	-29%	-26%	-25%	-28.0%	
The Japan Society of Industrial Machinery Manufacturers	CO_2 emissions	ktCO_2	610	609	576	566	552	515	498	480		A
	CO_2 emissions	FY 2013	-	+0%	-5%	-7%	-10%	-16%	-19%	-22%	-10.0%	
Japan Copper and Brass Association	CO_2 emissions	ktCO_2	476	457	423	451	400	377	352	330		C
	Energy intensity	FY 2005～FY 2010	+0%	-3%	-2%	+1%	-0%	-4%	-0%	+2%	-6.0%	
Japan Construction Equipment Manufacturers Association	CO_2 emissions	ktCO_2	503	473	403	410	448	411	357	325		A
	Energy intensity	FY 2013	-	-9%	-12%	-5%	-16%	-25%	-23%	-18%	-17.0%	
Limestone Association of Japan	CO_2 emissions	ktCO_2	284	280	273	266	264	260	256	244		B

Type of industry	Upper row： CO_2 emissions Middle and lower rows： Target indicators	Base year/BAU	Actual performance 2013	2014	2015	2016	2017	2018	2019	2020	Target Level 2030	Assessment of progress
	CO_2 emissions	BAU	-1%	-1%	-1%	-2%	-3%	-3%	-4%	-6%	-17kt-CO_2	
Japan Sanitary Equipment Industry Association	CO_2 emissions	ktCO_2	257	232	199	196	197	203	198	182		A
	CO_2 emissions	FY 1990	-48%	-53%	-60%	-60%	-60%	-59%	-60%	-63%	-55.0%	
Japan Machine Tool Builders' Association	CO_2 emissions	ktCO_2	363	370	354	334	337	329	294	255		B
	Energy intensity	FY 2008-FY 2012(average of 5 years)	-4%	-16%	-20%	-17%	-24%	-30%	-22%	-6%	-16.5%	
Japan Petroleum Development Association	CO_2 emissions	ktCO_2	254	221	215	211	203	231	212	211		A
	CO_2 emissions	FY 2013	-	-13%	-15%	-17%	-20%	-9%	-17%	-17%	-40.0%	
Japan Prefabricated Construction Suppliers & Manufacturers Association	CO_2 emissions	ktCO_2	163	138	137	137	134	123	114	101		B
	CO_2 emissions	FY 2013	-	-16%	-16%	-16%	-18%	-25%	-30%	-38%	-50.0%	
Japan Industrial Vehicles Association	CO_2 emissions	ktCO_2	48	47	44	43	42	40	37	37		A
	CO_2 emissions	FY 2005	-41%	-41%	-44%	-44%	-43%	-44%	-52%	-47%	-41.0%	
Japan Carbon Association	CO_2 emissions	ktCO_2	-	-	-	338	405	410	354	270		B
	CO_2 emission intensity	FY 2010	-	-	-	-5%	-12%	-12%	-8%	-2%	-18.2%	
Industry under Ministry of Land, Infrastructure, Transport and Tourism												
The Shipbuilders' Association of Japan/The Cooperative Association of Japan	CO_2 emissions	ktCO_2	650	694	693	705	650	595	535	533		A
	CO_2 emissions	FY 2013	-	+6%	+6%	+8%	-0%	-9%	-18%	-18%	-6.5%	
Japan Ship Machinery and Equipment Association	CO_2 emissions	ktCO_2	85	85	80	83	70	66	70	65		B
	Energy intensity	FY 1990	-30%	-29%	-27%	-23%	-33%	-37%	-33%	-24%	-30.0%	
Japan Marine Industry Association	CO_2 emissions	ktCO_2	26	27	26	26	26	27	26	20		A
	CO_2 emissions	FY 2010	-14%	-11%	-13%	-14%	-13%	-9%	-14%	-34%	-14.0%	
Japan Association of Rolling Stock Industries	CO_2 emissions	ktCO_2	36	36	34	34	35	32	31	29		A
	CO_2 emissions	FY 1990	-22%	-22%	-26%	-26%	-24%	-30%	-33%	-37%	-35.0%	
Japan Federation of Construction Contractors	CO_2 emissions	ktCO_2	4,113	4,382	4,313	4,237	4,119	4,291	4,448	3,949		A

Type of industry	Upper row：CO$_2$ emissions Middle and lower rows：Target indicators	Base year/BAU	Actual performance								Target Level	Assessment of progress
			2013	2014	2015	2016	2017	2018	2019	2020	2030	
	CO$_2$ emission intensity	FY 1990	-18%	-18%	-19%	-19%	-21%	-21%	-22%	-26%	-25.0%	
Japan Federation of Housing Organizations	CO$_2$ emissions (Whole Life cycle)	ktCO$_2$	2,600 (221,830)	2,400 (208,910)	2,390 (199,430)	2,410 (199,650)	2,280 (207,900)	2,110 (207,560)	2,060 (188,470)	1,980 (185,640)		D
	Environmental performance of new housing	–	-	-	-	-	-	-	-	-	Realization of ZEH in new building average	
Commercial and Other Sector												
Industry under Financial Services Agency												
Japanese Bankers Association	CO$_2$ emissions	ktCO$_2$	1,390	1,340	1,270	1,200	1,120	1,000	920	890		A
	Energy intensity	FY 2009	-17%	-18%	-20%	-22%	-24%	-26%	-29%	-30%	-19.0%	
The Life Insurance Association of Japan	CO$_2$ emissions	ktCO$_2$	1,107	1,019	956	851	796	727	667	627		D
	CO$_2$ emission intensity	FY 2013	-	-	-	-	-	-	-	-	-40.0%	
The General Insurance Association of Japan	CO$_2$ emissions	ktCO$_2$	270	257	235	223	200	188	170	165		D
	CO$_2$ emission intensity	FY 2013	-	-	-	-	-	-	-	-	-51.0%	
The National Association of Shinkin Banks	CO$_2$ emissions	ktCO$_2$	321	302	281	272	258	232	216	215		A
	Energy consumption	FY 2009	-11%	-14%	-17%	-17%	-18%	-21%	-24%	-23%	-19.0%	
Community Bank Shinyo Kumiai	CO$_2$ emissions	ktCO$_2$	-	-	-	-	-	-	-	-		A
	Energy consumption	FY 2009	-9%	-13%	-13%	-18%	-18%	-21%	-21%	-19%	-18.0%	
Japan Securities Dealers Association	CO$_2$ emissions	ktCO$_2$	194	180	168	160	147	136	122	113		A
	Energy intensity	FY 2009	-22%	-23%	-26%	-28%	-30%	-31%	-34%	-37%	-20.0%	
Industry under Ministry of Internal Affairs and Communications												
Telecommunications Carriers Association	CO$_2$ emissions	ktCO$_2$	5,706	5,652	5,520	5,204	5,010	4,806	4,630	4,680		B
	Energy intensity	FY 2013	-	-24%	-48%	-65%	-70%	-76%	-79%	-86%	-0.9%	

Type of industry	Upper row：CO_2 emissions Middle and lower rows：Target indicators	Base year/BAU	Actual performance								Target Level	Assessment of progress
			2013	2014	2015	2016	2017	2018	2019	2020	2030	
Telecom Services Association	CO_2 emissions	$ktCO_2$	1,021	963	895	894	811	772	812	801		B
	Energy intensity	FY 2013	-	-3%	-6%	-4%	-9%	-9%	-7%	-0%	-2.0%	
The Japan Commercial Broadcasters Association	CO_2 emissions	$ktCO_2$	245	226	223	222	220	202	213	216		A
	CO_2 emission intensity	FY 2012	-6%	-6%	-6%	-7%	-13%	-19%	-26%	-24%	-10.0%	
Japan Broadcasting Corporation	CO_2 emissions	$ktCO_2$	211	199	188	185	171	159	158	157		E
	-	-	-	-	-	-	-	-	-	-	-	
Japan Cable and Telecommunications Association	CO_2 emissions	$ktCO_2$	-	-	-	109	113	110	93	89		D
	Energy intensity	FY 2020	-	-	-	-	-	-	-	-	-1% or more	
Japan Satellite Broadcasting Association	CO_2 emissions	$ktCO_2$	10	9	8	7	6	23	10	12		B
	Energy intensity	FY 2010	-4%	-10%	-11%	-11%	-12%	-12%	-14%	-14%	-15.0%	
Japan Internet Providers Association	CO_2 emissions	$ktCO_2$	-	-	58	54	57	57	55	49		C
	Energy intensity	FY 2015	-	-	+0%	+21%	+6%	+7%	+7%	+31%	-1.0%	
Industry under Ministry of Education, Culture, Sports, Science and Technology												
The Federation of All Japan Private Schools' Associations	CO_2 emissions	$ktCO_2$	-	-	3,651	3,821	3,638	3,520	-	3,122		E
	-	-	-	-	-	-	-	-	-	-	-	
Industry under Ministry of Health, Labor and Welfare												
Japan Medical Association / Council of 4 Hospitals	CO_2 emissions	$ktCO_2$	9,170	8,776	8,515	8,705	8,638	8,129	7,568	-		A
	CO_2 emission intensity	FY 2006	-18%	-21%	-22%	-21%	-20%	-23%	-25%	-25%	-25.0%	
Japanese Consumers Co-operative Union	CO_2 emissions	$ktCO_2$	-	-	-	-	-	-	-	-		B
	CO_2 emissions	FY 2013	-	-	-	-	-	-	-	-	-40.0%	
Industry under Ministry of Fisheries, Forestry and Agriculture												
Japan Processed Foods Wholesalers Association	CO_2 emissions	$ktCO_2$	291	326	322	289	272	287	277	267		B
	Energy intensity	FY 2011	+2%	-2%	-9%	-5%	-7%	-8%	-16%	-15%	-5.0%	
Japan Foodservice Association	CO_2 emissions	$ktCO_2$	7,209	6,824	6,794	6,722	6,472	6,057	5,902	5,257		B

Type of industry	Upper row：CO_2 emissions Middle and lower rows：Target indicators	Base year/BAU	Actual performance								Target Level	Assessment of progress
			2013	2014	2015	2016	2017	2018	2019	2020	2030	
	Energy intensity	FY 2013	-	-4%	-5%	-8%	-10%	-14%	-15%	-10%	-15.7%	
Industry under Ministry of Economy, Trade and Industry												
Japan Chain Stores Association	CO_2 emissions	$ktCO_2$	5,400	4,950	3,929	2,832	2,198	2,094	2,060	2,099		A
	Energy intensity	FY 1996	-24%	-23%	-32%	-33%	-34%	-24%	-25%	-25%	-24.0%	
Japan Franchise Association	CO_2 emissions	$ktCO_2$	4,379	4,578	4,488	4,472	4,301	4,014	3,756	3,587		B
	Energy intensity	FY 2013	-	+1%	-2%	-3%	-5%	-7%	-10%	-8%	-16.0%	
Japan Council of Shopping Centers	CO_2 emissions	$ktCO_2$	3,317	2,755	2,688	2,585	2,554	2,308	2,207	1,984		A
	Energy intensity	FY 2005	-30%	-32%	-34%	-35%	-37%	-37%	-37%	-41%	-23.0%	
Japan Department Stores Association	CO_2 emissions	$ktCO_2$	1,905	1,726	1,594	1,513	1,339	1,196	1,132	875		A
	Energy intensity	FY 2013	-	-6%	-11%	-12%	-14%	-17%	-19%	-24%	-15.7%	
	CO_2 emissions	FY 2013	-	-9%	-16%	-21%	-30%	-37%	-41%	-54%	-50.0%	
Ote Kaden Ryutsu Kyoukai (home appliances retail)	CO_2 emissions	$ktCO_2$	811	777	713	704	671	605	603	561		A
	Energy intensity	FY 2006	-41%	-43%	-45%	-46%	-48%	-49%	-50%	-54%	-49.1%	
Japan DIY・HC Association	CO_2 emissions	$ktCO_2$	487	463	463	466	349	282	333	227		B
	Energy intensity	FY 2013	-	-9%	-11%	-13%	-11%	-22%	-10%	-13%	-17.0%	
Japan Information Technology Services Industry Association	CO_2 emissions	$ktCO_2$	206	166	134	115	105	96	90	100		A
	(Office) Energy intensity	FY 2006	-11%	-27%	-34%	-33%	-35%	-37%	-38%	-48%	-37.7%	
	(Data Center) Energy intensity	FY 2006	-8%	-7%	-7%	-7%	-7%	-10%	-11%	-13%	-7.8%	
Japan Association of Chain Drug Stores	CO_2 emissions	$ktCO_2$	1,325	1,502	1,551	1,589	1,688	1,683	1,551	1,597		B
	Energy intensity	FY 2013	-	-7%	-16%	-19%	-21%	-23%	-27%	-29%	-34.2%	
Japan Foreign Trade Council, Inc.	CO_2 emissions	$ktCO_2$	54	51	45	41	37	34	32	28		A
	Energy intensity	FY 2013	-	-3%	-6%	-10%	-11%	-13%	-13%	-26%	-15.7%	
Japan LP Gas Association	CO_2 emissions	$ktCO_2$	31	30	28	28	27	25	24	24		B
	Energy consumption	FY 2010	-5%	-7%	-8%	-7%	-6%	-7%	-7%	-7%	-9.0%	

Type of industry	Upper row：CO_2 emissions Middle and lower rows：Target indicators	Base year/BAU	Actual performance								Target Level	Assessment of progress
			2013	2014	2015	2016	2017	2018	2019	2020	2030	
Japan Leasing Association	CO_2 emissions	$ktCO_2$	9	18	17	16	15	14	14	14		B
	Energy intensity	FY 2013	-	+8%	+3%	-4%	-4%	-5%	-5%	-4%	-5.0%	
Industry under Ministry of Land, Infrastructure, Transport and Tourism												
The Japan Warehousing Association Inc.	CO_2 emissions	$ktCO_2$	1,190	1,060	1,210	1,220	1,290	1,250	1,250	1,250		A
	Energy intensity	FY 1990	-15%	-18%	-19%	-19%	-19%	-20%	-22%	-24%	-20.0%	
Japan Association of Refrigerated Warehouses	CO_2 emissions	$ktCO_2$	1,064	1,031	976	956	901	855	827	824		B
	Energy intensity	FY 1990	-12%	-13%	-15%	-15%	-16%	-17%	-16%	-19%	-20.0%	
Japan Hotel Association	CO_2 emissions	$ktCO_2$	627	601	572	553	539	508	475	361		A
	Energy intensity	FY 2010	-7%	-10%	-12%	-12%	-12%	-14%	-17%	-29%	-15.0%	
Japan Ryokan & Hotel Association	CO_2 emissions	$ktCO_2$	-	-	-	50	57	24	72	38		A
	Energy intensity	FY 2016	-	-	-	+0%	-10%	-10%	-7%	-37%	-10.0%	
Japan Automobile Service Promotion Association	CO_2 emissions	$ktCO_2$	4,155	4,165	4,185	4,191	4,133	4,161	3,999	4,196		B
	CO_2 emissions	FY 2007	-8%	-8%	-7%	-7%	-9%	-8%	-12%	-7%	-15.0%	
The Real Estate Companies Association of Japan	CO_2 emissions	$ktCO_2$	-	-	-	-	-	-	-	-		A
	Energy intensity	FY 2005	-21%	-24%	-25%	-26%	-24%	-27%	-27%	-32%	-30.0%	
Japan Building Owners and Managers Association	CO_2 emissions	$ktCO_2$	-	-	-	-	-	-	-	-		A
	Energy intensity	FY 2009	-9%	-14%	-15%	-13%	-15%	-15%	-16%	-22%	-20.0%	
Industry under Ministry of the Environment												
Japan Federation of Industrial Waste Management and Recycling Associations	CO_2 emissions	$ktCO_2$	5,251	5,381	5,567	5,536	5,582	5,810	5,771	5,701		C
	CO_2 emissions	FY 2010	+10%	+13%	+17%	+16%	+17%	+22%	+21%	+20%	-10.0%	
The Japan Newspaper Publishers & Editors Association	CO_2 emissions	$ktCO_2$	537	500	467	453	420	374	349	324		A
	Energy intensity	FY 2013	-	Annual average, -5.8%	Annual average, -5.0%	Annual average, -4.4%	Annual average, -4.4%	Annual average, -4.6%	Annual average, -4.6%	Annual average, -4.5%	Annual average -1.0%	
Zenkoku Pet Kyoukai (pet retail)	CO_2 emissions	$ktCO_2$	5	5	6	5	5	5	5	5		A
	CO_2 emission intensity	FY 2012	+28%	+35%	+4%	-18%	+0%	-4%	-6%	-9%	-0.0%	

Type of industry	Upper row： CO_2 emissions Middle and lower rows： Target indicators	Base year/BAU	Actual performance								Target Level	Assessment of progress
			2013	2014	2015	2016	2017	2018	2019	2020	2030	
Industry under National Police Agency												
All Japan Pachinko Association	CO_2 emissions	$ktCO_2$	5,020	4,470	4,260	4,010	3,830	3,290	3,110	2,660		A
	CO_2 emissions	FY 2007	-15%	-22%	-23%	-25%	-26%	-32%	-33%	-42%	-22.0%	
Japan Amusement Industry Association	CO_2 emissions	$ktCO_2$	253	237	238	233	225	190	187	188		A
	CO_2 emissions	FY 2012	-7%	-13%	-12%	-14%	-17%	-30%	-31%	-31%	-16.6%	
Transport Sector												
Industry under Ministry of Land, Infrastructure, Transport and Tourism												
The Japanese Shipowners' Association	CO_2 emissions	$ktCO_2$	55,388	54,172	52,145	52,582	54,025	32,662	45,635	40,237		A
	CO_2 emission intensity	FY 1990	-38%	-43%	-41%	-39%	-48%	-37%	-31%	-35%	-30.0%	
Japan Trucking Association	CO_2 emissions	$ktCO_2$	40,790	41,000	40,910	40,680	40,870	41,040	40,440	38,742		C
	CO_2 emission intensity	FY 2005	-9%	-7%	-4%	-7%	-7%	-7%	-10%	+3%	-31.0%	
The Scheduled Airlines Association of Japan	CO_2 emissions	$ktCO_2$	20,556	21,667	22,183	23,052	23,877	24,756	25,155	12,602		C
	CO_2 emission intensity	FY 2012	-1%	-5%	-5%	-8%	-11%	-7%	-5%	+5%	-16.0%	
Japan Federation of Coastal Shipping Associations	CO_2 emissions	$ktCO_2$	7,221	7,257	7,039	7,131	7,026	7,067	6,999	6,657		B
	CO_2 emissions	FY 1990	-16%	-15%	-18%	-17%	-18%	-18%	-18%	-22%	-34.0%	
Japan Passengerboat Association	CO_2 emissions	$ktCO_2$	3,613	3,656	3,509	3,479	3,424	3,356	3,377	3,215		A
	CO_2 emission intensity	FY 2012	-1%	-2%	-6%	-6%	-10%	-9%	-11%	-19%	-3.6%	
Japan Federation of Hire-Taxi Associations	CO_2 emissions	$ktCO_2$	3,383	3,254	3,100	2,861	2,729	2,527	2,270	1,280		A
	CO_2 emissions	FY 2010	-12%	-15%	-19%	-25%	-29%	-34%	-41%	-67%	-25.0%	
Nihon Bus Association	CO_2 emissions	$ktCO_2$	3,757	3,732	3,664	3,594	3,480	3,410	3,640	2,460		C
	CO_2 emission intensity	FY 2015	-2%	-1%	+0%	-0%	-4%	-0%	-0%	+16%	-6.0%	
Japan Private Railway Association	CO_2 emissions	$ktCO_2$	2,860	2,740	2,610	2,560	2,460	2,280	2,160	2,050		A
	Energy intensity	FY 2010	-4%	-6%	-7%	-6%	-7%	-8%	-9%	-12%	-5.7%	
East Japan Railway Company	CO_2 emissions	$ktCO_2$	2,150	2,230	2,160	2,180	2,120	2,060	1,990	1,940		B

Type of industry	Upper row： CO_2 emissions Middle and lower rows： Target indicators	Base year/BAU	Actual performance								Target Level	Assessment of progress
			2013	2014	2015	2016	2017	2018	2019	2020	2030	
	Energy consumption	FY 2013	-	-1%	-2%	-3%	-2%	-4%	-7%	-9%	-40.0%	
	CO_2 emissions	FY 2013	-	+4%	+0%	+1%	-1%	-4%	-7%	-10%	-50.0%	
West Japan Railway Company	CO_2 emissions	$ktCO_2$	1,854	1,813	1,761	1,711	1,643	1,498	1,457	1,329		A
	Energy consumption	FY 2010	-3%	-2%	-2%	-2%	-2%	-5%	-3%	-7%	-2.0%	
Central Japan Railway Company	CO_2 emissions	$ktCO_2$	-	-	-	-	-	-	-	-		A
	Energy intensity	FY 1995	-26%	-27%	-27%	-28%	-28%	-28%	-28%	-26%	-25.0%	
The Japan Harbor Transportation Association	CO_2 emissions	$ktCO_2$	390	384	377	378	377	373	365	333		A
	CO_2 emission intensity	FY 2005	-10%	-11%	-10%	-11%	-14%	-15%	-15%	-22%	-20.0%	
Japan Freight Railway Company	CO_2 emissions	$ktCO_2$	649	623	601	563	551	455	490	466		C
	Energy intensity	FY 2013	-	-2%	-4%	-7%	-8%	-11%	-4%	+1%	-15.0%	
Kyushu Railway Company	CO_2 emissions	$ktCO_2$	442	430	410	394	379	343	327	303		A
	Energy intensity	FY 2011	-1%	-1%	-2%	-1%	-2%	-1%	-2%	-4%	-2.5%	
Hokkaido Railway Company	CO_2 emissions	$ktCO_2$	321	314	305	308	305	310	321	315		A
	Energy intensity	FY 2013	-	-0%	-1%	-4%	-6%	-6%	-7%	-8%	-7.0%	
All Japan Freight Forwarders Association	CO_2 emissions	$ktCO_2$	129	129	127	125	123	123	120	110		B
	CO_2 emissions	FY 2009	-3%	-3%	-5%	-6%	-8%	-8%	-10%	-18%	-20.0%	
Shikoku Railway Company	CO_2 emissions	$ktCO_2$	80	77	77	76	74	69	69	66		A
	Energy consumption	FY 2010	-5%	-8%	-7%	-6%	-7%	-11%	-10%	-14%	-8.0%	
Energy Conversion Sector												
Industry under Ministry of Economy, Trade and Industry												
The Electric Power Council for a Low Carbon Society	CO_2 emissions	$ktCO_2$	493,000	469,000	441,000	430,000	411,000	372,000	345,000	329,000		B
	CO_2 emissions	BAU	-	-38%	-41%	-56%	-61%	-77%	-85%	-96%	-11 Mt-CO_2	
	CO_2 emission intensity	-	+53%	+49%	+44%	+39%	+34%	+25%	+20%	+19%	about 0.37 kg-CO_2/kWh	

Type of industry	Upper row：CO₂ emissions Middle and lower rows：Target indicators	Base year/BAU	Actual performance								Target Level	Assessment of progress
			2013	2014	2015	2016	2017	2018	2019	2020	2030	
Petroleum Association of Japan	CO_2 emissions	$ktCO_2$	4,033	3,823	3,833	3,844	3,808	3,682	3,440	3,082		B
	Energy reduction	BAU	+30%	+37%	+47%	+53%	+63%	+66%	+68%	+65%	-10^6 KL	
The Japan Gas Association	CO_2 emissions	$ktCO_2$	45.6	47.6	44.5	45.9	45.4	42.6	39.8	39.9		B
	CO_2 emission intensity	FY 1990	-91%	-90%	-91%	-91%	-91%	-90%	-90%	-90%	-88.0%	
	Energy intensity	FY 1990	-89%	-88%	-89%	-89%	-88%	-88%	-88%	-87%	-84.0%	

(2) Promotion of decarbonization in corporate management

Since the adoption of the Paris Agreement and with the background of the expansion of ESG finance, an increasing number of Japanese companies have taken climate change countermeasures as a management issue and are engaging in decarbonization management to decarbonize their businesses. For example, the number of Japanese companies that support the Task Force on Climate-related Financial Disclosures (TCFD) and those that set medium- and long-term targets, such as Science Based Targets (SBT[51]) and RE100, is among the highest in the world.

The government will provide technical advice to companies on information disclosure, setting of reduction targets and planning, etc., in order to further promote decarbonized management while taking into account trends in the financial aspects, including ESG finance. In calculating and reducing emissions, the calculation and reduction of emissions throughout the supply chain are promoted. The regional support system for the decarbonization of small and medium businesses will also be strengthened. Furthermore, by promoting the visualization of GHG emissions during the life cycle of products and services, the environment in which decarbonized management is valued by consumers is developed.

(3) Promotion of the introduction of facilities and equipment with high energy-saving performance

In accordance with the *Energy Conservation Act*, thorough energy management and the introduction of energy-efficient facilities and equipment will be promoted in order to improve energy intensity.

In addition, based on the periodic reports submitted in accordance with the Energy Conservation Act, the energy-saving status of businesses will be assessed, and stagnant businesses will be given intensive guidance and advice, while excellent businesses will be publicized and praised.

In addition, the benchmarking system, which sets high-energy conservation targets by industry and area and requires the achievement of those targets, will be expanded to cover more areas, and the target values will be revised to encourage further energy conservation efforts by the business.

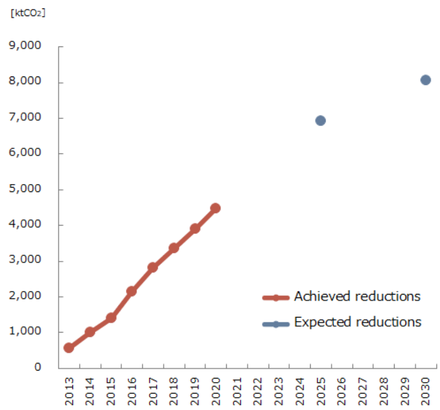
A. Promotion of the introduction of facilities and equipment with high energy-saving performance (across industries)

<Outline of policies and measures>

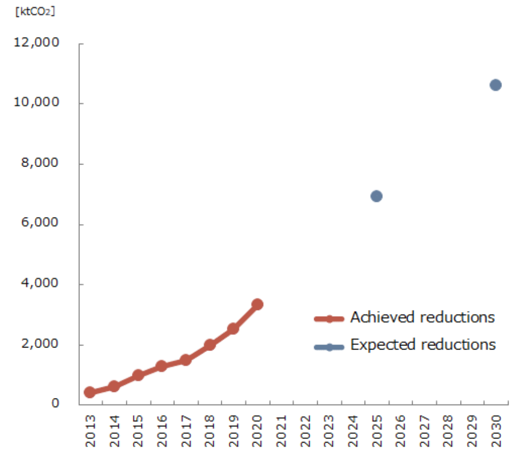
In the industry sector, the introduction of energy-efficient facilities and equipment will be promoted for major energy-consuming equipment used in a wide range of industries, including air conditioning, lighting, hot water supply, industrial furnaces, boilers, and cogeneration equipment

[51] An initiative that requires companies to set greenhouse gas emission reduction targets consistent with the levels required by the Paris Agreement (which aims to limit global temperature increase to well below 2°C above pre-industrial levels and 1.5°C below pre-industrial levels).

<Progress assessment of policies and measures> (*Only major measures are listed)

Name of policy and measure	Introduction of low-carbon industrial furnaces
Measure evaluation indicator	Cumulative number of units installed
Progress in the emission reductions	C. Expected to be equivalent to the target level in FY 2030
Supplement to the progress assessment and reasons	Measure evaluation indicators, energy savings, and emission reductions have been on an increasing trend for all facilities and equipment. This is due to the fact that the Energy Conservation Act and regulations have promoted the improvement of energy consumption efficiency of each facility, and as a result of support for the introduction of high-efficiency facilities and equipment, the replacement with high-efficiency facilities and equipment etc. has been promoted.
Emission reductions ($ktCO_2$)	

Name of policy and measure	Introduction of cogeneration
Measure evaluation indicator	Cumulative installed capacity of cogeneration
Progress in the emission reductions	C. Expected to be equivalent to the target level in FY 2030
Supplement to the progress assessment and reasons	The actual results of measure evaluation indicators, energy savings, and emission reductions have been on an increasing trend for all facilities and equipment. This is due to the fact that the Top Runner Program of the Energy Conservation Act has promoted the improvement of energy consumption efficiency of each facility and that the introduction of high-efficiency facilities and equipment has been supported, which in turn has promoted the replacement of high-efficiency facilities and equipment. However, while a certain amount of progress has been made, the current progress is largely in line with expectations compared to what would be expected if the measure evaluation indicators etc. remained linear each year toward FY 2030. Japan will continue to encourage businesses to invest in cogeneration facilities and introduce them through both regulatory measures under the Energy Conservation Act and support measures through subsidies.

Emission reductions ($ktCO_2$)	

B. Promotion of the introduction of facilities and equipment with high energy-saving performance (iron and steel industry)

As part of the introduction of the latest technologies, the efficiency of power-consuming equipment, waste heat recovery equipment, power generation equipment, and coke ovens will be further improved, and the use of waste plastics and other materials that can be used as a substitute for coal in coke ovens will be expanded.

In addition to the existing technologies, innovative technologies will be developed for significant energy conservation and low carbon emission in the steelmaking process with the aim of putting these technologies into practical use by around 2030.

C. Promotion of the introduction of facilities and equipment with high energy-saving performance (chemical industry)

CO_2 emissions will be reduced by promoting the development and introduction of new innovative energy-saving technologies, as well as promoting the recovery of an emitted energy and the rationalization of processes according to the characteristics of each process.

D. Promotion of the introduction of facilities and equipment with high energy-saving performance (cement and ceramic industry)

Energy consumption in the cement manufacturing process by introducing equipment that can use thermal and electrical energy with high efficiency and by promoting the use of waste as a substitute for thermal energy. In addition, through the practical application and introduction of advanced process technology, energy conservation will be achieved in the cement and glass manufacturing processes while ensuring the same quality as conventional products.

E. Promotion of the introduction of facilities and equipment with high energy-saving performance (pulp, paper, and paper product industry)

In the used paper pulping process, the introduction of pulpers that can more efficiently mix used paper and water and dissociate the used paper than conventional types will be supported with the aim of reducing operational energy consumption.

F. Promotion of the introduction of facilities and equipment with high energy-saving performance (construction work and use of special vehicles)

In the short term, the goal is to reduce CO2 emissions by promoting the use of construction equipment with excellent fuel efficiency. In the long term, a certification system for innovative construction machinery (electric, hydrogen, biomass, etc.) based on a radical conversion from the light oil-fueled power source will be established, and its introduction and widespread use will be promoted in order to achieve carbon neutrality. In addition, by promoting i-Construction and other such measures as the spread of construction using the information and communication technology (ICT) among small and medium-sized construction companies that carry out construction work for local governments, efficiency and labor saving in construction and maintenance will be further improved to cope with the declining number of skilled workers.

G. Promotion of the introduction of facilities and equipment with high energy-saving performance (horticulture, agricultural machinery, and fisheries)

As a measure to reduce GHG emissions from horticulture, the development and dissemination of efficient and low-cost energy utilization technologies (heat pumps, woody biomass heating equipment, etc.) in horticulture will be promoted. In addition, low CO_2 emissions in agricultural machinery and energy conservation on fishing vessels will be promoted, such as efficiency improvement through the introduction of LED fishing lights and energy-saving outboard engines. Another target is to establish technologies related to the electrification and hydrogenation of agricultural and forestry machinery and fishing vessels by 2040

(4) Promotion of energy conservation initiatives through inter-industry collaboration

Further energy conservation can be achieved through cooperation between multiple factories and businesses, such as energy sharing among multiple factories and businesses, including the use of unused heat disposed of at factories without being used. Thus, through the use of the coordinated energy efficiency and conservation planning system based on the *Energy Conservation Act* and other support measures, energy efficiency and conservation initiatives through such cooperation between multiple operators will be promoted.

(5) Electrification and Fuel Conversion

A. Promotion of fuel conversion

In conjunction with efforts to decarbonize power sources, electrification in final energy consumption has the potential to reduce fossil fuel consumption in such industrial processes as heating and drying processes, although it is more difficult to apply in some sectors and processes. By increasing the controllability of the process, it is expected to not only reduce energy consumption but also provide added value to the production process, such as low-volume, high-mix production, and automation. In addition, the implementation of the demand response will be promoted to shift demand by operating electricity-intensive production processes in a flexible manner. Initiatives toward electrification will be deepened with a focus on medium- to low-temperature heat.

Examples of fuel conversion include boilers with excellent environmental compatibility, industrial furnaces with excellent energy efficiency, natural gas cogeneration that achieves high-energy savings through combined heat and power supply, fuel cells, and gas air conditioning that mitigates peaks in grid power supply and demand. Fuel conversion in high-temperature industrial heat, which is difficult to electrify and hydrogenate, will be promoted.

(6) Implementation of thorough energy management

A. Implementation of thorough energy management using FEMS

In the industry sector, energy management is already advanced to some extent due to energy management obligations under the *Energy Conservation Act*. Further energy and CO_2 reductions can be achieved by visualizing energy consumption and promoting energy-saving efforts based on objective data through the promotion of the introduction of factory energy management systems (FEMS) using the IoT.

(7) Promotion of emissions reductions measures for small and medium businesses

To strengthen energy conservation and emission reduction measures in small- and medium-scale businesses, measures will be implemented, such as publicity to raise awareness toward energy efficiency and conservation, reduction of energy consumption through energy efficiency diagnoses, implementation of detailed training courses for those in charge of energy management in companies, horizontal development of best practices for energy efficiency and conservation measures, etc. Support will be provided to introduce emission reduction equipment to small and medium-sized businesses with a focus on reducing emission intensity.

In addition, a platform to provide detailed support for energy conservation efforts by small and medium-sized businesses in a given region will be established through collaboration among regional organizations, financial institutions, chambers of commerce and industry, local governments, etc. This platform will cover a wide range of activities, from identifying small and medium-sized businesses engaged in energy conservation to following up on their efforts, including operational improvements and capital investment.

(8) Creation of role models in factories and offices

The packaged support covers the formulation of ambitious CO_2 reduction plans for factories and offices based on their CO_2 reduction potentials and the installation of advanced equipment, electrification, fuel conversion, and operational improvements under the plans. Excellent examples will be published to be implemented horizontally.

■ Commercial sector

(1) Improvement of the energy efficiency of buildings

<Outline of policies and measures>

Looking at achieving carbon neutrality in 2050, the goal for buildings in 2030 is to ensure that new buildings have energy-saving performance at the level of the ZEB[52] standard[53] by making maximum use of currently available technical and economical technologies.

In order to strengthen energy efficiency and conservation measures in buildings, the *Act on the Improvement of Energy Consumption Performance of Buildings* (Law No. 53 of 2015, hereinafter referred to as the "*Building Energy Efficiency Act*") was revised in 2022 to make it mandatory, by FY 2025, for small buildings to conform to the Energy Efficiency Standard to which they are currently not obligated to conform. In addition, with the aim of securing ZEB standard level energy efficiency for new buildings built in FY 2030 and later, guiding standards will be raised in a consistent manner, and Energy Efficiency Standard levels will be raised in stages by no later than FY 2030.

At the same time, the Top Runner Program for equipment and building materials will be strengthened to improve the performance of equipment and building materials installed in buildings and to promote their widespread use. In doing so, from the perspective of ensuring resilience, the energy-saving performance of water heaters and other equipment will be improved, keeping in mind that equipment that uses diverse energy sources is necessary.

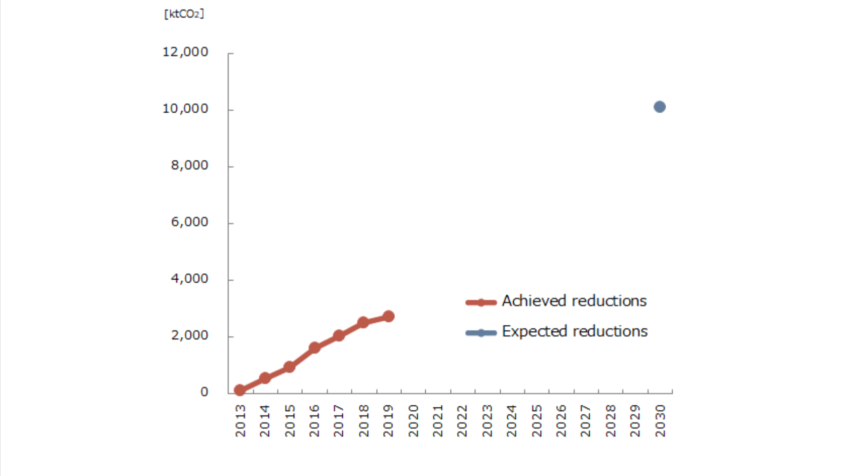
In addition, not only regulations but also proactive initiatives at public buildings will be strengthened, and support for ZEB demonstrations and further expansion will be provided. Furthermore, energy conservation measures, including support for renovation and reconstruction of existing buildings and energy conservation performance labeling, will be promoted.

<Progress assessment of policies and measures>

Name of policy and measure	Improvement of the energy efficiency of buildings (for new construction)
Measure evaluation indicator	Percentage of new medium- and large-sized buildings that meet the ZEB standard level of energy efficiency and conservation performance (%)
Progress in the emission reductions	C. Expected to be equivalent to the target level in FY 2030
Supplement to the progress assessment and reasons	The actual amount of energy-saving and emission reductions is on an increasing trend. This is because of the promotion of the spread of low-carbon buildings with high energy-saving performance and the promotion of the improvement of energy-saving performance in new buildings by providing support for leading projects with excellent energy-saving and CO_2 emission reduction feasibility. However, while some progress has been made, further efforts are needed to achieve the target.

[52] ZEB (Net Zero Energy Building): A building in which energy consumption is further reduced through the introduction of renewable energy etc. after achieving energy conservation of 50% or more. In addition, buildings that are expected to save 30% to 40% or more of energy and introduce technologies that are not currently evaluated in energy conservation calculation programs based on the Building *Energy Conservation Law*, although the energy conservation effects are expected to be achieved, are defined as "ZEB" (reduction of 75% to 100%), 3) ZEB Ready (no introduction of renewable energy), and (4) ZEB Oriented is defined as a building of 10,000 m^2 or more.

[53] Reduction of primary energy consumption, excluding renewable energy, by 30% or 40% (20% for small buildings) from the current energy conservation standard value, depending on the use.

Emission reductions ($ktCO_2$)	

(2) Promotion of the introduction of facilities and equipment with high energy-saving performance

A. Promotion of high-efficiency energy-saving equipment

The development of energy conservation technologies is further accelerated while further promoting the spread of high-efficiency energy conservation devices in order to further improve the efficiency of individual devices and systems.

In order to achieve 100% diffusion of high-efficiency lighting, such as LEDs in stock by 2030, the Top Runner Program for lighting fixtures and bulbs was revised in FY 2019, and incandescent bulbs were newly added to the Top Runner Program. Further diffusion of high-efficient lighting will be promoted by requiring businesses to comply with the Top Runner Standard. In addition, the installation of energy-efficient commercial water heaters, such as heat pump water heaters and latent heat recovery water heaters, will be promoted.

Furthermore, the energy efficiency of refrigeration and air-conditioning equipment will be improved by improving refrigerant management technology etc.

Also, information will be disseminated through leading decarbonization technologies (LD-Tech) and other Instruments.

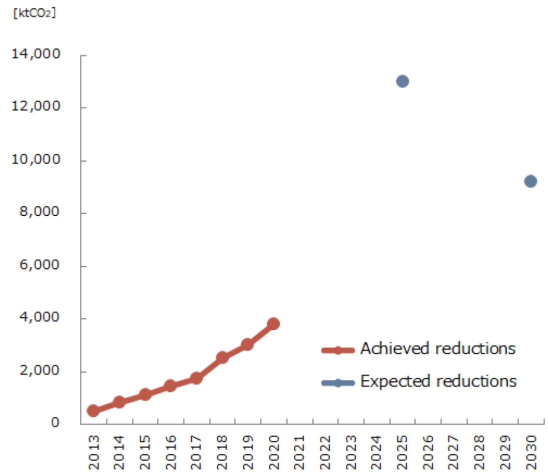
B. Improvement of energy efficiency of equipment through Top Runner Programs

<Outline of policies and measures>

The Top Runner Program based on the *Energy Conservation Act* was established in FY 1998, and the number of target equipment has been gradually expanded, covering 29 energy consumption equipment types as of FY 2020. In order to further improve the efficiency of individual equipment in the future, studies will be conducted to review the standards for target equipment for which the target year has been reached.

<Progress assessment of policies and measures>

Name of policy and measure	Improvement of energy-saving performance of equipment through the Top Runner Program
Measure evaluation indicator	-

Progress in the emission reductions	D. Expected to fall below the target level for FY 2030
Supplement to the progress assessment and reasons	The actual results of energy-saving and emission reductions are on an increasing trend for all equipment. This is due to the fact that the Top Runner Program of the *Energy Conservation Act* and other measures have promoted the improvement of energy consumption efficiency of each piece of equipment, and subsidies have supported the introduction of high-efficiency equipment, which in turn has promoted the replacement with high-efficiency equipment. However, while a certain amount of progress has been made in policies and measures, the current progress is evaluated to fall below the expected level compared to the amount of energy saved if the amount of energy saved remained linear each year toward the FY 2030 and further efforts are needed to achieve the target. Possible factors include, for example, the lack of progress in the diffusion of energy-efficient equipment.
Emission reductions ($ktCO_2$)	

(3) Greening of digital equipment and industry

Regarding the utilization of power semiconductors and next-generation semiconductors, research and development will be promoted for the commercialization of ultra-efficient next-generation power semiconductors (GaN, SiC, Ga_2O_3, etc.). Also, capital investment support will be provided for the necessary parts of the semiconductor supply chain in order to promote their introduction, thereby accelerating the commercialization and expansion of next-generation power semiconductors with energy savings of 50% or more by 2030. In addition, research, development, and demonstrations will be carried out to improve the energy efficiency of data centers and to improve the energy efficiency of the entire system by improving the efficiency of software development and processing. In the meantime, the energy efficiency of all new data centers will be improved by 30% or more, and part of the electricity used at data centers in Japan will be switched to renewable energies by 2030 by supporting capital investment to expand the manufacturing of energy-saving semiconductors and switching the electricity used at data centers in Japan to renewable energy. In addition to steadily implementing these initiatives, the necessary systems to realize carbon neutrality will be examined, such as the system to promote energy conservation and CO_2 emission reductions that cover electrical machinery and information and telecommunications industries where electricity consumption is increasing.

(4) Implementation of thorough energy management

A. Implementation of thorough energy management through the use of BEMS and

Energy Conservation diagnosis

In order to promote thorough energy saving and CO_2 reductions throughout buildings, a building energy management system (BEMS) that displays the energy usage status and supports the optimal operation of lighting, air conditioning, and other equipment and facilities will be installed in about half of all buildings by 2030. In addition, more efficient energy management in buildings will be promoted by utilizing energy use data obtained from BEMS.

In addition, GHG emissions will be reduced by promoting "eco-tuning", which involves appropriate operational improvements to equipment and systems while ensuring comfort and productivity in buildings.

Based on the results of visualization of energy consumption and energy conservation diagnosis, comprehensive services related to energy conservation will be provided. Also, the introduction of energy-saving equipment and facilities using businesses that warrant energy conservation effects (ESCO: Energy Service Company) and downsizing (optimization of equipment and facilities) will be promoted.

(5) Promotion of sector coupling of electricity, heat, and mobility

Considering that solar power generation systems generate electricity intensively during a certain time period, EVs, heat pump water heaters, fuel cells, cogeneration, etc. that provide demand-side flexibility will be introduced depending on the local characteristics. Also, the use of energy management systems (HEMS and BEMS) and ICT in homes and buildings will be promoted to adjust supply and demand in line with the amount of solar power generated (sector coupling of electricity, heat, and mobility).

In addition, while utilizing local renewable energy, the use of EV car sharing and the installation of EV/battery stations with replaceable batteries will be promoted to improve the demand/supply adjustment function at the local level and decarbonize local transportation.

(6) Promotion of local production for local consumption and areal use of energy

A. Promotion of local production for local consumption and areal use of energy

Local energy production for local consumption and energy use of energy is desirable from the perspective of "climate change x disaster prevention", which effectively links climate change measures with disaster prevention and mitigation measures since they lead to efficient energy use, regional revitalization, and reduced risk of power outages etc. in the event of a disaster. In order to utilize a combination of renewable energy and distributed energy resources, such as storage batteries and cogeneration in a region, the expectation is to construct a regional micro-grid using existing grid lines and a self-supporting and distributed energy system using self-owned lines and heat pipes etc. Seizing opportunities for urban development etc., the formulation of plans and the introduction of equipment and systems for the construction of such a system will be supported, and the facilitation of coordination among local governments and other related parties will be promoted. In addition, to promote true local production for local consumption, which contributes to strengthening regional resilience and revitalizing regional economies, honor will be given to outstanding businesses that coexist with the region and contribute to the construction of regional industrial infrastructure to encourage such activities.

(7) Other policies and measures

A. Decarbonization of urban areas through the improvement of the thermal environment by heat island control

Utilizing the knowledge gained from observations, surveys, and research on the heat island phenomenon, especially in urban areas, heat island-related measures will be comprehensively developed, such as the reduction of artificial heat emissions, improvement of ground surface cover, improvement of urban structures, improvement of lifestyles, and adaptation measures to reduce the impact on human health, including heat stroke, thereby promoting urban decarbonization through thermal environment improvements.

Urban CO2 emissions will be reduced by decreasing anthropogenic heat emissions, such as air-conditioning equipment systems and vehicles, through the promotion of the use of higher efficiency energy-consuming equipment, low-carbon buildings and facilities, technological development and the spread of next-generation vehicles, promotion of measures on traffic flows, and promotion of the use of unused energy.

In addition, from the perspective of reducing evapotranspiration and preventing/improving high temperatures on the ground surface by an artificial ground surface cover, the ground surface cover of the entire region will be improved by securing green spaces through the development of urban parks, greening of public spaces and government facilities, greening of building sites through the use of greening area systems, and preservation of privately owned green areas and agricultural land.

Furthermore, while preserving green spaces in cities, the urban structure will be improved through the formation of water and green networks and the promotion of multiple nature-type river creations from the perspective of securing green spaces and wind paths from the water surface.

In addition, the promotion of Cool Choice, including Cool Biz and Warm Biz, will encourage people to modify their lifestyles and achieve appropriate air-conditioning temperatures. Also, local governments and businesses are encouraged to implement heat stroke countermeasures and other adaptive measures according to the characteristics of their regions, city blocks, and businesses.

B. Introduction of energy conservation and renewable energy in water supply and sewage (promotion of energy conservation and renewable energy measures in waterworks)

C. Introduction of energy conservation and renewable energy in water supply and sewage systems (promotion of energy conservation and energy creation measures in sewage systems)

In waterworks, energy conservation will be promoted through the introduction of energy-saving and high-efficiency equipment, the introduction of energy-conservation facilities, such as inverter-controlled pumps, and the wide-area expansion, consolidation, and reallocation of facilities, as well as the introduction of renewable energy power generation facilities, such as small-scale hydroelectric and solar power generation.

In addition, as a long-term initiative, the potential for water supply facilities to contribute to the adjustment of electricity supply and demand will be pursued.

In sewage systems, the sophistication and efficiency of facility management will be promoted through digital transformation (DX), as well as the introduction of energy-saving equipment and renewable energy sources, such as solar power and sewage heat. Also, energy creation initiatives that effectively use sewage biomass, such as power generation from sewage sludge-derived solid fuel and digestion gas, will be promoted.

D.Initiatives in waste treatment

While promoting the 3Rs + Renewable, which contributes to the reduction of GHG emissions, under the *Circular Economy Roadmap* (announced in September 2022) formulated to accelerate the transition to a circular economy, aiming to establish the *Fifth Plan of the Basic Plan for Establishing a Material-Cycle Society* (hereinafter referred to as the "*Cycle Plan*") under the *Basic Act on Establishing a Sound Material-Cycle Society* (Act No. 110 of 2000), energy recovery, such as waste power generation and production of waste fuels at waste treatment facilities, will be further promoted. GHG emissions generated by vehicles during waste collection and transportation will be reduced through the introduction of energy conservation measures at waste treatment and recycling facilities and EV waste collection vehicles.

E. Systematic promotion of measures for inter-ministerial cooperation

In order to more reliably achieve the FY 2030 reduction targets in the commercial and other sectors, such as thorough promotion of energy conservation, the introduction of renewable energy, and energy conservation in buildings, the cooperation of relevant government agencies will be systematically promoted to more effectively and efficiently implement efforts in all areas.

■ Residential sector

(1) Improvement of energy efficiency of housing

Looking at achieving carbon neutrality in 2050, the goal for housing in 2030 is to ensure[54] that new housing has energy-saving performance at the level of the ZEH[55] standard by making maximum use of currently available technological and economical technologies.

In order to strengthen energy efficiency and conservation measures in housing, the *Building Energy Efficiency Act* was revised in 2022 to make it mandatory, by FY 2025, for homes to conform to the Energy Efficiency Standard to which they are currently not obligated to conform. In addition, with the aim of securing ZEH standard level energy efficiency for new homes built in FY 2030 and later, guiding standards and Residential Housing Top Runner standards will be raised in a consistent manner, and Energy Efficiency Standard levels will be raised in stages by no later than FY 2030.

At the same time, the Top Runner Program for equipment and building materials will be strengthened in order to improve the performance of equipment and building materials installed in homes and to promote their widespread use. In doing so, from the viewpoint of

[54] Compliance with enhanced envelope standards and a 20% reduction in primary energy consumption, excluding renewable energy, from the current energy conservation standard values.

[55] ZEH (Net Zero Energy House): A house that has achieved energy conservation of 20% or more and further reduced energy consumption by introducing renewable energy etc. is defined as (1) "ZEH" (reduction of 100% or more), (2) Nearly ZEH (reduction of 75% to less than 100%), or (3) ZEH Oriented (no introduction of renewable energy), depending on the reduction amount (75% to less than 100% reduction), and (3) ZEH Oriented (no introduction of renewable energy), depending on the amount of reduction.

ensuring resilience, the energy-saving performance of water heaters and other equipment will be improved, keeping in mind that equipment that uses diverse energy sources is necessary. Moreover, in order to promote the spread of window products with high thermal insulation performance, the ideal performance labeling system that can communicate the thermal insulation performance of window products to consumers in an easy-to-understand manner will be considered.

In addition, not only regulations will be strengthened, but also support will be provided for the demonstration of ZEH and further expansion of its use. Furthermore, comprehensive energy conservation measures will be promoted, including support for renovation and reconstruction of existing houses, development and dissemination of building materials and construction methods that are easily applicable to renovation with excellent energy conservation performance, and promoting energy conservation performance labeling when houses are sold or leased.

(2) Promotion of the introduction of facilities and equipment with high energy-saving performance

A. Diffusion of high-efficiency energy-saving equipment (household sector)

B. Diffusion of high-efficiency energy-saving equipment (household sector) (energy-saving septic tanks)

<Outline of policies and measures>

To further promote the development of energy-saving technologies to further improve the efficiency of individual devices and systems, as well as to promote the spread of high-efficiency energy-saving equipment.

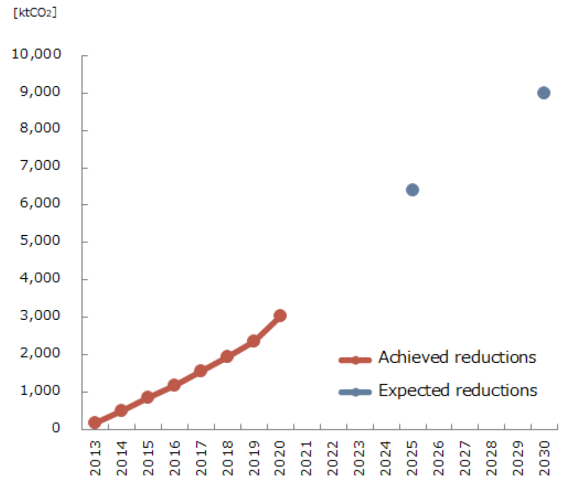
In order to achieve 100% diffusion of high-efficiency lighting such as LEDs in the stock by 2030, the Top Runner Program for lighting fixtures and light bulbs was revised in FY 2019, making incandescent light bulbs newly subject to the Top Runner Program in addition to fluorescent lamps and LED lamps. The Top Runner standards for water heaters, including heat-pump water heaters and latent heat recovery water heaters, were also revised, and the target level was raised, among others. Japan will continue to encourage the further spread of high-efficiency lighting and energy-efficient water heaters by requiring businesses to comply with the Top Runner standards.

Fuel cells for residential use are a distributed energy source that can achieve a total energy efficiency of up to 90% or more by producing hydrogen from city gas or LP gas, generating electricity through a chemical reaction with oxygen in the air, and effectively using the heat generated during power generation. Japan aims to further introduce hydrogen fuel cells, including pure hydrogen fuel cells, in the future.

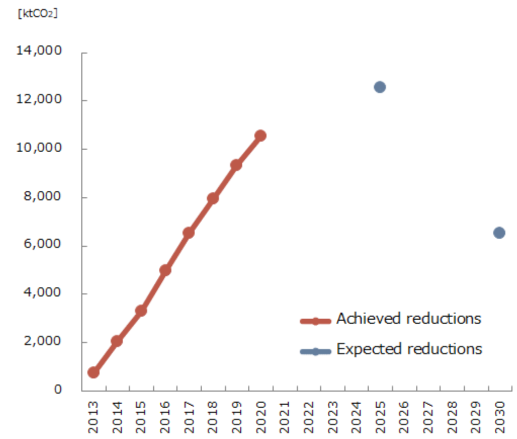
With regard to septic tanks, the spread of advanced energy-saving household septic tanks and the introduction of medium- and large-sized septic tanks with high energy-saving performance by guiding energy-saving measures will be promoted in support of the installation of septic tanks.

The related information will be disseminated through LD-Tech and other Instruments.

<Progress assessment of policies and measures>

Name of policy and measure	Installation of high-efficiency water heaters
Measure evaluation indicator	Cumulative number of units installed Heat pump (HP) water heaters
Progress in the emission reductions	C. Expected to be equivalent to the target level in FY 2030
Supplement to the progress assessment and reasons	The actual results of measure evaluation indicators, energy savings, and emission reductions have been on an increasing trend for all equipment. This is because the Top Runner Program of the *Energy Conservation Act* and other measures promoted the improvement of energy consumption efficiency of each appliance, and the introduction of high-efficiency hot-water supply equipment was supported through subsidies and support for the spread of zero-energy houses (ZEH), which encouraged the replacement of hot-water supply equipment with high-efficiency hot-water supply equipment. However, while some progress has been made, further efforts are needed to achieve the target.
Emission reductions ($ktCO_2$)	

Name of policy and measure	Introduction of high-efficiency lighting
Measure evaluation indicator	Cumulative number of units installed
Progress in the emission reductions	A Expected to exceed the target level for FY 2030, and the actual results in FY 2020 have already exceeded the target level for FY 2030
Supplement to the progress assessment and reasons	The actual results of measure evaluation indicators, energy savings, and emission reductions are on an increasing trend for all equipment. The current progress can be evaluated as exceeding the expected level compared to the forecast if the measure evaluation indicators etc. were linear each year toward FY 2030. This is because the Top Runner Program of the Energy Conservation Act has promoted the improvement of energy consumption efficiency of various equipment, and the introduction of high-efficiency lighting etc. has been supported through subsidies and support for the spread of zero-energy houses (ZEH), which has encouraged the replacement of lighting with high-efficiency lighting etc.

Emission reductions ($ktCO_2$)	

C. Improvement of energy-saving performance of equipment through the Top Runner Program, etc. (household sector)

(3) Implementation of thorough energy management

A. Implementation of thorough energy management through the use of HEMS, smart meters, and smart home devices and the provision of energy-saving information

In order to promote energy saving and CO_2 reductions in the entire house, home energy management systems (HEMS) and smart home devices that display energy usage status and support optimal operation of air conditioning, lighting, and other equipment will be spread almost widely by 2030. In addition, the introduction of smart meters that can measure electricity consumption at home in more detail than before and promote the visualization of electricity consumption through linkage with HEMS and other means will be promoted. Furthermore, by utilizing energy consumption data obtained from HEMS, more efficient energy management in homes will be promoted. Also, based on the *Energy Conservation Act*, energy retailers will be asked to provide information that contributes to energy conservation by general consumers, thereby encouraging further energy conservation efforts in the home.

Based on the results of visualization of energy consumption through these efforts, the introduction of energy-saving equipment and facilities using ESCOs will be promoted.

(4) Other policies and measures

A. Systematic promotion of inter-ministerial cooperation

In order to more reliably achieve the emission reduction targets for FY 2030 in the household sector, such as thorough promotion of energy conservation, the introduction of renewable energy, and improvement of energy efficiency in housing, the cooperation of relevant government agencies will be systematically promoted to more effectively and efficiently implement efforts in all areas.

■ Transport sector

(1) Measures concerning vehicles

A. Diffusion of next-generation vehicles, improvement of fuel efficiency, etc.

<Outline of policies and measures>

The spread and expansion of next-generation vehicles (electric vehicles (EVs), fuel cell vehicles (FCVs), plug-in hybrid electric vehicles (PHEVs), hybrid vehicles (HVs), etc.) that excel in energy efficiency will be promoted. To this end, comprehensive measures will be taken to expand the introduction of electric vehicles and infrastructure and to strengthen technologies, supply chains, and value chains related to electric vehicles, such as batteries. For those vehicles that are currently in the early stages of introduction and face such issues as high costs, support measures that include subsidy programs and preferential tax treatment will be provided. Through these efforts, Japan aims to increase the share of next-generation vehicles in new passenger car sales from 50% to 70% by 2030 and to increase the share of electric vehicles (EVs, FCVs, PHEVs, and HVs) in new passenger car sales to 100% by 2035.

In addition, the project will study the placement of EV charging facilities on roads and support research on in-transit power supply technology and promote the development of information signs on trunk roads in areas with few EV charging facilities. Furthermore, by providing incentives for the use of electric vehicles on expressways, Japan aims to reduce emissions and promote the spread of electric vehicles by shifting traffic from general roads to expressways.

To further expand the introduction of FCVs, support will be provided for the strategic development of hydrogen stations and the development and introduction of stations with large-scale filling capacity. In addition, technologies to reduce station-related costs will be developed, and the rationalization of regulations, including the unification of regulations related to fuel cell vehicles, will be promoted.

In March 2020, new fuel efficiency standards for passenger cars were established for the target fiscal year of FY 2030, including EVs and PHEVs, based on the Well to Wheel evaluation. Toward achieving carbon neutrality in the future, both regulatory methods and incentive measures are necessary to be used, and technology-neutral fuel efficiency regulations and a combination of all technologies will be used to effectively reduce CO_2 emissions.

To this end, the government will encourage automobile manufacturers, etc., to improve the fuel efficiency of new vehicles through the achievement of new fuel efficiency standards. In doing so, enforcement for compliance with fuel efficiency standards by reviewing the operation of recommendations and announcements will be strengthened. Furthermore, taxation measures etc. will be reviewed as necessary to further promote fuel efficiency improvement. Technological development and social implementation of cellulose nanofibers, modified lignin, etc., which are expected to improve fuel efficiency by reducing the weight of automobile components, will be promoted.

Biofuels[56] are carbon-neutral fuels made from plants, waste, and other materials, and efforts for

[56] There are generally three types of biofuels.

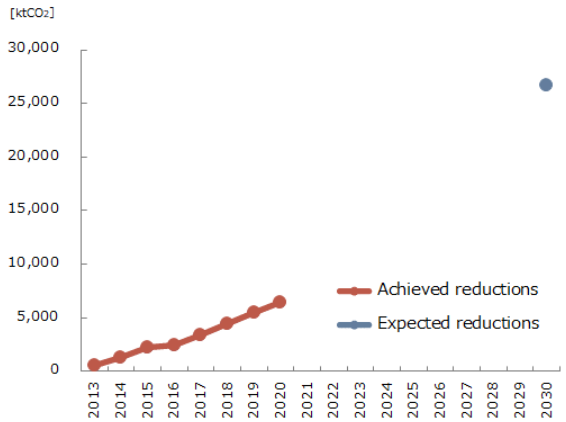
(1) Bioethanol: biofuels as an alternative to gasoline. The main raw materials are agricultural crops such as corn and sugarcane, woody cellulose, waste, etc.

(2) Biodiesel: Biofuels as an alternative to diesel. The main raw materials are palm oil, waste cooking oil, rapeseed oil, etc.

(3) Biojet: Biofuel as an alternative to jet fuel (kerosene). The main raw materials are woody cellulose, microalgae, waste cooking oil, etc.

their appropriate supply will be promoted.

<Progress assessment of policies and measures>

Name of policy and measure	Diffusion of next-generation vehicles, improvement of fuel efficiency, etc.
Measure evaluation indicator	Share of next-generation vehicles to new passenger car sales (%) Average fuel efficiency[57] (km/L) (passenger cars)
Progress in the emission reductions	C. Expected to be equivalent to the target level in FY 2030
Supplement to the progress assessment and reasons	The share of next-generation vehicles to new car sales and average fuel efficiency of owned vehicles, which are measure evaluation indicators, are indicators for passenger cars and will remain proportional to the steady progress of vehicle replacement. Since the introduction of the FY 2030 fuel efficiency standards for passenger cars has been decided, an improvement in fuel efficiency is expected in the future. Energy savings and emission reductions are for all vehicle types, and while passenger cars are making steady progress in saving energy and reducing CO_2 emissions, freight vehicles are not making progress in improving fuel efficiency at this time, so the two together show a downward trend. However, with the strengthening of enforcement to comply with the FY 2022 and FY 2025 fuel efficiency standards for freight vehicles, fuel efficiency will improve in the future, and energy conservation and emission reductions are expected to progress toward FY 2030.
Emission reductions ($ktCO_2$)	

（2） Measures for road traffic flow

A. Implementation of measures for road traffic flow.

B. Promotion of the installation of LED road lighting

C. Promotion of intelligent transport system (ITS) (centralized control of traffic signals)

D. Installation of traffic safety facilities (improvement of traffic signals and profiling [hybrid]

E. Installation of traffic safety facilities (promotion of the installation of LED traffic lights)

F. Promotion of automated driving

While recognizing the possibility that so-called induced and diverted traffic may occur as a result of road construction, the following measures will be implemented: the strengthening of arterial road networks, including ring roads that will contribute to reducing CO_2 emissions; specific countermeasures on bottlenecks of traffic congestion using big data such as ETC 2.0; study of

[57] The average fuel efficiency of existing vehicles as stock

the introduction of a planar congestion management system using ICT, AI, etc.; further energy savings and upgrading of road lighting; and installation of LED road lighting. In addition, studies will be conducted to promote the use of renewable energy sources, such as solar power generation, for the electricity required for road management, with the aim of nationwide deployment.

Other measures include the following: promotion of intelligent transport systems (ITS), such as centralized control of traffic signals; improvement of traffic signals, such as profiling; improvement of traffic safety facilities etc. that promote sustainable and green traffic, such as LED traffic signal lights; promotion of automated driving; and measures for road traffic flow that contribute to reductions in CO_2 emissions.

(3) Greening of vehicle transportation business by promoting the use of environmentally friendly vehicles etc.

A. Greening of the vehicle transportation business by promoting the use of environmentally friendly vehicles etc.

To promote eco-driving of commercial vehicles, such as trucks, buses, and cabs, the Eco-Drive Management System (EMS) will be disseminated and promoted among transportation companies etc. In addition, publicity centered on the Eco-driving Promotion Liaison Committee of the four relevant ministries and agencies will be used to promote the spread of eco-driving.

Also, the spread of the Green Management Certification System, which certifies transportation companies that implement excellent environmental initiatives, such as improved fuel efficiency, will be promoted.

(4) Promotion of the use of public transportation and bicycles

A. Promotion of the use of public transportation

B. Promotion of the use of bicycles

In order to decarbonize the public transportation sector and create an environment that facilitates mobility without relying solely on private cars, the use of public transportation services will be promoted in cooperation with community development while further improving their convenience through the following measures: promotion of the development of light rail transit (LRT[58]), bus rapid transit (BRT[59]), and other low-carbon transportation systems; support for the construction of regional public transportation plans by local governments; support for the social implementation of Mobility as a Service (MaaS[60]), promotion of compact plus networks; reorganization of regional transportation networks; promotion of barrier-free transportation; and strengthening of connections between various transport modes (modal connections) through public-private partnerships, such as through the development of transport nodes, including station squares and bus stations.

In addition, in order to promote the use of bicycles, in coordination with safety assurance

58 A next-generation tram system that is friendly to people and the environment and has excellent features in terms of ease of boarding and alighting, punctuality, speed, transportation capacity, comfort, etc., by improving the running space, vehicle performance, etc.

59 Bus rapid transit system utilizing dedicated lanes etc.

60 A service that uses a smartphone application etc., to provide an optimal combination of multiple public transportation and other transportation services to meet the trip-by-trip transportation needs of each local resident or traveler, including search, reservation, payment, etc., all at one time.

measures, the environment that encourages the use of bicycles will be created, including support for the formulation of bicycle use promotion plans by local governments, development of bicycle traffic space networks, development of bicycle parking facilities, and promotion of shared bicycle use.

In addition, the environmental load will be reduced through reductions in automobile traffic and other measures by promoting proactive efforts by businesses, including commuter traffic management, and by promoting efforts to encourage behavioral changes in the public, including how they use their cars on daily life. The government will continue to promote the use of public transportation and the active use of bicycles in government activities.

An environment that facilitates mobility without relying solely on private cars will also be created in order to realize environmentally sustainable transport (EST).

（5）　Measures for railways, ships, and aviation

A. Decarbonization of the railways

In the railways sector, energy-efficient railway vehicles and advanced energy-saving equipment, such as lightweight railway vehicles and railway vehicles equipped with variable voltage variable frequency control (VVVF) equipment[61], have been introduced and will continuously be promoted further introduction. The development of fuel-cell railway vehicles fueled by hydrogen will also be promoted. At the same time, photovoltaic power generation using rail and track facilities will also be introduced.

B. Decarbonization of the shipping sector

In the shipping sector, energy-saving and CO_2 emission-saving vessels will be promoted through the Domestic Vessel Energy Saving Rating System etc. Also, technological development, demonstration, and introduction of vessels, including LNG-fueled vessels, hydrogen-fueled vessels, and EV vessels that also contribute to the modernization and better operational efficiency in coastal shipping, will be promoted using innovative energy-saving technologies and digital technologies etc. Another aim is to begin commercial operation of zero-emission vessels as soon as possible by 2028.

C. Decarbonization of the aviation sector

In order to decarbonize the aviation sector, the following initiatives will be promoted: (1) promotion of the introduction of sustainable aviation fuel (SAF), (2) improvement of flight operation by renovating air navigation service, (3) the introduction of new technologies in aircraft and equipment, and (4) reduction of CO_2 emissions from airport facilities and airport vehicles. Also, measures to turn airports into renewable energy hubs will be examined and initiated, and public-private partnerships will be promoted.

（6）　Promotion of decarbonized logistics systems

A. Efficiency improvement of truck transportation and the promotion of joint transportation and delivery (Efficiency improvement of truck transportation)

B. Efficiency improvement of truck transportation and the promotion of joint

[61] A vehicle equipped with a mechanism that efficiently controls the speed of the motor without using electrical resistance.

transportation and delivery (Promotion of joint transportation and delivery)

<Outline of policies and measures>

Initiatives, such as consolidated collection and delivery, will be promoted through cooperation between shippers requesting deliveries and logistics operators undertaking deliveries. Initiatives to mitigate global warming will also be promoted by improving transport and loading efficiency while greening the entire logistics system.

Therefore, energy management will continuously be promoted by shippers and carriers in accordance with the *Energy Conservation Act*. Also, based on the *Act on Advancement of Integration and Streamlining of Distribution Business* (Act No. 85 of 2005), measures will be implemented to streamline transport, such as the establishment of truck sales offices at distribution facilities for storage, cargo handling, and distribution processing, and the introduction of truck reservation reception systems to consolidate and rationalize delivery networks. At the same time, the decarbonization of logistics will be promoted by providing support for operations that provide truck transport with no waiting time, further promotion of modal shifts, and the promotion of consolidated transport and delivery initiatives in depopulated areas and cities. Furthermore, the Green Logistics Partnership Conference[62] will carry out the following activities in cooperation between shippers, logistics companies, and other related parties: modal shifts, efficient truck transportation, and other initiatives to reduce the environmental impact of the logistics sector, improve logistics productivity, and create a sustainable logistics system. Awards will be given to companies that have made outstanding achievements in the construction of green logistics to motivate them to take independent initiatives and to promote the spread and expansion of green logistics. Responding to the growing needs of shippers, consumers, and others for the decarbonization of logistics services, initiatives will be promoted to utilize electric vehicles, such as for the electrification of intra-regional transportation and delivery and the development and dissemination of fuel cell trucks for long-distance transportation. In addition, in order to facilitate cooperation between shippers, logistics companies, and other related parties, the effectiveness of each initiative will be objectively evaluated using a unified method (guidelines) for calculating CO_2 emissions in the logistics sector that can be commonly used by both parties.

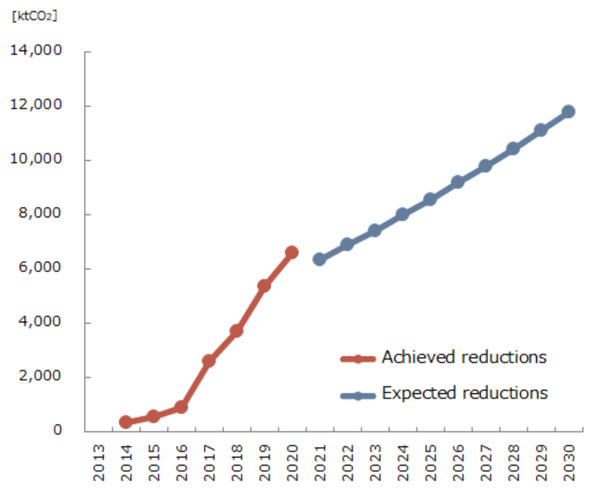
In addition, the rapid development of electronic commerce (EC) in recent years has led to an annual increase in the number of parcel deliveries handled, while the redelivery rate has just decreased to about 10%, partly due to an increase in the home delivery rate caused by the COVID-19 pandemic. The redelivery rate needs to be reduced continuously. Still, besides the perspective of increasing CO_2 emissions and the growing shortage of drivers, it is also necessary to promote noncontact and non-face-to-face methods of delivery to avoid the spread of COVID-19. Thus, efforts to reduce redelivery will be promoted, such as the use of delivery boxes, diversification of parcel receiving methods, such as receiving at stations and convenience stores, and the spread and improved operation of left-behind delivery systems. Delivery efficiency will also be improved using tools, such as drones and automatic delivery robots. Especially in depopulated areas, demonstration projects will be conducted for the social implementation of drone delivery. The possibility of using a delivery method with less environmental impact will

[62] The organization is composed of member companies and organizations from shipper companies, logistics companies, government, and other related fields, and is operated with the cooperation of the Ministry of Economy, Trade and Industry, the Ministry of Land, Infrastructure, Transport and Tourism, and related organizations in order to promote voluntary efforts by the industry toward green logistics.

be verified through the dissemination of the *Guidelines for Delivery of Packages by Drones Ver. 3.0* (March 31, 2022, formulated by the Cabinet Secretariat, and the Ministry of Land, Infrastructure, Transport and Tourism) to ensure its implementation in society in the near future.

In addition, the efficiency of logistics will be improved by promoting the spread of double-articulated trucks and other measures. Efficiency will also be enhanced by strengthening access to expressways, including direct connections to private facilities, supporting operation management using ETC 2.0, and speeding up traffic procedures through a new traffic system for special-purpose vehicles.

<Progress assessment of policies and measures>

Name of policy and measure	Efficiency improvement of truck transportation
Measure evaluation indicator	Number of vehicles with gross vehicle weight over 24t and under 25t Number of trailers owned = Number of commercial trailers over 26t owned Proportion of the number of private and commercial trucks (%)
Progress in the emission reductions	B (Expected to exceed the target level for FY 2030)
Supplement to the progress assessment and reasons	Among the measure evaluation indicators, the "number of vehicles with a gross vehicle weight of over 24t and under 25t" increased by about 3% compared to FY 2019 and is about 0.1% below the expected level for FY 2020. For "Number of trailers owned", the numbers are up about 3 % compared to FY 2019 and about 0.2 % below the expected level for FY 2020. The "Proportion of the number of private and commercial trucks" has increased by approximately 0.5% since FY 2019 and is approximately 0.5% above the expected level of FY 2020. Given that demand for private trucks is expected to exist to a certain extent, the proportion of the number of private and commercial trucks is considered to remain unchanged. The emission reductions have increased by about 23% compared to FY 2019 and about 13% above the expected level for FY 2020. The increase is largely due to an increase in the " proportion of the number of private and commercial trucks."
Emission reductions ($ktCO_2$)	

C. Promotion of a modal shift to marine transportation and rail freight transportation (Promotion of a modal shift to marine transportation)

D. Promotion of a modal shift to marine transportation and rail freight transportation (Promotion of a modal shift to rail freight transportation)

In order to promote the greening of the entire logistics system, the shift from automobile transportation to transportation by coastal shipping or rail, which emit less CO_2, will be promoted.

As part of this initiative, in order to increase the competitiveness of coastal shipping that takes on transport, transportation cost reduction and service improvement will be promoted through the development of domestic trade terminals for intermodal transportation while spreading and promoting energy-efficient coastal vessels. Furthermore, a modal shift to coastal shipping will be promoted through the introduction of trailers that can be detached from truck cabs and the use of the Eco-Ship Mark.

Similarly, in order to increase the competitiveness of freight transportation by rail, transportation capacity will be increased, and transportation quality will be improved by devising new timetable settings and enhancing transportation equipment, such as block trains and temperature-controlled freight trains. In addition, modal shifts will be promoted by introducing new technologies that contribute to better efficiency and labor savings and safety improvement at freight stations, enhancing BCP for container platform expansion in preparation for alternative transportation in preparation for disasters etc. and improving the convenience of freight railway by promoting the Eco Rail Mark etc.

The introduction of automated equipment and systems that utilize AI, IoT, and other digital technologies through collaboration among related businesses will also be promoted to improve transportation efficiency and energy conservation throughout the supply chain.

In addition, further efficiency improvements will be promoted in truck transportation. In doing so, the conversion from private trucks to commercial trucks and the use of larger vehicles and trailers, such as large CNG[63] trucks, will be promoted. Loading efficiency will also be improved by eliminating congestion and securing return cargo.

E. Promotion of decarbonization of logistics facilities

The spread of zero-energy models for warehouses will be promoted by supporting projects that simultaneously introduce renewable energy equipment, such as solar power generation facilities, and equipment that contributes to unmanned and laborsaving operations, such as unmanned forklifts and carriers, in facilities, such as sales warehouses, which are the core of logistics operations. The decarbonization of logistics facilities will also be promoted by converting to energy-efficient natural refrigerant equipment in refrigerated and frozen warehouses.

F. Initiatives at ports and harbors (Reduction of the distance of land transportation of cargo through optimal selection of ports and harbors)

G. Initiatives at ports and harbors (comprehensive decarbonization of ports and harbors)

Ports and harbors are international logistics hubs through which 99.6% of Japan's imports and exports are routed. They are also industrial centers where many of Japan's industries, including power generation, steel, and chemicals, which account for about 60%[64] of the country's CO_2 emissions, are located. In such ports and harbors, Carbon Neutral Port (CNP) initiative, which

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[63] Compressed Natural Gas

[64] Energy conversion sector (power plants, refineries, etc.), steel and chemical industries (including petroleum and coal products) The ratio of total energy-derived CO_2 emissions (before electricity and heat allocation) from the energy conversion sector (including oil and coal products) to Japan's CO_2 emissions (FY 2019 results).

includes upgrading port functions for decarbonization and improving the receiving environment for hydrogen, etc. is established to contribute to achieve "2050 carbon neutral".

Specific initiatives include the following: alleviation of traffic congestion in front of container gates through the establishment of a digital logistics system; promotion of the introduction of onshore power supply facilities for ships at berth; introduction of low-carbon and zero-carbon cargo-handling equipment, etc.; introduction of stand-alone hydrogen power generation, including from the perspective of maintaining necessary functions during disasters and responding to power shortages; development of fuel supply systems for hydrogen, ammonia, and other fuels for fuel vessels; promotion of the introduction of renewable energy sources, such as offshore wind and solar power; creation, restoration, and conservation of blue carbon ecosystems (seaweed beds, tidal flats, etc.) as CO_2 sinks; and a study on the establishment of a blue carbon offset credit scheme for seaweed beds, tidal flats, etc.

Also, by promoting the development of international marine container terminals, international logistics terminals, and domestic logistics bases that can handle intermodal transportation, marine transportation to the nearest port will be enabled, reducing the travel distance for truck transportation.

Other initiatives include the following: promotion of modal shift and transportation efficiency improvement by utilizing marine transportation related to venous logistics, creation of port green areas that contribute to CO_2 removals, and examination of the development of technologies to reduce CO_2 emissions at ports and harbors.

(7) Other policies and measures

A. Systematic promotion of measures for inter-ministerial cooperation

B. Utilization of the Special Zones for Structural Reform system related to global warming countermeasures

In order to more reliably achieve the 2030 emission reduction targets in the transport sector, including the decarbonization of each transport mode and the promotion of modal shifts, the relevant ministries and agencies will systematically promote cooperation and implement initiatives in all areas in a more effective and efficient manner. In addition, initiatives that take advantage of special regulatory measures under the Special Zones for Structural Reform system etc., will be promoted.

3.3.3 Industrial processes and product use (IPPU) sector

■ Expansion of the use of blended cement (CO_2)

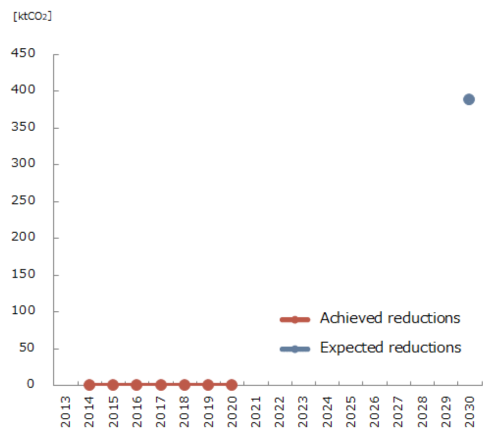
<Outline of policies and measures>

The production proportion and use of blended cement, which is made by mixing blast furnace slag with clinker as an intermediate cement product, will be increased.

In addition, the use of mixed cement will be promoted by taking the lead in the use of mixed cement in public works projects conducted by the government through the proactive use of mixed cement based on the Act on the Promotion of Procurement of Eco-Friendly Goods and Services by the State and Other Entities (2000, Act No. 100, hereinafter referred to as “Act on

Green Purchasing").

<Progress assessment of policies and measures>

Name of policy and measure	Expansion of the use of blended cement
Measure evaluation indicator	Share of blended cement production in total cement production (%)
Progress in the emission reductions	D (Expected to fall below the target level for FY 2030)
Supplement to the progress assessment and reasons	Unlike ordinary Portland cement, which is widely used in general, blended cement has disadvantages of slow initial strength development and increased occurrence of cracks depending on conditions. Because of these characteristics of blended cement, it takes longer than ordinary Portland cement to reach the desired strength after construction, and the main applications in Japan are public works projects for bridges, dams, and harbors that do not require early strength. Therefore, the demand for blended cement is highly dependent on the volume of public works projects. The procurement rate of blended cement in public works projects by the national government has already achieved an extremely high-level thanks to the *Act on Green Purchasing*. For example, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), which procures the largest amount of cement, has procured 99.8% (FY 2019: data published by the MLIT). Further promotion of its use in private-sector construction is needed, but there are issues of prolonged curing periods, increased cracking, and restrictions on raw material procurement and distribution. Since the use of blended cement is overwhelmingly driven by public demand, the drop in public demand is thought to be one of the main reasons for the negative progress.
Emission reductions ($ktCO_2$)	

■ Fluorinated gases: (HFCs, PFCs, SF_6, NF_3)

(1) Promotion of non-fluorocarbons and low GWP products

<Outline of policies and measures>

In order to reduce the environmental burden caused by fluorocarbons, gas manufacturers etc. (manufacturers and importers of fluorocarbons) are encouraged to implement such measures as the substitution of fluorocarbons with non-fluorocarbons alternatives and recycling, including lowering the GWP of fluorocarbons that they handle and reducing their production volume etc.

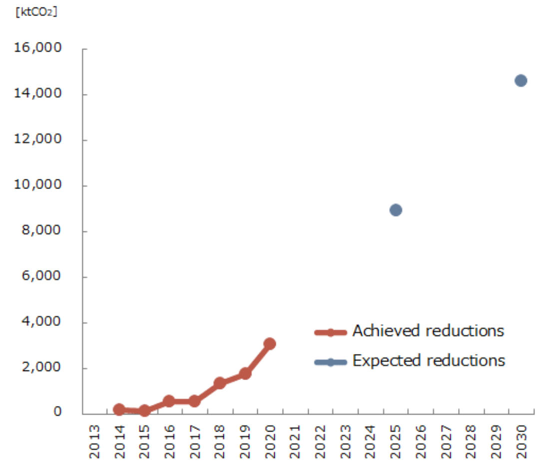
In response to the Kigali Amendment, gas manufacturers are requested to systematically reduce the amount of fluorocarbons they manufacture based on the outlook for the use of fluorocarbons established by the government in accordance with the *Act on Rational Use and Proper Management of Fluorocarbons*.

The following measures are implemented to promote the accelerated and steady shift to non-fluorocarbons and low-GWP refrigeration and air-conditioning equipment and other fluorocarbons-using products, taking into consideration that the equipment to be introduced will continue to be used for a certain period of time and taking into account future technological development and market trends in Japan and overseas.

- In accordance with the *Act on Rational Use and Proper Management of Fluorocarbons*, the designated product system, which requires manufacturers and importers to achieve a certain standard value in a certain target year for each appropriate product category, was developed. Regarding the system, the use of non-fluorocarbons and low GWP products will be promoted as early as possible by an active operation of the system by adding new products and revising target values.
- To raise awareness of the global warming potential effect of fluorocarbons and to educate users and consumers about the introduction of non-fluorocarbons and low GWP products, the labeling of products that use fluorocarbons will be improved in a way that is easy for them to understand.
- In addition to institutional measures, measures will be implemented to encourage product technology development by manufacturers and new technology introduction by users to promote the penetration of energy-saving equipment using natural refrigerants, to train technicians to install and maintain equipment compatible with new alternative refrigerants, to ensure the quality of these service providers, and to raise public awareness.

<Progress assessment of policies and measures>

Name of policy and measure	Promotion of non-fluorocarbons and low GWP products
Measure evaluation indicator	Percentage of non-fluorocarbon and low-GWP designated products installed and diffused Cumulative number of natural refrigerant equipment installed
Progress in the emission reductions	C. Expected to be equivalent to the target level in FY 2030
Supplement to the progress assessment and reasons	Regarding the measure evaluation indicator (Percentage of non-fluorocarbon and low-GWP designated products installed and diffused), steady progress is expected because the *Act on Rational Use and Proper Management of Fluorocarbons* designates average GWP values targets for individual products to achieve by specific years that are to be used as the criteria for the production of designated products and imposes on manufacturers the obligation to make efforts to reduce the environmental impact of fluorocarbons based on these criteria, although the progress may be affected by external factors such as economic fluctuations. Regarding the measure evaluation indicator (Cumulative number of equipment using natural refrigerants installed), the FY 2020 target was achieved ahead of schedule due to direct and ripple effects from the introduction assistance program. Regarding the emission reductions, steady progress is expected toward the target for FY 2030 because the *Act on Rational Use and Proper Management of Fluorocarbons* designates average GWP values targets for individual products to achieve by specific years that are to be used as the criteria for the production of designated products and imposes on manufacturers the obligation to make efforts to reduce the environmental

	impact of fluorocarbons based on these criteria, and non-fluorocarbon and low-GWP designated products will be introduced and diffused, although the progress may be affected by external factors such as economic fluctuations.
Emission reductions ($ktCO_2$)	

(2) Preventing leakage of fluorocarbons from the use of commercial refrigeration and air-conditioning equipment

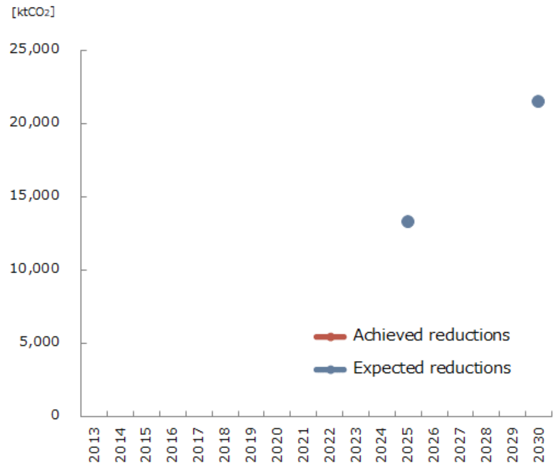
<Outline of policies and measures>

Based on the *Act on Rational Use and Proper Management of Fluorocarbons*, the prevention of leakage of fluorocarbons from commercial refrigeration and air conditioning equipment during use will be achieved through the promotion of the equipment management standard compliance including equipment inspections, implementation of the accounting and reporting system for fluorocarbons leakage, and promotion of compliance with proper filling of refrigerants, in cooperation with prefectures. In addition, applicable IoT and digital technologies due to the technological advancement will be considered to be introduced into regulations and standards, such as equipment inspection.

To prevent refrigerant leakage of refrigeration and air-conditioning equipment during use, not only product manufacturers and equipment users but also equipment service technicians should be the policy targets. The efforts to improve the technical level of equipment maintenance and management for early leakage detection and to secure and train personnel with expertise in the practical management of refrigeration and air conditioning equipment will be promoted.

<Progress assessment of policies and measures>

Name of policy and measure	Preventing leakage of fluorocarbons from the use of commercial refrigeration and air-conditioning equipment
Measure evaluation indicator	Reduction rate of leakage rate in use for equipment 7.5 kW and above
Progress in the emission reductions	E (Other (quantitative data are not available))
Supplement to the progress assessment and reasons	The survey on the leakage rate at the time of use is ongoing, and the actual situation will be grasped after the completion.

Emission reductions ($ktCO_2$)	

(3) Recovery and proper disposal of fluorocarbons from refrigeration and air-conditioning equipment

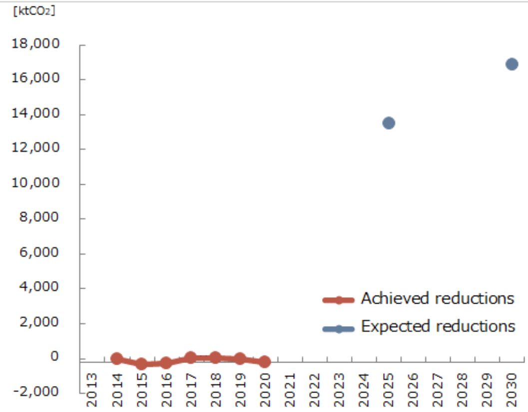
The recovery and proper disposal of fluorocarbons from refrigeration and air-conditioning equipment have been promoted through robust enforcement of the Act on Rational Use and Proper Management of Fluorocarbons, the *Act on Recycling of End-of-Life Automobiles*, and the *Act on Recycling of Specified Kinds of Home Appliances*.

In particular, HFCs emissions from the commercial refrigeration and air-conditioning equipment (excluding car air conditioners) account for approximately 70% of HFCs emissions HFCs emissions from the from refrigeration and air-conditioning equipment in total. Aiming the fluorocarbons recovery rate to be improved continuously, an institutionalized system that enables equipment disposers, dismantlers, waste management and recycling operators, fluorocarbons filling and recovery operators, and others to check each other has been thoroughly implemented in cooperation with prefectures under the *Act on Rational Use and Proper Management of Fluorocarbons*.

In addition, technical experiment on the refrigerant recovery from the equipment is conducted to increase the recovery rate per unit and further improve the recovery rate in total.

<Progress assessment of policies and measures>

Name of policy and measure	Recovery and proper disposal of fluorocarbons from refrigeration and air-conditioning equipment
Measure evaluation indicator	Recovery rate of HFCs at the disposal
Progress in the emission reductions	D (Expected to fall below the target level for FY 2030)
Supplement to the progress assessment and reasons	The *Act on Rational Use and Proper Management of Fluorocarbons* was amended in 2019 to improve the recovery rate of fluorocarbons at the time of disposal of commercial refrigeration and air-conditioning equipment, which had been stagnant, and the revised act went into effect in April 2020. After the amendment, a system was established to prevent unrecovered fluorocarbons through mutual cooperation among related businesses and to ensure that the recovery of fluorocarbons is carried out at the time of equipment disposal, including the introduction of direct penalties for equipment users' violation of the obligation to hand over fluorocarbons at the time of disposal. Also, guidance and supervision by prefectures are strengthened. The recovery rate at disposal in FY 2020 was 41%, which increased by 3% from the previous

	year.
Emission reductions ($ktCO_2$)	

(4) Recovery and proper disposal of fluorocarbons from waste household air conditioners

With regard to fluorocarbons contained in waste household air conditioners, the recovery rate of waste household air conditioners will be improved, thereby promoting the collection and proper disposal of fluorocarbons by steadily enforcing the *Act on Recycling of Specified Kinds of Home Appliances* and spreading awareness of the Act.

(5) Promotion of voluntary initiatives by industry

The industry's voluntary action plans related to fluorocarbons are evaluated and verified. Also, measures will be implemented to support businesses' efforts to reduce emissions, such as subsidies for the introduction of equipment that contributes to emission reductions.

3.3.4 Agriculture sector

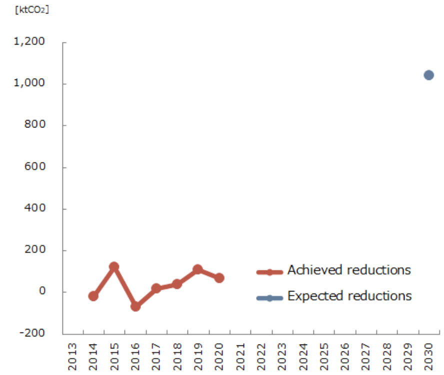
■ CH_4 emission reduction from rice cultivation

<Outline of policies and measures>

CH_4 emissions generated from rice cultivation (paddy fields) will be reduced by promoting the extended mid-season drainage period, which reduces CH_4 emissions as part of rice paddy water management based on the actual conditions of the region

<Progress assessment of policies and measures>

Name of policy and measure	CH_4 emission reduction from rice cultivation
Measure evaluation indicator	(Reference Indicator) Implementation rate of extension of mid-season drainage period
Progress in the emission reductions	D (Expected to fall below the target level for FY 2030)
Supplement to the progress assessment	Progress on the implementation rata of extending the mid-season drainage period will be evaluated based on future data. The reduction of CH4 emissions from paddy fields is currently below the target level, and in order to achieve the target level for FY 2030, it is necessary to further promote efforts to

and reasons	contribute to the reduction of CH4 emissions from paddy fields, including the extension of mid-season drainage period.
Emission reductions ($ktCO_2$)	

■ N_2O emission reduction associated with fertilizer application

N_2O emissions generated by fertilizer application will be reduced by reducing the amount of fertilizer applied, using a divided application, and using slow-release fertilizers.

3.3.5 Land use, land use change and forestry (LULUCF) Sector

■ Policies and measures for forest sinks

(1) Outline of policies and measures

Forests, which cover about 70% of Japan's land, play multiple roles in land and watershed conservation while simultaneously sequestering CO_2 from the atmosphere, contributing to the prevention of global warming as a sink for greenhouse gases. Wood also contributes to the reduction of CO2 emissions not only by storing carbon sequestered by forests, but also as a material that consumes relatively little energy during manufacturing and other processes, and as an energy source by replacing fossil fuels.

In order to achieve the goals of the *Basic Plan for Forests and Forestry* (approved by the Cabinet on June 15, 2021) regarding the fulfilment of the multifunctional role of forests and the supply and use of forest products, appropriate management and conservation of forests as well as utilization of wood will be promoted. Through these efforts, Japan aims to secure and enhance removals in forests over the mid- to long-term, and thereby contribute to achieving the GHG emissions reduction target for FY 2030 (the target for removals by forest is approximately 38 million t-CO_2 [approximately 2.7% of total GHG emissions in FY 2013]), and further to achieving net zero by 2050. To this end, in addition to efforts such as appropriate thinning, a sustainable and cyclic use of planted forests – a cycle of “harvesting, utilizing, re-planting and tending” – will be established to increase wood use and ensure the creation of young, fast-growing forests including by planting elite trees. The following measures, including cross-sectoral ones, will be comprehensively implemented with the cooperation of all actors, including local authorities, forest owners, private enterprises, and the public.

A. Maintenance of healthy forests

(a) Promotion of diverse forest management, including through appropriate thinning, reforestation after harvesting, development of multi-layered forests, and long rotation forest management.

(b) Promotion of additional thinning and reforestation, including through further promotion of municipal efforts based on the Act on Special Measures concerning Promotion of Forest Thinning (Act No. 32 of 2008).

(c) Promotion of forest management by public entities, utilizing the private forest management entrustment system and the Forest Environment Transfer Tax based on the Private Forest Management Entrustment Act (Act No. 35 of 2018).

(d) Development of forestry road systems by appropriately combining forest roads and forestry operation roads while also taking into consideration the preservation of the natural environment.

(e) Promotion of the development of mixed conifer-broadleaf forests through harvesting and introducing broadleaf trees depending on natural conditions.

(f) Promotion of reforestation through labor-saving and low-cost silviculture practices, including by using drones and forestry machinery to transport saplings, leveraging integrated harvesting and reforestation operations, low-density planting, and the use of elite trees and large saplings to reduce the frequency of weeding.

(g) Efficient development and expansion of seed and seedling production of elite trees with excellent growth, and promotion of countermeasures against damage by wild birds and animals.

(h) Securing reforestation through proper implementation of regulations such as the logging and reforestation notification system.

(i) Restocking of unforestered and unplanted areas in upstream watersheds. and rehabilitation of devastated satoyama forests.

B. Promotion of appropriate management and conservation of protection forests, natural parks and other areas.

(a) Appropriate operation of regulations under the protection forest system, planned designation of protection forests, appropriate conservation and management under the forest protection system in national forests, and promotion of measures to conserve and restore natural vegetation collaboratively including with NPOs.

(b) Systematic implementation of forest conservation projects in areas vulnerable to mountain disasters and in devastated forests.

(c) Prevention of forest pests and diseases, as well as the damage caused by animals and implementation of forest fire prevention measures.

(d) Expansion of nature parks and nature conservation areas and proper operation of regulations and strengthening of conservation management within these areas.

C. Fostering efficient and stable forestry management

(a) Securing long-term sustainable forestry management by clarifying forest ownership and boundaries, consolidating forest operations, promoting long-term outsourcing of operations, establishing management rights under the private forest management entrustment system, promotion of forest management projects by forest owners' cooperatives, and formulation of forest management plans.

(b) Promotion of "new forestry" initiatives through the reduction of silviculture cost as well as the labor saving and lightening of forestry work through the development and diffusion of remotely and automatically operated machinery.

(c) Development of forest resource information using laser scanning surveys, sharing and advanced use of forest-related information, including those on forest owners, and streamlining of timber production, distribution, and management using ICT.

(d) Introduction and efficient use of operation systems that properly combines forest road network development and high-performance forestry machinery, and implementation of initiatives based on the Forestry Innovation Program for On-site Implementation (formulated by the Ministry of Agriculture, Forestry and Fisheries in December 2019).

(e) Promotion of initiatives to train and secure forestry workers.

D.Promotion of peoples' participation in forest management

(a) Promotion of public participation in forest management activities through nationwide greening events such as the National Tree-Planting Festival.

(b) Support for forest management and conservation activities, such as tree planting by a wide range of entities, including companies and NPOs, and support for forest creation activities by companies etc., and promotion of green fundraising activities

(c) Improvement of skills of and safety systems for forest volunteers and others.

(d) Promotion of forest environment education

(e) Promotion of forest conservation and management and use of forest resources through cooperation among local residents, forest owners, and others

(f) Creation and promotion of forest service industries that comprehensively utilize forest spaces.

(g) Promotion of ecosystem maintenance and restoration projects related to deer and other animals and green worker projects, for the conservation of forest ecosystems in national parks and other areas.

(h) Cultivation of public awareness of the fact that people's lives are supported by the rich forests, countryside, rivers, and oceans

E. Promotion of the use of wood and woody biomass

(a) Promotion of the use of local timber for housing and construction.

(b) Further promotion of wood use in urban areas through the construction of wooden public buildings and medium- and large-scale buildings as well as the development and dissemination of products and technologies, such as cross-laminated timber (CLT) and fire-resistant wood materials under the Act for Promotion of Use of Wood in Buildings to Contribute to the Realization of a Decarbonized Society. (Act No. 36 of 2010, hereinafter referred to as "Wood Use Promotion Act")

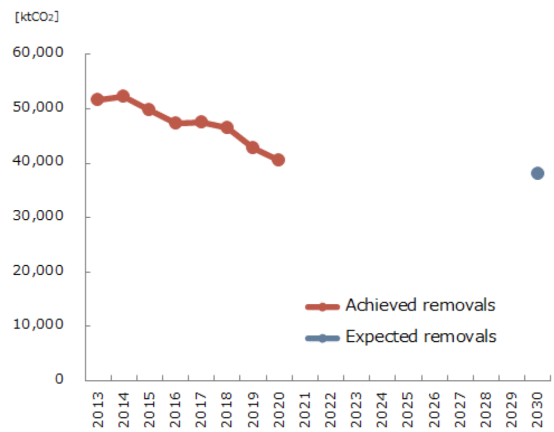
(c) Promotion of new technologies for forest product, utilization as well as, materials derived from woody biomass such as cellulose nanofibers and modified lignin, research, development and practical application of new wood-based materials. that can replace plastics.

(d) Establishment of a stable supply system for domestic wood to meet demand, including the development of efficient wood processing and distribution facilities

(e) Promotion of power generation and heat utilization through the establishment of efficient and low-cost collection and transportation systems for woody biomass in a manner that guarantees the sustainable use of forest resources.

(f) Promotion of initiatives, to foster public understanding toward wood use and lead to ESG investment in companies that engage in sustainable use of woods including the announcement of the meaning and benefits of wood use, wood promotion campaigns and wood education to encourage the use of wood, and networking of companies.

<Progress assessment of policies and measures>

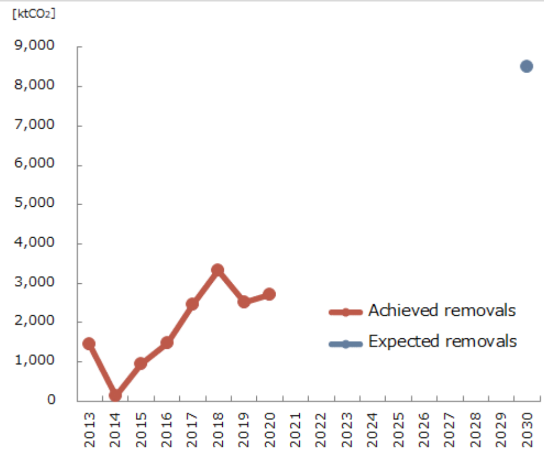
Name of policy and measure	Measures for carbon forest sinks
Measure evaluation indicator	Total area where the following forest management activities have been carried out: regeneration (land preparation, soil scarification, planting, etc.), tending (weeding, pre-commercial cutting, etc.), thinning, and harvesting.
Progress in the removals	C. Expected to be equivalent to the target level in FY 2030
Supplement to the progress assessment and reasons	The measure evaluation indicator (area of forest management activities of thinning and reforestation) has fallen below its target because of such factors as the following: 1. There are forests that are not being managed because of a decline in the willingness of forest owners to manage their forests; 2. There are some cases where reforestation is not carried out after the main logging due to issues such as the profitability of the forestry industry; and 3. Although efforts have been made to secure government budgets for forest management activities, these budgets have not been sufficient to cover the necessary area for forest management activities due to the increasing cost of forestry operations in remote areas and the rising unit cost of labor. Therefore, Japan is aiming to reach the target level for the measure evaluation indicator for FY 2030 through measures such as the following: 1. Promote the management of forests that are not being properly maintained by their owners, through the integration and consolidation of forestry operations under the private forest management entrustment system, while also utilizing the Forest Environment Transfer Tax; 2. Promote initiatives for the "New Forestry " that enables a shift towards a positive balance of income and expenditure from harvesting to reforestation and silviculture processes by utilizing new innovations such as elite trees and ICT, based on the *Basic Plan for Forestry and Forest Products*; and 3. From FY 2022 onward, reduce the cost of forest management by strengthening support for labor-saving and low-cost operations (such as reducing the number of trees planted and the frequency of weeding) while striving to secure the budget necessary for thinning and reforestation; collect and evaluate the progress of efforts by prefectures to introduce such operations; and disseminate and horizontally scale advanced cases. In addition to the steady implementation of forest management, Japan aims to enhance carbon storage in harvested wood products (HWP), which is accounted for as part of forest removals, by promoting the use of domestic timber in accordance with the Wood Use Promotion Act, which was amended and enforced on October 2021. Through these efforts, forest removals is expected to reach the target level for FY 2030.
Removals ($ktCO_2$)	

Policies and measures to increase carbon sinks in agricultural soils

<Outline of policies and measures>

It has been confirmed that carbon sequestration in cropland and grassland soils in Japan can be increased through the continuous application of organic matter, such as compost and green manure to the soil as part of soil preparation and the application of biochar. Thus, promoting these contributes to carbon sequestration in cropland and grassland soils.

<Progress assessment of policies and measures>

Name of policy and measure	Measures to increase carbon sinks in agricultural soils
Measure evaluation indicator	Carbon storage in soil (mineral soil)
Progress in the removals	D. Expected to fall below the target level for FY 2030
Supplement to the progress assessment and reasons	Since FY 2013, the amount of soil carbon sequestration has remained below the target level, although it has increased or decreased because of changes in temperature and other weather conditions. In order to achieve the target level for FY 2030, further promotion of soil cultivation through the application of organic materials such as compost and green manure is necessary.
Removals ($ktCO_2$)	

Promotion of urban greening

Urban greening is the most familiar sink measure for people in their daily lives. Its promotion is not only effective as an actual sink measure but also has a great effect on spreading awareness of the concept of global warming countermeasures.

Therefore, in accordance with the *Green Policy Guidelines* (decided by the Ministry of Construction on July 28, 1994), the *Green Basic Plan* formulated by municipalities and other comprehensive plans for the conservation and creation of greenery by the national and local governments, the following initiatives will be actively promoted: the development of urban parks; greening of roads, rivers and erosion control structures, ports and harbors, sewage treatment facilities, public rental housing, and government facilities; and creation of new green spaces on the rooftops of buildings.

As part of this initiative, the meaning and benefits of urban greening will be widely publicized to all sectors of the public. At the same time, support will be actively provided to create new green areas, such as in urban areas using a variety of different means, and entities, such as urban greening, through the participation of a variety of entities, including citizens, businesses, and NPOs, and the use of a citizen greening certification system and multistory urban park system.

In addition, the development of a system for reporting and verifying the removals by urban greening etc., will continue to be systematically promoted.

Initiatives related to blue carbon and other sinks

Blue carbon refers to CO_2-derived carbon that is absorbed and fixed by coastal and marine ecosystems, and its sinks include seaweed beds and tidal flats in shallow waters. The calculation method of greenhouse gas removals and fixation by blue carbon has not been finalized, except for some parts. Thus, relevant research will be carried out so that these calculation methods can be established, and they can be added to the IPCC guidelines for national greenhouse gas inventories. At the same time, effective seaweed bed and tidal flat conservation, creation, and restoration will be promoted. In addition, the creation of new industries based on marine resources will be promoted through the development and innovation of new materials, such as functional foods and biomass plastics made from aquatic plants.

Research and development related to technology to increase CO_2 removal efficiency and accelerate the growth of algae (algae production process technology) and technology for breeding to increase the tolerance of algae will be promoted. Through this, a large-scale demonstration will be conducted, and the cost will be reduced from the current range of 1,600 yen per liter to 100 yen per liter, which is equivalent to the cost of existing products, by around 2030 ahead of other countries to achieve practical application.

The capacity of healthy ecosystems will be increased to absorb CO_2 by promoting the conservation and restoration of forests, grasslands, peatlands, and other wetlands, soils, coastal areas, and other ecosystems that fix a substantial amount of carbon. Appropriate bird and animal management will be promoted, including damage control and population management, in order to reduce damage caused by birds and animals that have a significant impact on forests and other ecosystems and to help ensure removals by healthy ecosystems. Furthermore, to increase the adaptive capacity of ecosystems to climate change, stresses other than climate change (e.g., development, environmental pollution, overuse, and invasion of non-native species) will be reduced in conjunction with the formation of ecosystem networks, which are pathways for organisms to move and disperse.

In addition, green infrastructure that utilizes the diverse functions of the natural environment and ecosystem-based approaches, such as forests (EbA[65] and Eco-DRR[66]), can be used for disaster prevention and mitigation. A variety of benefits can also be expected, including mitigation of climate change through carbon storage; effective use of aboveground resources in satochi-satoyama; creation of diverse social, economic, and cultural reciprocity in local communities; and contribution to biodiversity conservation and sustainable use. These efforts, more comprehensively referred to as nature-based solutions (NbS), will be promoted in conjunction with the establishment of protected areas and other areas conducive to biodiversity conservation, as needed.

For CO_2-absorbing concrete, the aim is to achieve the same price as existing concrete (30 yen per kg) in 2030 as a cost target by expanding sales channels through public procurement. Thus, CO_2-

[65] Ecosystem-based Adaptation

[66] Ecosystem-based Disaster Risk Reduction

absorbing concrete will be registered in the Ministry of Land, Infrastructure, Transport and Tourism's database on new technologies (NETIS) and will be widely publicized to local governments. Another aim is to expand public procurement by national and local governments by introducing the system at the 2025 Japan International Expo and other events.

3.3.6 Waste sector

■ Diffusion of biomass plastics

CO_2 emissions from incineration of waste plastics (CO_2 derived from petroleum-based carbon in waste plastics) will be reduced by replacing petroleum-based plastics through the promotion of the use of plastics made from biomass.

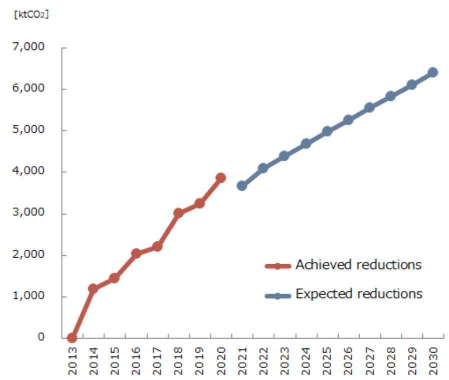
■ Reduction of waste incineration

<Outline of policies and measures>

The 3R + Renewable activities will be promoted to achieve the target set forth in the *Circulation Plan* under the *Circulation Act* and the waste reduction target based on the *Waste Management and Public Cleansing Act* (Act No. 137 of 1970). Also, the incineration of petroleum-based waste, such as waste plastic and waste oil, will be reduced under the *Circular Economy Roadmap* (announced in September 2022) formulated to accelerate the transition to a circular economy with the aim of developing the *Fifth Cycle Plan*. Specific actions to reduce CO_2 emissions from waste incineration include the enforcement of separate collection at municipalities and introduction of a charge for refuse, implementation of measures in accordance with the *Act on the Promotion of Resource Circulation related to Plastics* (Act No. 60 of 2021) and individual recycling acts, reduction of the generation of waste through such measures as the recycling of waste oil, and promotion of recycling and reuse.

<Progress assessment of policies and measures>

Name of policy and measure	Promotion of recycling of waste plastics
Measure evaluation indicator	The amount of waste plastics incineration (dry basis)
Progress in the emission reductions	C. Expected to be equivalent to the target level in FY 2030
Supplement to the progress assessment and reasons	Because of the progress of efforts to reduce waste incineration, the waste plastics incineration, which is a measure evaluation indicator, has been reduced from 5.15 Mt (preliminary figure for FY 2013) to 3.72 Mt (preliminary figure for FY 2020), and the emission reductions are 3.87 Mt-CO_2 (in FY 2020). The measure evaluation indicator and emission reductions are expected to be generally steady. Japan will continue to reduce the amount of waste plastics incineration by promoting waste reduction through the promotion of fee-charging of garbage and the sorted collection of plastic containers and packaging, as well as the collection of product plastics, which will be expanded under the *Plastic Waste Recycling Law* to be enforced in April 2022.

Emission reductions ($ktCO_2$)	

Reduction of final waste disposal

The 3R + Renewable activities will be promoted to achieve the target set forth in the *Circulation Plan* under the *Circulation Act*. Also, specific studies will be conducted under the *Circular Economy Roadmap* (announced in September 2022) formulated to accelerate the transition to a circular economy with the aim of developing the *Fifth Cycle Plan*. Specific measures to reduce CH_4 emissions from landfilling waste include reevaluation of the disposal method by municipalities, thorough waste sorting, and strengthening the disposal system, which will directly reduce the landfilling of organic waste, such as food waste.

Adoption of semi-aerobic landfill structures in final waste disposal sites

A semi-aerobic landfill structure will be adopted when installing a final waste disposal site. This will reduce CH_4 emissions from the biological decomposition of organic waste, such as landfilled food waste, compared to an anaerobic landfill structure.

Advancement of incineration at sewage sludge incineration facilities

N_2O emissions from the incineration of sewage sludge will be reduced by advancing combustion at sewage sludge incineration facilities and promoting incinerators and sewage sludge solid fuel conversion facilities that emit less N_2O.

Reduction in the amount of municipal waste incineration

The 3R + Renewable activities will be promoted to achieve the target set forth in the *Circulation Plan* under the *Circulation Act*. Also, under the *Circular Economy Roadmap* (announced in September 2022) formulated to accelerate the transition to a circular economy with the aim of developing the *Fifth Cycle Plan*, the amount of waste incinerated at general waste incineration plants will be reduced. Also, N_2O emissions from waste incineration will be reduced by increasing the upgraded combustion at general waste incineration plants through the conversion to full continuous feed incinerators due to the wide-area waste disposal and by increasing the proportion of waste treated by continuous operation at general waste incineration plants.

3.3.7 Cross-cutting measures

■ Cross-cutting measures to achieve the target

(1) Activation of J-Credit Scheme

A. Activation of J-Credit Scheme

<Outline of policies and measures>

The J-credit scheme[67], recognized as a reliable and high-quality credit system, is necessary for achieving carbon neutrality by 2050. While ensuring its continuity as a system even after FY 2030, in order to continue to actively promote measures to reduce emissions by introducing energy-saving equipment and utilizing renewable energy by various domestic actors, as well as removal measures through appropriate forest management, the J-credit scheme will be further activated to certify credits that can be used for carbon offsets and for increasing the added value of goods and services.

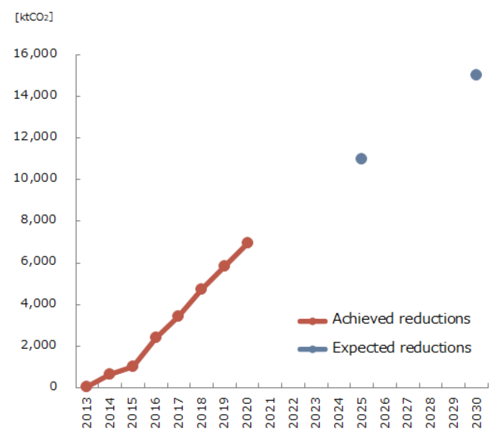
Specifically, in order to promote the creation of credits for increasingly important carbon removal and carbon absorption systems toward carbon neutrality, the creation of forest-based credits through forest management activities will be expanded by reconsidering how to encourage forest owners and managers to use the scheme and how to streamline the monitoring process.

Additionally, in order to promote the conversion to the credit of the environmental value generated by the introduction of energy-saving and renewable energy devices for individuals and small and medium-sized enterprises, the use of subsidized projects will be further promoted by the national government, as well as the integration of different small and medium-sized enterprises adopting energy-saving equipment and individual greenhouse gas reduction activities into large projects led by manufacturers of energy-saving equipment, leasing companies, and trading companies will also be promoted. Furthermore, its supply will be increased while at the same time ensuring quality by considering the creation of credits using new technologies like hydrogen, ammonia, and CCUS/carbon recycling. In addition to expanding the supply side this way, demand will also be expanded through the use of offsets by companies and central and local governments. Specifically, Japan will consider the utilization of the J-Credit for Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and will expand demand for the credit in collaboration with local governments aiming to realize Zero Carbon Cities and "Circular and Ecological Economy." At the same time, while promoting the revision of certification targets within a range that ensures the reliability of the system, including methodology and new formulations, in consideration of technological development and the business environment, improvement of the system's environment will be considered by promoting digitalization to ensure convenience, cooperating with similar systems like non-fossil certificates, and increasing activities to publicize the system. Furthermore, a framework for encouraging market-based voluntary transactions aimed at reducing carbon values will be considered.

<Progress assessment of policies and measures>

Name of policy and measure	Activation of the J-Credit scheme

[67] https://japancredit.go.jp/english/

Measure evaluation indicator	Amount of J-Credits certified
Progress in the emission reductions	C. Expected to be equivalent to the target level in FY 2030
Supplement to the progress assessment and reasons	The cumulative amount of J-Credits certified, which is the measure evaluation indicator and emission reductions, is 6.97 Mt-CO_2, and the amount has risen significantly (increased by 1.12 Mt-CO_2). By continuing to implement relevant measures to stimulate demand for credits, projects registered to date and those expected to be registered in the future are expected to reach the same level as the FY 2025 target (11 Mt-CO_2) and the FY 2030 target (15 Mt-CO_2). Therefore, the evaluation for the FY 2020 target is "C".
Emission reductions ($ktCO_2$)	

(2) Joint Crediting Mechanism (JCM)

A. Promotion of the Joint Crediting Mechanism (JCM)

<Outline of policies and measures>

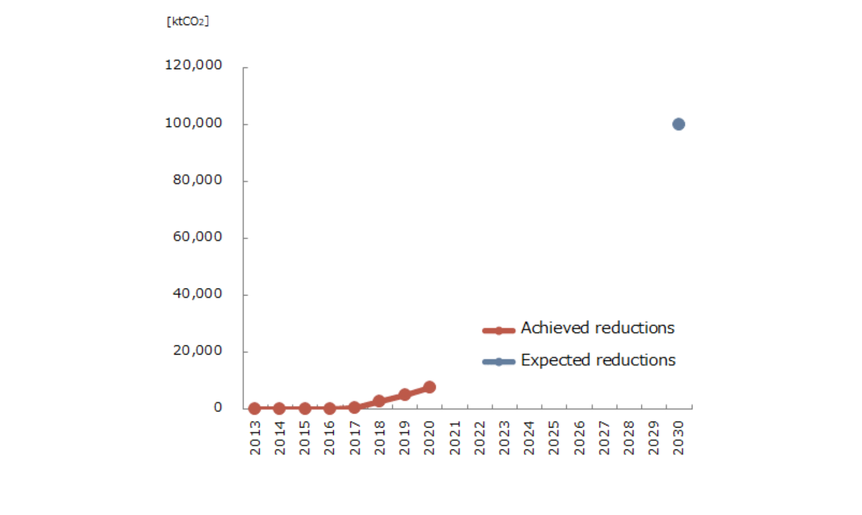
Reducing emissions and increasing removals through the diffusion of leading decarbonization technologies with a deep understanding of the needs of partner countries can help the transition to a decarbonized society and contribute to the creation of a virtuous cycle of the economy and the environment not only for partner countries but also for Japan.

For this reason, Japan establishes and implements the Joint Crediting Mechanism (JCM) in order to quantitatively evaluate contributions of Japan to greenhouse gas emission reductions and removals which are achieved through the diffusion of, among others, leading decarbonizing technologies, products, systems, services, and infrastructures as well as through the implementation of measures in developing countries and others, and in order to use such contributions to achieve Japan's NDC. By doing so, through public-private collaborations, Japan aims to secure accumulated emission reductions and removals at the level of approximately 100 Mt CO_2 by FY 2030. Japan will appropriately count the acquired credits to achieve its NDC.

Japan continues to properly operate the measurement, reporting, and verification (MRV) of the registration and credit issuance of JCM projects and promotes the system by improving intercity and regional cooperation, strengthening business-led international expansion with funding from different sources, including the private sector, and diversifying and scaling-up projects to contribute to decarbonization in a multisided approach. Additionally, Japan also supports the creation of projects and offers technical verification support, including in cooperation with related Japanese and international organizations like the New Energy and Industrial Technology Development Organization (NEDO), Japan International Cooperation Agency (JICA), Japan Bank for International Cooperation (JBIC), Nippon Export and Investment Insurance (NEXI), Asian Development Bank (ADB), World Bank (WB), United Nations Industrial Development Organization (UNIDO), the Japan International Research Center for Agriculture, Forestry and Fisheries (JIRCAS), and others. Furthermore, in order to implement JCM in Japan consistent with the Paris Agreement and related decisions, JCM-related bilateral documents and the rules and guidelines adopted by the Joint Committee established and based on the above documents, Japan established a JCM Promotion and Utilization Council at the Ministry in charge of JCM implementation. The JCM Promotion and Utilization Council carries out duties relating to the authorization of JCM credits as a Party to the Paris Agreement, the determination of a method to apply a corresponding adjustment to prevent double counting, and the revision of the Guidelines for the Implementation of the JCM.

<Progress assessment of policies and measures>

Name of policy and measure	Promotion of the Joint Crediting Mechanism (JCM)
Measure evaluation indicator	Estimated cumulative emission reductions/removals through JCM financial support programs, etc.
Progress in the emission reductions	C. Expected to be equivalent to the target level in FY 2030
Supplement to the progress assessment and reasons	The actual values of the measure evaluation indicator for FY 2020 have increased from the previous year. JCM is positioned in the *Plan for Global Warming Countermeasures* (approved by the Cabinet on October 22, 2021) as "aiming to secure international emission reductions and removals of about 100 Mt-CO_2 cumulatively by FY 2030 through a public-private partnership. In addition, the adoption of the rules of Article 6 of the Paris Agreement at the 26th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP26) has increased international momentum for the use of market mechanisms, including JCM. In addition to an increase in the FY 2022 budget approved for the JCM equipment subsidy project, which will play a central role in the expansion of JCM projects, projects with contributions to the Asian Development Bank (ADB) Trust Fund and projects co-financed by the Japan Bank for International Cooperation (JBIC) and general financial institutions have been implemented in collaboration with related entities. Although there is a gap between expected and actual emission reductions in terms of measure evaluation indicators and emission reductions, Japan will continue to scale up JCM to achieve the FY 2030 target level.

Cumulative amount of Emission reductions ($ktCO_2$)	

(3) Creation of urban/regional structures and socioeconomic systems contributing to decarbonization

Since urban and regional structures and transportation systems will continue to affect CO_2 emissions over the medium to long term through variations in traffic volume and work floor area, it will become necessary to move away from conventional diffusion-type urban development and promote urban and regional development that contributes to decarbonization by compacting cities and rebuilding public transportation networks (compact plus network), creating people-centered downtowns, improving the efficiency of the city's energy system and so on.

In order to do this, Japan will promote measures and projects based on the Comprehensive Urban and Regional Transportation Strategy and create spaces that are comfortable and walkable by combining pleasant stay enhancement zones with the Improved Pedestrian Convenience Road System (*Hokomichi*) and urban compacting based on location optimization planning and low carbon city planning. With regard to the decarbonization of each area in the city, Japan will also strongly promote smart-city type social development, as well as comprehensive efforts, including privately funded ones, like urban regeneration efforts through regional energy use, the conservation and creation of green spaces, as well as the upkeep of city parks that remove greenhouse gases, the utilization of digital technology, and support for environmentally conscious and high-quality private sector urban development projects. Japan will also promote the introduction of renewable energy in city parks.

As for local government action plans and regional climate change adaptation plans, Japan will proceed with such efforts in coordination with location optimization planning, low-carbon city planning, agricultural promotion area development plans, and other policies. Additionally, Japan will enhance systems for enabling the development of facilities that contribute to the local production and local consumption of renewable energy utilizing land of unknown owners. Japan will also promote the use of public transportation in coordination with land usage policies and consider optimizing the floor area of stores and commercial premises. As for existing infrastructure like public facilities, including water and sewage treatment facilities, waste processing facilities, transportation infrastructure, and energy infrastructure, Japan will enhance their energy-saving efficiency while turning them into regional energy centers and, at the same time, expanding and consolidating them, extending their life cycle, and improving their disaster prevention features. On top of that, Japan will promote the social implementation of green infrastructure that makes the best use of the diverse characteristics of the natural environment through public-private partnerships and cross-sectoral collaboration.

Moreover, Japan will promote the development of leading-edge, low-carbon cities and regions, including initiatives to build cities that can serve as models for the environmentally conscious cities of the future, as well as cross-expand the knowledge and know-how gained through them, which will lead to nationwide expansion.

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A. Decarbonization initiatives in national parks

In national parks and hot spring areas with full respect for the natural environment, Japan will create a virtuous cycle of nature conservation and usage by enhancing the attractiveness and resilience of the region through the creation of sustainable tourist destinations that aim to decarbonize the demand side, such as the generation of heat and power using hot springs, the decarbonization of mobility, the introduction of renewable energy equipment, and the introduction of energy-saving equipment for self-consumption to be used in accommodation and visitor facilities.

B. Initiatives for the effective utilization of distributed energy resources

To promote the use of distributed energy resources, it is necessary to further facilitate the activities of aggregators who can bundle a variety of distributed resources like storage batteries, renewable energies, fuel cells, and cogeneration and appropriately trade them in the market. In addition to reducing demand (negative demand response) from large consumers like factories, which currently represent the main business of aggregators, Japan will improve the market environment so that distributed energy resources can be prized as adjustment power and supply power in the supply and demand adjustment market and the wholesale electricity market. Additionally, with an eye on the FIP system, Japan will promote verification of renewable energy aggregation businesses, avoid output control, and promote efforts to alleviate grid congestion by shifting power demand (positive demand response) using distributed resources.

Additionally, storage batteries, which play a particularly important role among distributed energy resources, present the problem that the cost of the power storage system remains high compared to other countries. In order to further reduce costs, measures like setting a target price of 70,000 yen/kWh for household power storage systems and 60,000 yen/kWh for commercial and industrial power storage systems for FY 2030, a price at which investments can be recovered from profits obtained from power storage systems, and using it as a price target for the introduction support provided by the government in consideration of the fact that the number of used in-vehicle storage batteries is expected to increase in the future, as well as promoting the reuse of stationary storage batteries with high safety and performance reliability in order to reduce the burden on the environment, are expected to stimulate price reductions and promote widespread use.

C. Promotion of regional decarbonization

Based on the *Plan for Global Warming Countermeasures* and the *Regional Decarbonization Roadmap*, the relevant ministries and agencies will work together in all sectors to mobilize all decarbonization-based measures in order for a "decarbonization domino effect of implementation" to occur in which regional decarbonization spreads from areas with high willingness and feasibility to other areas. To this end, the government will actively support regional initiatives in terms of human resources, information and technology, and finance. For example, at least 100 "Decarbonization Leading Areas" are to be selected by FY 2025 and realized by FY 2030, which will achieve net zero CO_2 emissions from electricity consumption in the residential sector and commercial sector, and a sufficient reduction in other GHG emissions relative to Japan's FY 2030 emission reduction target. The "Regional Decarbonization Transition/Renewable Energy Promotion Subsidy" have been established to provide continuous and comprehensive support over multiple years to local governments and businesses that implement such ambitious initiatives. In addition, Japan Green Investment Corp. for Carbon Neutrality, established under the *Act on the Promotion of Global Warming Countermeasures*, supplies funds for decarbonization projects to further attract private funds.

■ Other relevant cross-sectoral measures

(1) Realization of a hydrogen society

With an eye to future carbon neutrality, hydrogen can be expected to make many important contributions, like reducing to zero the emissions of power sources, decarbonizing the transportation and the industrial sectors, helping in the production of synthetic fuels and synthetic methane, and stimulating a more efficient use of renewable energies. Its role is expected to expand even further in the future.

In order to achieve a hydrogen society in which hydrogen is universally used in daily life and in industrial activities, it is necessary to reduce hydrogen's supply cost and create demand across different fields in an integrated manner. To this end, we aim to reduce the hydrogen supply cost to 30 yen/Nm^3 (CIF price[68]) by 2030 and to 20 yen/Nm^3 or less by 2050.

In order to reliably guarantee a vast and inexpensive hydrogen supply over the long term, it is important to simultaneously promote the use of inexpensive hydrogen produced overseas and to establish a hydrogen production base that uses domestic resources. Therefore, with the aim of commercializing hydrogen production by 2030, thanks to an international hydrogen supply chain and water electrolysis equipment using surplus renewable energies and other energies, Japan will support increasing the size of transportation and supply facilities, including hydrogen carriers, as well as developing technology for the upsizing and modularization of water electrolysis equipment.

In order to increase hydrogen demand, it will be necessary to accelerate initiatives in each area where hydrogen is expected to play a role. In the transportation sector, in addition to supporting the introduction of FCVs and enhancing the strategic development of hydrogen stations, Japan will support the expansion of possible uses for trucks and ships, as well as the development of infrastructure to support large-scale stations. In the power generation sector, Japan will support

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[68] CIF (Cost, Insurance and Freight) price: the sum of the freight cost, freight charges and freight insurance premiums

the technological development of combustors for exclusive combustion and the verification of actual power generation capabilities of large-scale combustors, as well as set up systems for the appropriate evaluation of the non-fossil fuel energy values. In the industrial sector, Japan will promote the development of innovative technologies for the large-scale conversion of manufacturing processes like hydrogen-reduced iron making and will develop and verify technologies for building large boilers suited to the combustion characteristics of hydrogen.

Additionally, Japan will establish a model for an ideal hydrogen society that makes the best use of existing infrastructure and the supply and demand characteristics of nearby geographical regions, as well as verify self-sustaining and distributed energy systems that utilize local resources like renewable energies and other energies with the aim of expanding them nationwide.

As for hydrogen regulatory reforms, Japan has steadily implemented those aimed at introducing fuel cell vehicles and hydrogen stations, and Japan will continue to steadily consider unifying regulations on fuel cell vehicles. In sync with the progress of social implementation of hydrogen in each area, in addition to the transportation sector, Japan will expand the scope of consideration and consider streamlining regulations with the goal of ensuring safety.

(2) Initiatives based on guidelines for controlling GHG emissions

As for guidelines for emission reductions based on the A*ct on Promotion of Global Warming Countermeasures*, Japan will expand the countermeasure menu to include initiatives like making decisions on the decarbonization of energy based on technological trends like BAT, and Japan will formulate and announce as soon as possible initiatives in fields that are as of yet undeveloped. Furthermore, with the goal of contributing to the decarbonization of individual lifestyles, Japan will further expand the measures that must be implemented by businesses when manufacturing and providing products and services that people use in their daily lives. Japan will also promote voluntary and proactive efforts on the part of business operators to engage in environmentally conscious business activities by offering a variety of different forms of assistance and information to encourage the implementation of the measures included in the guidelines.

(3) GHG emissions accounting, reporting, and disclosure program

From the standpoint of establishing the foundation of voluntary emission reduction initiatives by having the emitters themselves calculate emissions and by promoting voluntary efforts by the general public and businesses through the increased visualization of emission data as outlined in the *Act on Promotion of Global Warming Countermeasures*, businesses that emit more than a certain amount of greenhouse gases are obliged to calculate their own emissions and report them every year to the national government that compiles them and publishes them as a report. Based on the *Amended Global Warming Countermeasures Promotion Act*, Japan will build an electronic reporting system that facilitates the task of reporting parties, and by setting as the standard the information reported through this system, Japan will speed up the collection and publication of information. At the same time, when disclosing the reported information, Japan will provide the information in a highly convenient form using the relevant systems and include the information for each business establishment in order to make it easy to consult. And when doing so, Japan will also provide information on the precautions needed to interpret the information, such as reporting that simple comparisons between businesses may not be significant.

Additionally, calculation rules will be reviewed based on the latest information, like IPCC guidelines, and factors like forest removals due to forest management and handling of CCS may be taken into consideration. Moreover, to improve the ease of using the reported information, Japan will actively encourage the reporting of information on initiatives for reducing emissions, in addition to emission data, and will stimulate the reduction of GHG emissions by business operators by listening to the opinions of businesses actively engaged in decarbonization.

(4) Promotion of environmental considerations in business activities

In order to reduce GHG emissions, Japan will appropriately incorporate the standpoint of environmental consideration into economic activities and promote investment and technological development in business activities.

More specifically, Japan will promote a cycle whereby businesses that are implementing environmental considerations can reap benefits by implementing a series of initiatives based on the following model: (1) the value of environmental consideration in products, services, and financial markets is widely appreciated and the public demands environmental consideration from businesses; (2) suppliers carry out environmentally conscious business activities and inform consumers about them in easy-to-understand terms; and (3) the accurate delivery of such information to consumers allows consumers to reward environmentally conscious businesses, as well as their products and services, by choosing and evaluating them.

To this end, Japan will encourage business operators to voluntarily and proactively engage in environmentally conscious business activities based on guidelines like those for reducing emissions.

Furthermore, based on the *Law Concerning the Promotion of Business Activities with Environmental Consideration by Specified Corporations, etc., and by Facilitating Access to Environmental Information and Other Measures* (Law No. 77 of 2004), Japan will establish the conditions for environmentally conscious business activities and environmentally conscious products to be held in high regard by society and the market by promoting the use of environmental information by businesses and the public through the disclosure of environmental data by businesses. To that end, Japan will promote efforts to improve the reliability and comparability of disclosed information throughout the supply chain.

Moreover, Japan will enhance the effectiveness of environmental management by promoting the deployment of environmental management systems incorporating a PDCA cycle, like ISO 14001 and Eco Action 21, for small and medium-sized enterprises and, at the same time, promote further environmental consideration in Japanese business activities by fostering the appropriate training of employees.

(5) Pro-Growth Carbon Pricing

The government will invest 150 trillion yen over the next ten years towards green transformation (GX) through public-private sector collaboration with the simultaneous aim of meeting international commitments, strengthening Japan's industrial competitiveness, and achieving economic growth.

To realize investments of over 150 trillion yen over the next decade, we will embody and make maximum use of the "Pro-Growth Carbon Pricing" that has an effect on maximizing both growth promotion and emissions reduction and absorption. Under this concept, we will consider procuring prior government funds of sufficient size to lead public-private investment of more than 150 trillion yen through "GX Economic Transition Bonds (tentative name)" backed by future financial resources and by promptly providing long term private investment support in decarbonization in a form foreseeable over multiple years, together with new regulations and systems.

In considering this issue, the plan will take into account such factors as the following.

- Consideration should be given to an effective mechanism, such as a hybrid system that combines both a carbon levy and an emissions trading market, while the emissions trading market should incorporate a public function to stabilize the carbon price without causing excessive fluctuations.
- To avoid increasing the total public burden for energy in the medium to long term, the carbon levy and the emissions trading market should be limited to the extent that the related taxation system will decrease in the future, in order to increase the predictability of companies, to avoid disruption of industrial business activities, and to attract bold investment from the private sector.
- Providing a forecast for the next 10 years to indicate in which areas and to what extent investment is expected to be promoted in combination with creating a market through a new regulatory system and investing support measures using the GX Economic Transition Bonds in cases where it is difficult for the private sector alone to make risky investments.
- Pursuing the dual pursuit of "both growth and the environment" by maximizing the acceleration of domestic decarbonization investments and leading projects to implement energy-related technologies, and to link these to a vast network.

(6) Greening of the tax system and effective use of tax for global warming mitigation

Greening of the environment-related tax system is an important step towards carbon neutrality by 2050. For this reason, Japan will formulate global warming countermeasures by comprehensively and systematically investigating and analyzing the environmental effects of environment-related tax systems, including the situation in other countries.

Making the best use of the special tax revenue from the petroleum and coal tax measures for global warming enforced since October 2012, we are steadily implementing, in cooperation with each ministry, a wide range of measures to reduce energy-related CO_2 emissions, such as energy-saving measures, diffusing renewable energy, improving the cleanliness and efficiency of fossil fuels, and strengthening wise spending by focusing on cost-effective measures according to the characteristics of each business.

(7) Promotion of sustainable finance

In order to realize the society envisioned in the Paris Agreement, it is necessary to further encourage private investment for companies working on climate change measures and innovation; therefore, the role of finance is becoming more important. Across the world, sustainable finance, in particular ESG finance, which incorporates environmental, social, and governance factors into investment and loan decisions from the standpoint of reducing investment risk and improving returns over the medium to long term, is becoming widespread. Furthermore, including climate change risk in investment decisions is becoming the standard in the international financial markets. In Japan, too, the scale of ESG investment has expanded significantly in recent years.

At the same time, demand is increasing for information disclosure of climate-related financial information with Japan having the largest number of organizations supporting TCFD in the world. On the other hand, a movement is gaining ground, mostly in Europe, to introduce regulations on the labeling of financial products and to make sustainability disclosures mandatory. Additionally, it is becoming necessary for financial institutions to calculate the greenhouse gas emission levels of their investments (financed emissions) and consider measures to reduce them as they respond to climate change throughout their entire portfolios.

In order to attract domestic and foreign environment-related investment in businesses that contribute to global warming countermeasures for the realization of a carbon-free society, Japan will promote sustainable finance like ESG finance in consideration of international trends.

More specifically, based on the Climate Innovation Finance Strategy 2020 (established by the Ministry of Economy, Trade and Industry on September 16, 2020), in collaboration with related ministries and agencies, in addition to renewable energies and other energies (green), Japan will integrally promote the transition to decarbonization (transition), including steady efforts to reduce CO_2 emissions by energy saving and more, as well as finance innovative technology (innovation) towards decarbonization. As for the green aspects, Japan will promote green finance, starting with green bonds, by establishing a system for issuing them and developing the market for them. Furthermore, with an eye toward the realization of a decarbonized society and with regard to transitional finance, for example, financing efforts to reduce GHG emissions according to a long-term strategy as outlined in the Basic Guidelines for Climate Transition Finance (set forth on May 7, 2021, by the Financial Services Agency, the Ministry of Economy, Trade and Industry, and the Ministry of the Environment), Japan will promote investment in companies that are engaged in transitioning to decarbonization and in innovation by formulating a sectoral roadmap for high-emission industries that cannot be decarbonized in a single step, and Japan will also support Asia's transition toward the realization of global carbon neutrality. In order to promote innovation, in September 2020, companies that have challenged themselves to boldly pursue innovation toward the realization of a carbon-free society have been hailed as Zero Emission Challenge Companies, and their efforts have been highlighted both in Japan and abroad. Besides continuing with this initiative, Japan will continue to help the market's understanding of the innovation by fostering dialogues between these companies and investors.

Additionally, the active disclosure of information by companies and the constructive dialogue based on such disclosures constitute the foundation of encouraging financing for initiatives to improve corporate value through the decarbonization of companies. In Japan, a private-sector-led TCFD consortium was established in 2019, and it has since hosted the TCFD Summit, a leading event for the utilization and development of TCFD. Following the revision of the Corporate Governance Code in June 2021, Japan will encourage Japan’s prime market-listed companies to enhance the quality and quantity of disclosures under the TCFD or equivalent international frameworks. Furthermore, Japan will actively participate in international discussions to establish a framework for sustainability-related disclosures at the International Financial Reporting Standards (IFRS) Foundation. Moreover, Japan will promote disclosure and debate and improve their quality by supporting scenario analysis by companies and financial institutions, as well as by supporting the formulation, revision, and diffusion of scenario analysis guides and guidance on green investment and TCFD.

From the standpoint of promoting regional decarbonization, the role of regional financing is extremely important. In order to link the decarbonization of a region to a virtuous cycle of economic and environmental progress in the same region, besides offering a clear nationwide vision, Japan will promote ESG regional financial efforts with a significant impact on the environment, economy, and society by advancing the creation of models for solving regional issues and the establishment of business using regional resources by forward-looking regional financial institutions in cooperation with local governments.

Furthermore, Japan will promote initiatives to steer private investment towards initiatives for reducing greenhouse gases by supporting investment in decarbonization projects where private funds are insufficient and by promoting investment in cutting-edge equipment through leasing methods.

Moreover, Japan will turn the spotlight on ESG finances by holding the ESG Financial High-Level Panel, a gathering of top executives from the financial and investment fields, and Japan will promote discussions to create a positive impact on the environment and society through finance.

3.3.8 International aviation and shipping (International bunker fuels)

The international transportation sector (international aviation and shipping), which operates across national borders, is covered in the national GHG inventories because of the difficulty of assigning emissions to individual countries, and the International Civil Aviation Organization (ICAO) and International Maritime Organization (IMO) are considering measures to reduce CO_2 emissions.

■ Policies and measures for international aviation

(1) Overview

For international aviation, ICAO has set a global emission reduction target that the global emissions will not increase after 2020, and the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) was launched in 2021 among the voluntary participating countries as a CO_2 emission reduction framework for international aviation. Japan has also voluntarily joined the scheme.

Under these circumstances, in order to accelerate the decarbonization of the aviation sector, Japan has established committees on CO_2 reduction in the "aircraft operations" and "airport" and has been holding discussions. The committee on aircraft operations has been discussing the direction of medium- and long-term initiatives to reduce CO_2 emissions through the following three approaches: (1) promotion of the introduction of sustainable aviation fuel (SAF), (2) improvement of flight operation by renovating air navigation service, and (3) introduction of new technologies for aircraft and equipment The committee for the airport has been discussing initiatives to reduce CO_2 emissions from airport facilities and airport vehicles by promoting the introduction of energy-saving systems such as LEDs at airport facilities; promotion of the introduction of clean energy airport vehicles such as EVs and FCVs; promotion of the introduction of power and air conditioning supply facilities from airports to aircraft (ground power unit: GPU); and airport's transformation into a renewable energy hub by promoting the introduction of solar power generation. Based on the discussions at the respective committees, Japan has developed a roadmap of CO_2 reductions for aircraft operations and the airport, respectively.

For aircraft operations, a public-private council has been established for each approach to accelerate efforts to steadily implement the roadmap from 2022. For the airport, the development of guidelines for decarbonization plans to be prepared at each airport is being promoted.

In addition, in light of the urgent need for decarbonization in the aviation sector, Japan revised the *Aviation Law*, which includes the development of the *Basic Policy for the Promotion of Decarbonization of Aviation* by the government, the preparation of the *Air Transport Business Decarbonization Promotion Plan* by air transport operators based on this basic policy above, and the approval of this plan by the government. The *Aviation Law* was promulgated in June 2022.

(2) Initiative for aircraft operations

(Sustainable Aviation Fuel (SAF))

SAF (Sustainable Aviation Fuel, including bio-jet fuel) has a significant CO_2 reduction effect compared to conventional fossil-origin jet fuel, and its use is essential to achieve the ICAO global reduction target, which is no increase in total emissions from international aviation after 2020. Therefore, the introduction of SAF is an urgent issue in Japan. The government, airlines, fuel suppliers, and others are cooperating to consider promotion measures for the introduction of SAF. In addition, since Japan believes that it is important to set a target of SAF as a direction for steady progress and as a milestone for the initiatives, Japan has set a target of "replacing 10% of fuel consumption by Japanese airlines with SAF" for the SAF consumption in 2030.

Based on this target, Japan will work with related ministries and agencies, airlines, fuel suppliers, and others to promote the development of domestically produced SAF, the establishment of a supply chain including imported mixed SAF, and the development of international standards toward the introduction of SAF.

(Improvement of flight operations by renovating air navigation service)

In response to the increase in air traffic, Japan is working to reduce fuel consumption and CO_2 emissions while ensuring safety through the introduction of new technologies and approaches to advance air traffic control.

While taking into account future developments in air traffic systems and trends in technological development, Japan will work to optimize air traffic as a whole and promote improvement measures for each situation, such as air routes, departures and arrivals, and airports.

(Introduction of new technologies for aircraft and equipment)

The development of low-carbon airframe and engine technologies is expected worldwide in the future. It is necessary to promote the spread of fuel-efficient airframes and low-carbon technologies to strengthen the international competitiveness of Japan's manufacturers.

Based on the background, NEDO will work on the "Project for Development of Core Technologies for Hydrogen Aircraft" and the "Project for Development of Complex Shapes and Dramatic Weight Reduction of Major Structural Parts of Aircraft" over a period of up to 10 years from FY 2021 to FY 2030. In addition, NEDO will work on the "Project for Technology Development of Next Generation Electric Aircraft" from FY 2019 to FY 2023 and the "Project for Technology Development of Next Generation Composite Materials Creation" from FY 2020 to FY 2024.

Aircraft technology requires extremely high safety. It is necessary for companies and the government to work together to consider safety standards in parallel with the development of technologies in order to achieve early commercialization of new technologies for which standards are currently being developed. In FY 2022, a public-private council consisting of manufacturers, industry associations, airlines, airports, research institutes, academia, and relevant ministries and agencies, are established to develop a plan including (1) selection of target technologies for priority consideration and introduction of safety standards and (2) approaches to consider and implement safety standards for each target technology.

(3) Initiative for airport

For the airports, the *Guidelines for the Realization of Environmentally Friendly Airports* (Eco-Airport Guidelines) (First Edition) was developed in 2003, and voluntary efforts for environmental measures in each airport, including low carbonization of an airport, have been promoted. In addition, the Committee on CO_2 Reduction in the Airport was established in 2021 to examine measures to reduce CO_2 emissions from airport facilities and vehicles, as well as measures to introduce renewable energy based on the characteristics of airports. In February 2022, the committee developed the *Policy for Airport Decarbonization*.

Japan will promote measures to reduce CO_2 emissions from airport facilities, airport vehicles, and ground-based aircraft and introduce renewable energy at airports in cooperation with airport-related stakeholders (airport administrators, airport buildings, airlines, and other businesses within airports) and other parties with the know-how of decarbonization. Also, Japan will develop guidelines and maintenance manuals to serve as a reference for the preparation of medium- and long-term targets for 2030 and 2050 and action plans at each airport.

■ Policies and measures for international shipping

Regarding international shipping, discussions to review the GHG reduction strategy adopted in 2018 at the IMO began at the 77th session of the IMO Marine Environment Protection Committee held in November 2021, and the review is scheduled to be completed in summer 2023. The EEXI (Energy efficiency regulations for existing ships) and CII (Rating of fuel efficiency performance) systems adopted at the 76th meeting of the IMO Marine Environment Protection Committee in June 2021 are scheduled to come into effect in Japan in January 2023. This will accelerate efforts to decarbonize international shipping. Japan aims to reach an international agreement on a common global goal of achieving carbon neutrality of emissions from international shipping by 2050 and will lead discussions on the introduction of an effective approach (economic approach) to realize GHG emission reductions through the use of market mechanisms.

In addition, since it is essential to convert fuels to hydrogen and ammonia, etc., which do not emit GHGs to achieve carbon neutrality in international shipping, Japan started the "Development of

Next-Generation Ships" project using the Green Innovation Fund in October 2021 and is supporting the development and demonstration of engines, fuel tanks, fuel supply systems, and other core technologies for zero-emission ships using hydrogen and ammonia. The ammonia-fueled ships are planned to start demonstration operations in 2026 and commercial operations as early as possible up to 2028. The hydrogen-fueled ships are planned to start demonstration operations in 2027 and commercial operations in 2030 or later.

Table 3-3 Progress in meeting quantified economy-wide emission reduction targets: information on mitigation actions and their effects (CTF Table 3)

Name of mitigation action	Sector(s) affected	Sub-sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in ktCO_2eq)									
										2013	2014	2015	2016	2017	2018	2019	2020	2025	2030
Reduction of CO_2 emission intensity in power sectors	Energy	Energy conversion	CO_2	Improving efficiency of thermal power generation	Law / Standard, Technology Development, Other	Implemented	Promotion of efforts by the electric power industry under a voluntary framework and follow-up of efforts under a voluntary framework by the government. Under the *Energy Conservation Act*, require power generation companies to meet power generation efficiency standards for newly constructed power generation facilities on a facility-by-facility basis. Also, require power generation companies that own coal-fired thermal power generation facilities to meet benchmark targets for power generation efficiency (on a per-unit basis) on par with state-of-the-art ultra-supercritical (USC) power generation facilities. Require retail electric utilities to increase the ratio of non-fossil power sources in the electricity they sell to more than the standard, in accordance with the Advanced Electricity Utilization Law. CCS initiatives based on the "Strategic Energy Plan" and the "Long-Term Strategy as a Growth Strategy Based on the Paris Agreement". Promotion of the adoption of BAT, taking into account future trends in the development of power generation technologies.	2016	METI	NE	4,200	4,500	6,200	6,700	8,500	9,300	10,600	NE	11,000
	Energy	Energy conversion	CO_2	Improving efficiency of thermal power generation, utilize nuclear power generation that has been confirmed safe, maximum introduction of renewable energy	Law / Standard, Technology Development, Other	Implemented	Promotion of efforts by the electric power industry under a voluntary framework and follow-up of efforts under a voluntary framework by the government. Under the *Energy Conservation Act*, require power generation companies to meet power generation efficiency standards for newly constructed power generation facilities on a facility-by-facility basis. Also, require power generation companies that own coal-fired thermal power generation facilities to meet benchmark targets for power generation efficiency (on a per-unit basis) on par with state-of-the-art ultra-supercritical (USC) power generation facilities. Require retail electric utilities to increase the ratio of non-fossil power sources in the electricity they sell to more than the standard, in accordance with the Advanced Electricity Utilization Law. CCS initiatives based on the "Strategic Energy Plan" and the "Long-Term Strategy as a Growth Strategy Based on the Paris Agreement". Promotion of the adoption of BAT, taking into account future trends in the development of power generation technologies.	2016	METI	NE	4,000	29,000	41,000	54,000	88,000	112,000	112,000	NE	353,000

Name of mitigation action	Sector(s) affected	Sub-sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in $ktCO_2eq$)									
										2013	2014	2015	2016	2017	2018	2019	2020	2025	2030
Maximum introduction of renewable energy	Energy	Energy conversion	CO_2	Expand use of renewable electricity	Law / Standard, Taxation, Subsidy, Financing, Technology Development, Other	Implemented	Reduce CO_2 emissions from fossil fuel combustion by expanding the use of renewable energy as an energy source for power generation use and replacing fossil fuels	2012	METI	76,620	86,160	96,600	99,840	110,260	115,240	120,360	128,895	NE	206,700
	Energy	Energy conversion	CO_2	Expand use of renewable heat energy	Law / Standard, Taxation, Subsidy, Financing, Technology Development, Other	Implemented	Reduce CO_2 emissions from fossil fuel combustion b expanding the use of renewable energy as an energy source for heat utilization and replacing fossil fuels	2012	METI	29,800	30,350	30,390	30,370	31,310	30,840	31,320	31,870	NE	36,180
Promotion the introduction of facilities and equipment with high energy-saving performance (petroleum product manufacturing sector)	Energy	Energy conversion	CO_2	Effective use of heat, introduction of advanced control and high-efficiency equipment, improvement of power system operations, and large-scale improvements and upgrade of processes	Subsidy	Implemented	Promote efforts to achieve energy reductions equivalent to 1 million kL in crude oil equivalent from BAU by (1) effective use of heat, (2) introduction of advanced control and high-efficiency equipment, (3) improvement of power system operations, and (4) large-scale improvements and upgrade of processes, based on the Industry's Action Plans for a Low-Carbon Society in the petroleum product manufacturing sector by petroleum refiners.	2013	METI	75	300	529	721	979	1,098	1,141	1,128	1,412	2,047
Steady Implementation, evaluation and verification of Industry's Action Plans for a Low-Carbon Society	Energy	Cross-Cutting	CO_2	Steady Implementation, evaluation and verification of Industry's Action Plans for a Low-Carbon Society	Voluntary Agreement	Implemented	Each industry sets emission reduction targets and works to reduce GHG emissions by improving energy efficiency, developing and promoting low-carbon products, and making international contributions through technology transfers, etc.	1997	METI, MOE, FSA, NPA, MIC, MOF, NTA, MEXI, MHLW, MAFF, MLIT	-	-	-	-	-	-	-	-	-	-
Promotion of the introduction of facilities and equipment with high energy-saving performance (across industries)	Energy	Industry	CO_2	Introduction of high-efficiency air conditioning	Law / Standard, Taxation, Subsidy, Technology Development	Implemented	Introduction of high-efficiency air conditioning	2008	METI	46	93	147	205	260	306	398	447	860	690
	Energy	Industry	CO_2	Introduction of industrial Heat pump	Law / Standard, Taxation, Subsidy, Technology Development	Implemented	Introduction of industrial HP (heat pump)	2008	METI	2	19	36	51	71	92	108	117	660	1,610

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	Energy	Industry	CO_2	Introduction of industrial lighting	Law / Standard, Taxation, Subsidy, Technology Development	Implemented	Introduction of industrial high-efficiency lighting	2008	METI	670	1,259	1,881	2,552	3,252	3,902	4,532	5,102	8,442	2,931
	Energy	Industry	CO_2	Introduction of low-carbon industrial furnaces	Law / Standard, Taxation, Subsidy, Technology Development	Implemented	Introduction of low-carbon industrial furnaces	2008	METI	575	1,017	1,416	2,155	2,823	3,363	3,910	4,472	6,925	8,069
	Energy	Industry	CO_2	Introduction of industrial motors and inverters	Law / Standard, Taxation, Subsidy, Technology Development	Implemented	Introduction of industrial motors and inverters	2008	METI	338	673	1,141	1,695	2,075	2,370	2,654	2,924	10,820	7,608
	Energy	Industry	CO_2	Introduction of high-performance boilers	Law / Standard, Taxation, Subsidy, Technology Development	Implemented	Introduction of high-performance boilers	2008	METI	292	618	934	1,277	1,584	1,917	2,235	2,500	3,307	4,679
	Energy	Industry	CO_2	Introduction of cogeneration	Law / Standard, Taxation, Subsidy, Technology Development	Implemented	Introduction of cogeneration	2008	METI	410	630	970	1,273	1,490	2,006	2,542	3,324	6,942	10,610
Promotion of the introduction of facilities and equipment with high energy-saving performance (iron and steel industry)	Energy	Industry	CO_2	Improvement of efficiency of main electricity demand facilities	Subsidy, Technology Development	Implemented	Replace the main facilities that consume electricity in steel mills with higher efficiency equipment (oxygen plant with higher efficiency, blowers, compressed air plant with higher efficiency)	2008	METI	-4	34	26	-24	3	43	90	87	NE	100
	Energy	Industry	CO_2	Expansion of chemical recycle of waste plastics at steel mills	Subsidy, Technology Development	Implemented	Reduce the use of coal by effectively utilizing waste plastics, etc. collected based on the Law Concerning the Promotion of Sorted Collection and Recycling of Containers and Packaging by pyrolyzing them in a coke oven, etc.	2008	METI	-70	110	70	110	180	-40	20	-180	NE	2,120
	Energy	Industry	CO_2	Efficiency improvement of Coke Oven	Subsidy, Technology Development	Implemented	Reduce the energy consumption for coke production by upgrading the coke ovens in the coke production process.	2008	METI	-100	-322	-192	-287	-339	-200	-77	-178	NE	480
	Energy	Industry	CO_2	Improvement of power generation efficiency (Joint thermal power generation facilities)	Subsidy, Technology Development	Implemented	Replace power generation equipment in joint thermal power generation with high-efficiency equipment.	2008	METI	194	232	286	286	286	286	286	398	NE	440

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	Energy	Industry	CO_2	Improvement of power generation efficiency (In-house power generation facilities)	Subsidy, Technology Development	Implemented	Replace power generation equipment in in-house power generation with high-efficiency equipment	2008	METI	112	112	234	330	384	384	494	494	NE	700
	Energy	Industry	CO_2	Enhancement of energy-saving facilities	Subsidy, Technology Development	Implemented	Expand energy-saving facilities such as Top pressure Recovery Turbine (TRT) for blast furnace top pressure and utilization of waste heat such as Coke Dry Quenching (CDQ) in coke ovens	2008	METI	9	31	55	41	44	44	46	65	NE	650
	Energy	Industry	CO_2	Introduction of innovative pig iron making process (ferro coke)	Subsidy, Technology Development	Implemented	Reduce energy consumption by about 10% in the operating process of the blast furnace by using ferro coke, an innovative alternative coke reduction material made from low-grade coal and low-grade iron ore, to speed up and lower the temperature of the reduction reactions in the blast furnace.	2013	METI	0	0	0	0	0	0	0	0	NE	820
	Energy	Industry	CO_2	Introduction of Environmentally harmonious ironmaking processes	Subsidy, Technology Development	Implemented	Introduce innovative steelmaking processes that reduce CO_2 emissions by integrating technologies such as CO_2 capture from blast furnace gas, unused medium- and low-temperature heat recovery, coke modification, water amplification, and iron ore hydrogen reduction	2008	METI	0	0	0	0	0	0	0	0	NE	110
Promotion of the introduction of facilities and equipment with high energy-saving performance (chemical industry)	Energy	Industry	CO_2	Introduction of energy-saving process technologies in chemistry	Subsidy, Technology Development	Implemented	Work on energy-saving by recovery of energy and rationalization of processes, etc.	2008	METI	456	898	1,370	1,730	2,361	2,750	3,200	3,781	NE	3,891
	Energy	Industry	CO_2	Introduction of technology for using carbon dioxide as feedstocks	Subsidy, Technology Development	Implemented	Promote the development and introduction of new and innovative energy-saving technologies	2013	METI	NE	0	0	0	0	0	0	0	2	173
Promotion of the introduction of facilities and equipment with high energy-saving performance (cement and ceramic industry)	Energy	Industry	CO_2	Conventional energy-saving technology	Subsidy	Implemented	Promote energy-saving in the cement manufacturing process by introducing equipment that can use thermal and electrical energy at high efficiency.	2008	METI	5	11	19	21	24	27	43	40	NE	64
	Energy	Industry	CO_2	Technology to use waste as a substitute for thermal energy	Subsidy	Implemented	Promote energy-saving in the cement manufacturing process by promoting the use of waste as an alternative to thermal energy.	2008	METI	-82	-60	121	260	260	243	328	424	127	192

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	Energy	Industry	CO_2	Innovative cement production process	Subsidy	Implemented	Achieve energy-saving in the cement manufacturing processes while ensuring the same quality as conventional products through practical application and introduction of advanced process technology	2010	METI	0	0	0	0	0	0	0	0	122	408
	Energy	Industry	CO_2	Glass melting process technology	Subsidy	Implemented	Achieve energy-saving in the glass manufacturing processes while ensuring the same quality as conventional products through practical application and introduction of advanced process technology	2008	METI	0	0	0	0	0	0	0	0	41	81
Promotion of the introduction of facilities and equipment with high energy-saving performance (pulp, paper, and paper product industry)	Energy	Industry	CO_2	Introduction of high-efficiency used paper pulping process technology	Subsidy	Implemented	Reduce operational energy consumption by supporting the introduction of pulpers that can more efficiently mix used paper and water and dissociate the used paper than conventional types in the used paper pulping process	2008	METI	5	19	43	46	54	57	76	81	92	105
Promotion of the introduction of facilities and equipment with high energy-saving performance (construction work and use of special vehicles)	Energy	Industry	CO_2	Introduction of hybrid construction equipment, etc.	Law / Standard, Subsidy, Financing, Technology Development, Awareness Raising	Implemented	In the short term, the goal is to reduce CO_2 emissions by promoting the use of construction equipment with high fuel efficiency. In the long term, a certification system for innovative construction machinery (electric, hydrogen, biomass, etc.) based on a radical conversion from the light oil-fueled power source will be established, and its introduction and widespread use will be promoted in order to achieve carbon neutrality. In addition, by promoting i-Construction and other such measures as the spread of construction using the information and communication technology (ICT) among small and medium-sized construction companies that carry out construction work for local governments, efficiency and labor saving in construction and maintenance will be further improved to cope with the declining number of skilled workers.	2010	METI	7	15	28	43	59	74	87	97	266	443
Promotion of the introduction of facilities and equipment with high energy-saving performance (horticulture, agricultural machinery, and fisheries)	Energy	Industry	CO_2	Introduction of energy-saving equipment in horticulture facilities	Subsidy, Awareness Raising	Implemented	Reduce the fuel oil consumption by installing energy-saving heating equipment in horticulture facilities, etc., and reduce CO_2 emissions from fuel oil (mainly heavy oil A) combustion in heating equipment	2007	MAFF	NE	180	290	390	480	580	680	760	1,150	1,550
	Energy	Industry	CO_2	Introduction of energy-saving agricultural machinery	Subsidy, Awareness Raising	Implemented	Reduction of fuel oil consumption in agricultural machinery	2007	MAFF	0	0	0	0	0	0	0	1	3	8

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	Energy	Industry	CO_2	Energy-saving on fishing vessels	Subsidy, Awareness Raising	Implemented	Conversion to energy-saving fishing vessels	2007	MAFF	NE	10	21	31	41	50	60	71	132	194
Promotion of energy conservation initiatives through inter-industry collaboration	Energy	Industry	CO_2	Promotion of energy conservation initiatives through inter-industry collaboration	Law / Standard, Taxation, Subsidy	Implemented	Promote energy conservation initiatives through cooperation among multiple operators	2013	METI	0	0	53	92	194	220	336	447	710	780
Promotion of fuel conversion	Energy	Industry	CO_2	Promotion of fuel conversion	Subsidy	Implemented	Reduction of CO_2 emissions at factories and business sites through fuel conversion from coal, heavy oil, etc., to gas, etc., which is a highly effective CO_2 reduction measure and can be steadily implemented.	2014	MOE	NE	204	260	420	449	582	760	869	1,510	2,110
Implementation of thorough energy management using FEMS	Energy	Industry	CO_2	Implementation of thorough energy management using FEMS	Law / Standard, Taxation, Subsidy, Technology Development	Implemented	Reduce energy consumption through the introduction of factory energy management systems (FEMS) and energy management based on these systems.	2013	METI	150	213	274	318	319	420	680	509	2,380	2,000
Improvement of the energy efficiency of buildings	Energy	Commercial	CO_2	Improvement of the energy efficiency of buildings (new buildings)	Law / Standard, Taxation, Subsidy, Technology Development, Awareness Raising, Other	Implemented	Reduce CO_2 emissions from energy consumed in buildings by increasing the proportion of energy-efficient building stock.	2003	MLIT	125	540	960	1,611	2,031	2,521	2,725	0	NE	10,100
	Energy	Commercial	CO_2	Improvement of the energy efficiency of buildings (renovation and reconstruction of existing buildings)	Law / Standard, Taxation, Subsidy, Technology Development, Awareness Raising, Other	Implemented	Reduce CO_2 emissions from energy consumed in buildings by increasing the proportion of energy-efficient building stock.	2003	MLIT	91	179	325	438	794	896	1,321	0	NE	3,550
Promotion of high-efficiency energy-saving equipment	Energy	Commercial	CO_2	Installation of energy-efficient commercial water heaters	Law / Standard, Subsidy, Technology Development	Implemented	Reduction of energy consumption by establishing appropriate management methods in the installation of high-efficiency water heaters.	2008	METI	50	139	227	319	411	511	657	726	1,150	1,410
	Energy	Commercial	CO_2	Introduction of high-efficiency lighting	Law / Standard, Subsidy, Technology Development	Implemented	Reduction of energy consumption by establishing appropriate management methods in the installation of high-efficiency lighting.	2008	METI	980	2,389	3,877	5,115	6,594	8,028	9,377	10,567	12,570	6,720
	Energy	Commercial	CO_2	Introduction of refrigerant management technology	Law / Standard, Subsidy, Technology Development	Implemented	Reduction of energy consumption by establishing appropriate management methods in the installation of refrigeration and air conditioning equipment.	2014	METI	235	256	269	288	299	346	323	318	216	16

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Improvement of energy efficiency of equipment through Top Runner Programs	Energy	Commercial	CO_2	Improvement of energy efficiency of equipment through Top Runner Programs	Law / Standard, Taxation, Subsidy, Technology Development, Awareness Raising	Implemented	Reduce the energy consumption of equipment in the commercial sector by promoting the improvement of energy consumption efficiency of top runner equipment.	1998	METI	520	820	1,122	1,439	1,753	2,534	3,027	3,816	13,000	9,200
Implementation of thorough energy management through the use of BEMS, and Energy Conservation diagnosis	Energy	Commercial	CO_2	Implementation of thorough energy management through the use of BEMS, and Energy Conservation diagnosis	Law / Standard, Subsidy, Technology Development	Implemented	Reduce energy consumption by installing BEMS and conducting energy efficiency audits to gain a detailed understanding of the energy usage status of commercial facilities (buildings, etc.) and control equipment based on this understanding.	1998	METI	560	950	1,283	1,618	2,015	2,307	2,529	2,920	6,280	6,440
Promotion of local production for local consumption and areal use of energy	Energy	Commercial	CO_2	Promotion of local production for local consumption and areal use of energy	Subsidy, Other	Implemented	Promote local production for local consumption and areal use of energy	2008	METI	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Decarbonization of urban areas through improvement of the thermal environment by heat island control	Energy	Commercial	CO_2	Decarbonization of urban areas through improvement of the thermal environment by heat island control	Law / Standard	Implemented	Promote low-carbon urbanization through the improvement of the thermal environment with rooftop greening and other heat-island countermeasures.	2008	MLIT	0	8	13	20	25	26	29	33	36	33
Introduction of energy conservation and renewable energy in water supply and sewage (waterworks)	Energy	Commercial	CO_2	Promotion of energy conservation and renewable energy measures in waterworks	Subsidy, Awareness Raising	Implemented	Reduce CO_2 emissions from electricity use through the implementation of energy conservation and renewable energy measures by waterworks operators and water supply companies nationwide.	2016	MHLW	0	31	18	6	-31	-8	-3	0	320	216
Introduction of energy conservation and renewable energy in water supply and sewage (sewage systems)	Energy	Commercial	CO_2	Promotion of energy conservation and energy creation measures in sewage systems	Law / Standard, Taxation, Subsidy, Technology Development, Awareness Raising	Implemented	Promote through digital transformation (DX), the sophistication and efficiency of facility management as well as the introduction of energy-saving equipment and renewable energy sources, such as solar power and swage heat, also reduce CO_2 emissions through power generation using sewage sludge-derived solid fuel etc., and through substitution of fossil fuels by supplying solid fuel.	2016	MLIT	NE	160	281	347	540	639	590	0	1,380	1,300
Initiatives in waste treatment	Energy	Commercial	CO_2	Promotion of sorted collection and recycling of plastic containers and packaging	Law / Standard, Subsidy, Other	Implemented	Promote sorted collection and recycling (material recycling and chemical recycling) of plastic containers and packaging based on the Containers and Packaging Recycling Law.	2000	MOE	NE	62	62	61	59	-65	69	75	44	62

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	Energy	Commercial	CO_2	Introduction of waste power generation at general waste incineration plants	Law / Standard, Subsidy, Other	Implemented	Reduce energy-related CO_2 emissions associated with the use of electricity by installing high-efficiency power generation equipment at the time of new construction, renewal, or core improvement of waste incineration facilities, depending on the size of the facility.	2016	MOE	NE	16	151	467	688	808	985	0	2,001	1,242
	Energy	Commercial	CO_2	Introduction of waste power generation at industrial waste incineration plants	Law / Standard, Subsidy, Other	Implemented	Reduce energy-related CO_2 emissions from fuel combustion by manufacturing fuel from waste plastics and paper waste, replacing fossil fuels used in manufacturing and other industries.	2003	MOE	NE	256	188	180	195	288	445	0	415	201
	Energy	Commercial	CO_2	Promote fuel production and energy conservation measures in the industrial waste management industry	Law / Standard, Subsidy, Other	Implemented	Reduce energy-related CO_2 emissions from fuel use by promoting energy conservation measures such as the introduction of fuel-efficient waste collection and transportation vehicles and treatment facilities, and initiatives to conserve electricity.	2016	MOE	NE	-46	23	194	220	248	196	0	888	1,345
	Energy	Commercial	CO_2	Introduction of EV waste collection vehicles	Law / Standard, Subsidy, Other	Implemented	Reduce CO_2 emissions from the waste collection vehicles by replacing the current internal combustion engine waste collection vehicles with EV waste collection vehicle, which is fully electric from driving to loading	2013	MOE	0	0	0	0	0	0	0	0	12	150
Improvement of Energy Efficiency of Housing	Energy	Residential	CO_2	Improvement of energy efficiency of housing (new housing)	Law / Standard, Taxation, Subsidy, Financing, Technology Development, Awareness Raising, Other	Implemented	Reduce CO_2 emissions from residential energy consumption by increasing the proportion of energy-efficient housing stock.	2003	MLIT	0	207	337	601	895	1,290	1,112	0	NE	6,200
	Energy	Residential	CO_2	Improvement of energy efficiency of housing (renovation and reconstruction of existing housing)	Law / Standard, Taxation, Subsidy, Financing, Technology Development, Awareness Raising, Other	Implemented	Reduce CO_2 emissions from residential energy consumption by increasing the proportion of energy-efficient housing stock.	2003	MLIT	NE	39	112	178	243	303	691	0	NE	2,230
Diffusion of high-efficiency energy-saving equipment	Energy	Residential	CO_2	Installation of high-efficiency water heaters	Law / Standard, Subsidy, Technology Development	Implemented	Reduction of energy consumption by installing high-efficiency water heaters.	2013	METI	180	507	837	1,181	1,549	1,937	2,351	3,023	6,400	8,980
	Energy	Residential	CO_2	Introduction of high-efficiency lighting	Law / Standard, Subsidy, Technology Development	Implemented	Reduction of energy consumption by installing high-efficiency lighting.	2008	METI	730	2,052	3,312	4,990	6,516	7,950	9,320	10,540	12,570	6,510

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Diffusion of high-efficiency energy-saving equipment (energy-saving septic tanks)	Energy	Residential	CO_2	Promotion of energy-efficient septic tank maintenance (introduction of advanced energy-efficient household septic tanks)	Subsidy	Implemented	Reduce the electricity consumption and CO_2 emissions associated with the use of electricity by installing advanced energy-saving septic tanks that consume 26% less electricity than the current low-carbon society-compatible septic tanks when installing new septic tanks	2016	MOE	NE	NE	11	15	19	23	27	27	61	49
	Energy	Residential	CO_2	Promotion of energy-efficient septic tank maintenance (replacement of existing medium- and large-sized septic tanks with low energy-efficiency performance)	Subsidy	Implemented	Reduce the electricity consumption and CO_2 emissions associated with the use of electricity by replacing existing medium- and large-sized septic tanks with new ones that have low energy efficiency when renewing septic tanks.	2022	MOE	NE	NE	16	23	27	31	37	46	92	74
Improvement of energy-saving performance of equipment through the Top Runner Program, etc.	Energy	Residential	CO_2	Improvement of energy-saving performance of equipment through the Top Runner Program	Law / Standard, Subsidy, Technology Development, Awareness Raising	Implemented	Reduce the energy consumption of equipment in the residential sector by promoting the improvement of energy consumption efficiency of top-runner equipment,	1998	METI	243	600	964	1,195	1,497	1,595	1,751	2,096	7,134	4,757
Implementation of thorough energy management through the use of HEMS, smart meters, and smart home devices and the provision of energy-saving information	Energy	Residential	CO_2	Implementation of thorough energy management through the use of HEMS, smart meters, and smart home devices	Subsidy, Technology Development, Awareness Raising	Implemented	Reduction of energy consumption through a detailed understanding of household energy consumption status and device control based on this understanding by introducing HEMS, smart meters, and smart home devices, and promotion of household energy-saving activities through the provision of information by energy retailers, etc.	2010	METI	24	32	41	52	58	68	82	1,272	3,658	5,691
Diffusion of next-generation vehicles, improvement of fuel efficiency, etc.	Energy	Transport	CO_2	Diffusion of next-generation vehicles, improvement of fuel efficiency	Law / Standard, Taxation, Subsidy, Financing, Technology Development, Awareness Raising	Implemented	Reduce energy consumption by diffusion of next-generation vehicles and improvement of fuel efficiency, as well as reduce CO_2 by developing a supply system for biofuels.	1979	METI	533	1,315	2,275	2,398	3,430	4,408	5,463	6,401	NE	26,740
Implementation of measures for road traffic flow	Energy	Transport	CO_2	Implementation of measures for road traffic flow	Other	Implemented	Promote traffic congestion countermeasures using ETC2.0 as well as connecting arterial road networks, including ring roads, in order to improve the driving speed	2012	MLIT	NE	NE	1,000	NE	NE	NE	NE	0	NE	2,000
Promotion of the installation of LED road lighting	Energy	Transport	CO_2	Promotion of the installation of LED road lighting	Law / Standard, Technology Development, Other	Implemented	Promote further energy-saving and advancement for road lighting and the use of LED road lighting.	2012	NPA	NE	NE	NE	NE	NE	NE	NE	40	50	130

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Promotion of intelligent transport system (ITS) (centralized control of traffic signals)	Energy	Transport	CO_2	Promotion of intelligent transport system (ITS) (centralized control of traffic signals)	Subsidy	Implemented	Reduce CO_2 emissions from automobiles by smoothing traffic flow and improving fuel efficiency through centralized control of traffic signals.	2012	NPA	1,330	1,370	1,400	1,400	1,410	1,410	1,420	1,420	1,440	1,500
Installation of traffic safety facilities (improvement of traffic signals and profiling [hybrid]	Energy	Transport	CO_2	Installation of traffic safety facilities (improvement of traffic signals and profiling [hybrid]	Subsidy	Implemented	Reduce CO_2 emissions from automobiles by improving traffic signals to facilitate traffic flow and improve fuel efficiency.	2012	NPA	470	490	500	500	500	500	500	510	520	560
Installation of traffic safety facilities (promotion of the installation of LED traffic lights)	Energy	Transport	CO_2	Installation of traffic safety facilities (promotion of the installation of LED traffic lights)	Subsidy	Implemented	Reduce energy consumption and CO_2 emissions by converting from bulb-type signal lights to LED-type signal lights	2012	NPA	65	98	103	110	114	113	117	126	122	110
Promotion of automated driving	Energy	Transport	CO_2	Promotion of automated driving	Technology Development	Implemented	Reduce energy consumption in transportation by utilizing auto-driving technology such as ACC/CACC technology, etc.	2012	METI	56	72	96	129	170	217	262	437	833	1,687
Greening of the vehicle transportation business by promoting the use of environmentally friendly vehicles etc.	Energy	Transport	CO_2	Greening of vehicle transportation business by promoting the use of environmentally friendly vehicles etc.	Subsidy, Awareness Raising	Implemented	Reduction of CO_2 emissions by promoting the use of environmentally friendly automobiles, etc.	2012	MLIT	0	8	42	249	492	670	710	690	752	1,012
Promotion of the use of public transportation	Energy	Transport	CO_2	Promotion of the use of public transportation	Taxation, Subsidy, Awareness Raising	Implemented	Reduce CO_2 emissions from the use of private automobiles by promoting the use of existing railway (e.g., by improving the convenience of railway stations), subsidies and tax incentives to promote the use of buses (e.g., by introducing bus location systems), and the spread of eco-commuting to encourage people to change their behavior, including the way they use their cars in their daily lives.	1992	MLIT	NE	235	1,037	796	559	403	98	0	1,310	1,620
	Energy	Transport	CO_2	Improving route efficiency through regional public transportation convenience improvement projects	Taxation, Subsidy, Awareness Raising	Implemented	Ensure means of transportation with reduced environmental impact by enhancing and improving the convenience of regional public transportation utilizing the Regional Public Transportation Revitalization Act, promote the spread of MaaS that can meet various needs, and develop public transportation systems such as new railway lines, LRT, and BRT to encourage people to change their behavior, including how they use cars in their daily lives, and reduce CO_2 emissions associated with private vehicle use.	2020	MLIT	NE	NE	NE	NE	NE	NE	NE	9	16	23

Name of mitigation action	Sector(s) affected	Sub-sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in $ktCO_2eq$)									
										2013	2014	2015	2016	2017	2018	2019	2020	2025	2030
Promotion of the use of bicycles	Energy	Transport	CO_2	Promotion of the use of bicycles	Law / Standard, Other	Implemented	Reduce CO_2 emissions associated with the use of private cars by promoting a shift from the use of private cars to bicycles by creating a safe and comfortable bicycle use environment	2017	MLIT	NE	NE	0	NE	NE	NE	NE	0	140	280
Decarbonization of the railways	Energy	Transport	CO_2	Promotion of decarbonization of railways	Law / Standard, Taxation, Subsidy, Technology Development	Implemented	Promote the introduction of energy-efficient vehicles, such as VVVF-equipped vehicles, storage battery vehicles and hybrid vehicles, and the installation of energy-saving equipment in railway facilities.	2005	MLIT	NE	172	387	670	1,007	1,583	2,428	2,860	1,835	2,600
Decarbonization of the shipping sector	Energy	Transport	CO_2	Promotion of energy-saving and CO2 emission-saving vessels	Taxation, Subsidy, Financing, Technology Development, Other	Implemented	Promote energy-saving and CO_2 emission-saving vessels through the Domestic Vessel Energy Saving Rating System etc. and also promote technological development, demonstration, and introduction of vessels, including LNG-fueled vessels, hydrogen-fueled vessels, and EV vessels that also contribute to the modernization and better operational efficiency in coastal shipping using innovative energy-saving technologies and digital technologies etc.	2005	MLIT	NE	-79	286	224	384	411	458	962	1,180	1,810
Decarbonization of the aviation sector	Energy	Transport	CO_2	Promotion of decarbonization of aviation	Technology Development, Law / Standard, Subsidy, Other	Implemented	Promote the introduction of new technologies in aircraft and equipment, improvement of flight operation methods by upgrading air traffic control, promotion of the introduction of sustainable aviation fuel (SAF), and reduction of CO2 emissions from airport facilities and airport vehicles, and promote public-private partnerships by examining measures to turn airports into renewable energy hubs	2005	MLIT	NE	468	880	807	816	871	970	6,261	1,410	2,024
Efficiency improvement of truck transportation	Energy	Transport	CO_2	Efficiency improvement of truck transportation	Law / Standard, Taxation, Subsidy, Awareness Raising	Implemented	Reduce CO_2 emissions by promoting efficiency improvement of truck transportation	2001	MLIT	NE	348	573	900	2,619	3,730	5,364	6,597	8,580	11,800
Promotion of joint transportation and delivery	Energy	Transport	CO_2	Promotion of joint transportation and delivery	Law / Standard, Subsidy, Awareness Raising	Implemented	Promote reduction of redelivery of parcels through joint transportation and delivery by carriers, etc.	2001	MLIT	0	12	13	15	19	19	19	0	44	50
	Energy	Transport	CO_2	Social implementation of drone logistics	Law / Standard, Subsidy, Awareness Raising	Implemented	Reduce CO_2 emissions by promoting the social implementation of drone logistics	2020	MLIT	NE	NE	NE	NE	NE	NE	NE	0	5	65

Name of mitigation action	Sector(s) affected	Sub-sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in $ktCO_2eq$)									
										2013	2014	2015	2016	2017	2018	2019	2020	2025	2030
Promotion of a modal shift to marine transportation	Energy	Transport	CO_2	Promotion of a modal shift to marine transportation	Law / Standard, Taxation, Subsidy, Financing, Awareness Raising	Implemented	Promote modal shift from truck transportation to coastal shipping through the introduction of vessels that contribute to reducing energy and CO_2 emissions, new vessels and equipment, and the application of the *Energy Conservation Act*.	2001	MLIT	NE	33	225	615	481	510	622	0	1,369	1,879
Promotion of a modal shift to rail freight transportation	Energy	Transport	CO_2	Promotion of a modal shift to rail freight transportation	Law / Standard, Taxation, Subsidy, Awareness Raising	Implemented	Promote modal shift from truck transportation to freight rail transportation because the CO_2 emission intensity of freight rail is 1/13 compared to that of trucks for business use.	2001	MLIT	NE	28	141	96	168	-314	-151	0	424	1,466
Promotion of decarbonization of logistics facilities	Energy	Transport	CO_2	Promotion of decarbonization of logistics facilities	Subsidy	Implemented	Reduce electricity consumption through the use of lighting and air-conditioning equipment by introducing energy-saving, man-free equipment such as forklift trucks and AGVs to create man-free zones. At the same time, achieve decarbonization of warehouses and other logistics facilities by installing photovoltaic power generation and other renewable energy facilities.	2020	MLIT	NE	NE	NE	NE	NE	NE	NE	1	NE	110
Reduction of the distance of land transportation of cargo through optimal selection of ports and harbors	Energy	Transport	CO_2	Reduction of the distance of land transportation of cargo through optimal selection of ports and harbors	Subsidy	Implemented	Reduce the travel distance for truck transportation by developing ports where vessels can call at ports will enable marine transportation to the nearest port	2016	MLIT	NE	168	192	249	301	301	301	301	960	960
Comprehensive decarbonization of ports and harbors	Energy	Transport	CO_2	Comprehensive decarbonization of ports and harbors [Promote introduction of energy-efficient cargo handling machinery, etc.]	Subsidy	Implemented	Promote the introduction of energy-efficient cargo handling machinery	2016	MLIT, MOE	NE	3	4	6	7	10	13	13	20	27
	Energy	Transport	CO_2	Comprehensive decarbonization of ports and harbors [promotion of modal shift and transportation efficiency improvement by utilizing marine transportation related to venous logistics]	Subsidy	Implemented	Promote modal shift and transportation efficiency related to venous logistics	2016	MLIT, MOE	NE	6	18	33	55	86	117	31	133	145

Name of mitigation action	Sector(s) affected	Sub-sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in $ktCO_2eq$)									
										2013	2014	2015	2016	2017	2018	2019	2020	2025	2030
Utilization of the Special Zones for Structural Reform system related to global warming countermeasures	Energy	Transport	CO_2	Utilization of the Special Zones for Structural Reform system related to global warming countermeasures	Law / Standard	Implemented	Reduce CO_2 emissions by reducing the number of carriages transporting steel products to public wharves by using special exception measures (projects to improve port logistics efficiency using special large-size transportation vehicles). Also, reduce CO_2 emissions by using special measures (special measures for the use of pipelines for the transport of specially controlled industrial waste).	2016	CAO	53	53	53	53	53	53	53	53	53	53
Expansion of the use of blended cement	Industry/Industrial Processes		CO_2	Expansion of the use of blended cement	Law / Standard, Awareness Raising, Other	Implemented	Reduce the amount of clinker, an intermediate product of cement, by expanding the use of blended cement, and reducing the amount of CO_2 produced by chemical reactions in the clinker manufacturing process from the raw material (black ash).	2001	METI, MLIT,MOE	NE	0	0	0	0	0	0	0	NE	388
Fluorinated Gases: (HFCs, PFCs, SF_6, NF_3)	Industry/Industrial Processes		HFCs,PFCs, SF_6,NF_3	Promotion of non-fluorocarbons and low GWP products in gas and product manufacturing fields	Law / Standard, Subsidy, Technology Development, Awareness Raising, Other	Implemented	Promote non-fluorocarbons and low-GWP products to gas and equipment manufacturers in accordance with the Act on Rational Use and Appropriate Management of Fluorocarbons.	2015	MOE, METI	NE	148	141	547	551	1,317	1,755	3,059	8,910	14,630
	Industry/Industrial Processes		HFCs,PFCs, SF_6,NF_3	Preventing leakage of fluorocarbons from the use of refrigeration and air-conditioning equipment for business use	Law / Standard, Subsidy, Technology Development, Awareness Raising, Other	Implemented	Request equipment users to take measures against leakage during use through inspections	2015	MOE, METI	NE	NE	NE	NE	NE	NE	NE	NE	13,300	21,500
	Industry/Industrial Processes		HFCs,PFCs, SF_6,NF_3	Recovery of fluorocarbons from waste business- use refrigeration and air-conditioning equipment	Law / Standard, Subsidy, Technology Development, Awareness Raising, Other	Implemented	Promote the recovery of fluorocarbons, for which measures were strengthened by the 2022 amendment of the law, and promote measures throughout the entire life cycle of fluorocarbons	2001	MOE, METI	NE	-19	-327	-288	12	32	-54	-208	13,500	16,900
	Industry/Industrial Processes		HFCs,PFCs, SF_6,NF_3	Recovery and proper disposal of fluorocarbons from waste household air conditioners	Law / Standard, Subsidy, Technology Development, Awareness Raising, Other	Implemented	Promote collection of waste household air conditioners based on the Act on Recycling of Specified Kinds of Home Appliances, and increase the amount of HFCs recovered contained as a refrigerant.	2021	MOE,METI	NE	NE	NE	NE	NE	NE	0	0	620	1,130
	Industry/Industrial Processes		HFCs,PFCs, SF_6,NF_3	Promotion of voluntary initiatives by industry	Law / Standard, Subsidy, Technology Development, Awareness Raising, Other	Implemented	Require comprehensive measures through emission controls based on the industry's voluntary action plans.	1998	MOE, METI	NE	244	179	193	221	223	221	206	880	1,220

Name of mitigation action	Sector(s) affected	Sub-sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in $ktCO_2eq$)									
										2013	2014	2015	2016	2017	2018	2019	2020	2025	2030
CH_4 emission reduction from rice cultivation	Agriculture		CH_4	Measure to reduce GHG emissions in agricultural soils [CH4 emission reduction from rice cultivation]	Law / Standard, Subsidy, Awareness Raising, Other	Implemented	Promote reduction of CH_4 emissions from rice cultivation by prolonging the mid-season drainage period, which reduces CH_4 generation as water management for rice cultivation	2007	MAFF	NE	-20	120	-70	20	40	110	70	NE	1,040
N_2O emission reduction associated with fertilizer application	Agriculture		N_2O	N2O emission reduction associated with fertilizer application	Subsidy, Awareness Raising	Implemented	Reduce N_2O emissions generated by fertilizer application by reducing the amount of fertilizer applied, using a divided application, and using slow-release fertilizers.	2007	MAFF	NE	51	123	93	40	-5	0	0	156	244
Policies and measures for forest sink	LULUCF		CO_2	Policies and measures for forest sink	Law / Standard, Taxation, Subsidy, Financing, Technology Development, Awareness Raising	Implemented	Based on the Basic Plan for Forests and Forestry and utilizing a variety of policies and measures, the government will secure CO_2 removals by forests by promoting forest sink measures such as the development of healthy forests through appropriate thinning and afforestation, appropriate management and conservation of security forests, efforts to foster efficient and stable forest management, forestation with public participation, and the use of wood and woody biomass.	2007	MAFF	51,690	52,210	49,790	47,310	47,630	46,550	42,790	40,510	NE	38,000
Policies and measures to increase carbon sinks in agricultural soils	LULUCF		CO_2	Measures to increase carbon sinks in agricultural soils	Law / Standard, Subsidy, Awareness Raising, Other	Implemented	Promote carbon sequestration in cropland and grassland soils by promoting soil preparation through the application of organic matter such as compost and green manure.	2008	MAFF	1,450	130	950	1,490	2,460	3,320	2,520	2,710	NE	8,500
Promotion of urban greening	LULUCF		CO_2	Promotion of urban greening	Law / Standard, Subsidy	Implemented	Promote greening in urban parks, roads, ports, etc.	2006	MLIT	1,150	1,170	1,190	1,210	1,230	1,240	1,270	1,279	1,220	1,240
Diffusion of biomass plastics	Waste management/Waste		CO_2	Diffusion of biomass plastics	Law / Standard, Subsidy, Technology Development, Other	Implemented	Promote the use of carbon-neutral biomass plastics to replace petroleum-based plastics used in products, thereby reducing non-energy related CO_2 dioxide emissions from the incineration of plastics, both general and industrial waste. Present policies and measures to expand the introduction of biomass plastics in the "Biomass Plastics Road Map" (formulated in January 2021). Develop guidelines for environmentally friendly design by the Act on the Promotion of Resource Circulation related to Plastics, and the government certify designs that comply with the guidelines, leading to increased use of plastic.	2016	MOE	0	-5	-6	5	7	13	20	0	1,410	2,090

Name of mitigation action	Sector(s) affected	Sub-sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in $ktCO_2eq$)									
										2013	2014	2015	2016	2017	2018	2019	2020	2025	2030
Reduction of waste incineration	Waste management/Waste		CO_2	Promotion of recycling of waste plastics	Law / Standard, Technology Development, Awareness Raising	Implemented	Reduce non-energy-related CO_2 emissions associated with the incineration of plastics by reducing incineration of municipal waste plastics by controlling their discharge and promoting recycling through sorted collection and recycling of plastic resources Reduce non-energy-related CO_2 emissions associated with the incineration of plastics by reducing incineration of industrial waste plastics by promoting the 3Rs	2013	MOE	0	1,190	1,430	2,030	2,210	3,020	3,240	3,870	4,980	6,400
	Waste management/Waste		CO_2	Promotion of recycling of waste oil	Law / Standard, Technology Development, Awareness Raising	Implemented	Reduce non-energy-related CO_2 emissions from incineration by reducing the amount of industrial waste oil incinerated by promoting the 3Rs and other measures	2013	MOE	0	74	74	0	74	99	49	-10	398	699
Reduction of final waste disposal	Waste management/Waste		CH_4	Reduction of final waste disposal	Law / Standard, Awareness Raising	Implemented	Reduce the amount of direct landfilled organic solid waste by banning direct landfill of organic solid waste. Reduce CH_4 emissions from the decomposition of organic municipal waste in landfill sites. Continue to reduce the volume of final disposal of industrial waste by promoting the 3Rs.	2016	MOE	NE	6	28	58	91	127	156	0	390	520
Adoption of semi-aerobic landfill structures in final waste disposal sites	Waste management/Waste		CH_4	Adoption of semi-aerobic landfill structures in municipal waste disposal sites	Law / Standard	Implemented	Reduce CH_4 generation from the decomposition of organic waste by adopting a semi-aerobic landfill structure and open outflow port of leachate collection system when a new municipal waste landfill site is constructed, compared to an anaerobic landfill structure.	2016	MOE	NE	0	3	5	6	6	7	0	39	54
	Waste management/Waste		CH_4	Adoption of semi-aerobic landfill structures in industrial waste disposal sites	Law / Standard	Implemented	Reduce CH_4 generation from the decomposition of organic waste by adopting a semi-aerobic landfill structure and open outflow port of leachate collection system when a new industrial waste landfill site is constructed, compared to an anaerobic landfill structure.	2016	MOE	NE	0	-1	-3	-3	-2	-1	0	2	4
Advancement of incineration at sewage sludge incineration facilities	Waste management/Waste		N_2O	Advancement of incineration at sewage sludge incineration facilities	Law / Standard, Taxation, Subsidy, Technology Development, Awareness Raising	Implemented	Reduce N_2O emissions from sludge incineration, which are generated during wastewater treatment, by advancing combustion efficiency	2001	MLIT	NE	100	40	145	35	20	250	0	630	780

Name of mitigation action	Sector(s) affected	Sub-sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in $ktCO_2eq$)									
										2013	2014	2015	2016	2017	2018	2019	2020	2025	2030
Activation of J-Credit Scheme	Cross-Cutting		CO_2, CH_4, N_2O, HFCs,PFCs, SF_6,NF_3	Activation of J-Credit Scheme	Law / Standard, Awareness Raising, Other	Implemented	Further revitalize the J-Credit scheme, which certifies the GHG emission reductions and removals achieved through emission reduction measures by installing energy-saving equipment and utilizing renewable energy, and through sink measures by appropriate forest management, as credits that can be used to achieve the targets of the Industry's Action Plans for a Low-Carbon Society, carbon offsets, and other measures.	2013	MOE,METI, MAFF	30	630	1,030	2,420	3,420	4,710	5,850	6,970	11,000	15,000
Promotion of Joint Crediting Mechanism (JCM)	Cross-Cutting		CO_2, CH_4, N_2O, HFCs,PFCs, SF_6,NF_3	Promotion of the Joint Crediting Mechanism (JCM)	Law / Standard, Subsidy	Implemented	Quantitatively evaluate Japan's contribution to the reduction of emissions and increase in removals through the deployment of decarbonization technologies, products, systems, services, and infrastructure, as well as the implementation of countermeasures, and implement the JCM to use it to achieve Japan's NDCs. By doing this, Japan aims to achieve international emission reductions and removals for a total of about 100 Mt-CO_2 by 2030 through public-private partnerships.	2013	MOE, METI	0	0	15	52	552	2,788	5,077	7,836	NE	100,000
Decarbonization initiatives in national parks	Cross-Cutting		CO_2, CH_4, N_2O, HFCs,PFCs, SF_6,NF_3	Promotion of initiatives for decarbonization in national parks [Promotion of "Zero Carbon Park"]	Subsidy	Implemented	Register areas in national parks that are taking prior actions to decarbonize through the use of electric vehicles, renewable energy, etc., as "Zero Carbon Parks" and promote such efforts.	2021	MOE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Proactive actions by the national government	Cross-Cutting		CO_2, CH_4, N_2O, HFCs,PFCs, SF_6,NF_3	Proactive actions by the national government	Law / Standard, Subsidy, Education, Other	Implemented	Implementation and inspection of government action plans Implementation and inspection of action plans of each ministry and agency	2001	MOE	NE	NE	NE	109	165	214	295	352	0	1,197
Proactive actions by local governments and promotion by the national government	Cross-Cutting		CO_2, CH_4, N_2O, HFCs,PFCs, SF_6,NF_3	Proactive actions by local governments and promotion by the national government	Law / Standard, Subsidy	Implemented	Reduce GHG emissions by establishing Local Government Action Plans for municipal operations and implementing their measures.	2001	MOE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Promotion of initiatives based on the Local Government Action Plans for entire municipal jurisdictions	Cross-Cutting		CO_2, CH_4, N_2O, HFCs,PFCs, SF_6,NF_3	Promotion of initiatives based on the Local Government Action Plans for entire municipal jurisdictions	Law / Standard, Subsidy	Implemented	Reduce GHG emissions by establishing Local Government Action Plans for entire municipal jurisdictions and implementing their measures.	2008	MOE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Transition to a decarbonized lifestyle	Cross-Cutting		CO_2	Promotion of thorough implementation of Cool Biz and Warm Biz	Law / Standard, Subsidy, Awareness Raising	Implemented	Promote understanding of the critical situation of global warming and its adverse effects on society, and promote Cool Biz and Warm Biz.	2005	MOE	-37	-233	-203	-254	-446	-616	-435	-239	742	553
	Cross-Cutting		CO_2	Home Eco-Diagnosis	Law / Standard, Subsidy, Awareness Raising	Implemented	Promote understanding of the critical situation of global warming and its adverse effects on society, and promote home eco-diagnosis.	2005	MOE	1	1	2	2	3	3	3	3	26	49

Name of mitigation action	Sector(s) affected	Sub-sector(s) affected	GHG(s) affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in $ktCO_2eq$)									
										2013	2014	2015	2016	2017	2018	2019	2020	2025	2030
	Cross-Cutting		CO_2	Eeco-driving	Law / Standard, Subsidy, Awareness Raising	Implemented	Implement eco-driving with consideration for reduction of environmental impact	2006	MOE	260	NE	NE	NE	NE	NE	4,680	5,884	5,800	6,570
	Cross-Cutting		CO_2	Car sharing	Law / Standard, Subsidy, Awareness Raising	Implemented	Implement car sharing with consideration for reduction of environmental impact	2005	MOE	70	167	292	388	529	674	853	726	1,170	1,920
	Cross-Cutting		CO_2	Reduction of food loss in households	Law / Standard, Subsidy, Awareness Raising	Implemented	Promote measures to reduce food loss to achieve a decarbonized society.	2018	MOE	0	92	60	51	83	120	189	0	281	396

3.4 Modifying longer-term trends in greenhouse gas emissions

Japan aims to reduce GHGs to net-zero, that is, to realize carbon neutrality by 2050, based on the idea that addressing climate change is no longer a constraint on economic growth and that proactive climate change measures bring the transformation of industrial structures as well as its economy and society, leading to dynamic economic growth. By the *Amended Global Warming Countermeasures Promotion Act* in the 204th session of the Diet (Act No. 54 of 2021), which was enacted in the 204 sessions of the Diet, net-zero by 2050 became a Basic Principle of the Act. The legislative amendment will enhance the continuity and predictability of policies and accelerate efforts and investments as well as innovation for decarbonization towards not only the achievement of the midterm target but also the realization of a decarbonized society.

The *Long-Term Strategy as a Growth Strategy Based on the Paris Agreement*, which was approved by the Cabinet on October 22, 2021, and submitted to the UNFCCC secretariat, presents long-term sector-by-sector visions as "ideal future models" toward the realization of net-zero by 2050. These visions will provide directions for all stakeholders to pursue possibilities toward the realization of the target. Together with policy directions, they will improve the predictability of investment and serve as the basis for expanding investment in Japan. At the same time, it identifies areas which need disruptive innovation to promote corporate research and development (R&D) and investment. Furthermore, by setting forth these visions, Japan will take the lead in future international discussions, including the formulation of frameworks and standards in the area of climate change.

Japan aims to reduce its GHG emissions by 46% in FY 2030 from its FY 2013 levels, setting an ambitious target that is aligned with the long-term goal of achieving net zero by 2050. Furthermore, Japan will continue strenuous efforts in its challenge to meet the lofty goal of cutting its emissions by 50%. From now on and towards 2030, Japan will work on various measures, including technology development, all of which will be in line with the goal of net zero by 2050. On the way to FY 2030, Japan will make the best use of the existing technologies to achieve this ambitious goal. On this basis, towards net-zero by 2050, Japan will strive to develop and diffuse decarbonization technologies that are yet to be widely deployed by further expanding and deepening the efforts for the FY 2030 target. Meanwhile, it is difficult at this stage to accurately estimate the outcome of the technology development or innovation to fulfil the 2050 goal. Thus, it is necessary to determine and update priorities in climate measures and technology development by constantly reflecting the up-to-date information while keeping the ambition of the 2050 net-zero target. Also important is to keep our minds open to all possibilities and to strive to utilize every available technology, aiming at achieving the updated emission reduction target for FY 2030 as well as the ambitious goal of net zero by 2050.

3.5 Policies and measures no longer in place

Among the policies and measures reported in the Seventh National Communication (NC7) submitted in December 2017, the policies and measures that have not been implemented are the following.

- "Introduction of energy-efficient processing technology for other chemical products", "Introduction of energy-efficient distillation processing technology by membrane", Introduction of chemical manufacturing technology by inedible plant-derived raw material", "Introduction of enclosed plant factory", and "Utilization of recycled plastic flakes" in "Promotion of introduction of highly energy efficient equipment and devices (Chemical industry)"

- "Introduction of black liquor recovery boilers that operate with higher temperatures and higher pressures" in "Promotion of introduction of highly energy efficient equipment and devices (Pulp, paper, and paper products industry)"
- " Promotion of equipment replacement " and "Efficient use of lighting devices" in "Development of public campaigns"

3.6 Assessment of economic and social consequences of response measures

3.6.1 Assessment of economic and social consequences of response measures

Japan takes action while taking into account the importance of making efforts to minimize adverse impacts in accordance with Article 3, paragraph 14 of the Kyoto Protocol. On the other hand, it should be noted that we have difficulty in accurately assessing specific adverse impacts due to the implementation of response measures to address climate change issues. For example, the fluctuations in crude oil prices are caused by the balance between supply and demand, as well as other factors (e.g., trends in the crude oil futures market or economic fluctuations), and direct causality and its extent between climate change measures and adverse impacts thereof remain uncertain.

Furthermore, for the genuine resolution of climate change problems, it is essential to change the perception related to response measures, and in such a light, sustainable growth may become a key. For instance, it should be underlined that the introduction of renewable energy has aspects that not only contribute to GHG emission reductions but also improve energy access and disaster preparedness and benefit job creation through the development of new industries. At the G20 Osaka Summit in 2019, we agreed on the importance of utilizing innovation to address urgent global environmental issues such as climate change, energy, and measures against marine plastic litter under the concept of a virtuous cycle of the environment and growth.

3.6.2 Actions to minimize adverse Impacts in accordance with Article 3, paragraph 14 of the Kyoto Protocol

Japan has, as a priority, implemented the following measures, taking into consideration the importance of minimizing adverse social, environmental, and economic impacts on developing country parties, particularly those identified in Article 4, paragraphs 8 and 9, of the Convention in implementing the commitments under Article 3, paragraph 1, of the Kyoto Protocol.

At the same time, it should be added that since there is no internationally established methodology for evaluating efforts related to the minimization of the above-mentioned adverse impacts, it is impossible to carry out such evaluations.

Technical assistance in the energy and environmental sectors

Japan has continued to contribute to the sustainable economic growth of developing countries, based on their needs, through the provision of technical assistance in the field of energy and the environment throughout the world. For example, Japan has provided assistance for the development and operation of institutions related to energy savings and renewable energy through cooperation in human resource development, such as inviting trainees from and sending experts to developing countries, including the Middle East region. Japan also announced Asia Energy Transition Initiative (AETI) newly in May 2021, which provides a variety of support for energy transitions to ASEAN countries through drawing a road map for energy transition, technology development, and capacity building of decarbonization technologies. Moreover, from the viewpoint of the use of renewable energy by small island nations particularly vulnerable to climate change, Japan, in collaboration with the International Renewable Energy Agency (IRENA), went to international workshops targeting island nations in the Asia-Pacific region and others, including in the Maldives in January 2019,) and in Tokyo and Miyako-Jima in November 2019, with a view to supporting human resource development and project formulations.

Development of carbon capture and storage (CCS) technologies

Japan will work on CCS, which is an important technology for addressing global warming based on decisions that include the Summary of the Director-Level Meeting on the Bid for Thermal Power Supply by the Tokyo Electric Power Company, and the Strategic Energy Plan and the Long-term Greenhouse Gas Emission Strategy as requested in the Paris Agreement. In particular, Japan has been implementing large-scale demonstration projects in the pursuit of aiming for its practical use while implementing research and development for cost reductions and safety improvements, evaluations of environmental impacts due to the CO_2 capture process, and geological surveys to identify potential CO_2 offshore storage sites in Japan. Furthermore, Japan has actively carried out information exchanges with stakeholders of European countries and the United States regarding technologies pertaining to CCS. In June 2021, Japan held the first CCUS Network Forum jointly with the Economic Research Institute for ASEAN and East Asia (ERIA). In this forum, Japan announced the launch of the Asia CCUS Network, which is an international industry-academia-government platform aiming at knowledge sharing and improvement of the business environment for the utilization of carbon capture, use, and storage (CCUS) throughout the Asia region.

Chapter 4

Projections

4.1 Overview

(General)

- The future projections of greenhouse gas (GHG) emissions and removals of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3) for FY 2030 are estimated by gas and sector.
- The projected total GHG emissions (excluding the net GHG removals contribution of the LULUCF sector) in FY 2030 under a *with measures* scenario is approximately 813 Mt CO_2 eq., which is a decrease of 42% from FY 2013. Taking into account the projections for the GHG removals contribution of LULUCF (removals by forest carbon sinks [approximately 38 Mt CO_2], carbon sinks in agricultural soils [approximately 8.5 Mt CO_2] and urban greening [approximately 1.2 Mt CO_2]) and the Joint Crediting Mechanism (JCM) in FY 2030, the projected total GHG emissions for FY 2030 will be a reduction of 46% from FY 2013.

(Projections by gas)

- The projected emissions of energy-related CO_2 in FY 2030 decrease by 45% compared to the emissions in FY 2013 (approximately 677 Mt CO_2). A significant reduction is expected in all sectors, and the reduction rate is particularly large in the residential and commercial sectors.
- The projected emissions of non-energy-related CO_2 (Fugitive emissions from fuels, Industrial Processes and Product Use (IPPU), Agriculture, Waste, and Indirect CO_2) in FY 2030 decrease by 15% compared to FY 2013 (approximately 70.0 Mt CO_2).
- The estimated CH_4 emissions in FY 2030 decrease by 11% compared to FY 2013 (approximately 26.7 Mt CO_2 eq.). The largest reduction rate from FY 2013 is in the waste sector, followed by fugitive emissions from fuels.
- The N_2O projected emissions in FY 2030 decrease by 17% compared to FY 2013 (approximately 17.8 Mt CO_2 eq.). The largest reduction rate from FY 2013 is in the fuel combustion sector, followed by the IPPU sector.
- The projected emissions of fluorinated gases (HFCs, PFCs, SF_6, and NF_3) in CY 2030 decrease by 44% from CY 2013 (approximately 21.8 Mt CO_2 eq.).

(Projections by sector)

- The projected emissions of the energy sector in FY 2030 are a decrease of 45% compared to FY 2013 (approximately 683.3 Mt CO_2 eq.).
- The projected emissions of the IPPU sector in FY 2030 are a decrease of 25% compared to FY 2013 (approximately 65.5 Mt CO_2 eq.). The main factor in the emission decrease in FY 2030 is an emission reduction in the refrigerants sector by leakage prevention of fluorocarbons from the use of refrigerators and air conditioners, promotion of the recovery of fluorocarbons in disposal and promotion of eliminating fluorocarbons, and the lowering of the GWP.
- The projected emissions from the agriculture sector in FY 2030 are a decrease of 3% compared to FY 2013 (approximately 31.7 Mt CO_2 eq.). The main driver of the emission decrease in FY 2030 is the emission reduction from rice cultivation through the implementation of emission reduction measures.

- The estimated net removals of the LULUCF sector in FY 2030 (based on the scope of the national GHG inventory) are approximately 39.8 Mt CO_2.
- The projected emissions from the waste sector in FY 2030 are a decrease of 24% compared to FY 2013 (approximately 30.7 Mt CO_2 eq.). The main drivers of the emission decrease in FY 2030 are a decrease in the amount of waste incineration, final disposal and treated wastewater by depopulation and promotion of 3R, and CO_2 emission reduction in plastics incineration by the introduction of biomass plastics.
- The estimated indirect CO_2 emissions in FY 2030 are a decrease of 11% compared to FY 2013 (approximately 2.1 Mt CO_2 eq.). The main drivers of the emission decrease in FY 2030 are a decrease in the carbon content and the amount of use of solvents such as paint.

4.2 Projections

4.2.1 Projected scenarios

The future projections of the emissions and removals of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3) for FY 2030 are estimated by gas and by sector as follows. The projections for FY 2020 are not reported because actual emissions for FY 2020 have already been reported in Japan's GHG inventory submitted to UNFCCC in April 2022, and the projections for FY 2020 were not re-estimated using the same methodologies and assumptions used for the projections for FY 2030.

Based on the outlook of the macro frame shown in section 4.4.1, the projections for FY 2030 are estimated under a *with measures* scenario taking into account future emission reductions by each policy and measure described in section 3.1.2. This *with measures* scenario takes into account the policies and measures that have already been implemented at the time of FY 2013 and those adopted and will be implemented by FY 2030 in the future.

A *without measures* scenario is not estimated because the energy supply structure satisfying the energy demand (primary energy supply) without implementing emission reduction measures is not estimated. Moreover, an *additional measures* scenario is not estimated as well because Japan first believes that it is most important to steadily implement the Plan for Global Warming Countermeasures to achieve the emission reduction target for FY 2030 with certainty, and any policies and measures that are not included in the Plan for Global Warming Countermeasures are not planned at present.

There are two types of projections reported for the forestry/LULUCF sector. One represents annual net emissions and removals from the LULUCF sector consistent with the scope of the national GHG inventory covering all categories, carbon pools and gases. The other is the projection consistent with the scope of the contribution from the LULUCF sector (GHG removals contribution) to be accounted for towards the achievement of the emission reduction target, which is described as part of Japan's NDC in chapter 2 of the BR5. The GHG removals contribution to be accounted for against the target is equivalent to the anticipated annual emission reductions or removals achieved through the implementation of specific policies and measures in the LULUCF sector, which are accounted for in accordance with the activity-based accounting in consideration of the existing methods and guidance of the LULUCF rules and modalities for the second commitment period of the Kyoto Protocol (CP2 KP-LULUCF). Therefore, the projection of the GHG removals contribution to be accounted for against the target is different from the projected annual emissions and removals of the land-based GHG inventory. Nonetheless, consistent calculation results were used for these two projections in the common categories, carbon pools and gases. See section 4.4.6 for further details.

4.2.2 Overall projections of GHG emissions

The projected total GHG emissions (excluding the net GHG removals by the LULUCF sector) in FY 2030 under a *with measures* scenario is approximately 813 Mt CO_2 eq., which is a decrease of 42% from FY 2013. Taking into account the projections for the GHG removals contribution of the LULUCF sector (removals by forest carbon sinks [approximately 38 Mt CO_2], carbon sinks in agricultural soils [approximately 8.5 Mt CO_2] and urban greening [approximately 1.2 Mt CO_2]) and the JCM in FY 2030, the projected total GHG emissions for FY 2030 will be a reduction of 46% from FY 2013.

The net total GHG emissions including the LULUCF sector (based on the scope of the national GHG inventory) is estimated at 774 MtCO_2 eq. in FY 2030.

Table 4-1　Information on greenhouse gas projections under a *with measures* scenario (CTF Table 6(a))

	GHG emissions and removals (kt CO_2 eq)								GHG emission projections (kt CO_2 eq)	
	Base year (2013)	1990	1995	2000	2005	2010	2015	2019	2020	2030
Sector										
Energy	1,044,605.83	885,721.08	920,230.74	940,422.23	987,698.74	938,930.52	961,568.68	855,961.07	815,161.07	552,000.00
Transport	217,069.43	206,170.68	247,210.19	257,399.77	241,129.79	224,196.07	210,730.93	200,327.96	179,199.36	146,200.00
Industry/industrial processes	89,521.83	110,970.50	137,224.97	109,148.10	87,550.28	81,014.06	93,456.45	101,520.91	101,390.12	65,500.00
Agriculture	32,137.87	37,479.41	37,076.48	35,299.54	34,618.19	33,719.24	32,198.32	32,074.97	32,185.76	31,700.00
Forestry/LULUCF	-63,059.81	-65,316.79	-79,203.79	-84,681.59	-88,699.30	-69,887.07	-56,442.32	-50,955.04	-52,010.42	-39,800.00
Waste management/waste	22,553.65	29,559.36	32,972.51	32,356.78	27,749.70	23,546.00	21,456.26	20,274.71	20,185.77	15,800.00
Indirect CO_2	2,302.62	5,548.42	4,767.51	4,305.79	3,256.19	2,464.87	2,213.38	2,061.86	1,963.44	2,100.00
Gas										
CO_2 emissions including net CO_2 from LULUCF	1,252,029.23	1,092,462.43	1,160,380.28	1,179,608.12	1,201,607.55	1,144,896.01	1,166,886.38	1,054,778.52	989,933.20	704,800.00
CO_2 emissions excluding net CO_2 from LULUCF	1,315,342.66	1,158,129.44	1,239,909.40	1,264,594.66	1,290,599.51	1,215,058.10	1,223,605.16	1,106,015.49	1,042,224.02	744,900.00
CH_4 emissions including CH_4 from LULUCF	30,110.77	44,164.00	41,765.26	37,718.14	34,826.40	32,061.36	29,331.12	28,546.09	28,462.83	26,800.00
CH_4 emissions excluding CH_4 from LULUCF	30,040.85	44,058.76	41,668.85	37,627.97	34,738.43	31,982.73	29,255.59	28,474.35	28,394.07	26,700.00
N_2O emissions including N_2O from LULUCF	21,589.32	32,603.54	33,827.14	30,560.60	25,693.28	23,037.64	21,516.03	20,462.27	20,198.56	18,000.00
N_2O emissions excluding N_2O from LULUCF	21,405.62	32,358.55	33,598.22	30,345.83	25,488.60	22,841.25	21,315.09	20,252.09	19,986.94	17,800.00
HFCs	32,120.72	15,932.31	25,212.86	22,850.63	12,783.62	23,326.51	39,280.55	49,732.59	51,725.38	14,500.00
PFCs	3,286.27	6,539.30	17,676.95	11,890.21	8,637.44	4,259.43	3,308.10	3,422.60	3,474.54	4,200.00
SF_6	2,075.25	12,850.07	16,447.52	7,031.36	5,027.35	2,398.14	2,075.11	2,001.03	2,028.31	2,700.00
NF_3	1,617.24	32.61	201.09	285.77	1,471.75	1,539.74	571.03	261.47	288.83	500.00
Indirect CO_2	2,302.62	5,548.42	4,767.51	4,305.79	3,256.19	2,464.87	2,213.38	2,061.86	1,963.44	2,100.00
Total with LULUCF	1,345,131.42	1,210,132.67	1,300,278.62	1,294,250.62	1,293,303.59	1,233,983.69	1,265,181.70	1,161,266.44	1,098,075.10	774,000.00
Total without LULUCF	1,408,191.23	1,275,449.45	1,379,482.41	1,378,932.21	1,382,002.89	1,303,870.77	1,321,624.02	1,212,221.48	1,150,085.52	813,000.00

- The values for FY 2020 in the column of GHG emission projections are not projected values but actual values.
- Projected emissions of the transport sector for FY 2030 include CO_2 emissions from electricity consumption in railways that should be included in the energy sector in the national GHG inventory under the UNFCCC.
- For FY 2030, the total does not match the sum of each sector because of rounding.
- The values in the base year (2013) are those when the emission reduction target was decided (the values in the national GHG inventory submitted in FY 2021).
- The projection in FY 2030 for the Forestry/LULUCF sector in this table represents the annual net removals based on the scope of the national GHG inventory, however, a part of the estimation scope is slightly different from the current national GHG inventory. This projection is different from the GHG removals target (approximately 47.7 Mt CO_2) set out in the NDC. . See section 4.4.6 for details.
- CO_2 emissions from energy use of waste are counted in the energy sector in this table, but they are counted in the waste sector in the following chapters in accordance with the emission categories for the projections.

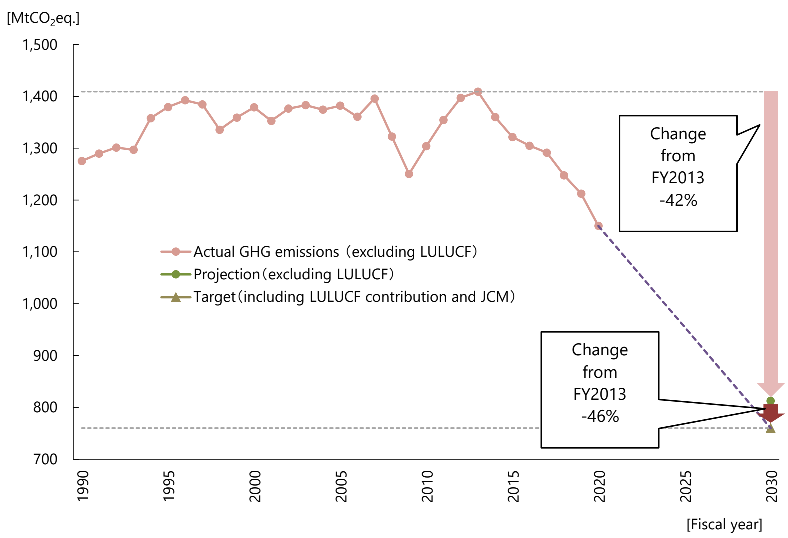


Figure 4-1　GHG emission and removal projections under a *with measures* scenario

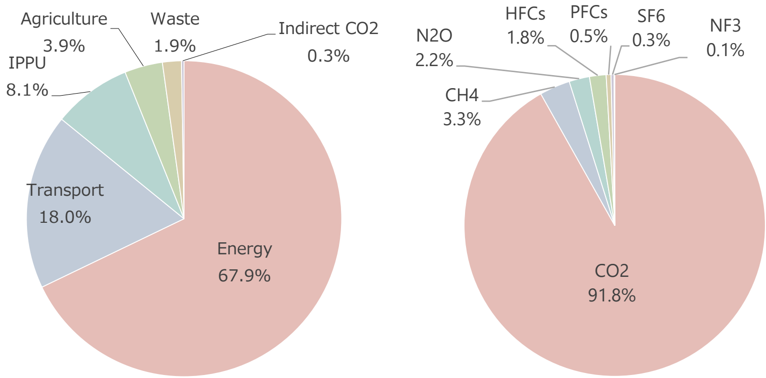


Figure 4-2 GHG emissions projections by sector (left) and by gas (right) under a *with measures* scenario (excluding LULUCF)

4.2.3 Projections by gas

CO_2

Energy-related CO_2 covers approximately 90% of Japan's GHG emissions. Based on the energy statistics of Japan, it can be broken down into the following five sectors: industry, commercial and other, residential, transport, and energy conversion. The emission reductions of policies and measures can be observed by each sector as well. Table 4-2 shows projections of emissions for each sector. The projection for energy-related CO_2 emissions by each sector is estimated on the basis of the CO_2 emissions with electricity generation and heat production allocated to the demand sectors, taking into account national circumstances for the planning and implementation of domestic policies and measures. In addition, CO_2 emissions from the energy use of waste are not included.

The projected emissions in FY 2030 decrease by 45% compared to the emissions in FY 2013 (approximately 677 Mt CO_2). A significant reduction is expected in all sectors, and the reduction rate is particularly large in the residential sector and the commercial and other sector. The actual emissions in FY 2020 show a reduction of 21.7% (approximately 967 Mt CO_2) compared to the emissions in FY 2013. Especially contributory is the reduction in the industry sector.

The projected emissions of non-energy-related CO_2 (Fugitive emissions from fuels, IPPU, Agriculture, Waste, and Indirect CO_2) in FY 2030 decrease by 15% compared to FY 2013 (approximately 70.0 Mt CO_2). In the projection for non-energy-related CO_2 emissions by sector, CO_2 emissions from the waste sector include CO_2 emissions from the energy use of waste, taking into account the national circumstances for the planning and implementation of domestic policies and measures.

The main emission sources in FY 2013 (the base year) of non-energy-related CO_2 are cement production (IPPU sector) and waste incineration (waste sector). The emission reductions in FY 2030 from FY 2013 are expected to be mainly reductions in the IPPU and waste sector.

Table 4-2 Projected emissions of CO_2 by sector

[Mt-CO_2]

	Base year emissions	Actual emissions							Estimated emissions	
									FY2030	
	FY2013	FY1990	FY1995	FY2000	FY2005	FY2013	FY2015	FY2020	Emissions	(Changes from FY2013)
Energy-related CO_2	**1,235**	**1,068**	**1,142**	**1,170**	**1,201**	**1,235**	**1,146**	**967**	**677**	**-45%**
Industry	463	503	489	477	467	464	430	356	289	-38%
Commercial and Other	238	131	162	190	220	237	218	182	116	-51%
Residential	208	129	150	156	171	208	187	166	70	-66%
Transport	224	208	249	259	244	224	217	185	146	-35%
Energy conversion	103	96	91	89	98	103	93	78	56	-45%
Non-energy-related CO_2	**82.3**	**96.1**	**102.5**	**98.6**	**93.3**	**82.5**	**79.9**	**76.8**	**70.0**	**-15%**
Fugitive emissions from fuels	0.4	0.2	0.5	0.5	0.5	0.4	0.4	0.3	0.8	+80%
Industrial Processes and Product Use	48.8	65.6	67.5	60.3	56.7	49.0	47.0	42.7	42.6	-13%
Agriculture	0.6	0.6	0.4	0.4	0.4	0.6	0.5	0.4	0.5	-9%
Waste	29.9	23.7	29.0	32.5	32.1	29.9	29.6	31.1	23.8	-20%
Other	0.3	0.4	0.4	0.5	0.5	0.3	0.2	0.2	0.2	-34%
Indirect CO_2	2.3	5.5	4.8	4.3	3.3	2.3	2.2	2.0	2.1	-11%

- Base year emissions are the emissions for FY 2013 (the base year for the FY 2030 target) in the national GHG inventory when the emission reduction target was decided. Actual emissions are the emissions in the latest national GHG inventory. Because of the recalculation with the changes in methodologies, these values are different from the base year emissions when the emission reduction target was decided. The estimated emissions for FY 2030 and the change ratio from FY 2013 are the estimated values when the emission reduction target was decided.
- CO_2 emissions from the energy use of waste are included in the waste sector in accordance with the classifications for the projections in Japan.

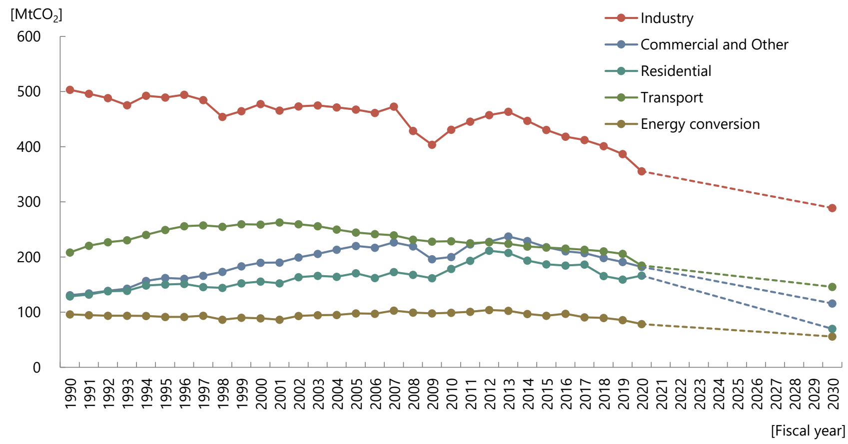


Figure 4-3 Projected emissions of energy-related CO_2 by sector

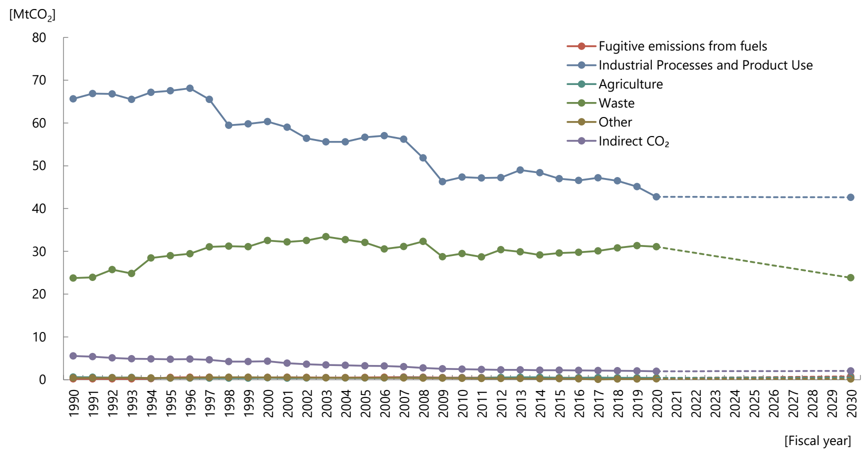


Figure 4-4 Projected emissions of non-energy-related CO_2 by sector

Methane

The projected CH_4 emissions in FY 2030 decrease by 11% compared to FY 2013 (approximately 26.7 Mt CO_2 eq.). In the projection for CH_4 emissions by sector, CH_4 emissions from the waste sector include emissions from the energy use of waste, taking into account the national circumstances for the planning and implementation of domestic policies and measures.

The main emission sources in FY 2013 (the base year) are rice cultivation, enteric fermentation of livestock (agriculture sector), and landfill of waste (waste sector). The largest reduction rate in FY 2030 from FY 2013 is the waste sector, followed by the fugitive emissions from fuels sector.

Table 4-3 Projected CH_4 emissions by sector

[Mt-CO_2]

	Base year emissions	Actual emissions							Estimated emissions	
	FY2013	FY1990	FY1995	FY2000	FY2005	FY2013	FY2015	FY2020	FY2030 Emissions	FY2030 (Changes from FY2013)
Fuel combustion	1.0	1.3	1.3	1.2	1.4	1.0	1.0	1.1	0.8	-14%
Fugitive emissions from fuels	0.8	5.1	2.8	1.9	1.0	0.8	0.8	0.7	0.7	-21%
Industrial Processes and Product Use	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	-19%
Agriculture	22.3	25.0	25.7	24.2	23.8	22.3	21.9	22.1	21.6	-3%
Waste	5.9	12.6	11.8	10.3	8.6	5.9	5.4	4.5	3.6	-40%
Total	**30.0**	**44.1**	**41.7**	**37.6**	**34.7**	**30.1**	**29.3**	**28.4**	**26.7**	**-11%**

- Base year emissions are the emissions for FY 2013 (the base year for the FY 2030 target) in the national GHG inventory when the emission reduction target was decided. Actual emissions are the emissions in the latest national GHG inventory. Because of the recalculation with the changes in methodologies, these values are different from the base year emissions when the emission reduction target was decided. The estimated emissions for FY 2030 and the change ratio from FY 2013 are the estimated values when the emission reduction target was decided.
- CH_4 emissions from the energy use of waste are included in the waste sector in accordance with the classifications for the projections in Japan.

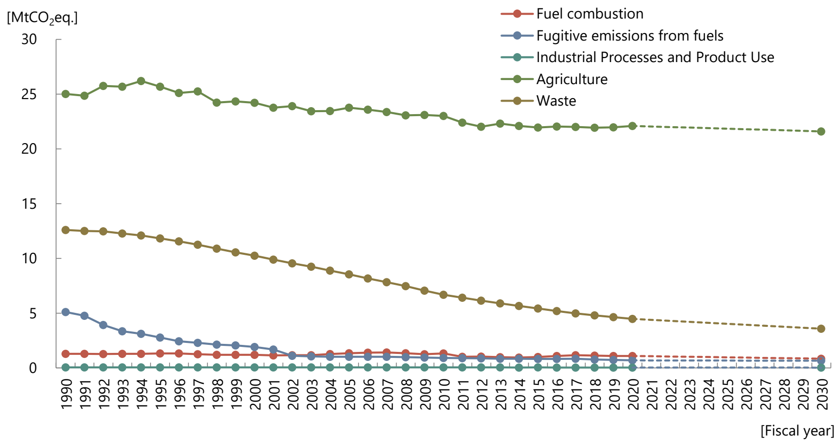


Figure 4-5 Estimated CH_4 emissions by sector

Nitrous oxide

The projected N_2O emissions in FY 2030 decrease by 17% compared to FY 2013 (approximately 17.8 Mt CO_2 eq.). In the projection for N_2O emissions by sector, N_2O emissions from the waste sector include emissions from the energy use of waste, taking into account the national circumstances for the planning and implementation of domestic policies and measures.

The main emission sources in FY 2013 (the base year) are agricultural soils and manure management (agriculture sector) and the fuel combustion sector. The largest reduction rate in FY 2030 from FY 2013 is the fuel combustion sector, followed by the IPPU sector.

Table 4-4 Projected N_2O emissions by sector

[Mt-CO_2]

	Base year emissions	Actual emissions							Estimated emissions	
									FY2030	
	FY2013	FY1990	FY1995	FY2000	FY2005	FY2013	FY2015	FY2020	Emissions	(Changes from FY2013)
Fuel combustion	6.2	6.2	7.5	7.8	7.2	6.2	6.1	5.1	3.9	-38%
Fugitive emissions from fuels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-26%
Industrial Processes and Product Use	1.6	9.9	10.1	6.7	2.9	1.6	1.2	1.1	1.0	-37%
Agriculture	9.3	11.9	11.0	10.7	10.5	10.0	9.8	9.7	9.6	+3%
Waste	4.3	4.4	4.9	5.1	4.9	4.3	4.2	4.1	3.3	-23%
Total	**21.4**	**32.4**	**33.6**	**30.3**	**25.5**	**22.0**	**21.3**	**20.0**	**17.8**	**-17%**

- Base year emissions are the emissions for FY 2013 (the base year for the FY 2030 target) in the national GHG inventory when the emission reduction target was decided. Actual emissions are the emissions in the latest national GHG inventory. Because of the recalculation with the changes in methodologies, these values are different from the base year emissions when the emission reduction target was decided. The estimated emissions for FY 2030 and the change ratio from FY 2013 are the estimated values when the emission reduction target was decided.
- N_2O emissions from the energy use of waste are included in the waste sector in accordance with the classifications for projections in Japan.

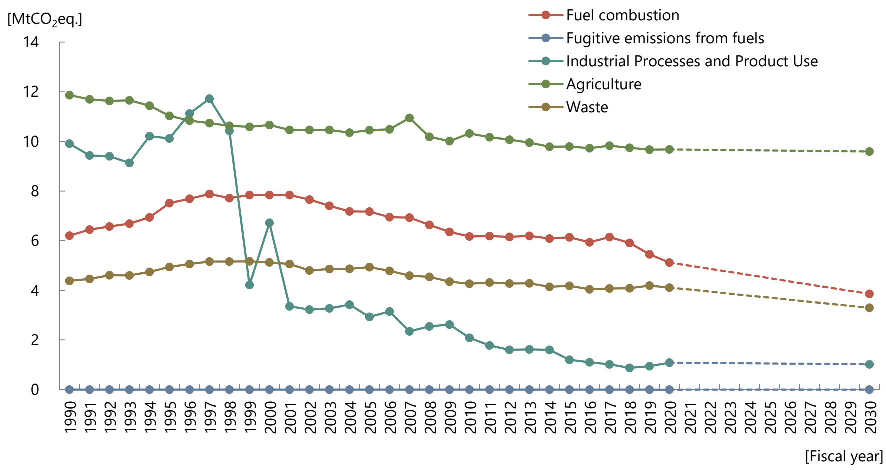


Figure 4-6 Projected emissions of N_2O by sector

Fluorinated gases

The projected emissions of fluorinated gases (HFCs, PFCs, SF_6, and NF_3) in CY 2030 decrease by 44% from CY 2013 (approximately 21.8 Mt CO_2 eq.).

The main emission sources in CY 2013 (the base year) are fugitive emissions during the production, use and disposal of HFCs used as refrigerants in refrigerators and air conditioners. The actual HFCs emissions in CY 2020 increased by 61.0% compared to the emissions in CY 2013, but the estimated HFCs emissions in CY 2030 are expected to decrease by 55% compared to CY 2013 by the measures of eliminating fluorocarbons, lowering the GWP, and leakage prevention.

Table 4-5 Projected emissions of fluorinated gases by gas

[Mt-CO_2]

	Base year emissions	Actual emissions							Estimated emissions	
	CY2013	CY1990	CY1995	CY2000	CY2005	CY2013	CY2015	CY2020	CY2030 Emissions	CY2030 (Changes from CY2013)
HFCs	32.1	15.9	25.2	22.9	12.8	32.1	39.3	51.7	14.5	-55%
PFCs	3.3	6.5	17.7	11.9	8.6	3.3	3.3	3.5	4.2	+26%
SF_6	2.1	12.9	16.4	7.0	5.0	2.1	2.1	2.0	2.7	+27%
NF_3	1.6	0.0	0.2	0.3	1.5	1.6	0.6	0.3	0.5	-70%
Total	**39.1**	**35.4**	**59.5**	**42.1**	**27.9**	**39.1**	**45.2**	**57.5**	**21.8**	**-44%**

- Base year emissions are the emissions for CY 2013 (the base year for the FY 2030 target) in the national GHG inventory when the emission reduction target was decided. Actual emissions are the emissions in the latest national GHG inventory. Because of the recalculation with the changes in methodologies, these values are different from the base year emissions when the emission reduction target was decided. The estimated emissions for CY 2030 and the change ratio from CY 2013 are the estimated values when the emission reduction target was decided.

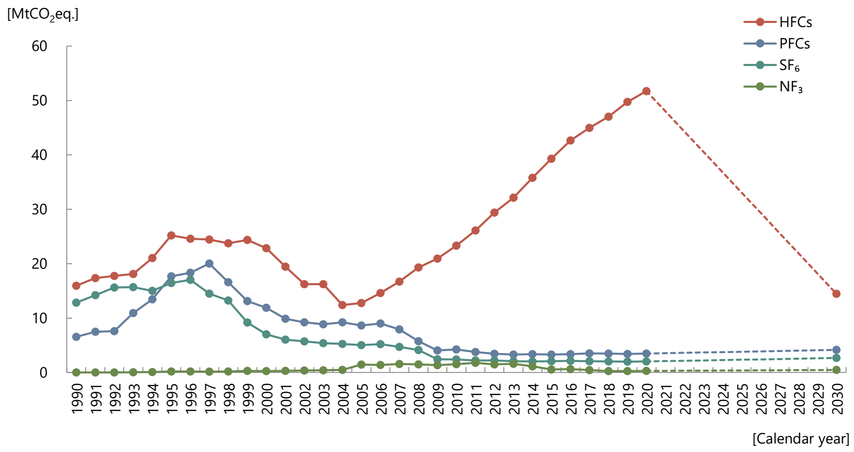


Figure 4-7 Projected emissions of fluorinated gases by gas

■ Precursors

The projected NO_X emissions in FY 2030 decrease by 25% from FY 2013 (approximately 1,052 kt). The projected SOx emissions in FY 2030 decrease by 25% from FY 2013 (approximately 534 kt). The projected CO emissions in FY 2030 decrease by 2% from FY 2013 (approximately 2,696 kt). The projected NMVOC emissions in FY 2030 decrease by 12% from FY 2013 (approximately 860 kt).

In FY 2013 (the base year), more than 90% of NOx, SOx, and CO emissions are from fuel combustion, and more than 70% of NMVOC emissions are from the IPPU sector. The sectors with large reductions in FY 2030 compared to FY 2013 are the same as the largest emissions sectors in FY 2013.

Table 4-6 Projected emissions of precursors by gas

(kt)

	Actual emissions							Estimated emissions	
	FY1990	FY1995	FY2000	FY2005	FY2013	FY2015	FY2020	FY2030 Emissions	FY2030 (Changes from FY2013)
NOx	1,979	2,080	2,042	1,955	1,396	1,283	1,150	1,052	-25%
SOx	1,253	1,204	1,131	1,011	715	667	571	534	-25%
CO	4,409	4,090	3,809	3,000	2,761	2,759	2,838	2,696	-2%
NMVOC	2,184	1,979	1,777	1,393	975	932	836	860	-12%

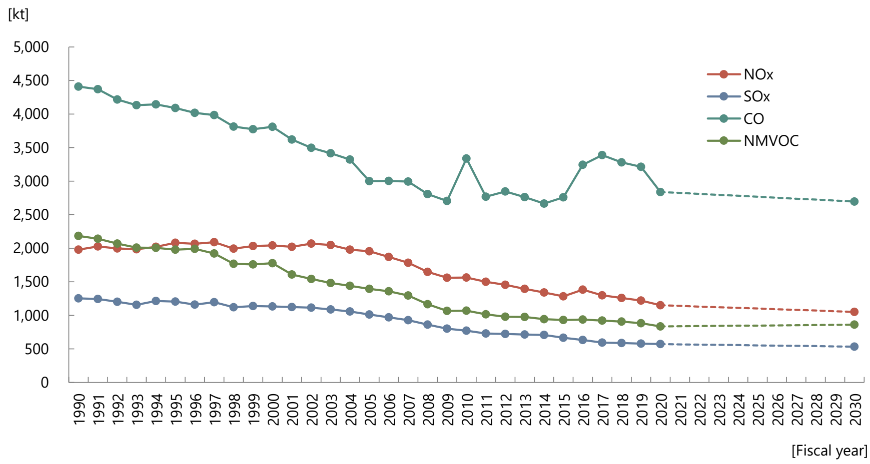


Figure 4-8 Projected emissions of fluorinated gases and each gas

4.2.4 Projections by sector

■ Energy

The projected emissions of the energy sector in FY 2030 are a decrease of approximately 45% compared to FY 2013 (approximately 683.3 Mt CO_2 eq.). Emissions from the energy use of waste are included in the waste sector in accordance with the classifications for projections in Japan.

Most emissions in the energy sector are CO_2 from fuel combustion (Energy-related CO_2). See the section of "CO_2" for the trend of future estimated energy-related CO_2 emissions.

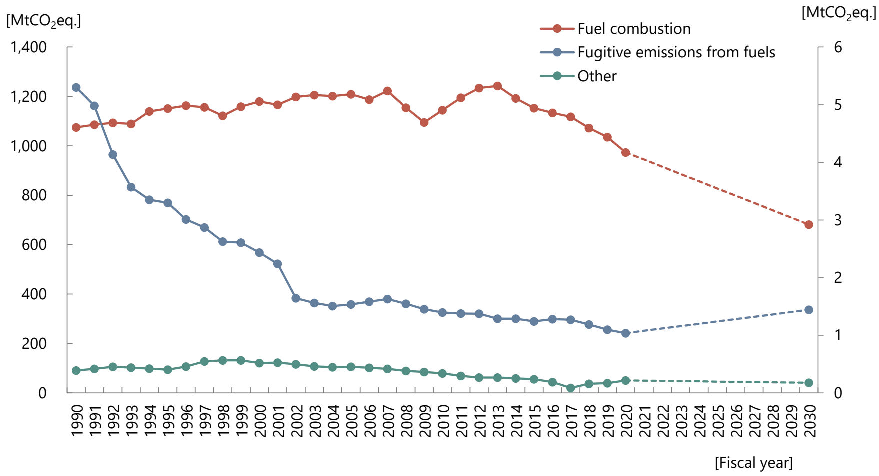
The projected emissions from fugitive emissions from fuels in FY 2030 increase compared to FY 2013. The reason for this increase is that it is assumed that CO_2 emissions in the steam produced by the steam production wells of geothermal power plants increase with the increase in geothermal power generation.

Table 4-7 Projected emissions of the energy sector

[Mt-CO_2]

	Base year emissions	Actual emissions							Estimated emissions	
									FY2030	
	FY2013	FY1990	FY1995	FY2000	FY2005	FY2013	FY2015	FY2020	Emissions	(Changes from FY2013)
CO_2	**1,236.1**	**1,068.1**	**1,143.1**	**1,171.3**	**1,201.5**	**1,236.1**	**1,146.6**	**968.0**	**678.0**	**-45%**
Fuel combustion	1,235.4	1,067.6	1,142.1	1,170.3	1,200.5	1,235.4	1,145.9	967.4	677.0	-45%
Fugitive emissions from fuels	0.4	0.2	0.5	0.5	0.5	0.4	0.4	0.3	0.8	+80%
Other	0.3	0.4	0.4	0.5	0.5	0.3	0.2	0.2	0.2	-34%
CH_4	**1.8**	**6.4**	**4.1**	**3.1**	**2.4**	**1.8**	**1.8**	**1.8**	**1.5**	**-17%**
Fuel combustion	1.0	1.3	1.3	1.2	1.4	1.0	1.0	1.1	0.8	-14%
Fugitive emissions from fuels	0.8	5.1	2.8	1.9	1.0	0.8	0.8	0.7	0.7	-21%
N_2O	**6.2**	**6.2**	**7.5**	**7.8**	**7.2**	**6.2**	**6.1**	**5.1**	**3.9**	**-38%**
Fuel combustion	6.2	6.2	7.5	7.8	7.2	6.2	6.1	5.1	3.9	-38%
Fugitive emissions from fuels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-26%
Total	**1,244.1**	**1,080.7**	**1,154.7**	**1,182.3**	**1,211.0**	**1,244.1**	**1,154.5**	**974.9**	**683.3**	**-45%**

- Base year emissions are the emissions for FY 2013 (the base year for the FY 2030 target) in the national GHG inventory when the emission reduction target was decided. Actual emissions are the emissions in the latest national GHG inventory. Because of the recalculation with the changes in methodologies, these values are different from the base year emissions when the emission reduction target was decided. The estimated emissions for FY 2030 and the change ratio from FY 2013 are the estimated values when the emission reduction target was decided.
- Emissions from the energy use of waste are included in the waste sector in accordance with the classifications for projections in Japan.



(※Fugitive emissions from fuels and others are on the right axis)

Figure 4-9 Projected emissions of the energy sector

■ Industrial Processes and Product Use (IPPU)

The projected emissions of the IPPU sector in FY 2030 decrease by approximately 25% compared to FY 2013 (approximately 65.5 Mt CO_2 eq.).

The main emission sources in FY 2013 are the mineral industry (CO_2), refrigerants (HFCs), chemical industry (CO_2, CH_4, and N_2O), and metal production (CO_2, CH_4). The main factor in the emission decrease in FY 2030 is an emission reduction in the refrigerants sector by leakage prevention of fluorocarbons from the use of refrigerators and air conditioners, promotion of recovery of fluorocarbons in disposal and promotion of eliminating fluorocarbons, and the lowering of the GWP.

Table 4-8 Projected emissions of the IPPU sector

[Mt-CO_2]

	Base year emissions	Actual emissions							Estimated emissions	
									FY2030	
	FY2013	FY1990	FY1995	FY2000	FY2005	FY2013	FY2015	FY2020	Emissions	(Changes from FY2013)
CO_2・CH_4・N_2O	**50.4**	**75.6**	**77.7**	**67.1**	**59.6**	**50.7**	**48.2**	**43.9**	**43.7**	**-13%**
Mineral industry	35.0	49.2	51.1	43.9	41.2	35.0	33.7	31.2	30.8	-12%
Chemical industry	6.1	16.7	16.7	13.2	8.4	6.1	5.4	4.4	4.5	-27%
Metal industry	6.2	7.3	6.9	6.9	6.7	6.4	6.2	5.4	5.1	-18%
Non-energy products from fuels and solvent use	2.7	2.0	2.4	2.7	2.9	2.7	2.5	2.3	2.8	+6%
Other product manufacture and use	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	+5%
Other	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	+27%
Fgas	**39.1**	**35.4**	**59.5**	**42.1**	**27.9**	**39.1**	**45.2**	**57.5**	**21.8**	**-44%**
HFCs	32.1	15.9	25.2	22.9	12.8	32.1	39.3	51.7	14.5	-55%
PFCs	3.3	6.5	17.7	11.9	8.6	3.3	3.3	3.5	4.2	+26%
SF_6	2.1	12.9	16.4	7.0	5.0	2.1	2.1	2.0	2.7	+27%
NF_3	1.6	0.0	0.2	0.3	1.5	1.6	0.6	0.3	0.5	-70%
Total	**89.5**	**111.0**	**137.2**	**109.1**	**87.6**	**89.8**	**93.5**	**101.4**	**65.5**	**-27%**

- Base year emissions are the emissions for FY 2013 (the base year for the FY 2030 target) in the national GHG inventory when the emission reduction target was decided. Actual emissions are the emissions in the latest national GHG inventory. Because of the recalculation with the changes in methodologies, these values are different from the base year emissions when the emission reduction target was decided. The estimated emissions for FY 2030 and the change ratio from FY 2013 are the estimated values when the emission reduction target was decided.

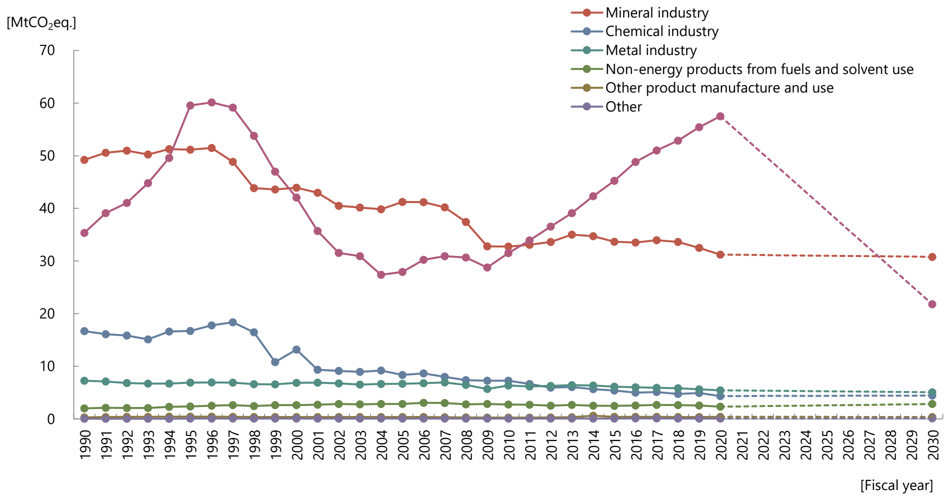


Figure 4-10 Projected emissions of the IPPU sector

■ Agriculture

The projected emissions from the agriculture sector in FY 2030 are a decrease of approximately 1% compared to FY 2013 (approximately 31.7 Mt CO_2 eq.).

The main emission sources in FY 2013 are rice cultivation (CH_4), enteric fermentation (CH_4), manure management (CH_4 and N_2O), and agricultural soils (N_2O). The main driver of the emission decrease in FY 2030 is an emission reduction from rice cultivation through the implementation of emission reduction measures.

Table 4-9 Projected emissions of the agriculture sector

[Mt-CO_2]

	Base year emissions	Actual emissions							Estimated emissions	
									FY2030	
	FY2013	FY1990	FY1995	FY2000	FY2005	FY2013	FY2015	FY2020	Emissions	(Changes from FY2013)
Enteric fermentation	7.7	9.4	9.3	9.0	8.7	7.7	7.5	7.6	8.2	+6%
Manure management	6.2	7.5	7.1	6.8	6.9	6.4	6.2	6.2	6.1	-2%
Rice cultivation	12.1	12.1	13.1	12.2	12.2	12.1	12.0	12.0	11.0	-9%
Agricultural soils	5.5	7.6	7.0	6.8	6.4	6.0	5.9	5.8	5.8	+6%
Field burning of agricultural residues	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-4%
Liming and Urea application	0.6	0.6	0.4	0.4	0.4	0.6	0.5	0.4	0.5	-9%
Total	**32.1**	**37.5**	**37.1**	**35.3**	**34.6**	**32.8**	**32.2**	**32.2**	**31.7**	**-1%**

- Base year emissions are the emissions for FY 2013 (the base year for the FY 2030 target) in the national GHG inventory when the emission reduction target was decided. Actual emissions are the emissions in the latest national GHG inventory. Because of the recalculation with the changes in methodologies, these values are different from the base year emissions when the emission reduction target was decided. The estimated emissions for FY 2030 and the change ratio from FY 2013 are the estimated values when the emission reduction target was decided.

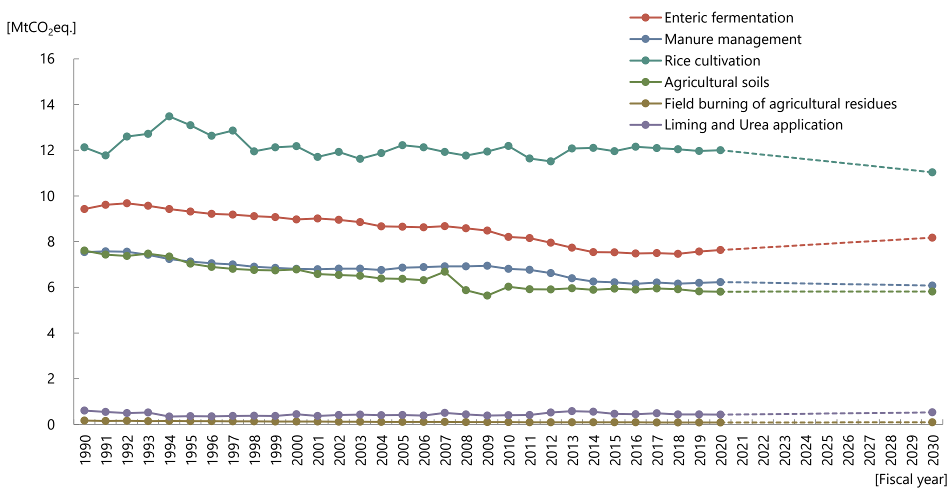


Figure 4-11 Projected emissions of the agriculture sector

■ LULUCF

The projected net removals of the LULUCF sector in FY 2030 (based on the scope of the national GHG inventory[69]) are approximately39.8 Mt CO_2.

The LULUCF sector covers CO_2 emissions and removals resulting from carbon stock changes and non-CO_2 emissions in forest land, cropland, grassland, wetlands, settlements and other land. Major parts of removals attribute to forest land sinks.

[69] Projections for forest land and HWP categories, which are relevant to the forest carbon sink measures, are consistent with the scope of the contribution from the LULUCF sector.

Table 4-10 Projected emissions and removals from the LULUCF sector

[Mt-CO_2]

	Actual emissions							Projected emissions	
								FY2030	
	FY1990	FY1995	FY2000	FY2005	FY2013	FY2015	FY2020	Emissions and Removals	(Changes from FY2013)
Forest land	-79.1	-87.6	-90.6	-92.6	-70.0	-63.1	-57.1	-31.2	-55%
Cropland	9.0	3.9	4.0	3.9	5.5	5.7	4.7	-1.0	-118%
Grassland	0.7	0.1	-0.9	-0.3	1.1	1.4	0.6	0.0	-99%
Wetlands	0.1	0.4	0.4	0.0	0.0	0.1	0.0	0.0	-99%
Settlements	2.9	1.3	-0.4	-0.9	-0.4	0.2	0.2	-1.1	+163%
Other land	1.3	1.0	0.8	0.3	0.2	0.3	0.2	0.0	-79%
HWP	-0.5	1.4	1.8	0.6	0.3	-1.2	-0.8	-6.8	-2,334%
Non CO_2 gases	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	+15%
Total	**-65.3**	**-79.2**	**-84.7**	**-88.7**	**-63.0**	**-56.4**	**-52.0**	**-39.8**	**-37%**

* based on the GHG inventory when the reduction target was decided.

- In the projected number of FY 2030, emissions associated with land use conversion from forest land to non-forest land uses are included under the category in forest land. Thus, the emissions and removals in each land use category levels are slightly different between historical values and projected values.
- The base year emissions and removals are those for FY 2013 (the base year for the FY 2030 target) in the national GHG inventory when the emission reduction target was decided. Actual emissions and removals are the ones reported in the latest national GHG inventory. Because of the recalculation with the changes in methodologies, these values are different from each other.
- The emissions and removals change ratios in FY 2030 are simply calculated as the values in FY 2030 divided by the values of the base year when the emission reduction target was decided. It should be noted that, for the accounting against the emission reduction target, the GHG removals contribution of the LULUCF sector indicated in Table 4-11 is used.

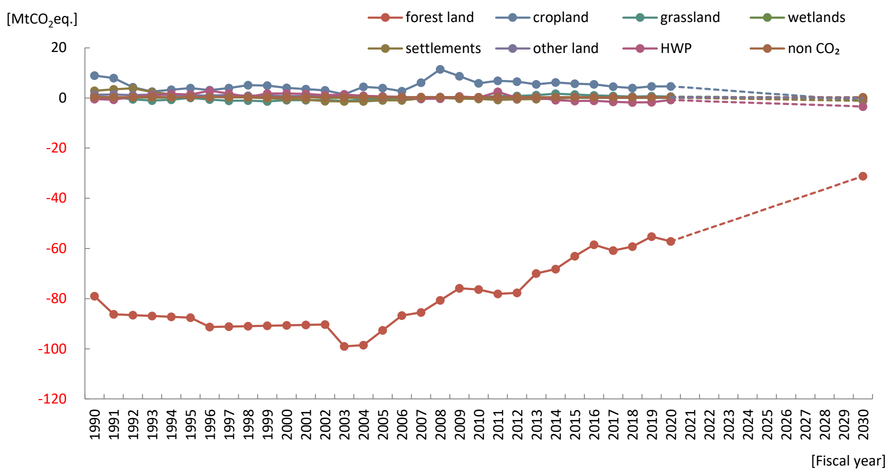


Figure 4-12 Projected emissions and removals from the LULUCF sector

As a reference, Table 4-11 below shows the details about the historical GHG removals contribution accounted for against the 2020 emission reduction target and the projected GHG removals contribution in FY 2030. The GHG removals contribution is equivalent to anticipated annual emission reductions or removals achieved through the implementation of a specific policy and measures in the LULUCF sector, which is accounted for in accordance with the activity-based accounting taking into account the existing methods and guidance of the LULUCF rules and modalities for the second commitment period of the Kyoto Protocol.

Table 4-11 Historical and projected GHG removals contribution accounted for against the emission reduction target

[Mt-CO_2]

LULUCF categories	LULUCF contribution									Accounting Approach
	Historical Values								Projection	
	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020	FY2030	
Forest Carbon Sink	**-51.7**	**-52.2**	**-49.8**	**-47.3**	**-47.6**	**-46.5**	**-42.8**	**-40.5**	**-38.0**	
forest management	-52.2	-52.7	-50.6	-48.1	-48.0	-47.0	-43.2	-41.0		reference level
afforestation/reforestation	-1.5	-1.5	-1.5	-1.5	-1.5	-1.4	-1.3	-1.2		gross-net
deforestation	2.0	2.0	2.3	2.3	1.8	1.8	1.7	1.7		gross-net
Carbon Sinks in agricultiral soils	**-1.5**	**-0.2**	**-1.0**	**-1.5**	**-2.5**	**-3.4**	**-2.6**	**-2.7**	**-8.5**	
cropland management (mineral soils)	-1.9	-1.2	-1.7	-2.0	-2.8	-3.4	-2.7	-2.8		net-net
cgrazing land management (mineral soils)	0.4	1.0	0.7	0.4	0.2	0.0	0.2	0.0		net-net
Urban greening	**-1.2**	**-1.2**	**-1.2**	**-1.2**	**-1.2**	**-1.2**	**-1.3**	**-1.3**	**-1.2**	
revegetation	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.3	-1.3		net-net
Total	**-54.3**	**-53.6**	**-52.0**	**-50.1**	**-51.4**	**-51.1**	**-46.6**	**-44.5**	**-47.7**	

Note: Historical values of the LULUCF contribution are the accounted numbers calculated by "annual estimated emissions/removals" minus "baseline" of each activities.

■ Waste

The projected emissions from the waste sector in FY 2030 are a decrease of approximately 24% compared to FY 2013 (approximately 30.7 Mt CO_2 eq.).

The main emission sources are waste incineration and incineration with energy recovery (CO_2, CH_4, and N_2O), wastewater treatment (CH_4 and N_2O), and final disposal (CH_4). The main drivers of the emission decrease in FY 2030 are a decrease in the amount of waste incineration, final disposal and treated wastewater by depopulation and promotion of 3R, and CO_2 emission reduction in plastics incineration by the introduction of biomass plastics.

Table 4-12 Projected emissions of the waste sector

[Mt-CO_2]

	Base year emissions	Actual emissions							Estimated emissions	
									FY2030	
	FY2013	FY1990	FY1995	FY2000	FY2005	FY2013	FY2015	FY2020	Emissions	(Changes from FY2013)
Solid waste disposal	3.9	9.5	8.9	7.5	6.1	3.9	3.4	2.7	1.8	-54%
Biological treatment of solid waste	0.4	0.2	0.2	0.2	0.4	0.4	0.4	0.4	0.4	-9%
Incineration and open burning of waste	31.3	24.9	30.7	34.6	34.0	31.3	30.9	32.4	24.6	-21%
Wastewater treatment and discharge	3.9	5.3	5.2	4.9	4.6	3.9	3.8	3.7	3.3	-14%
Other	0.6	0.7	0.7	0.7	0.5	0.6	0.6	0.6	0.5	-9%
Total	**40.1**	**40.7**	**45.7**	**47.9**	**45.5**	**40.1**	**39.2**	**39.7**	**30.7**	**-24%**

- Base year emissions are the emissions for FY 2013 (the base year for the FY 2030 target) in the national GHG inventory when the emission reduction target was decided. Actual emissions are the emissions in the latest national GHG inventory. Because of the recalculation with the changes in methodologies, these values are different from the base year emissions when the emission reduction target was decided. The estimated emissions for FY 2030 and the change ratio from FY 2013 are the estimated values when the emission reduction target was decided.
- Emissions from the energy use of waste are included in the waste sector in accordance with the classifications for projections in Japan.

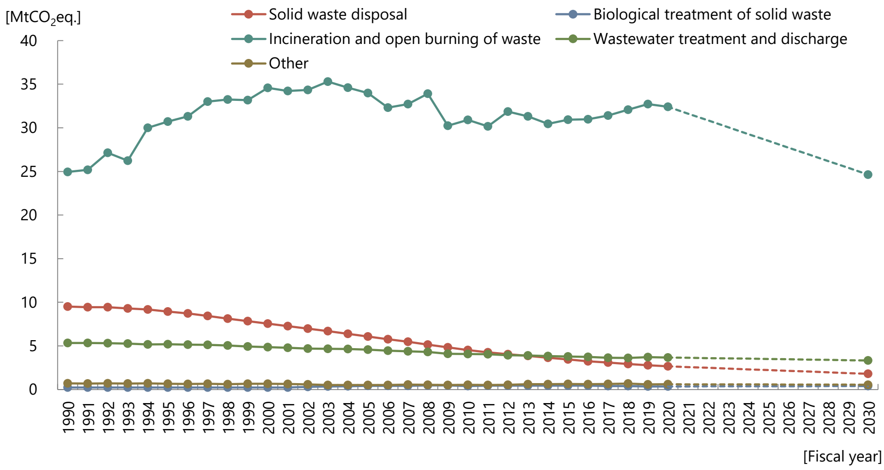


Figure 4-13　Projected emissions of the waste sector

■ Indirect CO_2

The projected indirect CO_2 emissions in FY 2030 are a decrease of approximately 11% compared to FY 2013 (approximately 2.1 Mt CO_2 eq.).

The main emission sources in FY 2013 are the incineration of NMVOC emitted from solvents such as paint. The main drivers of the emission decrease in FY 2030 are a decrease in the carbon content and the amount of use of solvents such as paint.

Table 4-13　Projected indirect CO_2 emissions

[Mt-CO_2]

	Base year emissions	Actual emissions							Estimated emissions	
									FY2030	
	FY2013	FY1990	FY1995	FY2000	FY2005	FY2013	FY2015	FY2020	Emissions	(Changes from FY2013)
Fugitive emissions from fuels (Derived from CH_4)	0.1	0.6	0.3	0.2	0.1	0.1	0.1	0.1	0.1	-23%
Fugitive emissions from fuels (Derived from NMVOC)	0.5	0.5	0.5	0.6	0.5	0.5	0.4	0.3	0.4	-18%
Industrial Processes and Product Use (Derived from CH_4)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-19%
Industrial Processes and Product Use (Derived from NMVOC)	1.7	4.5	3.9	3.5	2.6	1.7	1.7	1.6	1.6	-8%
Total	**2.3**	**5.5**	**4.8**	**4.3**	**3.3**	**2.3**	**2.2**	**2.0**	**2.1**	**-11%**

- Base year emissions are the emissions for FY 2013 (the base year for the FY 2030 target) in the national GHG inventory when the emission reduction target was decided. Actual emissions are the emissions in the latest national GHG inventory. Because of the recalculation with the changes in methodologies, these values are different from the base year emissions when the emission reduction target was decided. The estimated emissions for FY 2030 and the change ratio from FY 2013 are the estimated values when the emission reduction target was decided.

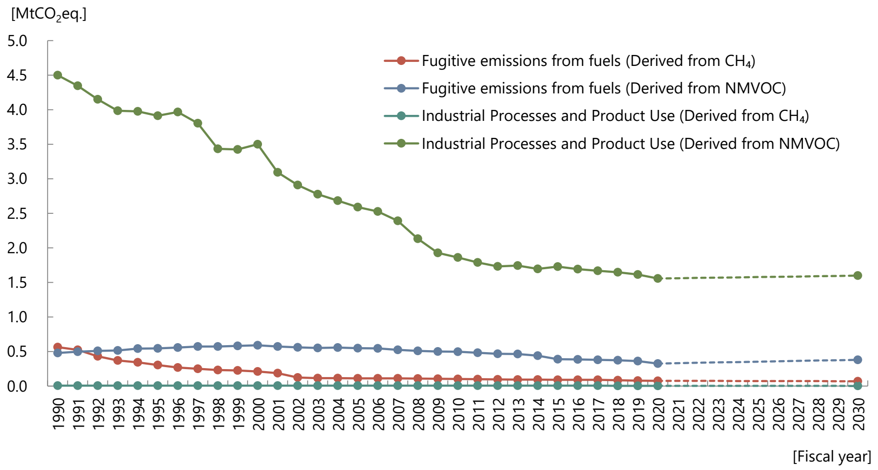


Figure 4-14　Projected indirect CO_2 emissions

Table 4-14　Projected emissions in FY 2030 by sector (excluding LULUCF)

[Mt-CO_2]

	Base year emissions	Actual emissions							Estimated emissions	
									FY2030	
	FY2013	FY1990	FY1995	FY2000	FY2005	FY2013	FY2015	FY2020	Emissions	(Changes from FY2013)
Energy	1,243.8	1,080.4	1,154.3	1,181.8	1,210.6	1,243.9	1,154.3	974.7	683.1	-45%
Industrial Processes and Product Use	89.5	111.0	137.2	109.1	87.6	89.8	93.5	101.4	65.5	-27%
Agriculture	32.1	37.5	37.1	35.3	34.6	32.8	32.2	32.2	31.7	-1%
Waste	40.1	40.7	45.7	47.9	45.5	40.1	39.2	39.7	30.7	-24%
Other	0.3	0.4	0.4	0.5	0.5	0.3	0.2	0.2	0.2	-34%
Indirect CO_2	2.3	5.5	4.8	4.3	3.3	2.3	2.2	2.0	2.1	-11%
Total	**1,408.2**	**1,275.4**	**1,379.5**	**1,378.9**	**1,382.0**	**1,409.1**	**1,321.6**	**1,150.1**	**813.3**	**-42%**

- Base year emissions are the emissions for FY 2013 (the base year for the FY 2030 target) in the national GHG inventory when the emission reduction target was decided. Actual emissions are the emissions in the latest national GHG inventory. Because of the recalculation with the changes in methodologies, these values are different from the base year emissions when the emission reduction target was decided. The estimated emissions for FY 2030 and the change ratio from FY 2013 are the estimated values when the emission reduction target was decided.

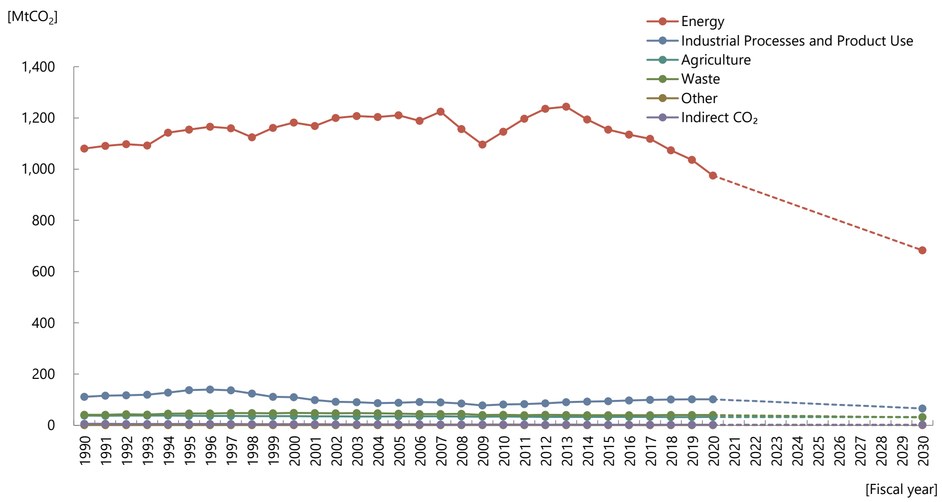


Figure 4-15　Projected emissions in FY 2030 by sector (excluding LULUCF)

International aviation and shipping

Japan has neither conducted emissions projections related to fuel sold to ships and aircraft engaged in international transport nor included them in the national total projected emissions.

4.3 Assessment of total effect of policies and measures

The total effect of the policies and measures is estimated by the sum of the estimates of the mitigation impacts of each emission reduction measure shown in Table 3 of the CTF. The emission reductions in FY 2030 are 657.1 Mt CO_2 eq. (CO_2: 599.0 Mt CO_2 eq., CH_4: 1.6 Mt CO_2 eq., N_2O: 1.0 Mt CO_2 eq., and fluorinated gases: 55.4 Mt CO_2 eq.). (Table 4-15)

For projected CO_2 emission reductions by reduction measures, since it is difficult to quantify the mitigation impacts for all measures and the definition of the mitigation impacts in CTF Table 3 is not the same for all measures, it needs to be noted that the total CO_2 emission reductions are just a reference value. Moreover, measures in which their emission reductions overlap with other measures are not included in the total effect of the policies and measures.

Table 4-15 Expected emission reductions by emission reduction measures

	Expected emission reductions FY2030 (Mt-CO_2)
CO_2	599.0
CH_4	1.6
N_2O	1.0
Fluorinated gases	55.4
Total	**657.1**

4.4 Methodology

4.4.1 Overview

The projections of GHG emissions are conducted by sectors, and the basic methodology is different between 'fuel combustion (CO_2)' in the energy sector and other sectors.

The projections in fuel combustion (CO_2) are conducted using the energy supply and demand model. The energy supply and demand model is composed of some sub-models and calculates the energy consumption and CO_2 emissions by inputting exogenous values, such as the macro frame. (The reduction measures in the model are set to avoid overlapping as much as possible, and the amount of expected energy savings [CO_2 reductions] is calculated by reduction measures.) With regard to the avoidance of the overlapping of reduction effects, for example, consideration is given to ensuring that there is no overlapping of emission reductions between measures (electricity and heat) on the energy consumption side and measures on the energy supply side. The strength of the energy supply and demand model is to be able to consider a variety of factors affecting energy consumption and CO_2 emissions comprehensively in one model. On the other hand, the weakness is that the more complex the model, the more difficult it is to understand the calculation process.

The projections in sectors other than fuel combustion (CO_2) are conducted by the bottom-up model by using spreadsheets. This model is the same framework as the calculation methods and models of the national GHG inventory, and the calculation years are extended for the future. Emissions and removals are calculated by multiplying the emission and removal factors by activity data. The future emissions and removals are calculated by using assumed future emission and removal factors and assumed future activity data. These future emission and removal factors and future activity data are set to avoid double counting of the reduction measures. When there are some reduction measures at one emission source, the synergistic reduction effect of measures is also taken into consideration. The strength of the bottom-up model is that it is highly consistent with the national GHG inventory because it uses the same calculation methods as the national GHG inventory, and it is highly transparent because of the simple calculation methods. On the other hand, the weakness is that the interrelationship between parameters is not sufficiently reflected because the parameters used in each emission source and removal sink are set independently.

4.4.2 Key parameters and assumptions

The outlook on the macro frame used for the projections is shown in Table 4-16. These assumptions are set based on the prospects of the economic growth rate, population, etc.

Table 4-16 Key assumptions on the macro frame (key parameters and assumptions) (CTF Table 5)

Key underlying assumptions		Historical											Projected	
Assumption	Unit	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2025	2030
Real GDP	trillion(2015)yen	430.86	462.18	485.62	515.13	512.06	539.41	543.48	553.17	554.55	550.13	527.39	NE	660.00
Population	thousands	123,611	125,570	126,926	127,768	128,057	127,095	126,933	126,706	126,443	126,167	126,146	NE	119,125
Household	10^3 households	41,797	44,831	48,015	51,102	53,783	56,951	57,477	58,008	58,527	59,072	59,497	NE	58,120
Crude steel production	Mt	112	100	107	113	111	104	105	105	103	98	83	NE	90
Cement production	Mt	87	92	80	70	51	54	54	55	56	53	50	NE	56
Ethylene production	Mt	5.8	6.9	7.6	7.5	7.0	6.8	6.3	6.5	6.2	6.3	6.0	NE	5.7
Paper and paperboard production	Mt	28	30	32	31	27	26	26	26	26	25	23	NE	22
Commercial floor area	10^6 m^2	1,286	1,500	1,657	1,758	1,829	1,870	1,885	1,893	1,903	1,911	1,922	NE	1,965
Passenger transport volume	10^9 passenger-km	1,295	1,385	1,417	1,409	1,348	1,394	1,414	1,437	1,454	1,438	1,067	NE	1,360
Freight transport volume	10^9 t-km	486	497	513	503	492	445	452	453	448	444	388	NE	420

- The actual values compiled from *National Accounts of Japan* (Jul.-Sep. 2022 (The 2nd preliminary)) (Cabinet Office) (GDP for FY 1990 is a reference value based on a simplified retrospective method.), *Population Estimates* (Ministry of Internal Affairs and Communications) (The data for the years the census was conducted are based on the census population.), *Counts of population, vital events and households derived from Basic Resident Registration* (Ministry of Internal Affairs and Communications), *Current Survey of Production* (Ministry of Economy, Trade and Industry), *Survey on Motor Vehicle Transport* (Ministry of Land, Infrastructure, Transport and Tourism), *Handbook of Japan's & World Energy & Economic Statistics* (The Institute of Energy Economics, Japan), and other sources.
- Projections compiled from *Economic and Fiscal Projections for Medium to Long Term Analysis* (July 2021) (Cabinet Office), *Medium projection* (National Institute of Population and Social Security Research), *Outlook for energy supply and demand in FY 2030 relevant material* (November 2021) (Agency for Natural Resources and Energy), and other sources.
- "NE" (Not Estimated) means that emissions are not estimated, and the macro frame is not set.

4.4.3 Energy

■ Fuel combustion (CO_2)

The projected values for energy consumption and CO_2 emissions are calculated on the basis of the energy supply and demand model as described above. The overall structure of the energy supply and demand model is shown in Figure 4-16. Table 4-17 shows a description of the primary sub-models included in the energy supply and demand model.

Table 4-17 Primary sub-models included in the energy supply and demand model

Sub-models	Details
Macroeconomic model	Calculates a consistent and balanced macro frame, including income distribution, production markets, labor markets, and general prices, and estimate economic activity indicators that directly and indirectly influence energy demand based on the macro frame.
Secondary energy price model	Estimates energy purchase prices that influence energy demand and selection behavior based on energy import prices, such as crude oil and LNG, and domestic general price index.
Optimum generation planning model	For the electricity demand estimated by the energy supply and demand model, the economic and optimum generation mix (electric power generation and installed capacity) is estimated by dynamically minimizing the total system cost (equipment cost and fuel cost) after conversion into a discounted current value during the target period. The optimum method uses dynamic programming.
Elements bottom-up model	Estimates energy-saving indicators, such as the efficiency of home appliances and vehicle fuel efficiency, to explicitly incorporate the effects of the Top-Runner Standard, which is difficult to deal with in the regression-type macroeconomic model.
Energy supply and demand model	Estimates energy demand in each final demand sector using economic activity indicators, price indicators, and energy-saving indicators, which are calculated from the above-mentioned models. Secondly, the primary energy supply is estimated through energy conversion in the power generation sector. Finally, CO_2 emissions are calculated on the basis of consumption by energy sources.

Reference: Energy environment integrated strategy investigation (research about the future structure of energy supply and demand) investigation report (The Institute of Energy Economics, Japan)

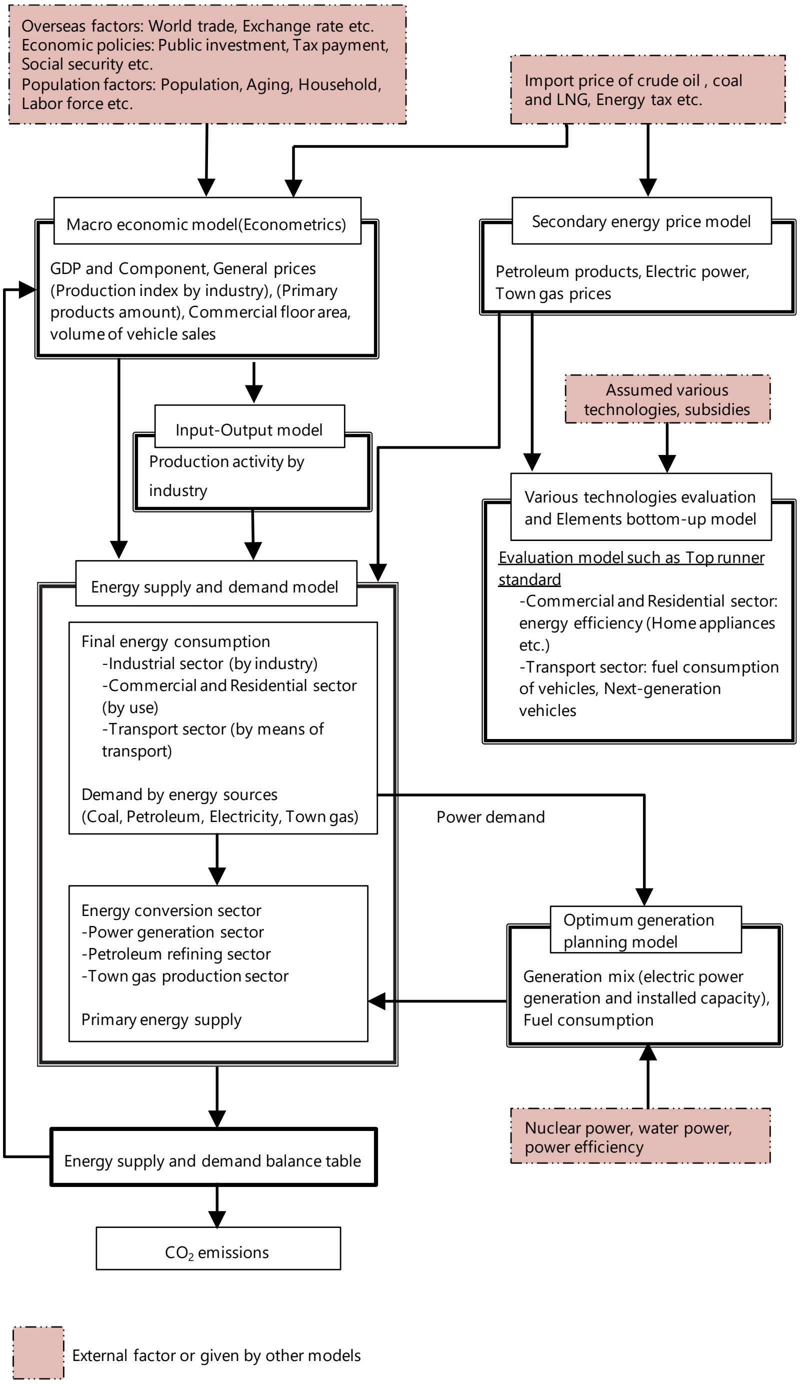


Figure 4-16 Overall structure for energy supply and demand model

Reference: Energy environment integrated strategy investigation (research about the future structure of energy supply and demand) investigation report (The Institute of Energy Economics, Japan)

Primary parameters used in the energy supply and demand models are shown in Table 4-16. The structure of power generation (Energy Mix) in the future is shown in Table 4-18. These data are entered as exogenous values. In the model, the energy consumption and CO_2 emissions in the future are calculated on the basis of policies, measures, and technologies that are supported by sufficient consideration of technical constraints and cost-related issues in order to maintain consistency with the energy mix. (The reduction measures in the model are set to avoid overlapping as much as possible and expected energy savings (CO_2 reductions) are calculated by reduction measures.)

Table 4-18 Energy mix used for FY 2030 emission projections

	FY 2030
●Final energy consumption	280 10^6kl
（Reduction of energy saving）	70 10^6kl
●Total electric power generation	approximately 934 TWh
Renewable energy	approximately 36%～38%
Nuclear	approximately 20%～22%
LNG	approximately 20%
Coal	approximately 19%
Oil	approximately 2%
Hydrogen/Ammonia	approximately 1%
（Breakdown of Renewable energy）	
Solar	approximately 14%～16%
Wind	approximately 5%
Geothermal	approximately 1%
Hydropower	approximately 11%
Biomass	approximately 5%

■ Fuel combustion (CH_4 and N_2O)

Based on the national GHG inventory, projections of CH_4 and N_2O emissions from fuel combustion cover five sectors: industry, commercial and other, residential, transport, and energy conversion.

The projected emissions are based on calculations multiplying the projected fuel consumption for each sector by the projected emission factors in accordance with the estimation method of the national GHG inventory. The projected fuel consumption is the same as the fuel consumption used in the estimation of fuel combustion (CO_2).

The projected emission factors are the same as those used as current (FY 2019) emission factors assuming that the present emission level is supposed to continue into the future.

■ Fugitive emissions from fuels

Based on the national GHG inventory, projections of fugitive emissions from fuels cover two sub-sectors: solid fuel (CO_2 and CH_4) and fugitive emissions from oil, natural gas, and other energy (CO_2, CH_4, and N_2O).

The projected future emissions are based on calculations multiplying the projected activity data (for example, coal, crude oil and natural gas production, crude oil refining volume and natural gas sales) by the projected emission factor for each emission source in accordance with the estimation method of the national GHG inventory.

The projected future activity data is established based on the future estimated domestic energy supply and demand in the fuel combustion sector. Activity data associated with the domestic production of fossil fuels, such as coal, crude oil, and natural gas production, is established assuming that the current activity level is supposed to continue into the future.

The projected emission factors are the same as those used as current (FY 2019) emission factors assuming that the present emission level is supposed to continue into the future.

■ CO_2 transport and storage

The future CO_2 emissions and removals from this sector are the same as current (FY 2019) emissions and removals assuming that the present emissions and removals are supposed to continue into the future.

4.4.4 IPPU

■ CO_2, CH_4, and N_2O

Based on estimations in the national GHG inventory, projected emissions from the IPPU sector cover five subsectors: mineral industry (CO_2), chemical industry (CO_2, CH_4, and N_2O), metal production (CO_2, and CH_4), non-energy products from fuels and solvent use (CO_2) and other product manufacture and use (N_2O).

The projected emissions are based on calculations multiplying the projected activity data (for example, clinker production and ethylene production) by the projected emission factor for each emission source in accordance with the estimation method of the national GHG inventory.

The projected future activity data is established based on the future production of various industrial products and the projected future Indices of Industrial Production. As for cement production sector where the reduction measure of increasing the use of blended cement is implemented, the activity data varies in accordance with the level of the measure by reflecting the reduction in the amount of clinker used due to the spread of blended cement to the clinker production.

The projected emission factors are the same as those used as current (FY 2019) emission factors assuming that the present emission process is supposed to continue into the future.

■ Fluorinated gases

Based on estimation in the national GHG inventory, projected future emissions from fluorinated gases cover five sectors: chemical industry (HFCs, PFCs, SF_6, and NF_3), metal production (HFCs, PFCs, and SF_6), electronic industry (HFCs, PFCs, SF_6, and NF_3), use of ozone-depleting substance alternative (HFCs and PFCs), and other product manufacture and use (PFCs and SF_6).

The projected future emissions are based on calculations multiplying the projected activity data (for example, the amount of charged refrigerant by type of refrigerant) by the projected emission factor for each emission source in accordance with the estimation method of the national GHG inventory. The activity data and emission factors for emission sources where the reduction measures, such as preventing leakage of fluorocarbons from the use of refrigeration and air conditioning equipment for business use, implemented and vary in accordance with the level of the measures.

4.4.5 Agriculture

Based on estimations in the national GHG inventory, projected future emissions from the agriculture sector cover seven sub-sectors: enteric fermentation (CH_4), manure management (CH_4 and N_2O), rice cultivation (CH_4), agricultural soil (N_2O), field burning of agricultural waste (CH_4 and N_2O), lime application (CO_2), and urea application (CO_2).

The projected future emissions are based on calculations multiplying the projected activity data (for example, livestock population and crop area) by the projected emission factor for each emission source in accordance with the estimation method of the national GHG inventory.

The projected future activity data is established based on the future livestock population and crop area in the *Basic Plan for Food, Agriculture and Rural Areas* (Ministry of Agriculture, Forestry and Fisheries, Cabinet decision on March 31, 2020). As for the agricultural soils where the reduction measure of "Emissions reduction of nitrous oxide associated with the application of inorganic fertilizers" is implemented, the activity data of the applied inorganic fertilizer is set to decrease in accordance with the reduction in the amount of inorganic fertilizer applied per unit area.

The projected emission factors are the same as those used as current (FY 2019) emission factors assuming that the present emission level is supposed to continue into the future. As for rice cultivation where the measure for the reduction of methane emissions associated with rice cultivation is implemented, a 30% lower emission factor than normal paddy fields is applied to the paddy fields where the mid-season drainage period is extended as the reduction measure (30% of the total area in FY 2030).

4.4.6 LULUCF

The projection of the LULUCF sector contains two types of calculations: 1) projection of annual emissions and removals from the LULUCF sector in FY 2030 consistent with the scope of the national GHG inventory (Table 4-10), and 2) projection consistent with the scope of the LULUCF contribution to be accounted for against the emission reduction target described in chapter 2 of the BR5 (Table 4-11). The number for FY 2030 in the CTF table 6(a) is the projection based on the scope of the national GHG inventory.

In the projection based on the scope of the national GHG inventory, projected emissions and removals from the LULUCF sector cover CO_2 emissions and removals resulting from carbon stock changes and non-CO_2 emissions in forest land, cropland, grassland, wetlands, settlements and other land in line with the land-use classification indicated in the IPCC guidelines. The emissions and removals projections by the following three activities, 1) measures for forest carbon sinks, 2) measures to increase carbon sinks in agricultural soils, and 3) urban greening, all of which are described in chapter 2 of the BR5 and chapter 3 of the NC8 and are estimated on the basis of the GHG removals contribution to be accounted for against the emission reduction target. The projections of other emissions and removals that are not covered in 1) to 3) are separately implemented.

1) The projections of forest land and HWP categories in FY 2030 are consistent with the target value of the forest carbon sink measures. The projected removals contribution (approximately 38 Mt CO_2) was revised upward compared to the previous values (approximately 27.8 Mt CO_2) which were reported in the BR4, because of the strengthening of forest carbon sink measures. They are estimated as net CO_2 removals resulting from carbon stock changes in land area subject to the activities of afforestation/reforestation, deforestation and forest management, which are basically equivalent to Articles 3.3 and 3.4 of the Kyoto Protocol, assuming that forest management and conservation will be implemented in accordance with the *Basic Plan of Forests and Forestry* in Japan. The projected net CO_2 removals are estimated taking into account the

existing methods and guidance for the LULUCF accounting rules for the second commitment period of the Kyoto Protocol (CP2 KP-LULUCF rules), which consist of the contribution of carbon sinks in forests and the contribution of harvested wood products (HWP). The former covers the national GHG inventory categories of 4.A.1 forest land remaining forest land (covering only those forests meeting the definition of forest management), 4.A.2 land converted to forest land and 4.B.2.1 – 4.F.2.1 land converted from forest land, while the latter covers carbon stock changes in 4.G. HWP category. Since the forest management reference level is set as zero, this projected CO_2 removals contribution in FY 2030 is directly used as the annual emissions and removals estimation for FY 2030. The carbon stock changes in forests which are outside the scope of forest management activities are excluded from the estimation.

2) The contribution of carbon sinks in agricultural soils is the accounted net emission reduction value taking into account the existing methods and guidance of CP2 KP-LULUCF rules (= based on net-net accounting against the base year of 1990) about cropland management and grazing land management activities under Article 3.4 of the Kyoto Protocol. The values are estimated based on a mathematical model (revised Rothamsted Carbon (Roth-C) Model), taking into account future temperature and cultivated areas provided in the *Basic Plan for Food, Agriculture and Rural Areas*, and corresponding to the carbon stock change in mineral soil of the national GHG inventory categories of 'cropland', 'grassland', and 'cropland/grassland converted to other land uses (forest land, wetlands, settlements and other land). The future projections of net emissions in FY 2030 are calculated by subtracting the emissions in FY 1990 from the contribution of carbon sinks in agricultural soils.

3) The net removals by urban greening in settlements are shown as the contribution for carbon sinks due to the promotion of urban greening, including revegetation implemented under Article 3.4 of the Kyoto Protocol. These are calculated by estimating the activity data as the cumulative area of urban green spaces under 30 years since its establishment in FY 2030 and using the estimation method of the national GHG inventory. It corresponds to the removals in all carbon pools in the settlements category of the national GHG inventory and considers the accounting approach, taking into account the existing methods and guidance of CP2 KP-LULUCF rules. The net removals shown in the contribution are the accounted values under net-net accounting with the base year 1990. However, the removals in FY 1990 were practically at the ignorable level. Therefore, the estimated value of the contribution in FY 2030 is used directly as the net removals in future projections in FY 2030.

4) The emissions and removals not contained in 1) to 3) are estimated in each of the most detailed categories and pool levels. Estimations related to cropland and grassland (not covered in 2) above) are calculated by using future cultivated area based on the value provided in the *Basic Plan for Food, Agriculture and Rural Areas*, in accordance with the estimation method of the national GHG inventory. Other small sources of emissions are estimated by simple extrapolation without the assumption of scenarios because the contribution of these emissions and removals is not large.

4.4.7 Waste

Based on estimations in the national GHG inventory, projected future emissions from the waste sector cover four sectors: solid waste disposal (CH_4), biological treatment of solid waste (CH_4

and N_2O), incineration and open burning of waste (CO_2, CH_4, and N_2O), and wastewater treatment and discharge (CH_4 and N_2O).

The projected future emissions are based on calculations multiplying the projected activity data (for example, the amount of municipal waste and industrial waste, and the amount of domestic wastewater and industrial wastewater) by the projected emission factor for each emission source in accordance with the estimation method of the national GHG inventory.

The future projected activity data is established based on the future population and industrial activity. For the diffusion of biomass plastics, which is the main reduction measure of the waste sector, the introduction amount of biomass plastics for the future is set based on the target for the diffusion of biomass plastics listed in the *Plastics Material Cycle Strategy*.

The projected emission factors are the same as those used as current (FY 2019) emission factors assuming that the present emission level is supposed to continue into the future.

4.4.8 Indirect CO_2

Based on estimations in the national GHG inventory, projected future emissions of indirect CO_2 emissions cover two sectors: fugitive emissions from fuels (derived from CH_4 and NMVOC) and the IPPU (derived from CH_4 and NMVOC).

The projected future emissions derived from CH_4 are the same as CH_4 emissions estimated in the fugitive emissions from fuels sector and the IPPU sector (see the section of "Fugitive emissions from fuels" and "IPPU" for the estimation method). The projected future emissions derived from NMVOC are based on calculations multiplying the projected activity data (for example, population and transport volume) by the projected emission factor and the carbon content of NMVOC for each emission source in accordance with the estimation method of the national GHG inventory. The emissions from small emission sources are the same as current (FY 2019) emissions.

The projected emission factors are the same as those used as current (FY 2019) emission factors assuming that the present emission level is supposed to continue into the future.

4.5 Sensitivity analysis

The methodologies for the projections of emissions and removals reported in the NC8 and BR5 were completely changed from the projections reported in the NC7 and BR4, however, sensitivity analysis for the revised projections was not performed.

4.6 Differences from the projections reported in the NC7/BR4

4.6.1 Changes in projection methodologies

Future emission projections and methodologies used in the BR4 submitted in December 2019 were not changed from those in the NC7 submitted in December 2017. In the NC8 and BR5, the methodologies are completely revised from the NC7 and BR4.

Specifically, historical emissions, which are the basis for future projections, were changed from emissions in the national GHG inventory submitted in 2015 to emissions in the national GHG inventory submitted in 2021, and the emission reductions by mitigation measures were revised. In addition, the methodology of estimating future emissions of indirect CO_2 was newly established, and the emissions were estimated. The future emissions of precursors were also newly estimated, responding to the recommendations of the technical review reports for the NC7 and BR4.

4.6.2 Comparison of projections

Since the future emissions of NC7 (submitted in 2017) and BR4 (submitted in 2019) are the same, the information below is comparison of the future emissions reported between in the NC8/BR5 and in the NC7/BR4.

The total GHG emission projections (excluding LULUCF) in FY 2030 reported in the NC7/BR4 was supposed to be decrease by 23% compared to FY 2013 (approximately 1,079 Mt CO_2eq.), while total GHG emission projections in FY 2030 in the NC8/BR5 is supposed to decrease by 42% compared to FY 2013 (approximately 813 Mt CO_2eq.). In the projections of the NC8/BR5, additional reductions were made overall, especially the additional emission reductions in energy-related CO_2 were large. The projected GHG removals also increased compared to the values in the NC7/BR4.

Table 4-19 Comparison of projections in the NC7/BR4 and NC8/BR5

$MtCO_2$	NC7/BR4			NC8/BR5		
	2013	2030	Changes from FY2013	2013	2030	Changes from FY2013
Sector						
Energy	1,041,551	784,200	-25%	1,044,606	552,000	-47%
Transport	217,947	165,500	-24%	217,069	146,200	-33%
Industry/industrial processes	86,929	74,800	-14%	89,522	65,500	-27%
Agriculture	39,531	37,500	-5%	32,138	31,700	-1%
Forestry/LULUCF	-64,660	-25,900	-60%	-63,060	-39,800	-37%
Waste management/waste	21,816	17,300	-21%	22,554	15,800	-30%
Indirect CO_2	-	-	-	2,303	2,100	-9%
Gas						
CO_2 emissions excluding net CO_2 from LULUCF	1,310,691	997,800	-24%	1,315,343	744,900	-43%
CH_4 emissions excluding CH_4 from LULUCF	36,042	31,600	-12%	30,041	26,700	-11%
N_2O emissions excluding N_2O from LULUCF	22,458	21,100	-6%	21,406	17,800	-17%
HFCs	31,777	21,600	-32%	32,121	14,500	-55%
PFCs	3,280	4,200	28%	3,286	4,200	28%
SF_6	2,166	2,700	25%	2,075	2,700	30%
NF_3	1,361	500	-63%	1,617	500	-69%
Indirect CO_2	-	-	-	2,303	2,100	-9%
Total with LULUCF	1,343,115	1,054,000	-22%	1,345,131	774,000	-42%
Total without LULUCF	1,407,775	1,079,000	-23%	1,408,191	813,000	-42%

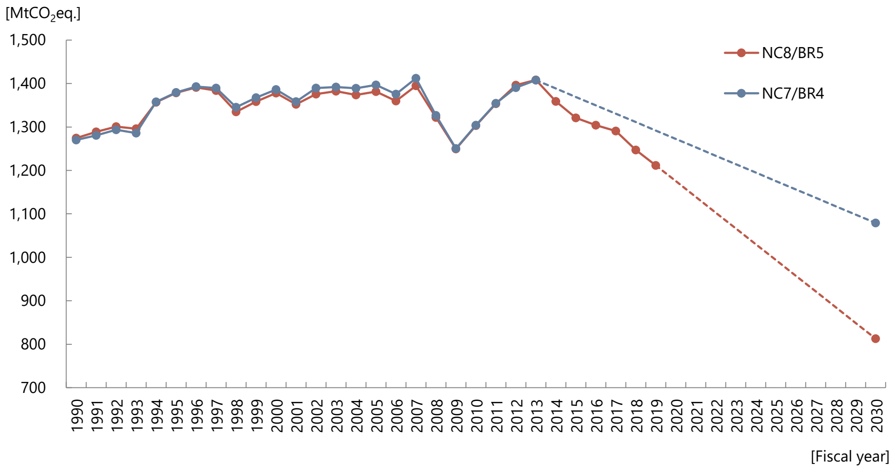


Figure 4-17 Comparison of projections in the NC7/BR4 and NC8/BR5（excluding LULUCF）

4.7 Supplementary information on mechanism under Article 6, 12 and 17 of the Kyoto Protocol

Since Japan does not have an emission reduction target for the second commitment period of the Kyoto Protocol, there is no supplementary information to be reported relating to the use of mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol.

Chapter 5

Vulnerability Assessment, Climate Change Impacts, and Adaptation Measures

5.1 Overview

(Institutional and legal framework for climate change adaptation measures)

- The *National Plan for Adaptation to the Impacts of Climate Change* was established and approved by the Cabinet in November 2015 (final revision: October 2021). Later, in order to define the legal position of climate change adaptation and to promote climate change adaptation more strongly in collaboration with a variety of stakeholders, including the national government, local governments, business operators, and citizens, the *Climate Change Adaptation Act* was promulgated in June 2018 and has been in force since December 2018.

(Objectives and progress management)

- The objectives of Japan's adaptation measures are to prevent and mitigate damage from the impact of climate change; to promote the stable life of citizens, sound development of society and the economy, conservation of the natural environment, and achievement of resilient national land by promoting measures related to climate change adaptation integrally and systematically based on scientific findings; and to build a safe, comfortable, and sustainable society.
- The progress of adaptation measures is to be periodically checked under the Climate Change Adaptation Promotion Council, which is chaired by the Minister of the Environment and composed of the relevant ministries and agencies.

(Major climate change impacts assessments and adaptation measures on individual sectors)

- In the *Assessment Report on Climate Change Impacts in Japan* that was published in December 2020, the impact that climate change could have on Japan is assessed for 71 categories covering seven sectors (agriculture, forestry, and fisheries; water environment and water resources; natural ecosystems; natural disasters and coastal areas; human health; industrial and economic activities; and life of citizenry and urban life) from three perspectives, including the degree and possibility of the impact (significance), the expression time of the impact, the time when adaptation efforts need to be started, and when an important decision needs to be made (urgency), and the certainty of evidence (confidence). The result of the assessment indicates that the impacts of climate change are significant and urgent.
- The *Adaptation Plan* that was revised in October 2021 sorted the climate change impacts for each category, and the basic concept of adaptation measures in consideration of the climate change impacts assessment in the aforementioned report.

(Adaptation efforts by local governments)

- In local governments, as of March 2022, 155 local governments have formulated *Local Climate Change Adaptation Plans* and are implementing adaptation measures based on local circumstances in a planned manner. As of March 2022, 47 local governments established Local Climate Change Adaptation Centers that serve as bases to collect, organize, analyze, and provide information related to local climate change impacts and climate change adaptation and to provide technical advice.

(Cross-sectoral efforts and international cooperation)

- Regarding cross-sectoral efforts, the *National Climate Change Adaptation Plan* stipulates basic measures for the enhancement and utilization of scientific knowledge on climate change and other related issues; basic measures related to ensuring the system for collection, organization, analysis, and provision of information related to climate change; basic measures related to the promotion of measures related to climate change adaptation with local governments; basic measures related to the promotion of climate change adaptation by business operators and business activities contributing to climate change adaptation; and basic measures for securing international collaboration and promoting international cooperation related to climate change.

- Concerning international cooperation, the *National Climate Change Adaptation Plan* positions the "contribution to increasing the adaptive capacity of developing countries" as one of its basic strategies, and the national government promotes the enhancement of scientific findings related to climate change risks, the provision of stakeholders' support tools, development of capacities related to the assessment of climate change impacts and climate change adaptations through the Asia-Pacific Climate Change Adaptation Information Platform (AP-PLAT). In addition, the national government promotes technical cooperation in the observation, monitoring, projection, and assessment of climate change and its impacts, as well as DRR, climate change adaptation of agriculture, among others, and the international development of Japanese adaptation businesses using AP-PLAT and DIAS, etc.

(Other basic measures related to promoting adaptation measures)

- In 2020, a new crisis, COVID-19, emerged in addition to climate change. They are deeply connected to each other. Social changes to improve the environment, economy, and society integrally, the conservation of biodiversity, and coexistence with nature are essential to overcoming the crisis. For this reason, it is important to direct environmental policy in Japan through three transitions: the transition to a decarbonized society, the transition to a circular economy, and the transition to a decentralized society in harmony with nature, and then for local governments to develop regions newly based on the concept of a Circular and Ecological Economy, and for citizens to redesign society into one where each person changes their lifestyle. Based on these concepts, Japan is taking on various efforts.

5.2 Introduction (Noteworthy efforts in recent years)

This report is the Eighth Japan's National Communication Chapter 5, "Vulnerability Assessment, Climate Change Impacts, and Adaptation Measures", under the United Nations Framework Convention on Climate Change (UNFCCC) and the second adaptation communication of Japan to be submitted to the UNFCCC Secretariat pursuant to Article 7, paragraph 10 of the Paris Agreement. Unless otherwise noted, the information in this report reflects the situation as of March 31, 2022 (end of FY 2021 in Japan). Climate change has impacts on agriculture, forestry and fisheries, ecosystems, natural disasters, heat illness, and a variety of other areas inside and outside Japan, and the negative impacts of climate change are called a "climate crisis" shaking the foundations of human survival and the survival of all other living things.

Japan aims to reduce its greenhouse gas emissions by 46% in FY 2030 from its FY 2013 levels, setting an ambitious target that is aligned with the long-term goal of achieving net zero by 2050. Furthermore, Japan will continue strenuous efforts in its challenge to meet the lofty goal of cutting its emissions by 50%.

If a carbon-neutral 2050 is achieved globally, it will increase the possibility of limiting the rise in temperatures to 1.5°C, and it could reduce the frequency and slow the increase in strength of heatwaves, other extreme high-temperature events, and heavy rains. However, looking at the world as a whole, it is difficult to say that the prospect of achieving a carbon-neutral 2050 exists, and certain impacts may not be avoided even if the goal of limiting global warming to 1.5°C is achieved.

Therefore, it is important to strongly implement mitigation and adaptation measures in a manner complementary to each other as climate change measures.

Based on this recognition, Japan has been engaged in climate change adaptation measures. Our noteworthy efforts in recent years are stated in (1) through (8) below.

(1) Establishment of the Climate Change Adaptation Act

In 2018, Japan established a single law for the promotion of adaptation measures, the *Climate Change Adaptation Act* (hereinafter referred to as the "*Adaptation Act*"), which is rare[70] in global terms, and stakeholders are accelerating efforts for adaptation together under the Act.

(2) Implementation of climate change impacts assessment

The Ministry of the Environment assessed the impact of climate change on 71 categories covering seven sectors, such as natural disasters and human health, based on scientific findings from three perspectives –significance, urgency, and confidence– and published the *Assessment Report on Climate Change Impacts in Japan* in December 2020. A total of 1,261 reference documents were used as the basis for the report, which is approximately 2.5 times more than the previous assessment (2015) in number, and confidence increased for 31 categories. As a result, confidence was at a medium or higher degree in 55 categories (77%). Concerning significance and urgency, compared with the assessment conducted in 2015, three categories were newly assessed as "recognized as having particularly significant impacts", and eight categories were assessed as "high urgency of response." This *Assessment Report on Climate Change Impacts* will be updated approximately every five years based on the latest scientific findings.

(3) Establishment of the Climate Change Adaptation Plan by the national government

The national government organized the basic idea and concrete measures for climate change adaptation measures concerning 71 categories covering seven sectors in consideration of the *Assessment Report on Climate Change Impacts in Japan* published in December 2020, and the *National Climate Change Adaptation Plan* was approved by the Cabinet in October 2021. Under the plan, for the fields with high significance and urgency (18 major items and 32 subitems), Key Performance Indicators (KPI) are established as part of a follow-up to the plan, changes to indicators are checked every fiscal year, etc., and in this way, the progress of each measure based on the plan is identified. When the plan was being developed, one or more KPIs were set for 16 (89%) out of 18 major items, and under the plan, the goal was set to achieve 100% within five years. The *National Climate Change Adaptation Plan* is scheduled to be revised based on

[70] In a range that could be identified by a survey conducted before enforcement of the *Adaptation Act* (November 2018), Japan was the only country in the world that legislated for adaptation alone.

the revision of the climate change impacts assessment.

(4) Organization of the Climate Change Adaptation Promotion Council by relevant ministries and agencies

In order to implement the *National Climate Change Adaptation Plan* appropriately, the Climate Change Adaptation Promotion Council, which consists of the Minister of the Environment as chairperson and the relevant ministries and agencies (the Cabinet Secretariat and 12 ministries and agencies), makes the necessary coordination between relevant ministries and agencies, promotes measures related to climate change adaptation by taking a whole-of-government approach while engaging in mutual collaboration, and checks on progress periodically. In addition, a follow-up report on the *National Climate Change Adaptation Plan* is posted on the website (Japanese only: https://www.env.go.jp/earth/tekiou.html) after each meeting every year. The Council organized the first meeting in December 2018. The Ministry of Defense has been participating since the second meeting in November 2019. The meeting has been held five times in total.

(5) Establishment of local climate change adaptation plans and a Local Climate Change Adaptation Center by local governments

Prefectural governments and municipal governments are required to strive to formulate a local climate change adaptation plan based on the *Adaptation Act* in order to promote adaptation measures depending on the natural, economic, and social circumstances in their local area. As of March 2022, plans have been established in 46 out of 47 prefectural governments, and adaptation measures based on the local circumstances are being implemented systematically. Under the *National Climate Change Adaptation Plan*, which was approved by the Cabinet in October 2021, the goal has been set to achieve 100% establishment of *Local Climate Change Adaptation Plans* within five years in all prefectures and government ordinance-designated cities. The Ministry of the Environment supports the establishment of *Local Climate Change Adaptation Plans* by local governments by creating manuals and dispatching specialists to formulate plans.

In addition, prefectural governments and municipal governments are required to strive to establish a Local Climate Change Adaptation Center as a base for collecting, organizing, analyzing, and providing information related to climate change impacts and climate change adaptation and for giving technical advice based on the *Adaptation Act*. As of March 2022, Local Climate Change Adaptation Centers have been established in 37 out of 47 prefectures. Under the *National Climate Change Adaptation Plan*, the goal is set to achieve 100% establishment of Local Climate Change Adaptation Centers within five years in all prefectures and government ordinance-designated cities. The Ministry of the Environment supports efforts related to the Local Climate Change Adaptation Centers.

(6) Efforts for heat illness measures

In Japan, approximately 71,000 people were taken to hospital by ambulance for heat illness in 2019, approximately 65,000 people in 2020, and approximately 48,000 people in 2021 (for the period from June to September in 2020 and for the period from May to September in 2019 and 2021). In 2018, 1,581 people died due to heatstroke, 1,224 people in 2019, and 1,528 people in 2020 (the percentage of elderly people over 65 out of the number of all the fatalities is 80% or higher). Taking the impact of climate change on heat illness into consideration, the national government provides weather information and Wet-Bulb Globe Temperatures (WBGT), as well as reminders, raises awareness of prevention and handling methods of heat illness, and provides appropriate information related to the occurrence status for emergencies, the education, healthcare, physical labor, agriculture, forestry and fisheries, sports, sightseeing, daily life, and other scenes in cooperation with the relevant ministries and agencies under the Heat Illness Prevention Conference. In particular, in order to have people take preventive action against heat illness, the government is operating the "Heat Stroke Alert" nationwide from April 2021, which was implemented in advance in the Kanto-Koshin region in the summer of 2020, and it continues to implement measures to prevent heat illness.

(7) Tackling weather-related disasters

In Japan, damage from weather-related disasters has become more severe in recent years. For example, as of the end of March 2022, 5 of the top 10 insurance payments (164.2 billion yen to 1,067.8 billion yen) occurred in 2018 and after.[71] In order to respond to disasters in the era of the climate crisis, drastic disaster risk reduction (DRR) measures based on climate change risks are necessary. For this reason, the Minister of the Environment and the Minister of State for Disaster Management compiled a strategy for effectively promoting coordinated measures for climate change and DRR in June 2020 in view of the achievement of the SDGs and by grasping various social issues from a broader perspective. The strategy clearly states that when recovering from a disaster, we must not be confined to simply restoring the affected area to the way it was before the disaster struck; rather, we must respond to disasters by conveying the idea of "Adaptive Recovery" by implementing resilient measures that include the control of land use where communities can ensure adaptation to climate change. Various efforts based on the strategy will continue to be implemented proactively in the future. In addition, ecosystem-based disaster risk reduction (Eco-DRR) and ecosystem-based adaptation (EbA) are implemented in consideration of the idea of nature-based solutions (NbS) and by paying attention to the fact that maintaining and restoring healthy ecosystems, including the establishment of an ecological network, contributes not only to mitigation measures by functioning as sinks for emissions but also to adaptation measures, including DRR.

(8) Efforts for international cooperation

Many developing countries generally lack the capacity to adapt to the impact of climate change. For this reason, Japan uses the Asia-Pacific Climate Change Adaptation Information Platform (AP-PLAT), which was launched to support decision-making to taking the risks of climate change into consideration and highly effective climate change adaptation in the Asia-Pacific region in order to improve scientific knowledge related to the risks of climate change, to provide stakeholder support tools, and to strengthen capacity related to the assessment of climate change impacts and climate change adaptation, in collaboration with countries and relevant institutions in the region. In addition, Japan promotes technical cooperation in the observation, monitoring, projection, assessment of climate change and its impacts, DRR, and climate change adaptation of agriculture in developing countries, with various international cooperation frameworks, meteorological satellites, etc. Furthermore, through AP-PLAT and

[71] Materials of the General Insurance Association of Japan https://www.sonpo.or.jp/report/statistics/disaster/ctuevu000000530r-att/c_fusuigai.pdf (data as of March 2022; viewed on August 3, 2022)

Data Integration and Analysis System (DIAS) etc., Japan promotes overseas development and international cooperation (*) by the government and the private sector, utilizing Japanese knowledge and experience such as technologies related to observation, monitoring, projection, and assessment of climate change and its impacts, as well as Japan's disaster experience and adaptation technology of DRR and agriculture, while promoting the international development of Japanese adaptation business.

* Among the preceding efforts, for example, the Ministry of the Environment supported the Independent State of Samoa and the Federated States of Micronesia in developing climate risk information on storm surges and high tides, which may affect their airports. Such information is expected to be used by those countries for formulating disaster prevention plans and maintenance plans for their airports. In addition, in Indonesia and Vietnam, the Ministry of the Environment supported the risk assessment of the impact of climate change on the production of paddy field rice, which is their staple diet, which resulted in the formulation of Climate Change Adaptation Plan in each country.

In addition, Japan announced in June 2021 at the G7 Cornwall Summit that Japan will provide climate finance, both public and private, totaling 60 billion USD over the next five years from 2021 to 2025 and that it will further enhance its assistance for adaptation. This is the same high level as its previous commitment up to 2020 of JPY 1.3 trillion (equivalent to approximately 11.8 billion USD) per year. This commitment stands out as a sizeable amount among other developed countries. At the COP26 World Leaders Summit held in November of the same year, Japan announced that Japan would provide up to 10 billion USD in addition to worth 60 billion USD above in order to lead the initiative in fulfilling the financial goal of climate finance that developed countries are collectively committed to the 100 billion USD per year. Japan also announced that Japan doubled its assistance for adaptation to climate change, such as disaster risk reduction, to approximately 14.8 billion USD. Under this commitment, Japan will continue to lead the global effort to tackle climate change.

Currently, under circumstances where the entire world is facing the historical crisis of COVID-19, balancing the prevention of infection with economic and social activities is a common issue around the world, including in Japan. Under the recognition that we are at a major turning point in the era, we are not required to return to the society that existed before COVID-19 but to achieve a revolution into a sustainable and resilient social system.

In addition, as recognized again in the 2030 Agenda for Sustainable Development, diverse social, economic, and environmental issues, including climate change, are inseparably linked. In order to achieve the Sustainable Development Goals (SDGs) simultaneously, it is necessary to engage in a variety of efforts comprehensively and strategically from a more inclusive perspective. For example, we need to give consideration to gender in measures against the impact of climate change, including natural disasters, and ensure the participation of women in the decision-making process related to climate change measures.

Based on the above, in Japan, cross-sectoral efforts that contribute to climate change adaptation are also being implemented proactively. We are proposing a redesign into a sustainable and resilient economic society, a Circular and Ecological Economy, Adaptive Recovery, and other new concepts, and we are engaging in efforts based on these concepts.

In this report, in addition to the aforementioned activities based on the *Adaptation Act*, these efforts related to a fundamental social change have also been introduced.

We are pleased to share the various initiatives and experiences related to adaptation that Japan has been addressing nationally with other countries through this report. Also, we expect that this report will contribute to examining various agendas in COP and the global stocktake in the near future.

5.3 Institutional and legal framework and implementation system for climate change adaptation measures

In Japan, increases in the national average temperature, increases in the frequency of heavy rain, and other long-term changes have been observed, and their diverse impacts have been reported. In the future, in association with the progress of climate change, it is projected that the risk from extremely high temperatures and heavy rain will continue to increase.

Under these circumstances, based on the *Report on Assessment of Impacts of Climate Change in Japan and Future Challenges* that was compiled as a comment submission by the Central Environment Council in March 2015, the *National Plan for Adaptation to the Impacts of Climate Change* was established and approved by the Cabinet in November 2015.

Later, in order to define the legal position of climate change adaptation and to promote climate change adaptation more strongly in collaboration among a variety of stakeholders, including the national government, local governments, business operators, and citizens, the *Adaptation Act* was promulgated in June 2018 and has been in force since December 2018.

The *Adaptation Act* consists roughly of the following four pillars:

(1) Integrated promotion of adaptation

- Defining the roles of the national government, local governments, business operators, and citizens in promoting adaptation to climate change.
- The national government shall establish a *Climate Change Adaptation Plan*.
- The Minister of the Environment shall receive the opinions of the Central Environment Council approximately once every five years and assess the impact of climate change.
- The national government shall consider a comprehensive assessment etc. of the latest impact of climate change, examine the *Climate Change Adaptation Plan*, and, if deemed necessary, promptly revise the plan.

(2) Developing information infrastructure

- The National Institute for Environmental Studies collects and provides information on the impact and adaptation of climate change and engages in operations related to technical support etc. for local governments and Local Climate Change Adaptation Centers.

(3) Enhancing local adaptation

- Prefectural governments and municipal governments strive to establish *Local Climate Change Adaptation Plans* in consideration of the *National Climate Change Adaptation Plan*.
- Prefectural governments and municipal governments strive to ensure a system that functions as a basis for collecting and providing information related to the impact of climate change and adaptation (Local Climate Change Adaptation Centers).
- Regional environment offices and other local administrative organs of the national

government, prefectures and municipalities and other entities may organize Regional Councils on Climate Change Adaptation in order to adapt to climate change through widescale collaboration.

(4) International development of adaptation and other issues

- The national government promotes international cooperation related to climate change adaptation and develops rules related to the promotion of business activities contributing to climate change adaptation by business operators.

The Japanese government has been implementing measures to reduce emissions of greenhouse gases (mitigation measures) under the *Act on the Promotion of Global Warming Countermeasures,* and the *Adaptation Act* is separate legislation for adaptation measures alone.

Based on the provisions of the *Adaptation Act*, the *National Climate Change Adaptation Plan* was established in November 2018 after coordination between relevant ministries and agencies, gathering opinions of the experts in the Global Environment Committee of the Central Environment Council and collecting and reviewing public comments.

The *National Climate Change Adaptation Plan* was followed up by the "Climate Change Adaptation Promotion Council," which was established based on the plan and consisted of relevant ministries and agencies and the progress of measures is identified and published every fiscal year. According to the latest *FY 2021 Measures Follow-up Report* published in March 2021 (Japanese only: https://www.env.go.jp/earth/tekiou.html), concerning sectoral measures and basic measures stated in the *National Climate Change Adaptation Plan*, the implementation status was inspected for each group of measures based on the details of this follow-up and previous follow-ups, and progress was confirmed to an extent in all groups of measures.

In December 2020, which was five years after the Climate Change Impacts Assessment in March 2015, a new *Assessment Report on Climate Change Impacts in Japan* was compiled based on the *Adaptation Act* in consideration of the latest scientific findings related to climate change and to the observation, monitoring, projection, and assessment of the impact of climate change in diverse fields.

In addition, in consideration of the aforementioned report, at the end of August 2021, the national government published the *Climate Change Adaptation Plan* (draft), and public comments were collected and reviewed. Subsequently, the *National Climate Change Adaptation Plan* was revised in October 2021 through specified procedures in consideration of the opinions submitted for the draft.

The matters in the following sections are stated based mainly on the *Assessment Report on Climate Change Impacts in Japan* published in December 2020 and the *National Climate Change Adaptation Plan* published in October 2021.

5.4 Objectives, basic roles of stakeholders, basic strategies, and progress management

The objectives, the basic roles of stakeholders, basic strategies, and the progress management of Japan's adaptation measures are stipulated in the *National Climate Change Adaptation Plan* as follows.

(1) Objectives

To prevent and mitigate damage from the impact of climate change; to promote the stable life of citizens, sound development of society and the economy, conservation of the natural environment, and achievement of resilient national land by promoting measures related to climate change adaptation integrally and systematically based on scientific findings; and to build a safe, comfortable, and sustainable society. In addition to a socioeconomic perspective, such as reduction of the population and post-COVID-19, other new perspectives, including Adaptive Recovery and NbS, will be considered.

(2) Basic roles of stakeholders

Diverse stakeholders take the following basic roles, respectively and in close cooperation with each other:

A. Basic roles of the national government

Integrated promotion of climate change adaptation, taking the initiative to implement measures related to climate change adaptation, promoting and ensuring collaboration in climate change adaptation among diverse stakeholders, promoting international cooperation, enhancing and using scientific findings, and assessing the impact of climate change.

B. Basic roles of local governments

Promoting climate change adaptation based on the natural, economic, and social circumstances of the local area, the local promotion of climate change adaptation for stakeholders, and the local enhancement and use of scientific findings.

C. Basic roles of business operators

Implementation of climate change adaptation based on the characteristics of their business operations and the expansion of adaptation business.

D. Basic roles of citizens

Implementation of individual climate change adaptation actions and cooperation for climate change adaptation policy.

E. Roles to be fulfilled by the National Institute for Environmental Studies (National Research and Development Agency) related to the promotion of climate change adaptation

Observation and monitoring, climate change projection, development of information infrastructures related to climate change impacts and climate change adaptation, technical support for local governments, and technical support for Local Climate Change Adaptation Centers.

(3) Basic strategies

In order to promote measures related to climate change adaptation integrally and systematically based on scientific findings and to achieve the goals of the *National Climate Change Adaptation Plan*, basic strategies are defined as stated below. The national government and relevant ministries and agencies collaborate closely and promote sectoral and basic measures effectively under these basic strategies.

Basic strategy [i] Embed climate change adaptation in every relevant policy.

Basic strategy [ii] Promote climate change adaptation based on scientific knowledge.

Basic strategy [iii] Consolidate the knowledge of research institutions in Japan and develop the information infrastructures.

Basic strategy [iv] Promote climate change adaptation according to local backgrounds.

Basic strategy [v] Deepen the understanding of citizens and promote climate change adaptation corresponding to business activities.

Basic strategy [vi] Contribute to enhancing the adaptive capacity of developing countries.

Basic strategy [vii] Ensure a system of close collaboration among relevant administrative agencies.

(4) Progress management

In order to implement the *National Climate Change Adaptation Plan* appropriately, the national government establishes a Climate Change Adaptation Promotion Council that consists of the Minister of the Environment as chairperson and relevant ministries and agencies, make the necessary coordination among relevant ministries and agencies under the Council, promotes measures related to climate change adaptation together by taking a whole-of-government approach while collaborating with each other, and checks the progress periodically.

A PDCA method is introduced for managing the progress of sectoral and basic measures. In concrete terms, the progress of short-term measures is managed by implementing a follow-up review every fiscal year using KPI. In addition, indicator data will be broadly collected. Concerning basic measures, the progress of medium- and long-term climate change adaptation is checked every five years.

PDCA methods are revised as necessary, and the methods to identify and assess the impact of adaptation measures are examined.

5.5 Major climate change impact assessments and basic concept of adaptation measures on individual sectors

In the *Assessment Report on Climate Change Impacts in Japan* that was published in December 2020, the impact that climate change could have on Japan is assessed for 71 categories covering seven sectors based on scientific knowledge from three perspectives, including the degree and possibility of the impact (significance), the expression time of the impact, the time when adaptation efforts need to be started and when an important decision needs to be made (urgency), and the certainty of evidence (confidence). The outline is as stated below.

Table 5-1 Results of climate change impact assessments (Summary)

List of climate change impact assessment result

Sector	Category	Sub-category	Significance (RCP2.6/8.5)	Urgency	Confidence
Agriculture Forest/, Forestry, Fisheries	Agriculture	Paddy field rice	●/●	●	●
		Vegetables, etc.	◆	●	▲
		Fruit trees	●/●	●	●
		Barley/wheat, soybean, feed crops, other crops	●	▲	▲
		Livestock farming	●	●	▲
		Plant pests, weeds, etc.	●	●	●
		Water, land and agricultural infrastructure	●	●	●
		Food supply and demand	◆	▲	●
	Forest/Forestry	Timber production (e.g., planted forests)	●	●	▲
		Non-timber forest products (e.g., mushrooms)	●	●	▲
	Fisheries	Migratory fish stocks (ecology of fishes)	●	●	▲
		Propagation and aquaculture	●	●	▲
		Fishery environments in coastal areas and inland waters, etc.	●/●	●	▲
Water Environment, Water Resources	Water environment	Lakes, marshes, dams (reservoirs)	◆/●	▲	▲
		Rivers	◆	▲	■
		Coastal zones and closed sea areas	◆	▲	▲
	Water resources	Water supply (surface water)	●/●	●	●
		Water supply (groundwater)	●	▲	▲
		Water demand	◆	▲	▲
Natural ecosystems	Terrestrial ecosystems	Alpine/subalpine zone	●	●	▲
		Natural forests, secondary forests	◆/●	●	●
		Countryside -landscape (“satochi-satoyama”)	◆	●	■
		Planted forests	●	●	▲
		Damage from wildlife	●	●	■
		Material balance	●	▲	▲
	Freshwater ecosystems	Lakes, marshes	●	▲	■
		Rivers	●	▲	■
		Marshlands	●	▲	■
	Coastal ecosystems	Subtropics	●/●	●	●
		Temperate, subarctic	●	●	▲
	Marine ecosystems		●	▲	■
Natural ecosystems	Others	Phenology	◆	●	●
		Shifts in distribution and populations (Endemic)	●	●	●
		Shifts in distribution and populations (Exotic)	●	●	▲
	Ecosystem services		●	—	—
		Nutrient and turbid material retention functions in watersheds	●	▲	■
		Supply of fisheries resources by coastal seagrass ecosystems	●	●	▲
		Eco-DRR functions of coral reefs	●	●	●
		Recreational functions related to natural ecosystems	●	▲	■
Natural Disasters, Coastal Areas	Rivers	Floods	●/●	●	●
		Inland waters	●	●	●
	Coastal areas	Sea-level rise	●	▲	●
		Storm surges, high waves	●	●	●
		Coastal erosion	●/●	▲	●
	Mountain areas	Debris flows, landslides, and other disasters	●	●	●
	Others	Strong winds, etc.	●	●	▲
	Impacts of complex disasters				
Human health	Winter warming	Mortality in winter season	◆	▲	▲
	Heat stress	Risk of mortality, etc.	●	●	●
		Heat illness, etc.	●	●	●
	Infectious diseases	Water- and food-borne diseases	◆	▲	▲
		Vector-borne infectious diseases	●	●	▲
		Other infectious diseases	◆	■	■
	Others	Complex impacts of warming and air pollution	◆	▲	▲
		Impacts on vulnerable populations (elderly, children, persons with underlying health conditions, etc.)	●	●	▲
		Other health impacts	◆	▲	▲
Industrial / Economic Activities	Manufacture	—	◆	■	■
		Food manufacturing industry	●	▲	▲
	Energy	Energy supply and demand	◆	■	▲
	Commerce		◆	■	■
		Retail industry	◆	▲	▲
	Finance, insurance		●	▲	▲
	Tourism	Leisure	◆	▲	●
		Leisure industry based on natural resources	●	▲	●
	Construction		●	●	■
	Medical		◆	▲	■
	Others	Others (overseas impacts)	◆	■	▲
		Others	—	—	—
Life of Citizenry, Urban Life	Urban infrastructure, critical services, etc.	Water supply, transportation, and others	●	●	●
	Life with sense of culture and history	Phenology, traditional events/ local industry (Phenology)	◆	●	●
		Phenology, traditional events/ local industry (Local industry)	—	●	▲
	Others	Impacts on life due to heat stress, etc.	●	●	●
Inter-sectoral Impact Linkages	Impacts of disruptions of urban infrastructure and critical services				

Legend

Significance
- ● : Recognized as having particularly significant impacts
- ◆ : Recognized as having significant impacts
- — : N/A (cannot currently be assessed)

Urgency and Confidence
- ● : High
- ◆ : Medium
- ■ : Low
- — : N/A (cannot currently be assessed)

Note: For some categories, urgency has been assessed separately for RCP2.6/ RCP8.5 senarios.

Indicates that changes and/or updates have been made in categories and/or assessment results since the first impacttassessm
Assessment of significanceand/orurgencyhas beenrevisedupwards
New category added for this assessment

The *National Climate Change Adaptation Plan* that was revised in October 2021 sorted the climate change impacts for each category and the basic concept of adaptation measures in consideration of the climate change that impacts the assessment in the aforementioned report.

In the following, the impact of climate change and the basic concept of adaptation measures are organized based on the statements in the *Assessment Report on Climate Change Impacts in Japan* and the *National Climate Change Adaptation Plan*. Concerning the basic concept of adaptation measures, concepts related to subcategories for which the significance, urgency, and confidence are all assessed to be high are excerpted and indicated as examples, while climate change impacts assessments related to sectors that include such subcategories are excerpted and indicated as examples, respectively. For details on basic concepts related to adaptation measures for other subcategories, a detailed assessment of the impact of climate change and the methods and scenarios used for projections on individual sectors, please refer to the latest *Assessment Report on Climate Change Impacts in Japan* and the *National Climate Change Adaptation Plan*.

http://www.env.go.jp/earth/tekiou.html (Japanese)
http://www.env.go.jp/en/earth/cc/adaptation.html (English).

5.5.1 Agriculture, forestry, and fisheries

■ Overview of climate change impacts

(1) Current status

In agriculture, the quality and yields of many crops have seen declines nationwide in Japan due to changes such as increased temperatures and changes in the temporal and spatial distribution of precipitation, with decreases in the ratio of first-class rice produced, poor growth of vegetables, and physiological disorders of fruit trees; the effects of heat stress are also becoming increasingly evident in the livestock sector. Crop damage is occurring because of the expanded distribution and increased outbreaks of pests and diseases. In the water, land, and agricultural infrastructure, the lack of rain and other factors are leading to shortages in agricultural water that impact agricultural water supply facilities. In relation to forestry activities, disease outbreaks in shiitake mushroom bed log cultivation are becoming prevalent in larger areas. In fisheries, there have been changes in the distribution areas of migratory species, such as the Japanese flying squid and Pacific saury (*samma* in Japanese), impacting the processing and distribution industries, as well as increased risk of fish and shellfish mortality in aquaculture and inland fisheries and decreased yields in seaweed production. There is also a serious decline in seaweed beds, believed to be due to increased seawater temperatures. Conversely, there have been reports of increased yields of crops, such as feed corn, in some areas, expansion of areas suitable for fruit tree cultivation (e.g., wine grapes), and increased fish catches (e.g., Japanese yellowtail [*buri*] and Japanese Spanish mackerel [*sawara*]). In addition, some reports have described impacts on production methods in response to climate change, especially in agriculture, with adaptation measures already being implemented for certain crops, such as growing heat-tolerant cultivars and making modifications to growing seasons.

(2) Projected impacts

A variety of approaches are being used for future projections, including research using greenhouse gas emissions and concentration scenarios, research that takes uncertainty into account using multiple climate prediction models, field experiments, and research that reflects cultivation test results in plant growth models etc. In subcategories, such as paddy field rice, fruit trees, and fishery environments in coastal areas and inland waters, new findings have been reported related to future projections using RCP2.6 and RCP8.5 scenarios. In agriculture, it has been suggested that yields will decrease for paddy rice, fruits and vegetables, fall wheat, soybean in warm regions, tea, etc.; it has been predicted that a greater ratio of paddy rice will become more susceptible to high-temperature risk; for fruit trees, there are projections for deterioration of grape coloration and changes in suitable growing areas for fruit, such as satsuma mandarin oranges and apples. In addition, decreases are predicted in livestock growth, increases in pest outbreaks and habitat area, and increases in damage resulting from disease. For the water, land, and agricultural infrastructure, a lack of agricultural water is predicted for some areas because of the decrease in snowmelt runoff during the wet-ploughing (*shirokaki*) season for paddy rice cultivation and an increased risk of damage to low-lying paddy fields due to heavy rainfall. In forestry, research is underway to estimate the net primary production of Japanese cedar (sugi) planted forests for shiitake bed log cultivation, and the earlier or more frequent occurrence of pests for shiitake is predicted. In fisheries, in the waters around Japan, the distribution is predicted to shift and expand for Japanese sardines (also known as pilchard; *maiwashi*) and Japanese amberjack, while the salmon and trout habitat is expected to decrease, and the larger marine areas are expected to see lower distribution densities of Japanese flying squid. In aquaculture, some areas that produce fish and shellfish are expected to become unsuitable for production because of increased water temperatures in summer. For seaweed, the habitat for kelp (kombu) is expected to move significantly northward, the harvest season for wakame seaweed to be shortened, the start of seedling raising for nori seaweed growing to be delayed, and the variety of seaweed types in seaweed beds along the coast of Japan to decrease.

Basic approach to adaptation measures

(a) Overview of agricultural production

- Although impact projection has been conducted with a focus on major crops, it is necessary to conduct further research on projected impacts.

(b) Paddy field rice

- Because of the high temperatures after the ear emergence period, high-temperature disorders causing immature white grains to occur frequently were often observed. Therefore, it is necessary to strive to avoid high temperatures during the grain ripening period by introducing high temperature-resistant varieties or by planting varieties with various ripening periods.
- The early onset of pests, increases in pest emergence volume, and an expansion in the areas where pests occur have been seen because of the impact of global warming. Therefore, appropriate pest control measures need to be implemented.

(c) Fruit trees

- Fruit trees are perennial crops, which require a certain period to produce fruit, and may easily cause price fluctuations because of a loss in the balance of supply and demand. Therefore, it is essential to introduce more measures from a long-term perspective than for other crops. Consequently, a network system between major production sites and major prefectures must be developed so that information related to the impact of global warming and its adaptation measures are shared, and action plans are appropriately examined in production site.
- Strive to disseminate the spraying of gibberellin combined with prohydrojasmon that mitigate the occurrence of peel puffing with satsuma mandarin oranges, the introduction of sprinkling water and reflective sheets as measures against poor coloring and sunburned fruit with apples, production stabilizing technologies of girdling to mitigate the coloring of grapes, the utilization of a sprout promoter for the purpose of mitigating damage caused by poor sprout emergence with Japanese pears, and other measures.
- In addition, promote demonstrations etc. on changing items from satsuma mandarin oranges to medium-late ripening citrus fruits, changing to superior-colored varieties of apples and grapes, introducing highly valuable subtropical and tropical fruits, and other measures.

(d) Plant pests, weeds, etc.

- In order to prevent the emergence of plant pests in Japan, promote pest control at an appropriate time based on pest forecasting information, early detection and control of invasive pest, and strengthening measures on plant movement restrictions, as well as advancing pest control techniques.

- With regard to mycotoxins, investigate the contamination status and continue to engage in establishing and disseminating measures to improve safety in cooperation with producers and validating the effects after a specified period.
- Concerning weeds, promote the development of technology to mitigate damage.

(e) Water, land and agricultural infrastructure

- In order to respond appropriately to more frequent and intense rainfall and other disasters and to achieve stable farming, as well as safe and comfortable lives in villages, promote the lifespan extension of farm irrigation facilities etc., water-resistant measures, the establishment of emergency power sources, or other tangible measures by combining them appropriately with the creation of hazard maps by conducting activities to raise awareness for local residents or other intangible measures based on the Fundamental Plan for National Resilience (approved by the Cabinet in June 2014; revised in December 2018) and the Basic Plan for Food, Agriculture and Rural Areas (approved by the Cabinet on March 31, 2020).

5.5.2 Water environment and water resources

Overview of climate change impacts

(1) Current status

In the water environment sector, newly observed impacts include increases in water temperatures already occurring in public waters (lake, marshes, rivers, seas) all over Japan, including a warming trend in water temperatures at 76% (summer) and 94% (winter) of 265 monitoring sites nationwide, and associated changes in water quality, as well as increases in the temperature of the water, and increased temperatures of spring water in spring-fed ponds. In the water resources sector, there have been reports of such impacts as water restrictions being imposed because of water shortages associated with the absence or lack of rain, the lack of irrigation water in spring due to an increase in snow melt during winter and increased agricultural and urban water demand. In terms of newly reported impacts, some examples include saltwater intrusion in coastal aquifers and the contraction of small island freshwater lenses.

(2) Projected impacts

Projected impacts in the water environment sector include more reservoirs being classified as being eutrophic water bodies, increased water temperatures and salinity concentrations in Lake Shinji and Nakaumi (brackish lakes in Shimane and Tottori prefectures), increased aquifer temperatures on the Sendai Plain, increased water temperature in the Seto Inland Sea and Ise Bay, and longer periods of turbid water discharge due to increases in suspended particulates associated with higher inflows into four reservoirs in the Tohoku region. Projected impacts in the water resources sector include more severe droughts due to an increase in rainless days, the increased river flows in winter due to a shift from snowfall to rain, decreased river flows in spring due to decreased snow melt, decreases in river flow during demand periods due to early snow melt, impacts on domestic water use by citizens in Sapporo due to future decreases in water resources, a mismatch between supply and demand for agricultural water due to dropping groundwater levels, etc., saltwater intrusion extending further upstream due to sea level rise, and because of that, impacts of the utilization of river water, a growing tendency for polarization of drought risk and flood risk, and the occurrence of landslides and other slope disasters due to increased groundwater supply as a result of heavy rainfall and snow melt.

Basic approach to adaptation measures

(a) Water supply (Surface water)

- Conduct assessments of water supply safety levels and drought risks for existing facilities that are the basis of measures to prevent and mitigate damage from droughts and prepare for droughts through drought risk information sharing with collaboration among actors, including the national government, local governments, water users, companies, and residents.
- In order to promote adaptation measures to deal with droughts, in collaboration with stakeholders, develop scenarios of drought impacts and damage and promote efforts to formulate drought response action plans that are time series and stipulate matters, including measures to mitigate damage from droughts.

5.5.3 Natural ecosystems

Overview of climate change impacts

(1) Current status

Impacts already occurring that have been reported around the country include long-term changes in species composition in forests near alpine and vegetation transition zones, seasonal mismatches between plant flowering seasons and pollinators, nationwide increases in sika deer habitat, and northward movement of the distribution of southern species in the river and coastal ecosystems. Newly appearing impacts include expansion near the northern limit of distribution of moso bamboo and Japanese timber bamboo over the past 30 years, a decline of seaweed bed ecosystems and a transition to coral reef communities in coastal areas, and further ocean acidification and oxygen depletion nationwide.

(2) Projected impacts

Projected impacts include the nationwide reduction or local disappearance of suitable habitat for such species as alpine ptarmigan and such cold-water fish as char, shifts in the distribution and growth of forest constituent tree species, expanded distribution of sika deer and bamboo species to higher latitudes and elevations, reduction or disappearance of suitable areas for the distribution of coral reefs in subtropical zones, a transition from seaweed bed ecosystems to coral reefs in temperate zones, and decreases in suitable habitat for species of coral, sea urchin and shellfish due to further ocean acidification. In subcategories, such as natural forests, secondary forests, and the subtropics (coastal ecosystems), new findings have been reported related to future projections using RCP2.6 and RCP8.5 scenarios.

Other changes being predicted include negative socioeconomic ripple effects due to impacts on ecosystem services, such as the reduced supply of fisheries resources due to reductions in the nutrient and turbid material retention functions in watersheds and the deterioration and disappearance of seaweed bed ecosystems in coastal areas, reductions in ecosystem-based disaster risk reduction (Eco-DRR) function due to the deterioration and disappearance of coral reefs, and reduced recreational functions associated with natural ecosystems.

Basic approach to adaptation measures

(a) Common efforts

- Ecosystems as a whole will change in response to climate change. Therefore, it is impossible to control ecosystem changes extensively by anthropogenic measures. In addition, it is necessary to recognize that ecosystem conservation functions as an adaptation measure for the aforementioned issues in agriculture, forestry, and fisheries.
- The basic adaptation measures in natural ecosystems are to identify changes in the ecosystems and species by conducting long-term continuous monitoring or other investigations, to look at sources of stress from non-climate change factors in addition to stress from climate change factors, to reduce these sources of stress, and to build an ecological network between protected areas and other effective area-based conservation measures and thereby promote the conservation and recovery of healthy ecosystems that are highly adaptable to climate change.
- In particular, it is also important to promote the strengthening of conservation and management in the areas that are expected to contribute to the adaptation in natural ecosystems (areas into which organisms can retreat or survive [refugium] under climate change and areas that can be sources of the supply of individuals), expanding whole areas, securing connectivity, and measures for using the natural environment to prevent lowland organism species from expanding unnecessarily into highlands.
- When building ecological networks, it is important to increase the connectivity and soundness of ecosystems from both a country-wide geographical perspective and a local perspective in order to establish a resilient country against environmental changes due to climate change etc.
- From the broader geographical perspective, in consideration of the fact that it was determined to support new global targets to conserve or protect at least 30% of global land and at least 30% of the global ocean by 2030 and to lead by example, effectively conserving or protecting at least the same percentage in theG7 nations, in the G7 2030 Nature Compact, which was adopted by the G7 Summit in 2021, it is necessary to expand protected areas and establish other effective area-based conservation measures in the most effective sites and to improve the quality of these areas in order to maintain the sustainability of ecosystem services by connections between forests, countryside, rivers, and sea.
- From the local perspective, methods to increase the quality of local ecosystems in supporting the life cycle of a living organism, such as securing diverse habitats and food resources. In particular, insects are fundamental in supporting ecosystems through their biomass and pollination and are important for the resilience of ecosystems. Therefore, it is also important to support the life cycles of these species in small green spaces in cities, farmland in villages and village forests, and other familiar natural environments.
- Active intervention may be conducted to maintain ecosystems, species, and ecosystem services to a limited extent; however, very careful study is necessary given the impact on ecosystems etc. and the burden of management. The creation of refugium has been considered to avoid impacts on ecosystems; however, there are species that can be transferred quickly and others that cannot be transferred with the effects varying by species. Therefore, careful attention must be paid. In addition, it is important to examine other measures based on the expected effects.

- When examining adaptation measures, it is important to collect basic information on subject regions/local areas, determine assessment indicators for existing visible impacts or expected impacts, project future impacts, and then establish measures based on the results, as well as to establish a plan related to the use and conservation based on local circumstances through discussions with local stakeholders, build consensus, and take action comprehensively in collaboration while sharing roles. When establishing measures, it is necessary to examine options based on whether the impact of climate change is projected for the distribution of species to be conserved in subject areas and other species that have an adverse impact on the species to be conserved and whether there is a refugium, etc. In addition, when implementing measures, it is necessary to monitor changes in the subjects of assessments and to engage in adaptive management to review the plan regularly. It is also necessary to foster human capital that is involved in the management and research, and studies of the natural environment from the long-term perspective in order to implement adaptation measures appropriately and effectively.
- Perspectives to maximize synergy and minimize tradeoffs with biodiversity conservation are important. The functions performed by healthy ecosystems include DRR, mitigation of heat stress in cities, and actions against the degradation of water quality in coastal areas and enclosed water areas, and they also contribute to adaptation measures in various fields. This concept is called Ecosystem-based Adaptation (EbA) or Ecosystem-based Disaster Risk Reduction (Eco-DRR) as part of NbS, and it is important as an effort that provides multiple benefits. In particular, in order to increase local resilience, it is necessary to avoid land use that is vulnerable to natural disasters based on the local landscape and ecosystem conditions to encourage a shift in residency from areas with high disaster risks to areas with low risks and to strengthen the local disaster resilience using the diverse functions of the natural environment.
- The impact of climate change is highly uncertain and advances over the long term. Therefore, it takes time before obvious changes are seen in the distribution and abundance of species and ecosystem services etc. These changes need to be defined from a long-term perspective, and it is impossible to judge the impact based on short-term monitoring results alone. For this reason, it is necessary to continue long-term monitoring and other investigations and to enhance and expand them as necessary.
- Concerning items with low confidence, study cases are limited, and there are anthropogenic impacts and impacts from land use. Therefore, it is necessary to accumulate scientific findings by promoting investigation and research to identify the impact of climate change on biodiversity etc. and to transmit and share appropriate information.

(b) Terrestrial ecosystems (Natural forests / Secondary forests)

- Concerning forests, it is necessary to promote the conservation and management of virgin forests and forests where rare wild organisms live and grow, as well as promote research and studies on the impact of climate change on forests.
- In order to conserve and restore sound ecosystems that are highly adaptive to climate change, it is necessary to promote the creation of an ecological network for the entire country between protected areas and other effective area-based conservation measures and to implement measures against the loss of biodiversity due to non-climate change factors that have been implemented by setting priorities in consideration of the perspective of adaptation to climate change.

- In particular, activities to strengthen the conservation of areas that are expected to mitigate the impact of climate change and to prevent lowland species from expanding to highlands are important.

(c) Coastal ecosystems (Subtropics)

- It is necessary to implement intensive long-term monitoring and other investigations with tidal flats, salt marshes, seaweed beds, seagrass beds, and coral reefs, where there is an especially high likelihood of impacts occurring. In addition, coastal areas have a strong relationship with the land through rivers etc. Therefore, it is necessary to expand observation through the entire river basin.
- In order to conserve and reproduce sound ecosystems that are highly adaptive to climate change, it is necessary to ensure the continuity of coastal ecosystems mainly by effectively allocating Marine Protected Areas etc. with various purposes, to form ecological networks, and to implement measures against the loss of biodiversity due to non-climate change factors that have been implemented, by setting priorities in consideration of the perspective of climate change adaptation.

(d) Shifts in distribution and populations (native species)

- In consideration of the perspective that changes in ecology and climate change provide useful basic data for investigations etc. of the impact on ecosystems and in consideration of the perspective that they have a cultural value in sensing the four seasons through living things, it is necessary to implement monitoring and other investigations to identify changes in phenology, including Citizen science.
- In order to identify changes in the distribution areas of species and populations, it is necessary to implement continuous long-term monitoring and other investigations.
- In order to secure routes for species to move and spread, it is necessary to promote the creation of ecological networks between protected areas and other effective area-based conservation measures and to implement measures against the loss of biodiversity due to non-climate change factors that have been implemented by setting priorities in consideration of the climate change adaptation perspective.
- Based on information obtained from monitoring and new scientific findings, it is necessary to take the appropriate action concerning species that risk causing adverse ecological impacts by considering climate change impacts when assessing invasive alien species.

(e) Ecosystem services (Eco-DRR function of coral reef)

- In addition to quantitative assessment and visualization of the various social benefits of NbS and other ecosystem services, it is necessary to promote investigation and research of the changes in the benefits and social impacts of climate change and to gather scientific findings to examine efforts for sustainable ecosystem services. In addition, it is necessary to promote the implementation of regional efforts.
- In the future, based on the fact that the impact on pollination services caused by changes in the distribution of pollinating insects due to climate change and mismatches between the visitation of pollinating insects and plant blossoming times, it is important to secure habitat size and continuity even for common species.

5.5.4 Natural disasters, coastal areas

■ Overview of climate change impacts

(1) Current status

There are reports on the occurrence of the following: vertical ground movement, a rising sea level trend that has been analyzed with corrections for air pressure and tides; extreme storm surges due to tropical cyclones; multiple deep-seated landslides and simultaneous multiple surface slope failures; large-scale complex disasters, such as combined sediment and flood damage, as well as serious sediment disasters in the Tohoku and Hokkaido regions where in the past there were few sediment disasters and catastrophic landslides on relatively gentle slopes, due to changes in the locations where heavy rains fall; changes in tropical cyclone intensity and tracks; increases in insurance payments from natural disasters; and reductions in the maximum number of years of fire insurance contracts due to the findings of climate change research. In addition, the use of event attribution and other methodologies is further clarifying the contribution of climate change to disasters, such as river and inland flooding.

(2) Projected impacts

Projected impacts include increased heavy rain events that can cause floods, increased flood peak flow and the probability of floods occurring, increased cost of damage; increased population likely to be affected by inundation due to inland flooding; increased expected costs of damage from inland flooding; a rising sea level trend and associated impacts on water intake facilities on rivers and coastal disaster prevention facilities, as well as port and fishing port facilities etc.; increased storm surge anomalies due to changes in scales and tracks of named tropical cyclones and increased risk of high waves; the disappearance of sandy beaches due to sea-level rise; increased frequency of combined sediment and flood damage and increased damage from driftwood due to severe rainfall conditions; and increased strong winds and intense tropical cyclones and increased frequency of strong tornadoes. There are also concerns about the impact of increased frequency of combined sediment and flood damage and increased damage from driftwood under severe rainfall conditions, as well as the impact of the increased frequency of strong tornadoes.

■ Basic approach to adaptation measures

(a) Floods and inland waters

- Projections of future climate change suggest increases in the frequency and strength of heavy rain, increases in total precipitation, mean sea level rise, and increases in extremes of storm surges and high waves. In addition to the intensification and frequent occurrence of water disasters, there is concern about the occurrence of large-scale disasters in new forms due to complex factors, such as combined sediment and river flooding, combined storm surges, and river flooding. Despite ranges in climate change projections concerning river infrastructure improvement and town (city) development that require a long time to implement, if measures are not started by assessing future climate change etc., the period required for necessary river infrastructure improvement may be prolonged because of reassessing the plan and implementation of additional measures. Therefore, prompt changes of plans to those established in consideration of climate change are urgent tasks.
- Review the plans that were established in consideration of climate change related to water disasters that are occurring more frequently and becoming more severe due to

climate change; promote "River Basin Disaster Resilience and Sustainability by All" conducted in the entire river basin in cooperation among the national government, prefectural governments, municipal governments, local companies, residents, and every stakeholder; and implement comprehensive DRR measures that integrate structural and nonstructural measures.

- In addition, concerning water disasters, which became more severe and more frequent due to climate change, when considering the speed of development against increases in external forces, it is not easy to increase flood control safety levels based on the plan only by means of conventional infrastructure development focused on river areas under the leadership of managers. For this reason, implement "River Basin Disaster Resilience and Sustainability by All" efforts that mitigate damage to the entire river basin, including catchment areas, rivers, and flood areas, and that is participated in by all people in the river basin, including people related to the river basin who have not previously been involved so that the water flow where rainfall flows into a river and the river floods can be considered as a system while implementing existing preliminary DRR measures under the leadership of managers.
- Concerning "River Basin Disaster Resilience and Sustainability by All," the following three elements should be implemented in a comprehensive and multilayered manner based on river basin characteristics, keeping in mind the occurrence of any type of flood up to an assumed maximum size flood, and including the participation of all people in the river basin:
    - Measures to prevent and mitigate flooding as much as possible (response to hazard)
      Implement development etc. of flood control facilities so that flooding can be prevented as much as possible.
    - Measures to reduce the targets of damage (response to exposure)
      Measures to reduce the targets of damage, such as town (city) development, including restrictions on land use and devising ways of living to avoid damage, with the idea of not living on dangerous land on the assumption of cases where massive flooding that exceeds the capacity of flood control facilities occur.
    - Measures to mitigate damage for early recovery and reconstruction (response to vulnerability)
      In response to the occurrence of floods, implement measures to mitigate damage, for example, by enhancing the system so that people can evacuate accurately and appropriately, and implement measures for early recovery and reconstruction in affected areas.
- Concerning increases in rainfall amounts and rising tide levels etc. due to climate change, implement the following measures that integrate structural and nonstructural measures in cooperation among relevant ministries and agencies, relevant local governments, and between the public and private sectors, in addition to flood control measures under the leadership of managers:
    - Strengthen the flood control function of existing dams and agricultural reservoirs, including water utilization dams.
    - Use the rainwater storage and infiltration function of paddy fields, agricultural reservoirs, etc.
    - Eliminate areas where there is no information related to water disaster risks.
    - In cooperation with departments in charge of urban planning, construction, etc.,

impose restrictions on land use in cooperation among multiple local governments, introduce residence guidance, devise ways of living, and propose other forms of town (city) development for DRR.

- Enhancement of first-aid activities and preparation for business continuity etc.

- In addition, when promoting "River Basin Disaster Resilience and Sustainability by All," promote the use of green infrastructure using the diverse functions of the natural environment, secure and increase rainwater storage and infiltration functions by control basin, etc., and proactively conserve or reproduce ecosystem functions that contribute to mitigating the risks of disaster and thereby create an ecological network.
- In order to respond to water disasters that are becoming more severe and frequent, it is also important to strengthen nonstructural measures, such as strengthening weather observation systems against concentrated heavy rains and tropical cyclones, and increasing prediction accuracy. Encourage resident evacuation behavior by technical improvements in the announcement of heavy rain emergency warnings, risk distribution to show the risk of disaster occurrence (Kikikuru), and other initiatives, strengthen and promote further activities for their appropriate use during ordinary times as well, and thereby reduce the number of casualties by weather-related disasters etc.
- In addition, in order to ensure the continued observation system of meteorological satellites to ensure people's safety and security, such as monitoring and predicting tropical cyclones and intense heavy rainfall, ensuring the safe navigation of aircraft and vessels, monitoring the global environment, and volcanic monitoring, the start of manufacturing of successor satellites in and around FY 2023 with the start of operation in and around FY 2029. Incorporate high-density observation and the latest technologies into the successor satellite to mitigate damage from natural disasters through advanced disaster prevention and weather information.
- When promoting these measures, it is important to avoid exposure by reading the local geography and ecosystems and adopting the concepts of ecosystem-based disaster risk reduction (Eco-DRR), where vulnerability is reduced using the functions of healthy ecosystems and green infrastructure.

(b) High waves and storm surges

1) Harbors and fishing ports

- Because of the characteristics of harbors and fishing ports that exist at the water level, adaptation to climate change must occur in the future. Therefore, it is appropriate to consider that the new facilities to be developed and existing facilities that are assumed to be used in combination for a long period are highly likely to suffer impacts during the period of combined use.
- Based on the *Disaster Risk Reduction Measures by Integrating Tangible and Intangible Measures in Future Harbors and Fishing Ports* (August 2020, Council for Transport Policy Report) and while considering socioeconomic activities and land use in areas on both the waterside and the landside, endeavor to control increases in risks from storm surges and other events in waterside and landside areas and maintain port and harbor activities by strategically and adaptively promoting the optimal combinations of tangible and intangible adaptation measures depending on the priority of risks to be mitigated. In addition, incorporate climate change adaptation measures into various types of programs and plans and promote the implementation of adaptation measures effectively through collaboration with a variety of other policies and efforts (mainstreaming of adaptation

measures).

2) Coastlines

- Accurately identify signs of the impact of climate change through marine monitoring, consider the medium- and long-term trends in socioeconomic activities and land use in the land-side areas, change from the single line of defense by breakwaters and seawalls to multiple lines of defense for tsunami protection by using all tangible and intangible measures, and implement measures with the optimal combination strategically and adaptively, and thereby control increases in disaster risks from storm surges and other events and conserve national land at coastlines.
- In addition, as to external forces that have increased because of climate change, concerning the design high-water level, a rise in mean sea level and increases in the amount of sea-level anomalies have been predicted, and concerning design waves, increases in the power of ocean waves, and other matters are predicted. For this reason, it is necessary to review these external forces that are the target of coastal conservation from those based on past sea levels and other results to those in consideration of sea levels based on future projections.
- Implement "River Basin Disaster Resilience and Sustainability by All" efforts where damage is mitigated for the entire river basin, including catchment areas, rivers, and flood areas and with the participation of all people in the river basin, including people related to the river basin who have not been involved before. In addition, at the river mouth, adjustment and consideration are necessary to continue the protection functions between rivers and coastlines, such as connecting river dikes and sea dikes, and setting the water levels used for river planning.

3) Fishing ports and villages

- Engage in DRR measures against disasters from tropical cyclones and low atmospheric pressure, and other events that are thought to become severe in the future and promote the creation of disaster-resilient fishery areas.
- In addition, since residential buildings are crowded in small spaces close to mountains and cliffs, and there are many vulnerable points for disasters in fishing villages, it also strengthens countermeasures against fire, mudslides, and other disasters.

4) Coastal disaster-prevention forests

- Promote the development and conservation of coastal disaster-prevention forests.

5) Airports

- The impact on airport facilities from increasing natural hazards associated with climate change, such as mean sea level rise and high waves should be studied to reflect it in DRR measures for airports.

(c) Sediment disasters (Debris flows, landslides, etc.)

- Sediment disasters occur because of the interrelation between complicated contributing factors and predispositions, and accurate forecasting is difficult. Therefore, implement structural measures and nonstructural measures and review plans of countermeasures for sediment disasters that are becoming more large-scale and occurring more frequently.
- In recent years, concerning combined sediment and flood damage, which are assumed

to occur frequently throughout Japan because of heavy rainfall in association with climate change and for which the risks are considered to increase from the simultaneous occurrence of slope failures and debris flows and increases in river discharge, establish the assessment method of sediment and flood damage, such as identifying dangerous areas for combined sediment and flood damage, and implement effective preliminary DRR measures, such as building sediment control dams and sediment-retarding basins in river basins with higher risks, and thereby promote effective development.

- Promote the effective installation of facilities for a large amount of driftwood that occurs and flows down with combined sediment and flood damage, debris flows, and other events.
- There is concern that sediment movement will occur more frequently because of the changes in rainfall characteristics in association with climate change, and it may become necessary to examine and review the timing and frequency of maintenance and management of sediment control dams etc., in addition to steadily implementing preliminary DRR, such as the installation of sediment control dams. Therefore, maintenance and management plans need to be considered.
- Concerning sediment disasters that will occur more frequently and become more severe, focus on the implementation of sediment disaster countermeasures to maintain lifelines, important traffic networks, local government offices, etc., and promote countermeasures against combined sediment and flood damage that will occur more frequently because of climate change, disseminate risk information using sediment disaster hazard maps based on the Act on Sediment Disaster Countermeasures for Sediment Disaster Prone Areas, and thereby promote structural and nonstructural countermeasures.
- Newly establish an assessment method to appropriately assess where and how sediment movement phenomena will occur more frequently than before or will newly occur because of changes in rainfall characteristics in association with climate change. In addition, make assessment results available so that they are recognized by society.
- Concerning "River Basin Disaster Resilience and Sustainability by All," the following three elements will be implemented in a comprehensive and multi-layered manner:
    - Measures to prevent and mitigate flooding as much as possible (response to hazard)
      Implement installation of flood and sediment control facilities so that damage can be prevented as much as possible.
    - Measures to reduce the targets of damage (response to exposure)
      Measures to reduce the targets of damage, such as town (city) development, including restrictions on land use and devising ways of living to avoid damage with the idea of not living on dangerous land, on the assumption of cases where massive flooding that exceeds the capacity of flood and sediment control facilities will occur.
    - Measures to mitigate damage for early recovery and reconstruction (response to vulnerability)
      In response to the occurrence of floods and sediment disasters, implement measures to mitigate damage, for example, by enhancing the system so that people can evacuate accurately and appropriately, and implement measures for early recovery and reconstruction in affected areas.
- The impact on airport facilities from climate change-induced increases in the frequency and intensity of heavy rainfall should be studied to reflect it in DRR measures for airports.

(d) Mountainous disaster and forest conservation works and forest road facilities (Debris flows, landslides, etc.)

- In light of the increasing and intensifying tendency of mountainous disasters resulting from the increasing frequency of heavy rain and heavy snowfall etc., promote forest conservation measures and forest management based on the Five-Year Acceleration Plan for Disaster Prevention, Disaster Mitigation, and Building National Resilience and other measures.
- In order to enhance preparedness for increases in water disaster risks due to climate change, promote the management and conservation of headwater forests in all river basins in collaboration with the "River Basin Disaster Resilience and Sustainability by All" efforts.
- Promote forest conservation measures that aim to build resilience against swollen sediment overflow triggered by the mass collapse of hillsides from the ridge line, more severe driftwood disasters, river flooding in wider areas, and other changes in the mode of occurrence of disasters.
- Promote preventive measures for mountainous disasters in a way that integrates erosion control in forests and information-based countermeasures and undertake research and studies on the impact on the forests and forestry industry in order to better respond to the increasing frequency of torrential rainfall in association with climate change.
- In order to respond to intensifying disasters, to accommodate larger vehicles, and to streamline the collection and transportation of logging residues, build more resilient and durable road networks by designing routes that go along the ridge lines and bypass areas along rivers, securing enough margins in the width of the road and curving lines, establishing lumberyards, and other spaces, and enhancing drainage functions.

(e) Promotion of adaptive recovery

- When recovering from a disaster, we must not be confined to simply restoring the affected area to the way it was before the disaster struck; rather, taking into consideration the perspective of controlling future maintenance costs for infrastructure, it is necessary to promote the idea of"Adaptive Recovery" that considers adaptation to climate change, including control of land use and moving residential buildings and facilities to places with lower disaster risks.

(f) Other common activities

1) Enhancement of preparations for the management of disaster waste etc.
- Promote the formulation of contingency plans for waste management and engage in activities to build a resilient waste management system.

2) Investigations and research, and technology development
- Based on the projection of increases in external forces, promote the technology development of dikes etc. in consideration of the impact on facilities, development of quantitative assessment methods of disaster mitigation functions by blue carbon ecosystems, etc., and other investigations and research.

5.5.5 Human health

Overview of climate change impacts

(1) Current status

It has been reported that excess mortality due to heat stress is on the rise, especially among the elderly. Regarding heat illness, the numbers of patients transported by ambulance, medical consultations, and mortalities related to heat illness are all on the rise, although the numbers vary from year to year. In 2018, the number of patients with heat illness transported by ambulance exceeded 95,000, a record high since studies began. There were more than 1,500 deaths due to heat illness that year, more than 80% of them being elderly people. The impact of the worsening of the heat stress environment on the elderly is significant, and the risk of heat illness for the young is increasing. The effects of extreme heat also have health impacts, such as sleep quality deterioration, fatigue and tiredness, exhaustion, and other signs of physical function deterioration, as well as mental and physical stress. In addition, there have been new reports that changes in outdoor air temperatures can change the risks and pattern of outbreaks of water-borne and food-borne infectious diseases, such as infectious gastrointestinal disease, rotavirus, and diarrhea, and other infectious diseases, such as influenza and hand, foot, and mouth disease. As for vector-borne infectious diseases, there are concerns that increased temperatures will change the distribution, population density, and active period of arthropods, and combined with the movement of infected people within the country, will cause a chain of infections.

(2) Projected impacts

Heat stress is expected to increase because of the increase in temperature, and the risk of heat illness is expected to increase, especially for the elderly. With regard to water-borne and food-borne infectious diseases, the morbidity of diarrhea is expected to decrease, particularly in winter throughout Japan, toward the end of the 21st century as the temperature increases. It has been indicated that the Asian tiger mosquito (hitosujishimaka, or *Aedes albopictus, subgenus Stegomyia*) may expand as far as north as southern Hokkaido, where it has not yet reached or become established, and the distribution of alien mosquitoes that transmit the Japanese encephalitis virus may expand north of Kagoshima Prefecture. In addition, tick species that prefer warmer regions have been reported in the Tohoku region, and ticks brought in from overseas may also become established in Japan. In the short term to the 2030s, the number of excess mortalities due to increases in pollutants, such as photochemical oxidants and ozone, are projected to increase as a result of warmer temperatures but decrease thereafter.

■ Basic approach to adaptation measures

(a) Heat stress (Mortality risk and heat illness)

- The nationwide increasing trend in the number of patients transported by ambulance, the number of patients that visited medical institutions, and fatalities due to heat illness have been confirmed, and increases in heat illness risks are projected; it is, therefore, necessary to provide reminders on heat illness and to disseminate them to relevant organizations etc. When transmitting information, it is effective to implement measures in combination with raising awareness of the measures to be taken by individuals.
- In particular, based on the fact that there are many elderly people with heat illness transported by ambulance and fatalities due to heat illness and that increases in the number of fatalities of elderly people due to heat stress and in the occurrence rate of heat illness are projected, it is important to disseminate information related to heat illness prevention to aging households. Measures targeting elderly people are important, but attention must be paid not to omit other targets who need measures, including those

working outside and playing sports.

- In addition, it has been reported that there are many cases where heat illness occurs while working outside. Therefore, when working under severe conditions, such as under the searing sun, it is important to reduce the intensity of physical labor by mechanization etc., shorten continuous working hours, change working hours, and implement other preventive measures against heat illness. It is also necessary to consider technology development and the improvement of machines contributing to making work lighter.
- It is also important to collect and assess information related to results etc. from the actual introduction of adaptation measures continuously and to collect information on advanced cases.
- In order to handle the aforementioned issues, the government revised and upgraded the Liaison Conference of Ministries and Agencies Concerned with Heat Illness to the Heat Illness Prevention Conference in March 2021 for the further promotion of heat stroke measures. The Heat Illness Prevention Conference established a Heat Illness Action Plan and determined that the national government, local governments, industry, various organizations, and people should implement heat illness measures together.

5.5.6 Life of citizenry and urban life

■ Overview of climate change impacts

(1) Current status

In recent years, the impact of such events as heavy rains, tropical cyclones, and droughts on infrastructure and critical services has been increasingly evident in many places in Japan. Besides causing direct damage to facilities for power generation, water purification, and waste treatment, these weather events also caused major disruptions to the lives of citizens by disrupting critical services, such as electricity, gas, and water, and isolating communities due to disruption of a transportation network.

Changes have been confirmed in the phenology of flora and fauna that have been experienced in the lives of the people, such as cherry blossoms, ginkgo trees, cicadas, and wild birds; in terms of local industries, there have been reports of deterioration in the quality of sake rice varieties due to warmer temperatures, as well as expanded production areas for wine-making grape varieties in Hokkaido. In urban areas, the combined impacts of temperature rise because of climate change and the heat island effect are increasing heat stress and the risks of heat illnesses and affecting the quality of life by causing fever, nausea, weakness, and deterioration in the quality of sleep.

(2) Projected impacts

There are concerns that future extreme weather events will have impacts on a variety of infrastructure and critical services of electricity, water supply, transportation, communications, and waste treatment. In terms of phenology, the season of the cherry blossom flowering and full bloom is expected to change because of the increase in temperatures, and that will have an impact on areas that rely on this season as a tourism resource.

The combined effects of climate change and the heat island effect are likely to keep temperatures increasing in urban areas, leading to concerns that the deterioration of the thermal environment in cities may have major impacts on urban life.

■ Basic approach to adaptation measures

(a) Water supply, transportation, etc.

- In order to respond to the impact of heavy rains, tropical cyclones, drought, etc. on the various infrastructures and lifelines, engage in making facilities and systems more resilient, disseminate the concept of green infrastructure and promote the implementation of the concept in society.
- It is necessary to implement multiple measures based on the surrounding environment (building up the electricity storage system and emergency water supply system) and to examine ideal infrastructures and lifelines based on sea-level rises in urban waterfront areas.

(b) Impacts on life due to heat stress

- In order to mitigate heat island effects, continue to implement feasible measures, including the securing of green spaces and greening in urban areas, along with measures that can show effects over a short period of time, such as intangible measures.
- Based on the fact that the mitigation of heat island effects requires a long period of time, monitor the actual status of heat island effects and engage in technical investigation and research of heat island measures.

5.6 Adaptation efforts by local governments and business operators

5.6.1 Efforts by local governments

Under the *Adaptation Act*, it is stipulated that local governments strive to promote measures related to climate change adaptation based on natural, economic, and social circumstances in the local areas and strive to provide information related to adaptation measures while taking other measures in order to promote the climate change adaptation of business operators and others and business activities contributing to climate change adaptation in the local areas.

In addition, under the *National Climate Change Adaptation Plan*, the basic role of local governments is defined as promoting climate change adaptation based on local natural, economic, and social circumstances, the local promotion of climate change adaptation with stakeholders, and the local enhancement and use of scientific findings. As stated below, there are relevant provisions in the section on basic measures.

As of March 2022, 155 local governments (including 46 prefectures, 18 ordinance-designated municipalities, and 91 municipalities) have formulated *Local Climate Change Adaptation Plans* and are implementing adaptation measures based on local circumstances in a planned manner.

In addition, as of March 2022, 47 local governments (including 37 prefectures, 3 ordinance designated municipalities, and 7 municipalities) established Local Climate Change Adaptation Centers that serve as bases to collect, organize, analyze, and provide information related to local climate change impacts and climate change adaptation and to provide technical advice.

In order to further strengthen the collaboration among stakeholders in the local areas and to promote climate change adaptation in collaboration among wide-ranging stakeholders at the local level, based on the provisions of the *Adaptation Act*, the Regional Councils on Climate Change Adaptation in which regional environment offices and other local administrative organs of the national government, prefectural governments, municipal governments, Local Climate Change Adaptation Centers, business operators, and other entities participated were established in seven regions in Japan.

The National Research and Development Agency National Institute for Environmental Studies manages and operates the Climate Change Adaptation Information Platform (A-PLAT) to consolidate and provide climate change risk information etc. to local governments etc. based on the provisions of the *Adaptation Act*. It establishes *local climate change adaptation plans* and provides technical support to Local Climate Change Adaptation Centers.

The national government implemented the "Regional Adaptation Consortium Project" as a collaboration project between the Ministry of the Environment, Ministry of Agriculture, Forestry and Fisheries, and Ministry of Land, Infrastructure, Transport and Tourism for three years from the fiscal year 2017; collected and organized information related to climate change impacts based on the needs of each region; built a collaboration system between local governments, universities, research institutions, and other local relevant people; and examined concrete adaptation measures. Furthermore, from the fiscal year 2020, the national government established subcommittees (two to three subcommittees/block) in the Regional Councils on Climate Change Adaptation and is implementing the Wide-range Action Plan Establishment Project for Climate Change Adaptation to examine issues requiring collaboration among stakeholders, such as adaptation issues beyond prefectural borders and other common issues.

5.6.2 Activities by business operators

Under the *Adaptation Act*, it is stipulated for business operators to engage in climate change adaptation based on the details of their business activities in order to implement their business activities smoothly and to strive to cooperate with the measures of the national government and local governments related to climate change adaptation.

In addition, under the *National Climate Change Adaptation Plan*, as the basic roles of business operators, the promotion of climate change adaptation based on the characteristics of business details and the development of adaptation businesses are defined. Furthermore, it developed basic measures for adaptation related to industrial and economic activities and has relevant provisions in the section on basic measures.

In the *Assessment Report on Climate Change Impacts in Japan* that was published in December 2020, concerning industrial and economic activities, 11 subitems (manufacture, food manufacture, energy, commerce, retail, finance/insurance, tourism, leisure industry using natural resources, construction, medical, and others) were assessed. The outline is as stated in the following table.

Table 5-2 Outline of the Assessment Report on Climate Change Impacts in Japan (industrial and economic activities)

Industrial and economic activities
(Manufacture) - Stopping operation plants, etc. due to heavy rainfall, tropical cyclones, etc.* **(Energy)** - Changes in energy demand in association with increased air temperature** - Changes in power generation of recyclable energy (hydroelectric power plants, etc.)** **(Commerce)** - Temporary closure of department stores, supermarkets, etc. due to heavy rainfall, tropical cyclones, etc.** - Growing difficulty in predicting demand for seasonal goods (beverages, clothing, etc.)** **(Finance/insurance)** - Increases in insurance payments due to large-scale natural disasters** - Increases in demand for insurance, increases in business opportunities, such as the development of new goods** **(Tourism)** - Loss or decreases in leisure sites and resources using natural resources (forests, snowy mountains, sandy beaches, tidal flats, etc.)*** **(Construction)** - Revision of design conditions, standards, etc. related to wind load, air-conditioning load, etc.* **(Medicine)** - Increases in damage from inundation of medical institutions due to flooding* **(Other (overseas impacts, etc.))** - Impacts on the economy in Japan through the global supply chain* - Impacts of climate change on national security -

Underlined: Newly added impacts in this climate change impacts assessment. Asterisks and codes at the end of each sentence indicate the assessment results related to confidence for the corresponding sub-items and detailed items.
***: High confidence **: Medium confidence *: Low confidence -: Cannot be assessed at current status.

There are no subitems where significance, urgency, and confidence are all high; however, in many industries, climate change impacts are predicted, and the necessity of preparing for these impacts and engagement in climate risk management are increasing.

Concerning climate risk management, the Ministry of the Environment revised the *Climate Change Adaptation Guide for Private Sector -Preparing for Climate Risk and Surviving* in March 2022, established in March 2019, and enhanced the description of the latest climate risk information and the concepts and methods to address adaptation measures. In addition, in September 2021, the relevant ministries and agencies established the Public-Private-Academic Networking Meeting on Climate-related Risks in Japan with the aim of improving issues in promoting climate change adaptation through the regular exchange of views and collaboration among industry, government, and academia. In addition to supporting the efforts of businesses through these initiatives, the National Research and Development Agency National Institute for

Environmental Studies compiled cases in construction, manufacture, wholesaling, retailing, etc., on the Climate Change Adaptation Information Platform (A-PLAT) that it manages and operates.

At the same time, concerning activities for adaptation businesses, the Ministry of Economy, Trade and Industry investigated the information disclosed by Japanese companies and analyzed activities that are analogized to contributing to overseas adaptation measures. As a result, seven major fields were indicated where Japanese companies could contribute internationally to adaptation businesses: Resilient Infrastructure against Natural Disasters; Sustainable Energy Supply; Food Security, Agriculture/Strengthening Food Production Base; Health and Sanitation; Weather Observation, Monitoring, and Early Warning; Securing Resources/Stable Water Supply; and Finance Related to Climate Change Risks. The Ministry of Economy, Trade and Industry created the Climate Change Adaptation Good Practices by the Japanese Private Sector (March 2021) based on these fields, introduced adaptation business cases of Japanese companies at seminars inside and outside Japan, and thereby supports adaptation business activities. In addition, the Climate Change Adaptation Information Platform (A-PLAT) compiled adaptation business cases in each sector, including agriculture, forestry and fisheries, water environment and water resources, natural ecosystems, natural disasters and coastal areas, human health, industrial and economic activities, and life of the citizenry and urban life, and adaptation business activities in and outside Japan are gradually being activated.

In addition, relevant ministries and agencies, local governments, research institutions, universities, private sectors, etc. are holding symposiums and seminars, creating and publishing guidebooks, etc., and business operators are promoting climate change adaptation based on business characteristics by business operators and supporting the development of adaptation business.

Towards acceleration of activities for climate risk management and adaptation business, behavioral changes are encouraged, and the need to expand adaptation financing is becoming recognized from the perspective of promoting the transfer and dispersion of increasing risks. Under these circumstances, the movement to encourage activities of financial institutions has started, such as the Ministry of the Environment published *Guide for Adaptation Finance* (March 2021).

Furthermore, in response to the proposal of the Task Force on Climate-related Financial Disclosures (TCFD) of the Financial Stability Board (FSB) that was published in June 2017, the number of companies that disclosed information related to climate change impacts (physical risks and opportunities) in their annual reports and sustainability reports is increasing. TCFD publishes institutions that have the intention of proactively disclosing financial information related to climate change. A total of 3,640 companies and institutions, including financial institutions, agreed with the intent globally, and Japan has the largest number of supporting companies and institutions, at 1,010 (as of July 25, 2022; confirmed with https://tcfd-consortium.jp/en/about on August 3, 2022).

5.7 Cross-sectoral efforts and international cooperation

5.7.1 Cross-sectoral efforts

In terms of cross-sectoral efforts, the *National Climate Change Adaptation Plan* stipulates the following as basic measures related to climate change adaptation.

- **Basic measures for the enhancement and utilization of scientific knowledge on climate change and other related issues,**
  - The government promotes observation, monitoring, prediction, assessment, and development of historical datasets related to climate change and climate change impacts in various sectors and their investigation and research. In particular, there is a lack of monitoring data in the Arctic. To improve the precision of climate change predictions, the government will enhance monitoring data by operations of the Arctic research vessel.
  - The government promotes DRR, water resource management, farming support, biodiversity conservation, and other technical developments related to climate change adaptation, and it promotes the proactive use of technologies related to climate change adaptation.
  - In addition, in order to ensure continuous meteorological satellite observation systems for the purpose of monitoring tropical cyclones, heavy rainfall, and other global environmental issues, the government will start the operation of a successor satellite that has high-density observation and other cutting-edge technologies in FY 2029.

- **Basic measures related to ensuring the system for collection, organization, analysis, and provision of information related to climate change, etc.**
  - The government consolidates the research results, data, information, etc. of various research and study institutions etc. and thereby enhances and strengthens A-PLAT and the Data Integration and Analysis System (DIAS). In addition, in collaboration with the National Institute for Environmental Studies, the government consolidates and shares data related to climate change etc. and information on activities related to climate change adaptation that is possessed by relevant ministries and agencies, local governments, business operators, private organizations, citizens, etc.

- **Basic measures related to the promotion of measures related to climate change adaptation with local governments**
  - The government ensures a system to collect, organize, analyze, and provide information related to climate change etc., develops a manual with which local governments can establish plans related to climate change adaptation smoothly, and thereby supports the establishment and implementation of climate change adaptation plans in local governments.
  - The government encourages local governments to raise the funds required to implement the measures with a green bond, which is issued with clarifying positive environmental impacts.

- **Basic measures related to the promotion of climate change adaptation by business operators, etc., and business activities contributing to climate change adaptation**
  - The government promotes public relations activities, awareness-raising activities, and other activities to deepen the interests and understanding of citizens and business operators as to

the importance of climate change adaptation.

- The government establishes guidance to promote the voluntary climate change adaptation of business operators while referring to preceding cases overseas so that business operators can accurately promote climate change adaptation.

- **Basic measures for securing international collaboration and promoting international cooperation related to climate change etc.**
  - The government prepares an international sharing system of climate change information.

5.7.2 International cooperation

Concerning international cooperation, the *National Climate Change Adaptation Plan* positions the contribution to increasing the adaptive capacity of developing countries as one of its basic strategies and lists the following strategies.

Many developing countries generally lack the capacity to adapt to the impact of climate change. Vulnerability to current and future climate change is significant, and the impact of climate change may become more severe. From the perspective of ensuring safety, actions on the impact of climate change in developing countries are important.

For this reason, the national government uses the Asia-Pacific Climate Change Adaptation Information Platform (AP-PLAT), which was established to support decision-making in consideration of climate change risks and highly effective climate change adaptation in the Asia-Pacific region, and promotes the enhancement of scientific findings related to climate change risks, the provision of stakeholders' support tools, development of capacities related to the assessment of climate change impacts and climate change adaptations, and other efforts in cooperation with countries and relevant institutions etc. in the region.

In addition, various international cooperation frameworks, meteorological satellites, etc. are used to promote technical cooperation (*) in the observation, monitoring, projection, and assessment of climate change and its impacts, as well as DRR, climate change adaptation of agriculture, among others.

> * Among the preceding efforts, for example, the Ministry of the Environment supported the Independent State of Samoa and the Federated States of Micronesia in developing climate risk information on storm surges and high tides, which may affect their airports. Such information is expected to be used by those countries to formulate disaster prevention plans and maintenance plans for their airports. In addition, in Indonesia and Vietnam, the Ministry of the Environment supported the risk assessment of the impact of climate change on the production of paddy field rice, which is their staple diet, which resulted in the formulation of adaptation plans in each country.

Based on regional circumstances, in order to establish projects to respond to future climate change impacts systematically, promote using local universities etc. so that the results of their research and technology development can be used.

In addition, the national government uses AP-PLAT and DIAS etc. to promote the international development of Japanese adaptation businesses. Furthermore, Japan utilizes the observation, monitoring, projection, and assessment of climate change and its impacts, disaster prevention experiences in Japan, technologies related to disaster prevention, climate change adaptation of agriculture, etc., and other knowledge to promote overseas development and international cooperation by the government and private sectors.

5.8 Other basic measures related to promoting adaptation measures

In 2020, a new crisis, COVID-19, emerged in addition to climate change. They are deeply connected to each other. Social changes to improve the environment, economy, and society integrally, the conservation of biodiversity, and the coexistence with nature are essential to overcoming the crisis. For this reason, it is important to direct environmental policy in Japan through three transitions: the transition to a decarbonized society, the transition to a circular economy, and the transition to a decentralized society in harmony with nature, and then for local governments to develop regions newly based on the concept of a Circular and Ecological Economy, and for citizens to redesign society into one where each person changes their lifestyle. Based on these concepts, Japan is taking on various efforts.

The aforementioned Circular and Ecological Economy is a concept of an “independent and decentralized society” where we use local resources in our area and incorporate them into the structure of society in the form of businesses and projects to improve the environment, economy, and society, and to create support networks between local areas by using regional characteristics, such as urban areas and farm villages. The concept was proposed in the Fifth Basic Environment Plan, which was approved by the Cabinet in 2018. The Circular and Ecological Economy is a concept aiming to resolve various local issues integrally from the perspective of the environment and to be achieved through partnerships. It is also an effort to implement local SDGs.

Chapter 6

Financial, Technological, and Capacity-Building Support

6.1 Overview

(Finance)

- Japan has provided a variety of climate change support through multilateral and bilateral frameworks to support the implementation of the Paris Agreement by developing countries.
- Under the Actions for Cool Earth 2.0 (ACE 2.0) announced at COP21 in 2015, Japan made a commitment to provide approximately 1.3 trillion yen per year of both public and private climate finance to developing countries in 2020. This commitment was achieved in 2020 according to Japan's latest climate finance figures.
- Japan's climate change support to developing countries during the two-year period from 2019 to 2020 reached to approximately 24.5 billion USD (public finance amounted to approximately USD billion USD, private finance amounted to approximately 3.8 billion USD. Regarding the Green Climate Fund (GCF), Japan, in addition to its contributions of 1.5 billion USD to the GCF for initial resource mobilization (2015-2018), has committed to making contributions of up to 1.5 billion USD for the First Replenishment (2020-2023) of the GCF.
- Based on these achievements, a new climate finance commitment from 2021 was announced by former Prime Minister Suga at the G7 Cornwall Summit in June 2021 to provide climate assistance for developing countries totaling 6.5 trillion yen in public and private over the five years from 2021 to 2025. In addition, at COP26 in November 2021, Prime Minister Kishida announced up to 10 billion USD over the five years from 2021 and 2025 on top the 6.5 trillion yen announced at the G7 Cornwall Summit in order to take the initiative in fulfilling the financial gap in annual 100 billion USD joint mobilization goal of climate finance by developed countries. Furthermore, as part of these financial commitments, Japan announced at COP26 that it would double its support for adaptation, totaling approximately 1.6 trillion yen in public and private financial support for adaptation over the five years from 2021 to 2025.
- As a major developed country, Japan will continue to support actions to address climate change in developing countries by steadily implementing its financial commitments.

(Technology Development and Transfer)

- Japan will contribute to solving the climate change problem all over the world through the development of technologies in the environment and energy fields (Innovation), and by taking a leadership role in the international diffusion of the technologies (Application) based on proactive diplomatic initiatives for countering global warming, which is called the Actions for Cool Earth Japan as announced in November 2013.
- Japan will deepen the discussions for driving innovation through the Innovation for Cool Earth Forum (ICEF), which aims to be the global platform to promote discussions and cooperation on innovation among the worldwide academic, industrial, and public sectors. Also, Japan will promote demonstration projects to create innovations for drastically redeveloping advanced low-carbon technology in accordance with the specific characteristics of developing countries. Japan will also create co-innovation projects by incorporating the needs of developing countries and the seeds provided by Japanese industries, while taking the initiative in dispatching business missions to developing countries and accelerating the collaboration of private companies and local governments on both sides. Furthermore, Japan will foster further innovation by sharing information on the dissemination of innovative technology to developing countries and its effectiveness.

- Regarding the implementation of adaptation projects in developing countries, Japan will support adaptation projects based on the priorities and needs of each country, while diversifying the financial resources, including mobilization of private finance, through collaboration with Japanese cooperation organizations or governmental financial institutions, including the Japan International Cooperation Agency (JICA), Japan Bank for International Cooperation (JBIC), and the Nippon Export and Investment Insurance (NEXI).
- Japan has been promoting the global application of existing low-carbon and decarbonizing technologies. Accelerating the diffusion of such technologies and verifying the reduction effect from the technologies through the Joint Crediting Mechanism (JCM) etc., which has implemented more than 200 GHG emission reduction projects, will realize further emission reductions of greenhouse gases and new economic growth simultaneously.

(Capacity-building)

- To accelerate climate change measures and sustainable development in developing countries, Japan will collaborate with them by utilizing its advanced technology and know-how, create co-innovation that reflects their challenges and needs, and contribute to the global reduction of GHG emissions. Japan will incorporate the needs of each country and the seeds of technology and know-how acquired by private Japanese companies and local governments and promote the creation of specific projects to find solutions that lead to co-innovation among Japan and developing countries.
- Regarding capacity-building support for adaptation, Japan will support the consolidation and dissemination of information on climate risk, the establishment of risk evaluation methods, and the development of national adaptation plans in developing countries.
- Regarding the capacity-building support for mitigation, Japan will support institutional and capacity development to develop concrete plans and measures as well as a review of progress. Japan will provide such support by using its experience and know-how and collaborating with JICA, the National Institute for Environmental Studies (NIES), etc.
- Regarding the capacity-building support for transparency, Japan provides institutional and capacity development to establish policies and systems to achieve the emission reduction target through the Partnership to Strengthen Transparency for Co-Innovation (Partnership to Strengthen Transparency for co-Innovation: PaSTI), and the Workshop on Greenhouse Gas Inventories in Asia (WGIA) to support Asian countries to improve the accuracy of their GHG inventories and to facilitate the enhancement of cooperative relationships.

6.2 Introduction

The implementation guidelines of the Paris Agreement (the Paris Rulebook) were completed with the agreement reached at COP26 in 2021, and the international community has entered a phase where the Paris Agreement should be steadily implemented. Nevertheless, the *IPCC Sixth Assessment Working Group Reports* were released sequentially in 2021 through 2022 and its *Working Group III Report* stated that "Global GHG emissions in 2030 associated with the implementation of Nationally Determined Contributions (NDCs) announced prior to COP26 would make it likely that warming will exceed 1.5°C during the 21st century." It is an urgent issue that the entire international community, including both developed and developing countries, should make further efforts to reduce GHG emissions in order to achieve the 1.5°C goal of the Paris Agreement. In addition, the IPCC Sixth Assessment Report Working Group II pointed out that human-induced climate change has caused widespread adverse impacts and the most vulnerable people and systems are observed to be disproportionately affected. It also pointed out that the near-term actions that limit global warming to close to 1.5°C would substantially reduce projected losses and damages related to climate change in human systems and ecosystems but cannot eliminate them all. The need for adaptation assistance has been increasing more than ever. In light of these trends in climate change where the international community faces, Japan has supported developing countries for their implementation of the Paris Agreement through a variety of different assistance projects addressing climate change through bilateral and multilateral frameworks.

In addition, in the face of a temporary economic stagnation due to the pandemic of COVID-19 since 2020, and in the subsequent recovery, Japan is working with relevant countries to achieve green recovery that aims at economic recovery from the COVID-19 pandemic in a way that contributes to achieving the goals of the Paris Agreement through the environment and climate-friendly investments. Specifically, in April 2021, at the Leaders Summit on Climate, hosted by the United States, former Japan's Prime Minister Suga and U.S. Prime Minister Biden announced the launch of "Japan-U.S. Climate Partnership on Ambition, Decarbonization, and Clean Energy", under which Japan and the U.S. affirmed to promote the cooperation in accelerating of transition towards decarbonization in third countries, in particular Indo-Pacific countries. Moreover, Japan announced the launch of Japan-EU partnership entitled "Towards a green alliance to protect our environment, stop climate change and achieve green growth" in May 2021. Both sides confirmed, under this partnership, the cooperation on a transition towards decarbonization in developing countries. In this way, Japan promotes assistance for decarbonization efforts in developing countries.

Japan has announced a number of climate finance commitments since 2013 and achieved all of them. As reported in the second biennial report, Japan developed the Proactive Diplomatic Strategy for Countering Global Warming (ACE: Actions for Cool Earth) in November 2013 and announced the provision of a total 1.6 trillion yen (approx. USD 16 billion) for developing countries during the three-year period from 2013 through 2015. This commitment was achieved in approximately one and a half years. In November 2015, at COP21, Japan announced its new climate finance commitment under the Actions for Cool Earth (ACE) 2.0 and committed to providing approximately 1.3 trillion yen from both public and private climate finances to developing countries in 2020. This commitment was also achieved in 2020, according to Japan's latest climate finance figures. Based on these achievements, a new climate finance commitment from 2021 was announced by former Prime Minister Suga at the G7 Cornwall Summit in June 2021 of providing climate assistance for developing countries totaling 6.5 trillion yen in public and private funds over the five years from 2021 to 2025. In addition, at COP26 in November 2021, Prime Minister Kishida announced up to 10 billion USD over the five years from 2021 and 2025 on top of 6.5 trillion yen announced at the G7 Cornwall Summit in order to take the initiative in fulfilling the financial gap of an annual 100 billion USD in the joint mobilization goal of climate finances by developed countries. As part of these financial commitments, Japan also announced at COP26 that it would double the assistance for adaptation, totaling approx. 1.6 trillion yen in public and private funds over the five years from 2021 to 2025. This commitment of doubling adaptation finances by Japan was the precursor to the Glasgow Climate Pact, which urged developed countries to at least double their provision of climate finances for adaptation to developing countries from 2019 levels by 2025. Japan, as a major developed country, continues steadily to implement its announced financial commitments and strongly supports climate actions by developing countries.

Financial support from Japan in the two years from 2019 to 2020 reached approximately 24.5 billion USD (public finances amounted to approximately 20.7 billion USD, and private finances amounted to approximately 3.8 billion USD).

Japan, in addition to its contributions of 1.5 billion USD to the Green Climate Fund (GCF) for initial resource mobilization (2015-2018), has committed to making contributions of up to 1.5 billion USD for the First Replenishment (2020-2023) of the GCF. As a major donor, Japan has seats as a board member and alternate member at the GCF Board and has actively contributed to the operation of the GCF. Among Japanese entities, the Japan International Cooperation Agency (JICA), MUFG Bank, Ltd, (MUFG), and Sumitomo Mitsui Banking Corporation (SMBC) have been approved as accredited entities of the GCF. So far, two funding proposals from JICA (enhancing climate resilience and reduction of deforestation in Timor-Leste and coastal management in the Maldives) and two from MUFG Bank (pumped storage hydroelectric with solar PV in Chile and sustainable forestry fund in Sub Saharan Africa and Latin America) were approved by the GCF Board. These projects support climate actions of developing countries through the GCF.

6.3 National approach to tracking and reporting the provision of support to non-Annex I Parties

The main types of climate finance from Japan are as follows (1) grant aid; (2) concessional loan; (3) technical assistance; (4) contribution to international organizations; (5) Other Official Flows (OOF); and (6) private finance. The implementing agencies of types (1)-(3) above are the Ministry of Foreign Affairs, Ministry of Finance, Ministry of Agriculture, Forestry and Fisheries, Ministry of Economy, Trade and Industry, Ministry of the Environment and the Japan International Cooperation Agency (JICA). Type (4) is contributions to environment-related funds and development organizations such as the Global Environment Facility (GEF), Green Climate Fund (GCF), the World Bank, and the United Nations Development Programme (UNDP), which act as implementing agencies of this type of assistance. Regarding type (5), the Japan's relevant ministries and Japan Bank for International Cooperation (JBIC) are the main implementing agencies, and type (6) is private finance mobilized by co-finance of the JBIC and trade insurance from Nippon Export and Investment Insurance (NEXI).

The Ministry of Foreign Affairs gathers the data related to support for developing countries provided by the above-mentioned institutions from the relevant ministries and institutions and compiles the information on financial, technological and capacity-building support for climate change.

In gathering the assistance data, Japan counts projects that contribute to climate change mitigation and adaptation in developing countries using the OECD Rio marker[72]. For bilateral,

[72] OECD DAC Rio Markers for Climate Handbook
https://www.oecd.org/dac/environment-development/Revised%20climate%20marker%20handbook_FINAL.pdf

egional and other channels, in 2019 data, Japan counts 100% of the total face value of projects with OECD DAC Rio Markers as climate specific. Since 2020 data, Japan further promotes its climate change assistance to developing countries. By doing so, Japan introduces the coefficient method, applying a certain coefficient to some projects, depending on the degree of climate change objective embedded in each project. As of the coefficient, in light of the OECD DAC Rio Markers, Japan counts 100% for projects whose climate change objective is principal and 50% for projects whose climate change objective is significant. For multilateral channels, Japan counts climate-specific amounts of Japan's contributions to multilateral climate funds, MDBs and climate-related international organizations, calculated on the basis of the imputed share of the 2019-2020 average calculated by OECD DAC. Note that the scope of the reported assistance by Japan in this report is targeted to non-Annex I Parties of the UNFCCC.

In this report, Japan's climate finance is newly committed or contributed during the reporting period in 2019 and 2020, therefore, it is "new and additional". Japan positions new and additional climate finance as newly committed or disbursed finance that contributes to addressing climate change in developing countries. For this purpose, Japan gains new funding with the approval of the Diet on an annual basis and does not include those committed or disbursed climate finance reported in previous biennial reports. In addition, funds reported as "committed" are those that have been approved by the Diet or cabinet decisions or committed through international agreements but have not yet actually completed disbursement during the reporting period. Funds reported as "disbursed" are those that have actually transferred as money or goods to the recipient countries.

6.4 Finance

6.4.1 Measures to effectively address the needs and priorities of developing country parties

Japan implemented projects in as many as 150 countries in 2019 and 2020. Through Japanese embassies and JICA's overseas offices in a number of developing countries, the Japanese government has been developing projects in close consultation with the governments of developing countries and international organizations in response to the requests and needs of the recipient countries. Japan has been providing assistance through a variety of different channels, including grant aid, concessional loans, and technical assistance, taking into account local economic situations and the natures of the projects.

In addition, Japan has actively engaged in adaptation support for the SIDS, which are especially vulnerable to the negative impacts of climate change and provided more than 120 million USD in adaptation for the SIDS during 2019 and 2020.

6.4.2 Public financial support

Overview

The summary of Japan's public support, which amounted to 24.5 billion USD during 2019 and 2020 is as follows.

The total amount of public financial support in 2019 was approximately 1,154.9 billion yen (10.6

billion USD) with approximately 103.2 billion yen (950 million USD) through multilateral channels and approximately 1,051.7 billion yen (9.6 billion USD) through bilateral and regional channels.

The total amount of public financial support in 2020 was approximately 1,091.4 billion yen (10.2 billion USD) with approximately 99.8 billion yen (930 million USD) through multilateral channels and approximately 991.6 billion yen (9.3 billion USD) through bilateral and regional channels.

Note that Japan's support for developing countries accords importance to establishing a mechanism that not only ensures the effective use of public finances but also facilitates the mobilization of private finances. Large-scale projects on infrastructure, such as the installation of facilities with high energy efficiency and for renewable energy, as well as the construction of electric power transmission facilities, require massive investments, and thus leveraging private finances is crucially important (This is why Japan mobilized more than 3.8 billion USD in private finances in developing countries during 2019 and 2020). Japan also provides support in capacity building to improve access to funds, such as the Green Climate Fund (GCF) and Global Environment Facility (GEF), by providing study and training sessions.

The exchange rates are 109.01 Japanese yen/USD in 2019 and 106.775 Japanese yen/USD in 2020, which are based on the OECD exchange rate.

Table 6-1 Provision of public financial support: summary information in 2019 (CTF Table 7)

Allocation channels	Year									
	Japanese yen - JPY					USD				
	Core/ general	Climate-specific				Core/ general	Climate-specific			
		Mitigation	Adaptation	Cross-cutting	Other		Mitigation	Adaptation	Cross-cutting	Other
Total contributions through multilateral channels:	252,788.49	442.49	0.00	102,802.42	0.00	2,318.95	4.06	0.00	943.05	0.00
Multilateral climate change funds	23,676.67	0.00	0.00	38,083.60	0.00	217.20	0.00	0.00	349.36	0.00
Other multilateral climate change funds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral financial institutions, including regional development banks	212,123.95	0.00	0.00	61,648.11	0.00	1,945.91	0.00	0.00	565.53	0.00
Specialized United Nations bodies	16,987.88	442.49	NE	3,070.70	NE	30.98	4.06	NE	28.17	NE
Total contributions through bilateral, regional and other channels		957,543.31	90,657.82	3,452.02			8,784.00	831.65	31.67	
Total	**252,788.49**	**957,985.80**	**90,657.82**	**106,254.44**	**0.00**	**2,318.95**	**8,788.05**	**831.65**	**974.72**	**0.00**

Footnotes
The unit of JPY is "million yen" and the unit of USD is "million dollars".
The exchange rate: 109.010 JPY/USD (2019). 106.775JPY/USD(2020)

Table 6-2 Provision of public financial support: summary information in 2020 (CTF Table 7)

Allocation channels	Year									
	Japanese yen - JPY					USD				
	Core/ general	Climate-specific				Core/ general	Climate-specific			
		Mitigation	Adaptation	Cross-cutting	Other		Mitigation	Adaptation	Cross-cutting	Other
Total contributions through multilateral channels:	111,146.11	759.24	0.00	99,042.02	0.00	1,040.94	7.11	0.00	927.58	0.00
Multilateral climate change funds	23,676.67	0.00	0.00	79,355.23	0.00	221.74	0.00	0.00	743.20	0.00
Other multilateral climate change funds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral financial institutions, including regional development banks	76,839.32	320.33	0.00	18,778.55	0.00	719.64	3.00	0.00	175.87	0.00
Specialized United Nations bodies	10,630.12	438.91	NE	908.24	NE	11.37	4.11	NE	8.51	NE
Total contributions through bilateral, regional and other channels		412,712.03	536,198.30	42,653.72			3,865.71	5,022.35	399.52	
Total	**111,146.11**	**413,471.27**	**536,198.30**	**141,695.73**	**0.00**	**1,040.94**	**3,872.82**	**5,022.35**	**1,327.10**	**0.00**

Footnotes
The unit of JPY is "million yen" and the unit of USD is "million dollars".
The exchange rate: 109.010 JPY/USD (2019). 106.775JPY/USD(2020)

Contribution by channels

(1) Multilateral channels

Public financial support through multilateral channels in 2019 was approximately 103.2 billion yen (950 million USD) of which approximately 38.1 billion yen (350 million USD) was provided to multilateral climate change funds, approximately 61.6 billion yen (570 million USD) to multilateral financial institutions, and approximately 3.5 billion yen (30 million USD) to specialized United Nations bodies.

Public financial support through multilateral channels in 2020 was approximately 99.8 billion yen (930 million USD) of which approximately 79.4 billion yen (740 million USD) was provided to multilateral climate change funds, approximately 19.1 billion yen (180 million USD) to multilateral financial institutions, and approximately 1.3 billion yen (10 million USD) to specialized United Nations bodies.

Table 6-3 Contribution through multilateral channels in 2019 (CTF Table 7(a))

Donor funding	Total amount				Status	Funding source	Financial instrument	Type of support	Sector
	Core/general		Climate-specific						
	Japanese yen - JPY	USD	Japanese yen - JPY	USD					
Total contributions through multilateral channels	252,788.49	2,318.95	103,244.91	947.11					
Multilateral climate change funds	23,676.67	217.20	38,083.60	349.36					
1. Global Environment Facility	23,676.67	217.20	19,651.63	180.27	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund	0.00	0.00	0.00	0.00	-	-	-	-	-
3. Special Climate Change Fund	0.00	0.00	0.00	0.00	-	-	-	-	-
4. Adaptation Fund	0.00	0.00	0.00	0.00	-	-	-	-	-
5. Green Climate Fund			18,329.41	168.14	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
6. UNFCCC Trust Fund for Supplementary Activities			102.56	0.94	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
7. Other multilateral climate change funds	0.00	0.00	0.00	0.00					
Multilateral financial institutions, including regional development banks	212,123.95	1,945.91	61,648.11	565.53					
1. World Bank	40,501.32	371.54	13,770.45	126.32	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. International Finance Corporation	0.00	0.00	0.00	0.00	-	-	-	-	-
3. African Development Bank	0.00	0.00	0.00	0.00	-	-	-	-	-
4. Asian Development Bank	0.00	0.00	0.00	0.00	-	-	-	-	-
5. European Bank for Reconstruction and Development	0.00	0.00	0.00	0.00	-	-	-	-	-
6. Inter-American Development Bank	0.00	0.00	0.00	0.00	-	-	-	-	-
7. Other	171,622.63	1,574.38	47,877.67	439.20					
(1) International Development Association	114,609.57	1,051.37	35,528.97	325.92	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(2) African Development Fund	12,878.99	118.15	4,250.07	38.99	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(3) Asian Development Fund	34,343.60	315.05	5,494.98	50.41	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(4) Inter-American Investment Corporation	795.40	7.30	174.99	1.61	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(5) Multilateral Investment Fund	8,995.07	82.52	2,428.67	22.28	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
(6) World Bank Partnership for Market Implementation	0.00	0.00	0.00	0.00	-	-	-	-	-
Specialized United Nations bodies	16,987.88	155.84	3,513.19	32.23					
1. United Nations Development Programme	7,038.23	64.57	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. United Nations Environment Programme	348.28	3.19	136.26	1.25	Disbursed	Other(ODA/OOF)	Grant	Cross-cutting	Cross-cutting
3. Other	9,601.37	88.08	3,376.93	30.98					
(1) United Nations Framework Convention on Climate Change			383.04	3.51	Disbursed	Other(ODA/OOF)	Grant	Cross-cutting	Cross-cutting
(2) Climate Technology Center Network			125.28	1.15	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
(3) Intergovernmental Panel on Climate Change			27.46	0.25	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
(4) IPCC Task Force on National Greenhouse Gas Inventories / Technical Support Unit			150.00	1.38	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
(5) The Multilateral Fund for the Implementation of the Montreal Protocol	2,659.32	24.40	141.21	1.30	Disbursed	ODA	Grant	Mitigation	Energy
(6) International Fund for Agricultural Development	6,246.27	57.30	2,248.66	20.63	Committed	ODA	Non-concessional loan	Cross-cutting	Agriculture
(7) United Nation Office for Disaster Risk Reduction	566.88	5.20	NE	NE	Disbursed	ODA	Grant	Adaptation	Cross-cutting
(8) International Renewable Energy Agency			301.28	2.76	Disbursed	Other(ODA/OOF)	Grant	Mitigation	Energy
(9) International Tropical Timber Organization	128.91	1.18	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Forestry

Abbreviations: ODA = official development assistance, OOF = other official flows.

Footnotes

The unit of JPY is "million Yen". The unit of USD is "million dollars"

(1) The exchange rate: 109.010 JPY/USD (2019). 106.775JPY/USD(2020)

(2) The climate-specific share of the core contributions is calculated based on the climate-specific imputed shares published on a year-by-year basis by the OECD Development Assistance Committee.

(3) The contribution to the Green Climate Fund in 2019 is the encashed amount of the promissory notes which were issued during the Initial Resource Mobilization period. The contribution to the Green Climate Fund in 2020 is the sum of the encashed amount of the promissory notes which were issued for the Initial Resource Mobilization and the amount of the promissory note which was issued in 2020 for the GCF-1.

(4) Values converted from Japanese Yen to USD using the exchange rate above may not match the total USD amount reported due to rounding.

Table 6-4 Contribution through multilateral channels in 2020 (CTF Table 7(a))

Donor funding	Total amount				Status	Funding source	Financial instrument	Type of support	Sector
	Core/general		Climate-specific						
	Japanese yen - JPY	USD	Japanese yen - JPY	USD					
Total contributions through multilateral channels	111,146.11	1,040.94	99,801.25	934.69					
Multilateral climate change funds	23,676.67	221.74	79,355.23	743.20					
1. Global Environment Facility	23,676.67	221.74	19,651.63	184.05	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund	0.00	0.00	0.00	0.00	-	-	-	-	-
3. Special Climate Change Fund	0.00	0.00	0.00	0.00	-	-	-	-	-
4. Adaptation Fund	0.00	0.00	0.00	0.00	-	-	-	-	-
5. Green Climate Fund			59,546.92	557.69	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
6. UNFCCC Trust Fund for Supplementary Activities			156.67	1.47	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
7. Other multilateral climate change funds	0.00	0.00	0.00	0.00					
Multilateral financial institutions, including regional development banks	76,839.32	719.64	19,098.88	178.87					
1. World Bank	0.00	0.00	0.00	0.00	-	-	-	-	-
2. International Finance Corporation	1,882.12	17.63	564.64	5.29	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
3. African Development Bank	4,883.76	45.74	1,758.15	16.47	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
4. Asian Development Bank	0.00	0.00	0.00	0.00	-	-	-	-	-
5. European Bank for Reconstruction and Development	0.00	0.00	0.00	0.00	-	-	-	-	-
6. Inter-American Development Bank	0.00	0.00	0.00	0.00	-	-	-	-	-
7. Other	70,073.44	656.27	16,776.09	157.12					
(1) International Development Association	19,132.00	179.18	6,122.24	57.34	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(2) African Development Fund	16,101.08	150.79	5,635.38	52.78	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(3) Asian Development Fund	34,343.60	321.64	4,464.67	41.81	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(4) Inter-American Investment Corporation	496.76	4.65	233.48	2.19	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(5) Multilateral Investment Fund	0.00	0.00	0.00	0.00	-	-	-	-	-
(6) World Bank Partnership for Market Implementation			320.33	3.00	Disbursed	OOF	Grant	Mitigation	Cross-cutting
Specialized United Nations bodies	10,630.12	99.56	1,347.15	12.62					
1. United Nations Development Programme	7,031.46	65.85	NE	NE	Disbursed	ODA	Grant		
2. United Nations Environment Programme	318.39	2.98	133.47	1.25	Disbursed	Other(ODA/OOF)	Grant	Cross-cutting	Cross-cutting
3. Other	3,280.27	30.72	1,213.68	11.37					
(1) United Nations Framework Convention on Climate Change			277.97	2.60	Disbursed	Other(ODA/OOF)	Grant	Cross-cutting	Cross-cutting
(2) Climate Technology Center Network			320.07	3.00	Disbursed	Other(ODA/OOF)	Grant	Cross-cutting	Cross-cutting
(3) Intergovernmental Panel on Climate Change			26.73	0.25	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
(4) IPCC Task Force on National Greenhouse Gas Inventories / Technical Support Unit			150.00	1.40	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
(5) The Multilateral Fund for the Implementation of the Montreal Protocol	2,604.79	24.40	138.31	1.30	Disbursed	ODA	Grant	Mitigation	Energy
(6) International Fund for Agricultural Development	0.00	0.00	0.00	0.00	-	-	-	-	-
(7) United Nation Office for Disaster Risk Reduction	564.64	5.29	NE	NE	Disbursed	ODA	Grant	Adaptation	Cross-cutting
(8) International Renewable Energy Agency			300.60	2.82	Disbursed	Other(ODA/OOF)	Grant	Mitigation	Energy
(9) International Tropical Timber Organization	110.83	1.04	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Forestry

Abbreviations: ODA = official development assistance, OOF = other official flows.

Footnotes

The unit of JPY is "million Yen". The unit of USD is "million dollars"

(1) The exchange rate: 109.010 JPY/USD (2019). 106.775JPY/USD(2020)

(2) The climate-specific share of the core contributions is calculated based on the climate-specific imputed shares published on a year-by-year basis by the OECD Development Assistance Committee.

(3) The contribution to the Green Climate Fund in 2019 is the encashed amount of the promissory notes which were issued during the Initial Resource Mobilization period. The contribution to the Green Climate Fund in 2020 is the sum of the encashed amount of the promissory notes which were issued for the Initial Resource Mobilization and the amount of the promissory note which was issued in 2020 for the GCF-1.

(4) Values converted from Japanese Yen to USD using the exchange rate above may not match the total USD amount reported due to rounding.

[Cooperation with international organizations (examples)]

- Contribution to GEF (Mitigation/Adaptation)

  Japan contributed to the Global Environment Facility (GEF), which is a multilateral financial mechanism to support developing countries' efforts to preserve and improve the global environment.

- Contribution to GCF (Mitigation/Adaptation)

  Japan contributed to the Global Climate Fund (GCF), which is a fund for supporting reductions in greenhouse gases and addressing the impacts of climate change in developing countries.

- World Bank Partnership for Market Implementation Facility Multi-Donor Trust Fund (Mitigation)

  Through the World Bank's Partnership for Market Implementation (PMI), Japan contributes to the decarbonization efforts of each country by supporting the development of carbon pricing policy instruments (emission trading system, carbon tax, and crediting mechanism, including Article 6 of the Paris Agreement) in emerging and developing countries while utilizing the experience of implementing the Joint Crediting Mechanism (JCM).

- Cooperation with UNDP (Adaptation)

  Through the Japan-UNDP Partnership Fund, Japan has been implementing grant aid projects, including risk analysis of tsunami, emergency responses, development of evacuation plans, education for reducing disasters, and emergency training at 373 schools in 23 countries of the Asia-Pacific region.

- Cooperation with UNEP (Mitigation)

  Through the contributions to the Trust Fund, Japan supports the activities of the Climate and Clean Air Coalition (CCAC), an international partnership launched under UNEP to reduce short-lived climate pollutants (SLCPs) such as hydrofluorocarbons and methane.

(2) Bilateral and regional channels

Public financial support through bilateral and regional channels in 2019 was approximately 1,051.7 billion yen (9.6 billion USD) of which approximately 957.5 billion yen (8.8 billion USD) was for mitigation, approximately 90.7 billion yen (830 million USD) for adaptation, and approximately 3.5 billion yen (30 million USD) for cross-cutting.

Public financial support through bilateral and regional channels in 2020 was approximately 991.6 billion yen (9.3 billion USD) of which approximately 412.7 billion yen (3.9 billion USD) was for mitigation, approximately 536.2 billion yen (5 billion USD) for adaptation, and approximately 42.7 billion yen (400 million USD) for cross-cutting.

Table 6-5 Contribution through bilateral and regional channels

	Japanese yen - JPY				USD			
	Total	Type of support			Total	Type of support		
		Mitigation	Adaptation	Cross-cutting		Mitigation	Adaptation	Cross-cutting
2019	1,051,653	957,543	90,658	3,452	9,647	8,784	832	32
2020	991,564	412,712	536,198	42,654	9,288	3,866	5,022	400

The unit of JPY is "million Yen". The unit of USD is "million dollars"

(1) The exchange rate: 109.010 JPY/USD (2019). 106.775JPY/USD(2020)

(2) Values converted from Japanese Yen to USD using the exchange rate above may not match the total USD amount reported due to rounding.

Grant aid in bilateral cooperation (examples)

- Prevention of Disasters and Rehabilitation (Adaptation)

  Apart from the assistance during a disaster, Japan has provided facilities and equipment that contribute to the prevention and mitigation of disaster and transferred technologies to local government staff. For example, in Pakistan where heavy rainfalls, floods and landslides frequently strike, in order to provide weather forecasts and deliver early warning information more accurately and in a timely manner, Japan has installed a new meteorological radar system in the area that was not covered by the existing radar system. The project is expected to mitigate damage caused by natural and hydro-meteorological disasters as well as to ensure human security and the improvement of social infrastructure.

- Water Supply (Adaptation)

  Japan supports constructing and repairing water supply facilities in areas that have been experiencing droughts caused by climate change. For example, in Mozambique, Japan has constructed water supply facilities with deep wells that are less affected by droughts and floods, thereby contributed to access to safe water. Moreover, in Marshall, in order to address the challenges of rainfall fluctuations, increases in water demand, and water leakage from reservoirs, a new rainwater reservoir is being constructed at the water treatment plant together with an adjoining aqueduct and embankment, which will increase the water storage capacity. This project is expected to contribute to securing the water supply during droughts caused by climate change or other factors and meet increased demand in the future.

- Support for Agriculture (Adaptation)
  Japan has promoted resilient agriculture systems that adapt to changes in climate patterns. In Niger, Japan promoted irrigated rice cultivation which is less affected by fluctuation of rainfall in order to support activities related to food security and contributed to increasing resilience to climate change in the country.

Loan support in bilateral cooperation (Examples)

- Energy Efficiency and Conservation Promotion (Mitigation)
  Japan contributes to sustainable development through energy efficiency and conservation promotion contributes to sustainable development through energy efficiency and conservation promotion to mitigate the effects of climate change by reducing the increase in energy consumption caused by economic development. For example, in Bangladesh, Japan facilitated the installation of equipment for energy efficiency and conservation by extending concessional loans and other support, thereby securing the balance between energy supply and demand and contributing to a reduction in greenhouse gas emissions.

- Improvement of Energy Access via the Maintenance of Electricity Transmission Equipment (Mitigation)
  Japan has been cooperating in reducing GHG emissions through the electrification of local areas and the improvement of transmission efficiency while aiming for the transfer to clean energy. For example, in Egypt, Japan supports the enhancement of financial sustainability, governance reform, and installation of renewable energy and energy efficiency in order to address the issues in the power sector and enhance its reformation.

- Climate Change Program Loan (Mitigation/Adaptation)
  Japan's ODA loan is implemented by JICA, and one of its characteristic programs is the Climate Change Program Loan (CCPL). This project helps to develop a multi-year national climate change policy for developing countries ("policy matrix") based on policy dialogues, and supports the implementation of those policies. In this process, Japan applies various ODA schemes, such as loans or technical assistance. Japan monitors the implementation of the policy matrix every year and considers the possibilities of extending loans. Japan has provided "the Disaster Resilience Enhancement and Management Program Loan" to Indonesia multiple times, which was co-financed by the French Development Agency (AFD). It aims to support the reform of disaster-related policies and strategies, as well as investment in the reduction of disaster risk, including floods caused by climate change.

[Technical assistance in bilateral cooperation (examples)]

- Prevention of Disaster and Rehabilitation (Adaptation)
  Japan has provided assistance for disaster risk reduction in line with the Sendai Framework for Disaster Risk Reduction 2015-2030 as adopted by UN Member States in 2015 and the Sendai Cooperation Initiative for Disaster Risk Reduction of the government of Japan, in addition to

initiatives on Climate Change. Japan has provided assistance for capacity development to the government of the Philippines, Chile, and other countries and has provided assistance to facilitate the implementation of measures for disasters, such as formulating urban stormwater drainage plan in Sri Lanka and formulating master plans and implementing feasibility studies on flood control and drainage that include climate change aspects in Indonesia and the Philippines. Additionally, Japan plans to support concrete measures for disasters, such as through projects for formulating climate-aligned master plans on flood control and drainage in Vietnam, the Philippines, Timor-Leste, Honduras, and Mozambique. Moreover, Japan is providing support through projects for meteorological and disaster monitoring capacity enhancement in the Philippines, Vietnam, Bhutan, Mauritius, and other countries.

- Agriculture (Adaptation)

  Japan promotes the technological transfer of irrigation skills that are essential for agriculture. In more than 10 countries such as Timor-Leste, India, Sudan and Zambia, Japan has implemented Technical Cooperation in the field of irrigation and water management. Also, in more than 10 African countries, such as Kenya and Senegal, Japan supports the development and dissemination of technologies in order to improve the productivity of irrigated rice. Furthermore, in Indonesia and Ethiopia, Japan cooperates with farmers in agricultural insurance in order to enhance climate change adaptation in their agricultural activities.

- Introduction of Energy Savings and Renewable Energy (Mitigation)

  Japan promotes decarbonization in developing countries by using Japan’s expertise on energy efficiency and conservation (EE&C) and renewable energy. For example, Japan has been providing training programs on EE&C policies and technologies for participants from such regions as Latin America and Asia and planning and constructing hydropower facilities and optimal dam operations, including visiting hydropower facilities for sub-Saharan countries. In Malaysia, Japan proposed a project for the development of advanced hybrid Ocean Thermal Energy Conversion (H-OTEC). Through joint research, the University of Technology of Malaysia and a Japanese research institution develop new hybrid-system OTEC technology, establish a method for multiple uses of deep-sea water, and implement human capital development in order to provide support for establishing a sustainable Malaysia model.

- Promotion of REDD+ Efforts (Adaptation/Mitigation)

  Japan is implementing technical cooperation projects in eight developing countries in order to strengthen policies and disseminate technology that can contribute to forest conservation, particularly through REDD+ (reducing emissions from deforestation and forest degradation in developing countries, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries). In addition, Japan implemented training courses for senior officials from nine countries to develop human resources responsible for policy formulation and implementation based on the international framework of REDD+. Furthermore, training courses were provided for 12 countries to acquire the knowledge and skills required for tropical forest conservation using JJ-FAST (JICA-JAXA Forest Early Warning System in the Tropics) and for 6 countries to acquire basic GIS techniques for forest resource monitoring. JICA started preparations to apply for REDD+ result-based payment (RBP) under the Green Climate Fund (GCF) for Laos and Vietnam, recognizing the need for long-term financial commitments through leveraging external funds, such as RBP, and collaboration with the private sector to reduce GHG emissions from deforestation and forest degradation.

Contribution by type of support

(1) Mitigation: 12.7 billion USD

Assisting developing countries in such areas as the promotion of renewable energy, including solar energy, biomass, and geothermal, and the introduction of facilities with high-energy efficiency, to contribute to reducing GHG emissions.

(Example)

- Project for Supporting the Advancement of Energy Matrix Transition (Ecuador: USD Ecuador: 70 million USD)
- Energy Efficiency and Conservation Promotion Financing Project (Phase 2) (Bangladesh: 184 million USD)
- North-South Commuter Railway Extension Project (I) (Philippine: 1,534 million USD)

(2) Adaptation: 5.8 billion USD

The purpose of these funds is to strengthen developing countries' capability to cope with natural disasters caused by climate change, and to provide the necessary equipment and facilities to implement precautionary measures against and for recovery from natural disasters, including floods and droughts.

(Example)

- Pasig-Marikina River Channel Improvement Project (Phase IV) (Philippine: 348 million USD)
- Infrastructure Reconstruction Sector Loan in Central Sulawesi (Indonesia: 262 million USD)
- Improvement of Water Reservoir at Majuro Atoll (Marshall Islands: 16 million USD)
- The Economic and Social Development Programme (providing early warning system) (Republic of Fiji: 8 million USD)
- The Project for Enhancing Resilience of Children to Climate and Disaster Risks (Kyrgyz Republic: 4 million USD)

(3) Mitigation and Adaptation: 2.1 billion USD

The purpose of these funds is to assist developing countries in multiplying funds to tackle climate change issues (both mitigation and adaptation) to address climate change.

(4) Forestry: 275 million USD

The purpose of these funds is to promote sustainable management and conservation of forests in developing countries by assisting in monitoring forest resources, formulating forest management plans and facilitating afforestation, including through the provision of equipment necessary for such activities.

(Example)

- Project for Operationalization of the National Forest Monitoring System and REDD+ Pilot (Democratic Republic of the Congo: 3.2 million USD)

- Sustainable Forest Management and REDD+ Support Project (Lao People's Democratic Republic: 1.8 million USD)
- Capacity Development Project for Operationalization of PNG Forest Resource Information Management System for Addressing Climate Change (Independent State of Papua New Guinea: 1.0 million USD)
- Project on Capacity Development for Forest Conservation and REDD+ Mechanisms (Republic of Peru: 1.9 million USD)
- Project on Capacity Building for Ecosystem-Based Disaster Risk Reduction through Sustainable Forest Management in Macedonia (Project Eco-DRR in Macedonia) (Republic of North Macedonia: 2.5 million USD)

(5) Response measures

Japan supports energy transition in developing countries through its assistance, including the formulation of energy master plans and the Science and Technology Research Partnership for Sustainable Development (SATREPS). For example, Japan supported improvements in the capabilities of Sri Lanka to implement the master plan (promotion of renewable energy) formulated through Japan's ODA and provided Bangladesh with a concessional loan in the field of energy efficiency based on the master plan. Under the SATREPS, Japan has been providing scientific and technical assistance in biomass in Asian countries.

6.4.3 Mobilization of private finance

In order to further promote action on climate change, Japan has been working to establish a mechanism to leverage private investment by using public finance. Co-financing by the JBIC with the private sector and trade insurance by NEXI are examples of using private finance. Private financing also plays an important role in tackling climate change as its total amount was more than 3.8 billion USD in 2019 and 2020.

■ Other Official Flow, including co-funding with private sector

In April 2010, JBIC started a new operation titled GREEN (Global action for Reconciling Economic growth and Environmental preservation), wherein the primary purpose is to support projects with favorable impacts on the preservation of the global environment, such as renewable energy projects and energy efficiency projects. Under the GREEN operation, JBIC implements support by using untied loans, guarantees, and equity investments while mobilizing private funds. Furthermore, in January 2020, JBIC launched a new facility titled Growth Investment Facility and enhanced support for projects that contribute to the preservation of the global environment, including climate change measures, by expanding the scope of the eligible projects, for example.

<Examples>

- Credit line for Vietcombank under GREEN Operations (Supporting renewable energy projects/ JBIC loan portion: 100 million USD)
- Credit line for CAF under GREEN Operations (Supporting environment-related projects/ JBIC loan portion: 100 million USD)

- Credit line for BANCOMEXT under GREEN Operations (Supporting environment-related projects/ JBIC loan portion: 110 million USD)

In addition, in July 2019, NEXI launched the Loan Insurance for Green Innovation with an increased risk coverage rate compared with that of its usual loan insurance. This insurance can be applied for financing projects in the field of environmental protection and climate change prevention, such as projects using renewable energy, energy savings, and innovative technology. Furthermore, in December 2020, NEXI established the "LEAD initiative" to actively promote the underwriting of projects with "Leading Features". The Leading Features include a contribution to global carbon neutrality and DX (digital transformation), alliances with international partners, a solution to social issues, and achievement of the SDGs.

6.5 Technology development and transfer

Japan will contribute to solving the climate change problem all over the world through the development of technologies in the environment and energy fields (Innovation), and by taking a leadership role in the international diffusion of the technologies (Application) based on proactive diplomatic initiatives for countering global warming, which is called the Actions for Cool Earth Japan as announced in November 2013.

6.5.1 Innovation of decarbonizing technology and promotion of its dissemination

The "Green Growth Strategy Through Achieving Carbon Neutrality in 2050" was formulated, which includes (1) clear timeframe targets, (2) research and development and demonstration, (3) institutional improvement with regulatory reform and standardization, and (4) international cooperation etc. for areas that are expected to grow in the pursuit of carbon neutrality. Among the priority areas, in areas where the policy effects are particularly large and where long-term continuous support is needed with a view to social implementation, the newly created Green Innovation Fund is used to provide consistent support from R&D to social implementation of innovative technologies to companies that demonstrate commitments to specific goals and initiatives ways to achieve them.

Japan will also deepen the discussions for driving innovation through the Innovation for Cool Earth Forum (ICEF), which aims to be the global platform to promote discussions and cooperation on innovation among the worldwide academic, industrial, and public sectors. Furthermore, Japan will promote demonstration projects to create innovations for drastically redeveloping advanced low-carbon technology in accordance with the specific characteristics of developing countries. Japan will also create co-innovation projects by incorporating the needs of developing countries and the seeds provided by Japanese industries, while taking the initiative in dispatching business missions to developing countries and accelerating the collaboration of private companies and local governments on both sides. Japan will foster further innovation by sharing information on the dissemination of innovative technology to developing countries and its effectiveness.

Japan has been supporting the dissemination of advanced decarbonizing technologies through public-private partnerships via the Joint Crediting Mechanism (JCM), where Japan has established partnerships with 22 partner countries and supported more than 200 projects.[73] Japan will also support both the introduction of waste power generation as one of the environmental infrastructure and waste management systems as a package. Japan will also support the optimization of existing infrastructure and operation and maintenance (O&M) by private companies by using the Internet of Things (IoT), which contributes to emission reduction and visualization of the reduction effects. In addition, in order to implement large-scale projects and wider dissemination of low-carbon and decarbonizing technologies, Japan will enhance collaboration with public financing of, among others, the JICA, and JBIC and NEXI will enhance capacities and carry out feasibility studies for project formation to improve access to GCF. As the chair of the Global Research Alliance on Agricultural Greenhouse Gases (GRA), Japan will promote the improvement of low-carbon irrigation technology and its dissemination in developing countries. Regarding emission reduction of fluorocarbons, Japan, as the leading country of the Initiative on Fluorocarbons Life Cycle Management (IFL), has been providing support for system strengthening and capacity building with developing countries based on its knowledge and promoting an understanding of the importance of such activities for life cycle management of fluorocarbons.

6.5.2 Implementation of adaptation projects

Through collaboration with Japanese cooperation organizations or governmental financial institutions, including the JICA, JBIC, and NEXI, Japan will support adaptation projects based on the priorities and needs of each country, while diversifying the financial resources, including mobilization of private finance.

In order to enhance resilience to climate change, Japan will support infrastructure development, including the fields of irrigation, waterworks, and disaster risk reduction. Japan will also support the development and dissemination of drought-resistant and short-duration rice varieties for a sustainable and stable food supply and provide support for agricultural insurance for smallholder farmers vulnerable to climate change. Japan's support extends to ecosystem-based adaptation for coastal protection by using the ecosystems of coral reefs and mangroves. Being mindful of the situation among Small Island Developing States (SIDS), which are particularly vulnerable to climate change, Japan will provide comprehensive support focused on disaster risk reduction by integrating the provision of necessary equipment, such as meteorological observation and disaster early warning equipment, and technical cooperation.

6.5.3 Emission reductions in overseas countries by diffusing technologies

Japan has been promoting the global application of existing low-carbon and decarbonizing technologies. Accelerating the diffusion of such technologies and verifying the reduction effect from the technologies will realize further emission reductions of greenhouse gases and new economic growth simultaneously.

■ Joint Crediting Mechanism (JCM)

Japan has been implementing the JCM in order to quantitatively evaluate the contributions of Japan

[73] As of September 2022.

to greenhouse gas emission reductions and removals which are achieved through the diffusion of, among others, leading decarbonizing technologies, products, systems, services, and infrastructures as well as through the implementation of measures in developing countries and others, and in order to use such contributions to achieve Japan's NDC.

Since Japan and Mongolia signed a bilateral agreement in January 2013 for the first time to start the JCM, the number of partner countries has increased to 22. There are more than 200 GHG emission reduction projects being implemented so far, and the accumulated emission reductions from these projects are expected to be about 20 Mt-CO_2 (preliminary estimation towards the period by FY 2030). At this point, there are more than 80 registered projects with 48 projects issued JCM credits. Furthermore, more than 90 MRV methodologies (methods for calculating GHG emission reductions) have been approved as a step toward project registration. Japan will continue to support the further formulation of JCM projects in collaboration with the relevant ministries and agencies.

■ Development of the basic framework to diffuse technologies

- Support for International Standardization and Institutional Arrangement

  The government has contributed to the international standardization of measuring CO_2 emissions through steel processing. The government will also propose assessing measures for energy efficiencies such as LED lighting and thus will contribute to international standardization onwards. In addition, the government will provide support for institutional arrangements for enhancing the abilities of appropriate measuring and developing standards of energy savings in developing countries.

- Support for Formulating Low-Carbon Strategies and Enhancing Adaptive Ability in Developing Countries with Technologies and Know-How of Japan

  See sections 6.5.1 and 6.5.2 for details.

- Utilization of Satellites

  The government launched the successor to GOSAT, GOSAT-2, in October 2018 to contribute to tackling climate change. It will support nations in making use of satellite data to verify their national GHGs inventories and to decide on GHG reduction policies by refining the accuracy of estimations of GHGs at the national, mega-city, and/or major emission source levels. The GOSAT-GW is currently under development to take over the GHG observation missions and to further expand the observation capabilities.

- Assessments

  Technological needs will be identified, and the direction of technology creation and diffusion will be effectively verified based on verification of the effectiveness of the introduced low-carbon technologies and technology assessment (assessment of utility and environmental impact of technologies).

■ Other supports for developing countries

In developing countries in particular, addressing deforestation and forest degradation due to the expansion of agricultural lands, illegal logging and other factors is an urgent issue. Leveraging its knowledge and expertise, Japan will contribute to forest conservation in developing countries, including through the following actions: actively support REDD+ and sustainable forest management activities; provide support to combat illegal logging and promote sustainable forest management in cooperation with international organizations such as the International Tropical Timber Organization (ITTO) and the Food and Agriculture Organization of the United Nations (FAO).

Furthermore, in order to achieve both economic growth and environmental protection in developing countries, Japan will promote cooperation through a co-benefits approach that will simultaneously reduce environmental pollution and greenhouse gas emissions that need to be addressed on a global scale.

6.5.4 Projects related to the provision of support for technology development and transfer

Detailed information on Japan's projects on the provision of support for technology development and transfer is shown in Annex I *Japan's Fifth Biennial Report*, Chapter 5.2 "Technology development and transfer".

In addition, as an example of a success story related to a project to facilitate the transfer of environmentally sound technologies, the descriptions of 29 MW Binary Power Generation Project at the Palayan Geothermal Power Plant (JCM Model project) implemented by Japan are shown in Table 6-6.

Table 6-6 Description of project to facilitate the transfer of environmentally sound technologies

Project/program title: 29 MW Binary Power Generation Project at the Palayan Geothermal Power Plant (JCM Model project)			
Purpose: This project aims to reduce greenhouse gas (GHG) emissions by installing a new binary geothermal power plant to the existing flash type geothermal power plant.			
Recipient country: Philippines	Sector: Energy	Total funding: 19 million USD	Years in operation: Since 2020
Description: This project introduces a new 29 MW binary geothermal power plant with the Organic Rankine Cycle (ORC) system to the existing 120 MW flash type geothermal power plant. The power plant is located in the Palayan area of the southern part of Luzon Island. This binary geothermal power plant effectively uses exhaust hot water from the existing flash geothermal power plant. This project replaces the grid power produced by fossil fuels with renewable energy and reduces GHG emissions.			
Factors that led to project/program success: • The representative partner in Japan successfully addressed the needs in the Philippines, where the demand for power rapidly increased, especially by renewable energy sources because of larger concerns for climate change, and took advantage of the country's unique and abundant geothermal energy sources and existing flash geothermal power station by introducing the ORC binary plant, which utilizes low-enthalpy brine without producing hazardous gases or excavating additional wells, • The representative partner has also been successful in raising awareness toward environment-friendliness among the people at the local partner by introducing a JCM model project. • The representative partner has also been successful in building trust with the local partner by collaboration with the group companies.			
Technology transferred: This binary geothermal power plant effectively uses exhaust hot water of low enthalpy from the existing flash			

geothermal power plant without producing hazardous gases nor excavating additional wells. This project replaces the grid power produced by fossil fuel with renewable energy, which can be generated stably without interference from weather factors and reduces GHG emissions. The key component of this binary cycle power generation equipment is an ORC turbine that uses low-boiling-point organic matter as the boiling medium. The generation system can use relatively low-temperature heat sources such as biomass, factory waste heat and geothermal energy.
Impact on greenhouse gas emissions/removals (optional): 72,200 t-CO_2/year (estimated amount of the credit issuance)

6.6 Capacity-building

6.6.1 Overview of capacity-building support

With the early entry into force of the Paris Agreement in November 2016, the world is now moving toward its implementation. In order to achieve the 2-degree goal (1.5-degree pursued) of the Paris Agreement and to establish a decarbonized society with balancing anthropogenic emissions by sources and removals by sinks of greenhouse gases (GHG), in the second half of this century, we must diminish GHG emissions extensively worldwide and reduce vulnerability deriving from climate change and contribute to establishing a resilient society. In addition, it is essential to pursue the Sustainable Development Goals (SDGs) through economic growth, increased employment, infrastructure development and improved access to water, food, and energy.

To transform the world into such a state, innovation of technology and social and economic systems are indispensable. The immediate action will enable developing countries to address their infrastructure needs and avoid lock-in effects.

To accelerate climate change measures and sustainable development in developing countries, Japan will collaborate with them by utilizing its advanced technology and know-how, create "co-innovation" that reflects on their challenges and needs, and contribute to the global reduction of GHG emissions. Japan will incorporate the needs of each country and the seeds of technology and know-how acquired by private Japanese companies and local governments and promote the creation of specific projects to find solutions that lead to co-innovation among Japan and developing countries. Moreover, those needs and seeds should be visualized in order to create more opportunities for co-innovation. For this purpose, Japan is supporting the establishment of institutional infrastructures and capacity building of developing countries to promote the engagement of private companies and governments officials on climate change activities under the Partnership to Strengthen Transparency for Co-Innovation (Partnership to Strengthen Transparency for co-Innovation: PaSTI), which was launched at COP23 in 2017.

For achieving this vision, Japan will coordinate closely within its relevant ministries, organizations, companies, and local governments, and continue to enhance collaboration with international organizations and international initiatives.

6.6.2 Capacity-building support for adaptation

■ Science-based development of adaptation plans and strategies

Risk evaluations based on scientific knowledge and their reflection upon the adaptation plans are essential for implementing adequate adaptation plans. Implementing adaptation measures also requires innovation of policy processes in both developed and developing countries. By providing the latest technology and know-how obtained by its industry-government-academia partnership, Japan will support the consolidation and dissemination of information on climate risk, the establishment of risk evaluation methods, and the development of national adaptation plans in developing countries.

More specifically, Japan will support impact assessments of climate change and the development of national adaptation plans through bilateral collaboration. For example, based on the long-term risk evaluation on storm tides and waves caused by cyclones in small island developing states, which were implemented in the Republic of Fiji, Samoa and other islands, Japan will propose the Nature-based Solution (NbS) focusing on the disaster prevention function of reef-building coral. Japan has supported the development of a system of Analysis and Mapping of Impacts under Climate Change for Adaptation and Food security (AMICAF). In addition, Japan will promote human resource development in the field of climate change by supporting the construction and institutional development of the Pacific Climate Change Center in cooperation with the Secretariat of the Pacific Regional Environment Programme (SPREP), as well as strengthening of the Climate Change International Technical and Training Center (CITC) in Thailand.

Japan uses the Asia-Pacific Climate Change Adaptation Information Platform (AP-PLAT), which was launched to support decision-making, to take the risks of climate change into consideration for highly effective climate change adaptation in the Asia-Pacific region in order to improve scientific knowledge related to the risks of climate change, to provide stakeholder support tools, and to strengthen capacity related to the assessment of climate change impacts and climate change adaptation in collaboration with countries and relevant institutions in the region.

In order to promote international discussions on climate change and security, Japan will promote the findings of its recent report, *Analysis and Proposal of Foreign Policies Regarding the Impact of Climate Change on Fragility in the Asia-Pacific Region - With focus on natural disasters in the Region,* published in September 2017, in various diplomatic fields.

Japan will widely share these programs and the knowledge and lessons acquired through these initiatives by using international networks, including the Asia-Pacific Adaptation Network (APAN), the Global Adaptation Network (GAN), and the Global Earth Observation System of Systems (GEOSS) Asia-Pacific Symposium, and then enhance further cooperation with each country.

■ Promotion of adaptation actions by non-state stakeholders

The private sector and local governments play important roles in responding to the diverse needs of each country and implement adequate adaptation actions according to the local circumstances.

The Japanese government will enhance engagement with the private sector and promote adaptation business through the matching of the needs of developing countries and the advanced technology and services by private companies in Japan, including disaster risk reduction infrastructure technology, early-warning technology, and weather index insurance using rainfall data estimated by satellites. Japan will promote adaptation action by local governments in developing countries by supporting impact assessment and development of local adaptation plans while involving local researchers, local governments, and communities.

6.6.3 Capacity-building support for mitigation

■ Capacity building on development, implementation, and progress management of NDC

The Paris Agreement requires each country to prepare and submit a nationally determined contribution (NDC) and to pursue domestic mitigation measures to achieve the emission reduction target presented in the NDC. Under the enhanced transparency framework to promote effective implementation, each country needs to monitor and report the status of implementation of measures. Toward the implementation of the Paris Agreement, the needs have been increasing for institutional development and capacity building in developing countries.

Japan will support institutional and capacity development to develop concrete plans and measures, as well as a review of progress. Japan will provide such support by using its experience and know-how and collaborating with JICA, the National Institute for Environmental Studies (NIES) etc.

Japan will support the submission, updating, and implementation of each country’s NDC through the development of a precise emission reduction scenario and specification of the programs and the technology necessary to achieve the successful reduction by using evaluation models. Moreover, through continuous global monitoring by utilizing the series of GHG Observing Satellite GOSAT and the development and dissemination of monitoring methods by using ICT, Japan will continue its contribution to securing the transparency of reduction actions and to measuring the progress of achievement of the reduction targets of each country towards the first Global Stocktake in 2023.

■ Promotion of mitigation actions taken by non-state actors

In order to enhance the actions and innovation by cities and private sectors, Japan will implement cooperation projects and nurture mutual learning among cities in developing countries and Japan, as well as promote private companies’ investments in decarbonization technologies in developing countries.

Japan will provide technical support to prepare GHG emission inventories at the city level, develop master plans, and support institutions towards zero-carbon cities in developing countries by utilizing the experience and know-how of Japanese local governments and coordination among cities both in developing countries and Japan. To assist Japanese companies working on climate change programs, Japan will support the development and implementation of corporate targets consistent with the Paris 2-degree target (Science-Based Target, SBT) as well as activities to contribute to global emission reductions based on industry's action plans for a low-carbon society and promote emission reduction in the global value chain of Japanese companies in addition to domestic emission reductions.

Moreover, Japan will collaborate with the alliances of the private sector, including the Japan Climate Leaders Partnership (Japan-CLP), which reckons climate change measures as business opportunities and backup programs led by the private sector. Japan will also promote REDD+ through public-private partnerships.

6.6.4 Capacity-building support for transparency

■ Partnership to Strengthen Transparency for Co-Innovation (PaSTI)

As mentioned above, at COP23 in 2017, Japan launched the Partnership to Strengthen Transparency for Co-Innovation (PaSTI) in cooperation with developing countries and international organizations. Under the PaSTI, Japan will support institutional and capacity development to establish policies to achieve the target and provide such support by collaborating with international initiatives such as the NDC Partnership. Also, Japan will promote the active engagement of companies and local governments in developing countries for mitigation measures and provide incentives for their actions through these programs.

Based on the "Letter of Intent on Enhancing Transparency in the Private Sector" signed in 2018 between the Ministry of Environment of Japan and the Ministry of National Development Planning of Indonesia, Japan provided support towards the establishment of a unified platform for a reporting greenhouse gas emissions by private companies in Indonesia. In 2019, letters of cooperation on strengthening transparency were exchanged between the Ministry of Environment of Japan and the Ministry of Natural Resources and Environment of Vietnam, and between the Ministry of Environment of Japan and the Ministry of Environment and Natural Resources of the Philippines. Based on these letters, workshops were held in Vietnam to assess the progress of efforts related to GHG accounting, reporting, and verification and to build the capacity of the private sector. In the Philippines, Japan supported a workshop for capacity building to establish a domestic GHG emissions reporting system for the industrial process and product use sector and the waste sector.

In addition, under the support of the ASEAN Working Group for Climate Change (AWGCC), and with Singapore as the project proponent, Project Phase 1 using the Japan ASEAN Integration Fund (JAIF) was implemented in 2019. In Project Phase 1, a roadmap for the development of facility-level greenhouse gas measurement and reporting guidelines for the ASEAN region was made. The guideline will be developed under Project Phase 2.

■ Workshop on Greenhouse Gas Inventories in Asia (WGIA)

Japan will carry out the Workshop on Greenhouse Gas Inventories in Asia (WGIA), which has been held periodically since 2003, in order to support Asian countries to improve the accuracy of their GHG inventories and to facilitate the enhancement of cooperative relationships.

■ Mutual Learning Program for Enhanced Transparency (MLP)

Japan will provide support to the development a system for effectively implementing market mechanisms under the Paris Agreement for government agencies and research institutions in target countries, including JCM partner countries.

Japan will participate in workshops and other events aimed at promoting understanding of Article 6 of the Paris Agreement. Also, Japan is implementing Mutual Learning Program on reporting on the use of Article 6 and on reporting on Article 13, which is essential for the realization of reporting on the use of Article 6.

6.6.5 Projects related to the provision of capacity-building support

Detailed information on projects/programs to promote capacity building in developing countries is shown in Annex I *Japan's Fifth Biennial Report*, Chapter 5.3 "Capacity-building."

Chapter 7

Research and Systematic Observation

7.1 Overview

(General)

- The Plan for Global Warming Countermeasures stipulates that Japan promotes research on climate change and strengthens the observation and monitoring system as a fundamental measure for global warming policies and measures.
- The Plan for Adaptation to the Impacts of Climate Change stipulates that Japan promotes observation, monitoring, prediction, and assessment, as well as research and studies of climate change and climate change impacts in various fields and develops scientific knowledge on climate change prediction based on the latest research results as a basic strategy.

(Research)

- The Sixth Science, Technology and Innovation Basic Plan set the promotion of social transformation and discontinuous innovation toward overcoming global-scale challenges as an initiative to transform Japan into a sustainable and resilient society that ensures the safety and security of the people. Specifically, Japan creates highly accurate climate change prediction information and promotes the accumulation and utilization of global environment big data, such as greenhouse gas observation data and prediction information, in order to contribute to solving climate change.
- Under the Environment Innovation Strategy, Japan aims to establish innovative technologies by 2050 that will enable the world to become carbon-neutral and reduce CO_2 emissions in the stock-base.
- Japan participates in and cooperates with international global environmental research programs, such as the World Climate Research Program (WCRP) and Future Earth, and conducts research and studies based upon the appropriate international division of tasks, as well as promotes joint research and other initiatives with overseas research organizations.
- Through the Asia-Pacific Network for Global Change Research (APN), Japan enhances activities related to global change research in the Asia-Pacific region by cooperating with researchers and governmental officers throughout the region.

(Systematic observation)

- Japan promotes comprehensive measures for observation and monitoring of climate change under the “Implementation Policy of Earth Observations for 10 years” based on the “Earth Observation Promotion Strategy” and the “Sixth Science, Technology, and Innovation Basic Plan”. In the promotion, bearing in mind Japan’s contribution to developing the Global Earth Observation System of Systems (GEOSS), ensure the consistency with international observation and monitoring projects in terms of methods and take care to enable effective data utilization through exchanging outcomes of activities of observation and monitoring organizations each other, such as by utilizing the “Data Integration and Analysis System” (DIAS) connected to GEOSS on behalf of Japan.
- Japan participates in and cooperates with international observation and monitoring programs conducted under the Global Climate Observing System (GCOS), Global Atmosphere Watch (GAW), the Global Ocean Observing System (GOOS), and the Global

Environmental Monitoring System (GEMS), which contribute to the development of GEOSS. Japan also conducts wide-area observation and monitoring based on the appropriate sharing of international tasks. In addition, Japan also facilitates the utilization of observation and monitoring data through joint research and knowledge networks, such as the APN.

- It is important to effectively promote Earth observation by satellites with coordination on a worldwide scale in accordance with Japan's Basic Plan on Space Policy. Japan actively leads the activities of the Committee on Earth Observation Satellites (CEOS) and other international forums and promotes the development, launch, and operation of satellites in conformity with these activities. Furthermore, through GEOSS, Japan promotes integrated global observations combining satellites, aircraft, ships, and ground-based observation in cooperation with international organizations and research projects.

7.2 General policy on and funding of research and systematic observation

The *Plan for Global Warming Countermeasures* (approved by the Cabinet on October 22, 2021) stipulates that Japan promotes research on climate change and strengthens the observation and monitoring system as a fundamental measure for global warming policies and measures. In addition, the Plan for Adaptation to the Impacts of Climate Change (approved by the Cabinet on October 22, 2021) stipulates that Japan promotes the observation, monitoring, prediction, and assessment as well as research and studies of climate change and climate change impacts in various fields and develops scientific knowledge on climate change prediction based on the latest research results, as a basic strategy. The details of the measures are as follows.

Global environment conservation:

In April 2018, the Fifth Basic Environment Plan was decided by the Cabinet. As the vision of a sustainable society which should be realized, this plan envisions a circulation and symbiosis-oriented society (a society of environment and life civilization), which also realize a low-carbon society, minimizing the burden on the environment, realizing a healthy cycle of materials and life, maintaining and restoring healthy ecosystems, and achieving a symbiosis between nature and humans, as well as between regions, while continuing economic growth and making maximum use of scientific technologies, such as information and communication technologies (ICT).

The Fifth Environment Basic Plan considers climate change countermeasures as one of the environmental policies supporting the priority strategies established in accordance with the concept that it is necessary to set up cross-sectoral measures where specific measures can solve multiple different problems in an integrated manner. In promoting specific measures, measures that contribute to the integrated improvement of the environment, economy, and society are promoted by taking advantage of local resources, technological innovation, and ingenuity so as to revitalize Japan's economy, create employment, and solve local problems.

Under the basic plans, Japan established the Global Environment Research Fund in 1990 (currently the Environment Research and Technology Development Fund). This fund was for research, observation, and technological development concerning global environmental issues, for the comprehensive promotion of various types of research and studies on global environmental conservation, and for inviting interdisciplinary and international proposals for global environmental research from a broad range of industry, academia and government sources. In April 2001, the Global Environment Research Account for National Institutes was created to further encourage studies on global warming from both the medium- and long-term perspectives.

Science technology

In March 2021, the Sixth Science, Technology, and Innovation Basic Plan (2021-2025) based on Basic Act on Science and Technology was decided by the Cabinet. In this plan, "Promoting social transformation and discontinuous innovation to overcome global-scale challenges" is listed as an initiative to achieve transformation into a sustainable and resilient society that ensures the safety and security of people.

Specifically, Japan creates highly accurate climate change prediction information and promotes the accumulation and utilization of global environment big data, such as greenhouse gas observation data and prediction information, in order to contribute to solving climate change.

In January 2020, the "Environment Innovation Strategy" was decided by the Integrated Innovation Strategy Promotion Council. Japan aims to establish innovative technologies by 2050 that will enable the world to become carbon-neutral and reduce CO_2 emissions in the stock-base.

In addition, outcomes of climate change prediction in the "Integrated Research Program for Advancing Climate Models" using the Earth Simulator as well as outcomes of natural science research related to global warming supported by the "Adjustment Cost for Science and Technology Promotion", "Sciences Research Grant" and other current research fund have contributed greatly to the *Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report*. Also, a five-year plan of the "Program for the Advanced Studies of Climate Change Projection" has been launched from FY 2022 as a subsequent plan of the "Integrated Research Program for Advancing Climate Models", and research using the Earth Simulator is continuously being conducted.

Systematic observation

In the area of systematic observation, Japan has been promoting the establishment of an observation network that combines observation on the ground with an observation by satellites, aircraft and ships. The following international and national observation activities are underway.

Japan led the establishment of the "Group of Earth Observations" (GEO) and the development of the "GEO Strategic Plan 2016-2025". Also, Japan has been contributing to the development of the post-2025 strategic plan by bringing Japanese experts in the process. Furthermore, Japan has been proactively contributing to the establishment of "The Global Earth Observation System of Systems" (GEOSS) through serving as a member of the Executive Committee of the GEO as well as participating in initiatives addressing global environmental issues such as water resource management, agricultural monitoring and forest monitoring. As another contribution from Japan, the "Data Integration and Analysis System (DIAS)" developed and operated by the

Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT) has realized the connection with the data center of member countries participating in the GEO. The Global Climate Observing System (GCOS), an internationally coordinated network of observation systems for monitoring climate change and assessing its impacts, was established in 1992 in response to outcomes of the Second World Climate Conference in 1990, which was sponsored by the World Meteorological Organization (WMO) and other international organizations. The GCOS implementation plan (GCOS IP 2016) was developed in cooperation with related organizations all over the world, including Japan. GCOS IP 2016 was submitted to the COP22 of UNFCCC in November 2016, and a COP decision was made to encourage the Parties to work towards its full implementation. Japan is contributing to the GCOS activities by serving as a member of the GCOS Steering Committee and the scientific expert panels (atmosphere, oceans, and terrestrial) as well as operating various central facilities.

Domestically, in response to the deepening international discussions, the Council for Science, Technology and Innovation (CSTP) drew up the "Earth Observation Promotion Strategy" in December 2004. Based on this Strategy, the Earth Observation Promotion Committee was established under the Council for Science and Technology of the MEXT in February 2005. In August 2015, the Earth Observation Promotion Committee developed "Japan's enforcement policy for Earth observation in the next decade" and elaborates annually the "Earth Observation Implementation Policy in Japan". Currently, the relevant ministries and agencies as well as other concerned organizations, are working together toward the realization of comprehensive, needs-driven Earth observation.

7.3 Research

7.3.1 Basic principles

Overview:

- In order to promote global warming countermeasures from a long-term and global perspective, it is indispensable to continuously accumulate the latest scientific knowledge in Japan and overseas. Research, observation and monitoring of climate change are extremely significant measures that form the basis of this knowledge.

Measures (Priority policies and strategies)

- The Sixth Science, Technology and Innovation Basic Plan set the "promotion of social transformation and discontinuous innovation toward overcoming global-scale challenges" as an initiative to transform Japan into a sustainable and resilient society that ensures the safety and security of the people. Specifically, Japan creates highly accurate climate change prediction information and promotes the accumulation and utilization of global environment big data, such as greenhouse gas observation data and prediction information in order to contribute to solving climate change.
- Under the Environment Innovation Strategy, Japan aims to establish innovative technologies by 2050 that will enable the world to become carbon-neutral and reduce CO_2 emissions in the stock-base.
- Japan participates in and cooperates with international global environmental research programs such as the World Climate Research Program (WCRP) and Future Earth, and

conducts research and studies based upon the appropriate international division of tasks, as well as promotes joint research and other initiatives with overseas research organizations.

- Through the Asia-Pacific Network for Global Change Research (APN), Japan enhances activities related to global change research in the Asia-Pacific region by cooperating with researchers and governmental officers throughout the region. There are six research areas targeted: (1) Climate, (2) Biodiversity and Ecosystems, (3) Air, land, coasts and oceans, (4) Food, water and energy, (5) Risk and Resilience, and (6) Human dimensions. Within them, high-demanded research themes are prioritized through discussion in subregional committees.
- In an effort to contribute to the development of government policy on climate change and global warming, Japan actively promotes research on global environmental problems from a human and social perspective, academic research integrating the natural and social sciences, and research on socioeconomic systems. Japan also cooperates with the Institute for Global Environmental Strategies (IGES), which was established in March 1998 as an international research institute for the study of political and practical strategies to help realize sustainable development on a global scale, particularly with regard to the Asia-Pacific region.

7.3.2 Priority fields

As for research on global warming, based on previous efforts, Japan promotes strategically and intensively clarification of climate change mechanism; understanding and projection on global warming; necessary technology development promotion; assessment of impacts of global warming on the environment, society, and economy; and research on reducing greenhouse gas emissions and adaptation measures with international cooperation. In particular, since the issue of uncertainty of climate change projection is important by following per under a need of the Convention, Japan has addressed the reduction of these uncertainties mainly through the “Integrated Research Program for Advancing Climate Models” using the Earth Simulator and by the “Environment Research and Technology Development Fund”. Also, in the “Integrated Research Program for Advancing Climate Models”, the climate change prediction information contributing to domestic and international climate change measures was created as well. The latest results from these projects contributed to the report of the Working Group I of the IPCC Sixth Assessment Report, and the projection results were provided to Southeast Asian countries through joint research as the prediction technologies for climate change measures. As a subsequent plan of “Integrated Research Program for Advancing Climate Models”, a five-year plan of the “Program for the Advanced Studies of Climate Change Projection” has been launched from FY2022, and research using the Earth Simulator is continuously being conducted. Furthermore, Japan-EU research workshops on climate change projection studies are held once in several years to exchange information and compare projection results.

7.3.3 Main contents of research

■ Research on climate processes and the climate system, including paleoclimate research

Research and studies have been carried out on the following subjects: research on spatiotemporal variability and climate change impact of ozone and black carbon in Asia; analysis of seawater temperature in the Asian monsoon region based on coral dendroclimatology; and research on highly uncertain physical processes in climate models, such as the indirect effect of aerosols including the effect on cloud radiation forcing. In the Integrated Research Program for Advancing Climate Models, process studies focusing on the terrestrial ecosystem and the cloud-precipitation process have been implemented, and the research results have been reflected in the development of climate models.

■ Climate change projection modeling and projection studies

Climate change projection studies in the areas of projection model sophistication, reduction of uncertainties, and hazards in natural disasters have been conducted under the "Integrated Research Program for Advancing Climate Models" using the Earth Simulator. In the "Integrated Research Program for Advancing Climate Models", using the Earth Simulator supercomputer, developments and projection studies of Japan's many climate models are supported, and the CMIP6 experiment, which is necessary to prepare the *IPCC Sixth Assessment Report*, is conducted in this project. Thus, climate change projection studies of Japan contributed to the *IPCC Sixth Assessment Report* by creating scientific knowledge.

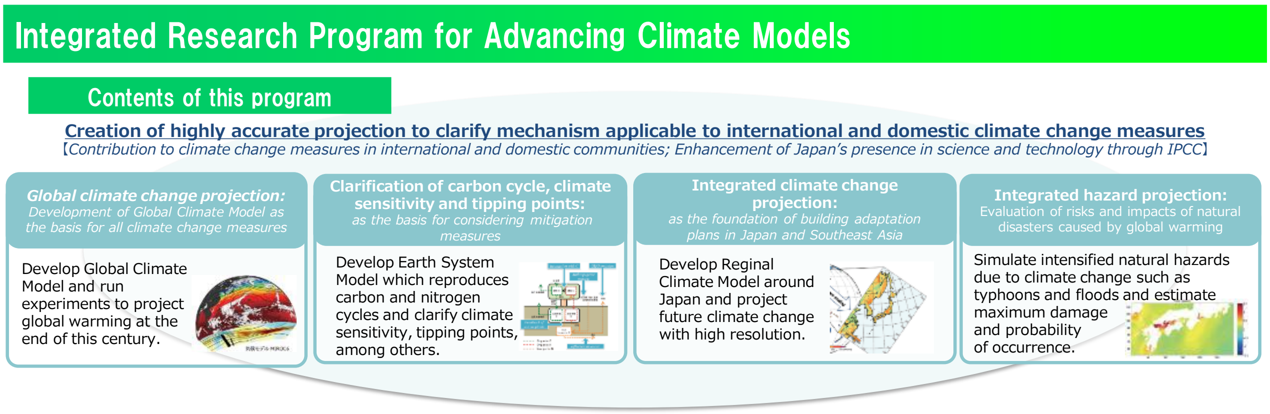


Figure 7-1 Overview of Integrated Research Program for Advancing Climate Models

■ Studies on climate change impact

Strategic Research on Environment Research and Technology Development Fund S-8 (Comprehensive Study on Impact Assessment and Adaptation for Climate Change) conducted research relating to the examination of the effects of impact projection and adaptation measures based on climate projection on the national and regional level, scientific support for the promotion of municipalities adaptation measures, and contribution to planning and implementation of adaptation measures in the Asia-Pacific region with a view to supporting regional adaptation measures to the impacts of climate change.

■ Socioeconomic analysis, including analysis of both climate change impact and response options

Strategic Research on Environment Research and Technology Development Fund S-10 (Integrated Research on the Development of Global Climate Risk Management Strategies) conducted research related to scientifically and socially reasonable risk management strategies and options on climate change considering constraints uncertainty, risk management options, and social value decisions etc. under climate change.

Research and development on reduction and adaptive technology

Strategic Research on Environment Research and Technology Development Fund S-14 (Strategic research on Global Mitigation and Local Adaptation to Climate Change) conducted research to prepare the most effective and efficient basic data for implementing mitigation and adaptation measures under conditions where economic, human and institutional resources are limited and contribute to the appropriate planning of climate change measures as risk management.

7.4 Systematic Observation

7.4.1 Basic principles

Overview

- In order to promote global warming countermeasures from a long-term and global perspective, it is indispensable to continuously accumulate the latest scientific knowledge in Japan and overseas; research, observation and monitoring of climate change are extremely significant measures that form the basis of this knowledge.

Measures

- Japan promotes comprehensive measures for observation and monitoring of climate change under the “Implementation Policy of Earth Observations for 10 years” based on the “Earth Observation Promotion Strategy” and the “Sixth Science, Technology, and Innovation Basic Plan”. In the promotion, bearing in mind Japan’s contribution to the development of GEOSS, Japan will ensure the consistency with international observation and monitoring projects in terms of methods and take care to enable effective data utilization through exchanging outcomes of activities of observation and monitoring organizations each other, such as by utilizing the “Data Integration and Analysis System” (DIAS) connected to GEOSS on behalf of Japan

- Japan participates in and cooperates with international observation and monitoring programs conducted under the Global Climate Observing System (GCOS), Global Atmosphere Watch (GAW), the Global Ocean Observing System (GOOS), and the Global Environmental Monitoring System (GEMS), which contribute to the development of the Global Earth Observation System of Systems (GEOSS). Japan also conducts wide-area observation and monitoring based on the appropriate sharing of international tasks. In addition, Japan also facilitates the utilization of observation and monitoring data through joint research and knowledge networks such as the APN.

- It is important to effectively promote Earth observation by satellites with coordination on a worldwide scale in accordance with Japan’s Basic Plan on Space Policy as decided by the Cabinet in June 2020. Japan actively leads the activities of the Committee on Earth Observation Satellites (CEOS) and other international forums and promotes the development, launch, and operation of satellites in conformity with these activities. Furthermore, through GEOSS, Japan promotes integrated global observations combining satellites, aircraft, ships, and ground-based observation in cooperation with international organizations and research projects.

7.4.2 Priority fields

As for observation and monitoring of global warming, comprehensive observation and monitoring system to understand greenhouse gas, climate change, and its influence has been strengthened based on the "GEO Strategic Plan 2016-2025” approved at the Intergovernmental Meeting on Earth Observation (GEO) Ministerial Summit (November 2015, Mexico City) as the successor to "GEOSS 10-year implementation plan" on Earth observation approved at the 3rd Earth Observation Summit (2005), “Space Agency Response to GCOS Implementation Plan” at COP23 in November 2017, and "Promotion Strategy on Global Monitoring" of the Council for Science.

In particular, Japan is conducting: observing GHGs at multiple points all over the world through the Greenhouse gases Observing SATellite "GOSAT” and the Greenhouse gases Observing SATellite-2 "GOSAT-2” and conducting comprehensive atmospheric observation in the Asia-Oceania region, construction of an ecosystem monitoring system at the terrestrial carbon cycle observation base in the Asian region, improvement of the ocean carbon dioxide observation network, monitoring of global warming impacts in areas vulnerable to climate change, such as the cryosphere and coastal areas, and integration of observational data and socioeconomic data.

7.4.3 Main contents of systematic observations

■ Atmospheric climate observing systems, including atmospheric constituent

Under the GCOS framework, Japan participates in GSN and GUAN for the most essential climate variables, as well as in GAW and BSRN for atmospheric composition and radiation, respectively. Especially in the activity of GAW as part of the atmospheric chemistry component of GCOS, Japan has been contributing to the operation of GAW’s World Data Centre for Greenhouse Gases (WDCGG) and the preparation of the *WMO Greenhouse Gas Bulletin* for submission to the annual COP of UNFCCC. Additionally, implementation of political measures toward sustainable observation and monitoring systems aiming to reveal the temporal and spatial distribution of greenhouse gases such as CO_2, CH_4, N_2O, CFCs and tropospheric ozone has been made. Homogeneous and high-quality climate observations have been implemented over 150 meteorological stations in Japan for a long period more than several decades. CLIMAT reports (the reporting format of monthly values from a land station set by the WMO) from some of these stations are exchanged internationally on a monthly basis. In a joint effort with Germany, Japan has been monitoring the reception rates and data quality of CLIMAT reports from all over the world under the framework of the WMO. Japan has also been providing quasi-real time climate change-related information based on climate data collected and analyzed through the above activities, both within and outside Japan. Data from geostationary meteorological satellites are used to monitor long-term changes in global radiation and associated climate change. The Dual-frequency Precipitation Radar (DPR) on board the core satellite of Global Precipitation Measurement (GPM) provides global precipitation data from weak rain to heavy rain by sterically observed precipitation in the rain-bearing cloud. In addition to highly accurate monitoring of the atmospheric composition from the ground, ships and aircraft, Japan is providing observational data through the Greenhouse gases Observing SATellite (GOSAT) and the Greenhouse gases Observing SATellite-2 "GOSAT-2” to monitor the states of greenhouse gas emissions and removals for each region. Furthermore, Japan has been providing observational data through the Global Change Observation Mission-Water (GCOM-W), which continuously observes water-related parameters, such as water vapor and soil moisture, and the Global Change Observation Mission-Climate (GCOM-C), which continuously conducts global observations of climate change using a multi-wavelength optical radiometer. Moreover, Japan has been promoting the following activities in order to contribute internationally in the field of global observation: development of Cloud Profiling Radar (CPR) to be on board Earth Clouds, Aerosols and Radiation Explorer (EarthCARE), a development of Global Observing SATellite for Greenhouse gases and Water cycle (GOSAT-GW), which is a successor to GCOM-W, GOSAT and GOSAT-2; international joint research for the development of comprehensive observation systems for the middle atmosphere; and joint research into global environmental measurement technologies in Asia.

Table 7-1 Participation in the Global Climate Observing System

	GSN	GUAN	GAW	BSRN	Other
Number of stations	14	7	7	6	
Number of operating stations	14	7	7	6	
Number of stations operating to GCOS standards	14	7	7	6	
Number of stations expected to be operational in 2023	14	7	5	6	
Number of stations providing data to the International Data Center	14	7	7	6	

*As of January 1, 2022, including the Syowa Station in the Antarctic.

Note: GSN: GCOS Surface Network

GUAN: GCOS Upper-Air Network

GAW: Global Atmosphere Watch

BSRN: Baseline Surface Radiation Network

Table 7-2 Atmospheric Observing Systems for Climate (Surface Meteorological Observations)

System	Climate parameters	Total stations	Appropriate for characterizing national/ regional climates?			Duration: Stations [digital data]			Adequate quality control procedures?			Meta data available? Stations [digitized (%)]	Continuity: Stations expected to be operational in 2023
			Fully	Partly	No	30-50 years	50-100 years	More than 100 years	Fully	Partly	No		
Stations useful for national climate monitoring purposes	Atmospheric pressure	156	○			0 [1]	85 [84]	71 [71]	○			156 [100]	156
	Clouds	12	○			0 [0]	3 [12]	9 [0]	○			12 [100]	12
	Weather	12	○			0 [0]	3 [12]	9 [0]	○			12 [100]	12
	Humidity	156	○			0 [1]	85 [84]	71 [71]	○			156 [100]	156
	Precipitation	154	○			0 [0]	83 [83]	71 [71]	○			154 [100]	154
	Global solar radiation	49	○			0 [6]	16 [43]	33 [0]	○			49 [100]	49
	Sunshine duration	156	○			0 [1]	86 [84]	70 [70]	○			156 [100]	156
	Temperature	156	○			0 [0]	85 [85]	71 [71]	○			156 [100]	156
	Visibility	154	○			0 [3]	83 [151]	71 [0]	○			154 [100]	154
	Wind	155	○			0 [1]	84 [144]	71 [10]	○			155 [100]	155
Stations reporting internationally		53											
CLIMAT reporting Stations		53											

*As of January 1, 2022, including the Syowa Station in the Antarctic.

Table 7-3 Available Homogenous Data Sets for Surface Meteorological Observations

Data set name	Climate parameters	Stations and region covered	Time period	Contact
Surface meteorological observation monthly and 10-day mean/total data file	Atmospheric pressure, clouds, weather, humidity, precipitation, global solar radiation, sunshine duration, temperature, wind	156 stations in Japan	1880s–2021	Japan Meteorological Agency
Surface meteorological observation daily mean/total data file	As above	As above	1880s–2021	Japan Meteorological Agency
Surface meteorological observation monthly mean/total data file	As above	As above	1880s–2021	Japan Meteorological Agency

*As of January 1, 2022, including the Syowa Station in the Antarctic.

Table 7-4 Atmospheric Observing Systems for Climate (Upper Air Meteorological Observations)

System	Total stations	Appropriate for characterizing national/regional climates?			Duration: Stations [digital data]				Adequate quality control procedures?			Meta data available? Stations [digitized (%)]	Continuity: Stations expected to be operational in 2023
		Fully	Partly	No	5-10 years	10-30 years	30-50 years	More than 50 years	Fully	Partly	No		
Radiosonde stations	17	○			0 [0]	2 [2]	0 [14]	15 [1]	○			17 [100]	17
Stations reporting internationally	17												
Wind profiler stations	33	○			2 [2]	31 [31]	0	0	○			33 [100]	33

*As of January 1, 2022, including the Syowa Station in the Antarctic.

Table 7-5 Available Homogenous Data Sets for Upper Air Meteorological Observations

Data set name	Climate parameters	Stations and region covered	Time series	Contact
Upper air meteorological observation daily mean/total data file	Humidity, temperature, wind, altitude	17 stations in Japan Data at standard atmospheric pressure levels	1988–2021	Japan Meteorological Agency
Upper air meteorological observation monthly mean/total data file	As above	As above	1951–2021	Japan Meteorological Agency

*As of January 1, 2022, including the Syowa Station in the Antarctic.

Table 7-6 Atmospheric Observing Systems for Climate (Atmospheric Composition Observations)

Parameters	Total stations	Appropriate for characterizing national climate?			Duration: Stations [digital data]				Adequate quality control procedures?			Meta data available? Stations [digitized (%)]	Continuity: Stations expected to be operational in 2023
		Fully	Partly	No	10-20 years	20-30 years	30-50 years	More than 50 years	Fully	Partly	No		
CO_2	23	○			18 [18]	4 [4]	2 [2]	0	○			23[100]	23
Vertical CO_2 distribution	41	○			41 [41]	0	0	0	○			41[100]	41
Surface ozone	12	○			8 [8]	3 [3]	1 [1]	0	○			12[100]	12
Total ozone	4	○			0	0	1 [1]	3 [3]	○			4[100]	2
Vertical ozone distribution	2	○			0	0	0	2 [2]	○			2[100]	2
Other greenhouse gases	22	○			17 [17]	4 [4]	1 [1]	0	○			22[100]	22
Aerosols	6	○			2 [2]	1 [1]	1 [1]	0	○			6[100]	6
Vertical aerosols distribution	0	○			0	0	0	0	○			0[0]	0

*As of January 1, 2022.

Total of the Meteorological Agency's observation stations (including the Syowa Station in the Antarctic) and the National Institute for Environmental Studies' observation stations.

Table 7-7 Atmospheric Observing Systems for Climate (Surface Radiation Observations)

System	Total stations	Appropriate for characterizing national climate?			Duration: Stations [digital data]				Adequate quality control procedures?			Meta data available? Stations [digitized (%)]	Continuity: Stations expected to be operational in 2023
		Fully	Partly	No	10-20 years	20-30 years	30-50 years	More than 50 years	Fully	Partly	No		
Surface radiation	6	○					2 [2]	4 [4]	○			6 [100]	6

*As of January 1, 2022.

Total of the Meteorological Agency's observation stations (including the Syowa Station in the Antarctic).

■ Ocean observing system for climate

Japan has been promoting the development of the Global Ocean Observing System (GOOS) and is also contributing actively to its regional pilot project, the North-East Asian Regional Global Ocean Observing System (NEAR-GOOS).

Furthermore, Japan has been making efforts to enhance observation and monitoring systems and measures to grasp temporospatial distributions of CO_2 in the ocean as well as implementing continuous observation at nationwide observation points to monitor changes in sea levels due to global warming. Japan has also been carrying out oceanographic observations in the western North Pacific to monitor oceanic changes associated with climate change. In addition, under international programs constituting GOOS, such as the WMO Voluntary Observing Ship Scheme, Japan has been promoting oceanographic and marine meteorological observations by general ships, deployment of drifting buoys, and automatic shipboard upper-air observations. Furthermore, with the aim of elevating the sophistication of climate change projection models, Japan has been improving the marine observation system by deploying Triton buoys in the tropical Western Pacific since 1998 and by deploying ARGO floats since 2000 by the development of Advanced Ocean Observing System (ARGO Project). Moreover, as an initiative utilizing Remote Sensing Technology from space, Japan has been conducting the following activities: providing data observed by satellite GOSAT and GOSAT-2; providing observation data of Global Change Observation Mission-Water (GCOM-W) and Global Change Observation Mission-Climate (GCOM-C) as well as data from the Dual-frequency Precipitation Radar (DPR) to be on board the main satellite Global Precipitation Measurement (GPM) and hourly global precipitation distribution map named "GSMaP", which combines multiple data from earth observatory satellite and a weather-monitoring satellite HIMAWARI; a development of Global Observing SATellite for Greenhouse gases and Water cycle (GOSAT-GW), which is a successor to GCOM-W, GOSAT and GOSAT-2; and implementing research into remote sensing technologies. In addition, data from geostationary meteorological satellites are utilized to monitor sea surface temperature.

■ Terrestrial observing systems for climate

Japan has been carrying out the following: monitoring of greenhouse gas flux in northern forests; providing observation data by the GOSAT and the GOSAT-2; analysis of crustal deformation monitoring of changes in forests and mangroves, monitoring of land use changes including city area and crop land by the Advanced Land Observing Satellite-2 (ALOS-2); stereoscopic observation of precipitation in a rain-bearing cloud by Global Precipitation Measurement (GPM); observation of the amount of water vapor in the atmosphere and soil distribution by Global Change Observation Mission-Water (GCOM-W); observation of the amount and activity of particulate matter and plants in the atmosphere by Global Change Observation Mission-Climate (GCOM-C). Furthermore, Japan has been implementing the development of the Global Observing SATellite for Greenhouse gases and Water cycle (GOSAT-GW), which is a successor to GCOM-W, GOSAT and GOSAT-2, and research into remote exploration technologies for carrying out terrestrial environmental observations of vegetation amounts (biomass), land use and land cover, changes ground moisture, and snow and ice. In addition, data from geostationary meteorological satellites are used to monitor snow/ice cover.

Under the framework for the worldwide network of energy, water vapor, and greenhouse gas flux observations (FLUXNET), long-term monitoring has begun at 30 sites in various ecosystems in Japan by many domestic institutions. Promotion of an Asian regional network (AsiaFlux), development of a database, and capacity building have been conducted as well.

■ Cryosphere observing systems for climate

The National Institute of Polar Research has been organized to promote general research based on observations in the polar region. It has observation bases in the Antarctic and Arctic to provide researchers in Japan with foundations of observations in the Antarctic and Arctic as an inter-university research institute. It addresses promotions of polar region science by a public offering of a joint research project as well as providing materials and information and so on.

■ Support for developing countries to establish and maintain observation

systems, relevant data, and monitoring systems

Japan has been conducting joint research on global environmental observation and promoting technical transfers in order to build observation networks in Asia in areas lacking such facilities. Japan has also been promoting the establishment of strategic environmental monitoring systems using satellites in the Asia-Pacific region, pilot projects concerning the utilization of satellite data, and capacity development

■ DIAS (Data Integration and Analysis System)

DIAS (Data Integration and Analysis System), as an information foundation to archive and analyze big data, such as global observation, and projection information has been developed, and it has promoted the use of the data to solve the global-level problems of climate change, disaster prevention, and infectious disease in collaboration with the private sector. Moreover, the DIAS is providing global monitoring information all over the world through the framework of the Group of Earth Observations (GEO) that promotes decision-making based on the global observation information.

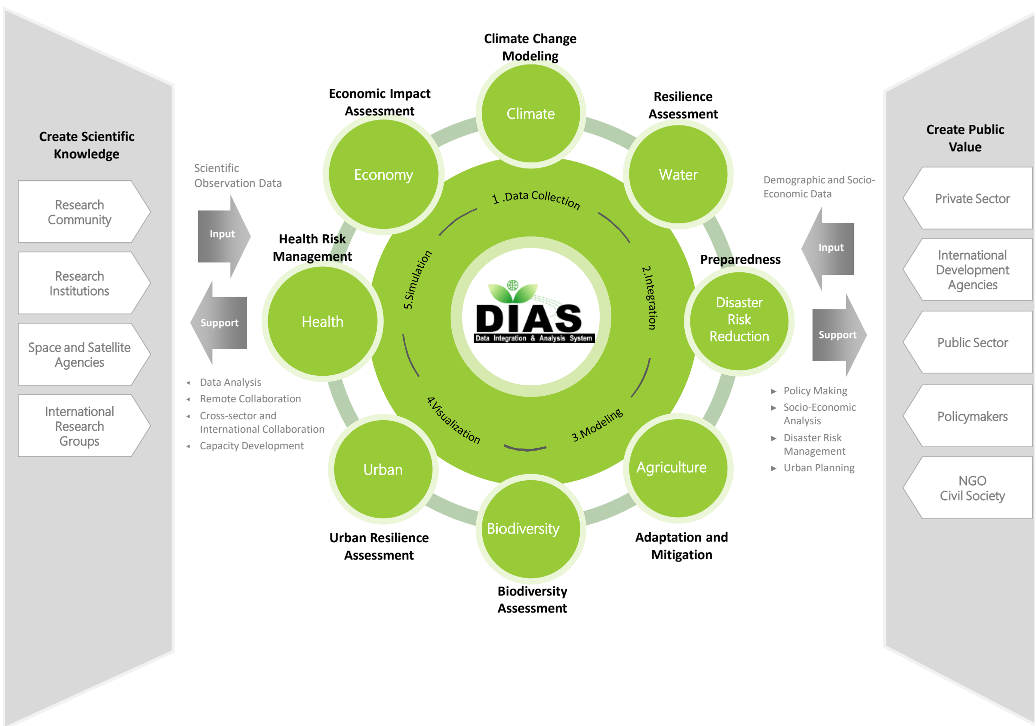


Figure 7-2 Overview of DIAS

Chapter 8

Education, Training, and Public Awareness

8.1 Overview

(General)

- The government of Japan provides opportunities to learn about global warming and energy issues via home education, school education and social education through the operation of the Law for the Promotion of Environmental Conservation Activities through Environmental Education and the promotion of Education for Sustainable Development (ESD). Furthermore, Japan promotes improved awareness through advertising in the mass media, distributing pamphlets, and holding symposiums. Japan is also committed to increasing support for environmental NGOs, which promise to play a leading role as advisors in public efforts to address global warming.
- Japan actively provides and shares knowledge about the global warming issue, the specific actions for which enormous efforts are needed in order to curb GHG emissions, and information about what each individual must do. Japan also carries out public relations and dissemination activities on these topics in order to improve the awareness of households and businesses and to rouse them to take action.

(Education in schools)

- Japan formulated the basic policies for the promotion of environmental education based on the Law for the Promotion of Environmental Conservation Activities through Environmental Education, and promotes integrated measures related to environmental education in order to encourage the public, private organizations, and others to address the initiatives of environmental conservation on their own initiative.
- Japan set up the Interministerial Meeting for the Education for Sustainable Development (ESD) and actively promotes the related measures. The implementation plan of ESD in Japan was formulated in May 2021, and efforts are being made for its systematic implementation.

(Public awareness raising and public involvement)

- Japan encourages voluntary actions by each individual citizen by strongly appealing to public awareness. This is done through the appropriate provision of information using diverse methods. In doing so, Japan works to foster a sound sense of crisis, using the latest scientific knowledge, and to provide information and educate the public concerning what specific actions or purchases contribute to the education in greenhouse gas emissions or the promotion of measures for carbon sinks.

(Support for NGOs and other organizations)

- The government of Japan and local governments provide financial support for environmental NGOs which are indispensable for the success of mitigating global warming. Japan continues to strengthen its support to the extent that is does not distort the original objective of their activities.

(Monitoring, review and evaluation of the implementation of Article 6 of the Convention)

- In Japan, there is no formal monitoring, review and evaluation process specific to the implementation of Article 6 of the Convention. However, as described in the relevant chapters of this report, activities related to Article 6 are implemented as a part of Japan's ongoing climate change education, training, and public awareness activities; transparency activities such as the preparation of national greenhouse gas inventories, national communications and biennial reports; implementation of mitigation and adaptation policies; and activities related to supporting developing countries.

8.2 General policy on education, training and public awareness

CO_2 emissions have consistently been increasing in recent years in the residential sector, which is closely related to public life. To mitigate global warming, everyone must shift from the mass consumption and disposal lifestyle to one where people engage in resource and energy conservation and recycling. At the same time, the use of non-fossil fuel energy, including renewable energy, should be considered.

To these ends, the government of Japan provides opportunities to learn about global warming, as well as closely related energy issues via home education, school education and social education through the operation of the Law for Promotion of Environmental Conservation Activities through Environmental Education (hereinafter "the Law for Promotion of Environmental Conservation Activities") and promotion of Education for Sustainable Development (ESD). Japan promotes improved awareness through advertising in the mass media, distributing pamphlets, and holding symposiums. Japan is also committed to increasing support for environmental NGOs, which promise to play a leading role as advisors in public efforts to address global warming.

Japan actively provides and shares, in as visible a manner as possible, knowledge about the increasingly serious global warming issue, the specific actions for which enormous efforts are needed in order to curb GHG emissions, and information about what each individual must do. Japan also carries out public relations and dissemination activities on these topics in order to improve the awareness of households and businesses and rouse them to take action.

8.3 Education in schools

8.3.1 Overview

Environmental education in Japan was triggered by pollution education and nature conservation education. The environmental education is defined as "education and learning about environmental conservation to foster better understanding about the links between environment and society, economy, and culture and other environmental conservation in households, schools, working place, community and throughout everywhere, to aim to build a sustainable society" in the Law for Promotion of Environmental Conservation Activities established in June 2011 from a global-level point of view and with the object of promotion of integrative development for environment conservation, economy and society. Japan formulated basic policies for promotion of environmental education based on the same law, and promotes integrated measures related to environmental education in order to encourage the public, private organizations and others to address the initiatives of environment conservation on their own initiative.

Also, regarding the Education for Sustainable Development (ESD), which was started based on Japan's proposal in 2005, Japan set up the Interministerial Meeting for ESD and promotes related measures. Following the UN Decade of ESD (hereinafter "DESD") (2005-2014) and the Global Action Programme on ESD (hereinafter "GAP") (2015-2019), the Education for Sustainable Development: Towards achieving the SDGs (hereinafter "ESD for 2030") has been launched in 2020. The implementation plan of ESD in Japan was formulated in May 2021, and efforts are being made for its systematic implementation.

8.3.2 Specific measures

Promotion of environmental education and environmental leaning provided by schools <Ministry of Education, Culture, Sports, Science and Technology (MEXT)>

- It is important to promote environmental education and environmental Learning in order for students to be able to deepen their understanding and interests in the environment and to conduct the measures in a proactive manner for environment conservation. In the March 2008 and March 2009 revisions to the National Curriculum Standards, Japan upgraded the contents of environmental education, focusing on such closely related subjects as Social Studies, Science, and Technology and Home Economics. Also, the National Curriculum Standards for elementary and junior high schools were revised in March 2017 and for high schools in March 2018, respectively, to upgrade the contents of environmental education. Japan is continuously promoting environmental education and environmental learning at schools.

- Japan is also promoting eco-schools (environmentally friendly schools) by introducing energy conservation, such renewable energy as solar power generation in school facilities, and promoting the further use of lumber. Such facilities are certified as "Eco-School Plus", and are used as educational materials to promote environmental education for students.

- Japan is conducting environmental leadership training projects and supporting Global Learning and Observations to Benefit the Environment (GLOBE) model schools.

- In elementary and junior high schools, environmental education is provided in various subjects based on the National Curriculum Standards.

Promotion of environmental education and environmental learning at various places

The Law for Promotion of Environmental Conservation Activities defines that the government implements the necessary measures to promote environmental education in a manner wherein the public can deepen its understanding and interest in environmental conservation through all opportunities from infancy in accordance with their development stages. The relevant ministries and agencies are promoting environmental education and environmental learning not only in schools but also in various sites such as community learning centers, youth educational facilities, urban parks and forests.

- Operation of certification system "Opportunities for Experience" <Ministry of the Environment (MOE)>

  Based on the Law for Promotion of Environmental Conservation Activities, Japan has established a system that the local governors certify by certain criteria and publish venues of experience opportunities provided by private land and building owners through hands-on activities such as nature-based experimental activities to deepen the understanding and interest in environment conservation. As of September 2022, 27 venues were certified all over Japan, and the number of people who experienced count approximately 16,600 in a year (FY 2020). Concerning the certification, many business operators feel that the improvement in company value, coexistence with local communities, and strengthening with schools are significant. Also, many schools have ideas that they can let the students conveniently participate in the experience of learning, and it strengthens teachers' scholastic ability.

- Environmental education at community learning centers <MEXT>

  In order to help build up cooperation among community learning centers and other relevant organizations in respective regions so as to increase learning activities and opportunities for solving regional problems, including environmental issues, Japan disseminates information on good regional efforts nationwide to promote similar efforts.

  Japan is also promoting environmental education at youth educational facilities by providing opportunities for hands-on environmental education and activities for experiences in nature utilizing the rich natural environments.

- Environmental education in urban parks <Ministry of Land, Infrastructure, Transport and Tourism (MLIT)>

  Japan is providing opportunities and venues for the training of leaders and practitioners of environmental education and environmental learning, which is working together with users, local communities, and schools, and promoting the development of urban parks to implement those activities. In order to improve awareness and encourage urban greening, Japan is establishing the Green Consultation Center.

- Promotion of initiatives for forest environmental education activities <Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF)>

  The Forestry Agency is promoting initiatives for forest environmental education activities, providing opportunities to experience and learn about forests and forestry, and disseminating the benefits of wood and the significance of its use.

  In addition, the Forest Agency provides part of the National Forests as spaces for experience-based activities led by NPOs, schools and other organizations. The Regional and District Forest Offices of the Forestry Agency are providing a variety of support, including the organization of experience-based activities, the offering of activity programs, and the providing of technical guidance.

- Improvement of the environment at the port and provision of opportunities for education < MLIT>

  In order to utilize the favorable natural environment of ports and harbors and to enhance opportunities to learn the importance of the natural environment, Japan is promoting the development of green areas and tidal flats that can serve as venues for nature experience and environmental education programs by local governments and NPOs. Also, Japan is promoting “seaside nature schools" that provide nature experiences and environmental education utilizing the natural environment of the seashore.

Promotion of ESD activities

- Contribution to the international framework on ESD <MEXT>

  The ESD has been promoted by UNESCO under the framework of DESD (2005-2014) and GAP (2015-2019). After that, the ESD for 2030 was launched in 2020 as the succeeding framework. In May 2021, the UNESCO World Conference on ESD was held online and attended by MEXT Minister Hagiuda. Also, the UNESCO-Japan Prize on ESD was established in 2014 with financial support from Japan to recognize outstanding ESD projects around the world, and since then, three projects have been selected each year until 2019, and three projects every other year after 2020. In 2016, the “Okayama ESD project” by the Okayama ESD Promotion Commission was selected as one of the winners.

- Promotion of ESD centering on school educations <MEXT>

  MEXT has been promoting ESD at various educational sites centering on school education. In particular, UNESCO Associated Schools (schools that practice international collaboration in order to realize UNESCO’s ideals as set forth in the Constitution of UNESCO) have been positioned as hubs to promote ESD. The number of UNESCO Associated Schools in Japan reached 1,120 as of November 2019 while it was only 19 at the beginning of UNDESD.

  Specific activities being implemented include the necessary support for UNESCO Associated Schools’ activities (such as providing human resources and information and promoting exchanges), development of the *UNESCO Associated Schools Guidebook* (revised in March 2022), the Annual National Conference of ASPnet where practitioners of UNESCO Associated Schools gather from all over Japan to share good practices and exchange views on various challenges, and teacher training using *A Guide to Promoting ESD*. In addition, the ESD-SDGs Consortium is implementing and disseminating ESD in local communities cooperating with various ESD/SDGs-related organizations, such as schools, companies, and UNESCO associations.

- Formation of the “ESD promotion network” <MOE>

  In order to realize a sustainable society, the ESD Activity Support Center as a national level hub function and Local ESD Project support centers as a wide-area block hub function have been established to promote, in various level and cross-sectoral ways, ESD in cooperation with stakeholders who work initiatives related to ESD as core activities in local regions. Japan is promoting the following initiatives in cooperation with local ESD operation bases by gaining cooperation from local stakeholders for the following: (1) gathering and publishing ESD-related information, (2) support of ESD Activities, (3) promotion of mutual learning of ESD practices, and (4) human resource development.

8.4 Public awareness raising and public involvement

8.4.1 Overview

In order to mitigate global warming, it is necessary for each member of the public to modify their lifestyle, and this requires public awareness and action.

Japan encourages voluntary actions by each individual citizen by strongly appealing to public awareness. This is done through the appropriate provision of information using diverse methods. In doing so, Japan works to foster a sound sense of crisis by using the latest scientific knowledge and to provide information and educate the public concerning what specific actions or purchases contribute to the limitation of greenhouse gas emissions or the promotion of measures for carbon sinks.

8.4.2 Specific measures

■ Development of national campaigns (COOL BIZ, WARM BIZ)

In order to promote understanding across all sectors of society, including the nation and business sector, and to allow them to absolutely understand specific global warming prevention actions, the government disseminates knowledge and develop national campaigns while collaborating with local governments, business circles, NPOs, labor circles, and researchers.

Specifically, with respect to countermeasures concerning the reduction of greenhouse gas emissions, there have been coordinated campaigns using the internet, television, newspapers, and radio, which have enlightened people to take a variety of different global warming prevention actions, including setting heaters and air conditioners to appropriate temperatures.

As one example of these efforts, Japan is promoting the COOL BIZ and WARM BIZ, which encourage people in offices to wear clothes that enable them to set the air conditioner to 28°C in the summer and set the heating to 20°C in the winter and live comfortably at these room temperatures.

■ Measures through the Japan Center for Climate Change Actions and Prefectural Centers for Climate Change Actions

In accordance with the Act on Promotion of Global Warming Countermeasures, enacted in April 1999 and revised in June 2008, the Japan Center for Climate Change Actions and Prefectural Centers for Climate Change Actions have been engaged in activities to help raise public awareness and publicize global warming countermeasures.

The Japan Environment Association was designated as the Japan Center for Climate Change Actions in July 1999, and its name was changed to the Japan Network for Climate Change Actions in October

2010. As of July 2022, a total of 59 regional centers for climate change actions have been designated across Japan, serving as promoters of global warming countermeasures in their respective regions.

■ Activities of the global warming prevention activities advisors

In accordance with the Act on Promotion of Global Warming Countermeasures, activities that are aimed at controlling the emission of greenhouse gases related to daily life by providing advice and seeking to improve public awareness have been carried out by global warming prevention activities advisors designated by prefectural governors.

■ Promotion of green procurement

The Law Concerning the Promotion of Procurement of Eco-Friendly Goods and Services by the State and Other Entities (Law on Promoting Green Procurement) established in 2000 stipulates the Basic Policy on Promoting Green Procurement in order to comprehensively and systematically promote the procurement of environmentally friendly goods and services. The national and local governments are stipulating their goods and services procurement policies in line with this Basic Policy and implementing priority procurement of environmentally friendly goods and services. The law also requires local governments, businesses, and the public to endeavor to select environmentally friendly goods and services. In order to contribute to this selection process, the government is providing information through the Internet and is involved in public education activities such as green purchase information sessions.

■ Measures focusing on Environment Month

Both the national and local governments engage in various efforts to raise public awareness regarding environmental conservation. These activities are mainly conducted in June, which is Japan’s Environment Month, and particularly on June 5, which is Japan’s annual Environment Day. Specific activities include the following: the Eco-Life Fair, an environment-themed exhibition; various lectures, symposiums, and events; preparation and distribution of pamphlets and posters; the commendation of parties who provide outstanding environmental conservation services; and public relations campaigns using such media as television, radio, newspapers, and magazines.

■ Measures focusing on Global Warming Prevention Month

December has been designated Japan’s Global Warming Prevention Month, and the national and local governments promote a variety of activities to further this aim. Specifically, the following have been promoted: various events, such as holding symposiums that contribute to global warming prevention; the commendation of parties who provide environmental conservation services; and PR campaigns conducted by the various media.

■ 3R awareness campaign

In order to disseminate and promote 3R awareness, Japan operates the website “Re-Style” to help improve public awareness through the Internet.

Measures focusing on the 3R Promotion Month

October has been designated Japan's 3R (reduce, reuse, and recycle) Promotion Month, when the national and local governments promote various activities to help raise public awareness about 3R activities. Specific examples of such activities and events for the month include the holding of the 3R Promotion National Convention, the Minister of the Environment's award honoring to Persons of Merit in Promoting 3R Activities and Winners of the 3R Poster Contest, as well as an Award Ceremony for Resource-Recycling Technologies and Systems designed to promote recycling businesses.

Promotion of visualization of greenhouse gas emissions by building the carbon footprint system

In order to help promote businesses' efforts to efficiently reduce greenhouse gas emissions and to induce consumer behavior promoting emission reductions through choices of lower-emission products and services, Japan is promoting the creation and spread of the carbon footprint system. This system involves displaying greenhouse gas emissions generated throughout a product or service's life cycle, from the procurement of raw materials to its disposal and recycling in terms of the equivalent of CO_2 emissions in a simple and easy-to-understand manner.

Awareness campaign for energy conservation

In order to promote cooperation on energy conservation measures in all sectors of society, the Council for Promoting Energy and Resource Conservation Related Measures decides on "summer (winter) energy conservation efforts" every year and strengthens its awareness campaigns in conjunction with various ministries and agencies during these seasons in which energy consumption tends to increase.

Furthermore, in order to promote energy saving in the industrial, residential and commercial, and transport sectors, public relations activities are being undertaken to inform the public of concrete energy-saving behaviors in an easy-to-understand manner through advertisements, events, the Web, brochures, etc.

Provision of information related to nuclear power

Since the incident occurred at Fukushima Daiichi Nuclear Power Plant, Japan has been steadily carrying out public relations activities, for promoting public understanding and the energy policy including nuclear energy policy.

Dissemination of the importance of wood use to consumers

The national and local governments are promoting the "Kizukai (due care for wood use)" initiative to disseminate the importance of wood use to consumers and thereby expand the use of wood. In addition to the award for wood use (Wood Design Award), which acknowledges outstanding wood products and related activities that contribute to the rediscovery of the excellence and value of wood from the viewpoint of consumers, various events are held, and public relations activities are carried out through a variety of media.

■ Awareness campaign for National Greenery and Urban Greening

Examples of awareness campaigns concerning national greenery and urban greening include the development of public participation in greening campaigns such as national greening campaigns during Greenery Month and Urban Greening Month, as well as promoting the forest establishment and management by the private sector, and greening activities funded through charity collections, and urban greening funds.

■ Awareness campaign for transport sector environmental issues

Environmental measures for the transport sector are being promoted throughout Japan by implementing specific measures and improving awareness of global environmental issues through activities that include the creation of pamphlets concerning global warming issues, energy conservation measures like Eco-drive, and environmental issues for the transport sector, such as air pollution problems. This information is distributed to local governments, related industrial circles, and the general public.

■ Awareness campaign for fuel-efficient vehicles

Fuel-efficient vehicles have been promoted by preparing and publishing the Automobile Fuel Efficiency List, showing fuel efficiency and CO_2 emissions from vehicles and by providing the latest information through the Internet.

■ Provision of information on the current status and future predictions of global warming

Japan has been encouraging the general public to become more aware of the latest information on climate change with publications describing its monitoring results and future predictions, such as *Climate Change in Japan 2020* and *Climate Change Monitoring Report*, and symposiums to present scientific findings from climate change prediction research.

In March 2020, *Climate Change in Japan 2020*, which compiles the facts observed to date on climate change in Japan and future projections under the 2°C increase in global average temperature scenario (RCP 2.6) and a 4°C increase scenario (RCP 8.5) in the future was published.

The World Data Centre for Greenhouse Gases (WDCGG) of World Meteorological Organization (WMO) operated by the Japan Meteorological Agency gathers and analyzes observation data on greenhouse gases in the world. The results are published as the *Greenhouse Gas Bulletin* by the WMO. (The Japanese translation is also published by the Japan Meteorological Agency.) The *Greenhouse Gas Bulletin* is distributed at the Conference of the Parties to the UNFCCC and is being used as fundamental information on global climate change countermeasures.

Furthermore, the Japanese translation of the Summary for Policymakers (SPM) of various reports of the Intergovernmental Panel on Climate Change (IPCC) has also been prepared and published.

■ Awareness campaign for ethical consumption

In order to widely inform the public about the meaning and necessity of "ethical consumption," which refers to consumption behavior with consideration of people, society, and the environment, the Consumer Affairs Agency has prepared pamphlets, movies, and other educational materials and is promoting their use, as well as enhancing information dissemination through a special website.

■ Good Life Award

The Good Life Award is a program that invites activities and initiatives for "environmentally and socially friendly living" practiced in various parts of Japan and supports them by presenting awards by the Minister of the Environment. By publicizing the commended activities to the public, the program aims to provide an opportunity for each and every person living in Japan to review their lifestyle.

8.5 Support for NGOs and other organizations

8.5.1 Overview

The vital activities and healthy development of environmental NGOs and similar private groups are indispensable for the success of mitigating global warming. Such groups can also play important roles as leaders or advisors in efforts to get the general public involved. However, many groups do not have the sufficient financial resources needed to operate adequately and have depended on assistance from the national and local governments. Japan is committed to strengthening financial support for environmental NGOs and other private groups to the extent that is does not distort the original objective of their activities.

8.5.2 Specific measures

■ Platform project to create a circular and ecological economy that energizes local communities from environmental aspect

The project supports the establishment of regional platforms to energize the region from environmental aspect through the development of a sustainable region by creating a circular and ecological economy as advocated in the Fifth Basic Environment Plan (approved by the Cabinet in April 2018). To this end, Japan strongly promotes the creation of a "circular and ecological economy" by consolidating professional human resources and information, formulating a concept for a comprehensive regional initiative, and supporting commercialization through the formation and dispatch of expert teams based on that concept.

■ Japan Fund for the Global Environment

The Japan Fund for the Global Environment by the Environmental Restoration and Conservation

Agency provides subsidies and other support for about 200 projects each year to environmental NGOs, NPOs and other private organizations both within Japan and abroad for activities such as the formation of decarbonized society, implementation of climate change countermeasures, formation of recycling-based society, and nature conservation.

■ Funds for the conservation of the local environment by local governments

Local governments also support environmental conservation activities by NGOs and similar groups through their respective funds for the conservation of the local environment.

■ Activities of the Global Environment Outreach Centre

Based on the Law for Promotion of Environmental Conservation Activities through Environmental Education, business operators, NPOs, and others are given information, including seminars and exhibitions, and provided places to communicate in order to promote environmental preservation activities at the Global Environment Outreach Centre (a joint project with the United Nations University) and Local Environmental Partnership Offices, so that nations, private organizations, and the national and local governments are able to cooperate with each other on an equal footing.

■ Support for sustainable forest management in developing countries

The Forestry Agency, in its "International Forestry Cooperation Program", implements environment maintenance for NGOs and other organizations to engage in forest conservation and reforestation.

■ Provision of opportunities for forest growing activities

The Forestry Agency has been providing support to groups engaged in forest growing activities, such as training leaders, providing safety and technical training and offering part of the National Forest as spaces for their forest growing activities.

8.6 Monitoring, review and evaluation of the implementation of Article 6 of the Convention

As per Article 6 of the UNFCCC, in carrying out their commitments under Article 4.1(i), the Parties shall develop and implement educational and public awareness program on climate change and its effects, make information on climate change and its effects publicly available, and at the international level, develop and exchange educational and public awareness materials on climate change and its effects.

In Japan, there is no formal monitoring, review and evaluation process specific to the implementation of Article 6 of the Convention. However, as described in the relevant chapters of this report, activities related to Article 6 is implemented as a part of Japan’s ongoing climate change education, training, and public awareness activities; transparency activities such as the preparation of national greenhouse gas inventories, national communications and biennial reports; implementation of mitigation and adaptation policies; and activities related to supporting developing countries.

Annex I

Fifth Biennial Report

Annex I Chapter 1

Information on Greenhouse Gas Emissions and Trends

1.1 Summary information

Total GHG emissions in fiscal year (FY) 2020 (excluding LULUCF, including indirect CO_2) were 1,150 million tonnes in CO_2 eq. (Mt CO_2 eq.), which decreased by 9.8% compared to the emissions in FY 1990, by 16.8% compared to FY 2005, which is the base year of Japan's emission reduction target for FY 2020, and by 18.4% compared to FY 2013, which is the base year of Japan's emission reduction target for FY 2030. The main driving factor for the decrease in GHG emissions compared to FY 2005 is decreasing energy-related CO_2 by the decrease in energy consumption due to energy savings, while the HFCs emissions increased as a result of substitution from ozone-depleting substance (ODS) in the refrigeration and air conditioning sector.

Regarding the emission trends by gas, between FY 1990 and FY 2020, CO_2 emissions (excluding LULUCF, excluding indirect CO_2) decreased by 10.0%, CH_4 emissions (excluding LULUCF) decreased by 35.6%, and N_2O (excluding LULUCF) decreased by 38.2%. Furthermore, between calendar year (CY) 1990 and CY 2020, HFCs emissions increased by 224.7%, PFCs emissions decreased by 46.9%, SF_6 emissions decreased by 84.2%, and NF_3 emissions increased by 785.7%.

In FY 2020, CO_2 emissions accounted for 90.6% of total GHG emissions. The breakdown of CO_2 emissions showed that emissions from fuel combustion accounted for 94.7%, followed by industrial processes and product use (4.1%) and waste (1.2%). As for the breakdown of CO_2 emissions within fuel combustion, energy industries accounted for 41.9%, followed by manufacturing industries and construction (22.4%), transport (17.0%), and other sectors (13.3%). The main driving factor for the increase in CO_2 emissions since FY 1990 was an increase in solid fuel consumption for electricity power generation.

Net removals (including CO_2, CH_4 and N_2O emissions) from the LULUCF sector in FY 2020 were 52.0 Mt CO_2 eq. The net removals from Kyoto Protocol Article 3.3 and 3.4 activities in FY 2020 were 34.5 Mt CO_2 eq.

Further information on Japan's greenhouse gas emissions and trends can be found in Section 2.2 of Japan's *Eighth National Communication* (NC8) under the UNFCCC.

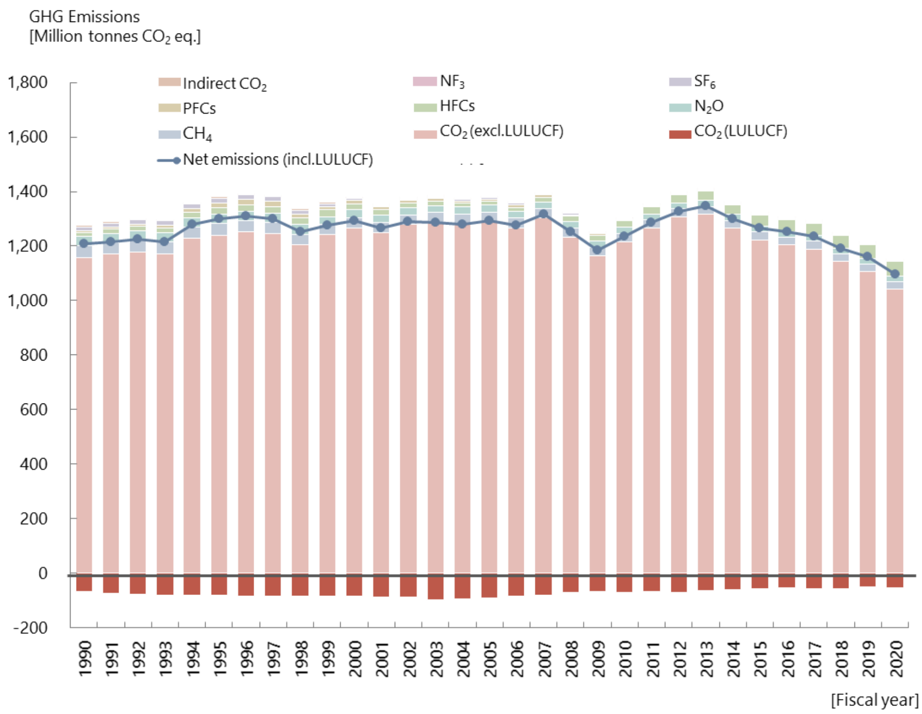


Figure A1-1 Trends in GHG emissions and removals in Japan

1.2 National inventory arrangements

1.2.1 Overview of national inventory arrangements

The government of Japan is to calculate the emissions and removals of GHGs for Japan and disclose the results every year, in accordance with Article 7 of Chapter 1 "General Provisions," the Act on Promotion of Global Warming Countermeasures, which determines the domestic measures for the UNFCCC and the Kyoto Protocol. The Ministry of the Environment (MOE) with the cooperation of relevant ministries, agencies, and organizations prepares Japan's national inventory and compiles the supplementary information required under Decision 2/CMP.8, which is annually submitted in accordance with the UNFCCC and the Kyoto Protocol.

The MOE assumes overall responsibilities for the national inventory and organizes the Committee for the Greenhouse Gas Emission Estimation Methods (Committee) in order to integrate the latest scientific knowledge into the inventory and to modify it to meet international requirements. The estimation of GHG emissions and removals are then carried out by taking the decisions of the Committee into consideration. Substantial activities, such as the estimation of emissions and removals and the preparation of the Common Reporting Format (CRF) tables and National Inventory Report (NIR), are done by the Greenhouse Gas Inventory Office of Japan (GIO), which belongs to the Center for Global Environmental Research, Earth System Division of the National Institute for Environmental Studies. The relevant ministries, agencies, and organizations provide the GIO with the appropriate data (e.g., activity data, emission factors, and GHG emissions and removals) by compiling various statistics and provide relevant information on supplementary information required under Decision 2/CMP.8. The relevant ministries and agencies check the inventories (i.e., CRF, NIR), including the spreadsheets that are actually utilized for the estimation (Japan National Greenhouse gas Inventory files, hereinafter referred to as "JNGI files") as a part of the Quality Control (QC) activities.

The checked inventories are determined as Japan's official GHG emission/removal values. The inventories are then published by the MOE and are submitted to the UNFCCC Secretariat.

The overall institutional arrangement for Japan's inventory preparation is described below.

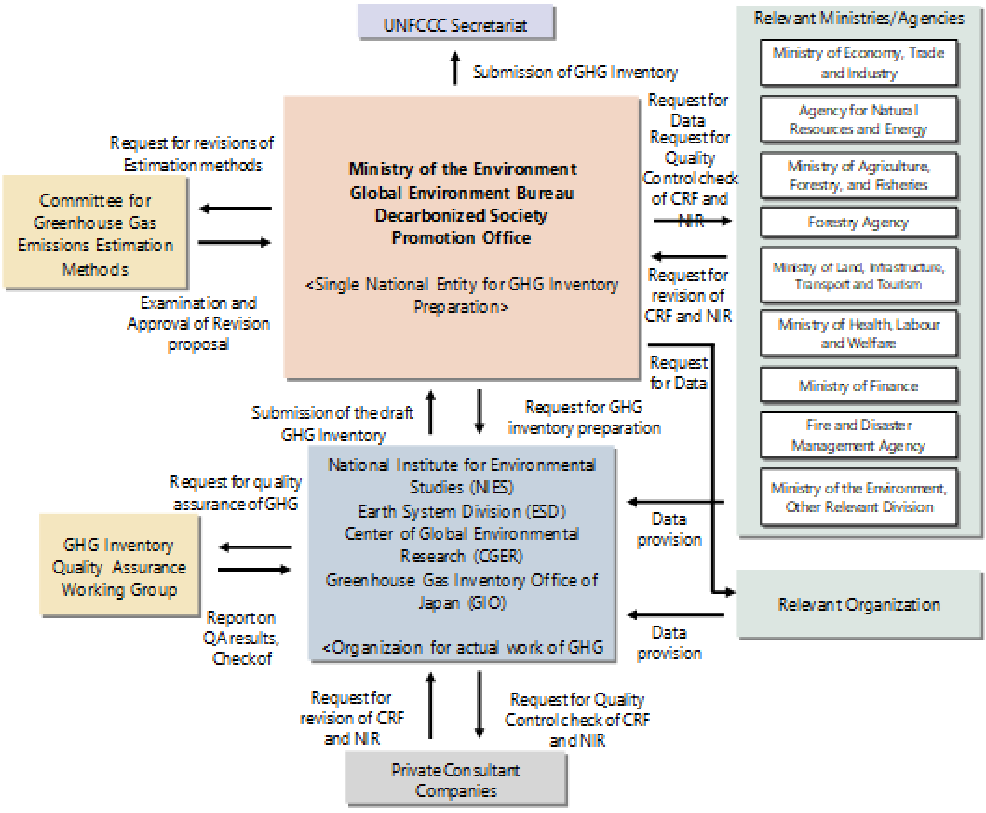


Figure A1-2 Japan's Institutional Arrangements for the National Inventory Preparation

Further information on Japan's national inventory arrangements can be found in Section 2.3 of *Japan's Eighth National Communication* under the UNFCCC.

1.2.2 Changes in national inventory arrangements since BR4

The following changes have been implemented since the national inventory arrangements described in the fourth biennial report (BR4) submitted in December 2019

- Change of name from the "Law-carbon Society Promotion Office" to "Decarbonized Society Promotion Office" of the Ministry of the Environment, which is the single national entity for GHG inventory preparation.
- Addition of sub-breakout group on CCU to the Committee for the Greenhouse Gas Emissions Estimation Methods.

1.3 Common Tabular Format Tables (CTF)

Table A1-1 Emission trends: summary（CTF Table 1）

GREENHOUSE GAS EMISSIONS	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	kt CO_2 eq															
CO_2 emissions without net CO_2 from LULUCF	1,158,129.44	1,158,129.44	1,169,777.72	1,179,504.32	1,172,487.31	1,227,513.53	1,239,909.40	1,252,447.05	1,245,139.36	1,205,249.92	1,241,835.60	1,264,594.66	1,249,988.54	1,279,362.30	1,287,691.83	1,283,076.66
CO_2 emissions with net CO_2 from LULUCF	1,092,462.43	1,092,462.43	1,096,076.95	1,102,387.86	1,092,059.98	1,147,374.88	1,160,380.28	1,168,726.99	1,160,401.72	1,120,402.18	1,157,850.02	1,179,608.12	1,164,434.91	1,192,042.71	1,189,648.71	1,188,580.74
CH_4 emissions without CH_4 from LULUCF	44,058.76	44,058.76	43,454.54	43,459.67	42,638.61	42,762.09	41,668.85	40,487.73	40,095.34	38,494.90	38,198.40	37,627.97	36,542.11	35,789.60	34,948.60	34,689.25
CH_4 emissions with CH_4 from LULUCF	44,164.00	44,164.00	43,555.36	43,556.44	42,756.47	42,870.58	41,765.26	40,606.37	40,219.86	38,590.26	38,286.49	37,718.14	36,636.57	35,892.91	35,031.63	34,781.39
N_2O emissions without N_2O from LULUCF	32,358.55	32,358.55	32,033.40	32,196.07	32,077.99	33,324.15	33,598.22	34,703.22	35,504.34	33,933.05	27,809.60	30,345.83	26,714.57	26,134.87	25,996.26	25,828.51
N_2O emissions with N_2O from LULUCF	32,603.54	32,603.54	32,275.21	32,434.97	32,315.60	33,558.42	33,827.14	34,928.54	35,725.86	34,150.41	28,025.54	30,560.60	26,928.28	26,347.68	26,205.12	26,035.24
HFCs	15,932.31	15,932.31	17,349.61	17,767.22	18,129.02	21,051.64	25,212.86	24,597.77	24,436.43	23,741.69	24,367.38	22,850.63	19,460.88	16,234.18	16,227.35	12,421.07
PFCs	6,539.30	6,539.30	7,506.92	7,617.29	10,942.80	13,443.46	17,676.95	18,321.50	20,041.41	16,615.96	13,146.06	11,890.21	9,893.28	9,213.57	8,868.55	9,230.71
Unspecified mix of HFCs and PFCs																
SF_6	12,850.07	12,850.07	14,206.04	15,635.82	15,701.97	15,019.96	16,447.52	17,022.19	14,510.54	13,224.10	9,176.62	7,031.36	6,066.02	5,735.48	5,406.31	5,258.70
NF_3	32.61	32.61	32.61	32.61	43.48	76.09	201.09	192.55	171.06	188.13	315.27	285.77	294.81	371.48	416.10	486.04
Total (without LULUCF)	1,269,901.03	1,269,901.03	1,284,360.85	1,296,213.01	1,292,021.18	1,353,190.92	1,374,714.90	1,387,772.01	1,379,898.48	1,331,447.76	1,354,848.93	1,374,626.42	1,348,960.21	1,372,841.48	1,379,555.00	1,370,990.94
Total (with LULUCF)	1,204,584.25	1,204,584.25	1,211,002.71	1,219,432.22	1,211,949.32	1,273,395.04	1,295,511.11	1,304,395.91	1,295,506.88	1,246,912.74	1,271,167.38	1,289,944.83	1,263,714.76	1,285,838.01	1,281,803.77	1,276,793.90
Total (without LULUCF, with indirect)	1,275,449.45	1,275,449.45	1,289,732.69	1,301,310.43	1,296,897.44	1,358,056.76	1,379,482.41	1,392,569.43	1,384,529.96	1,335,691.21	1,359,087.41	1,378,932.21	1,352,817.54	1,376,440.79	1,383,004.40	1,374,350.14
Total (with LULUCF, with indirect)	1,210,132.67	1,210,132.67	1,216,374.55	1,224,529.64	1,216,825.58	1,278,260.88	1,300,278.62	1,309,193.34	1,300,138.36	1,251,156.18	1,275,405.85	1,294,250.62	1,267,572.09	1,289,437.32	1,285,253.17	1,280,153.10

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	kt CO_2 eq															
1. Energy	1,091,891.77	1,091,891.77	1,102,277.91	1,110,362.52	1,104,411.14	1,155,387.46	1,167,440.93	1,178,892.95	1,173,497.26	1,139,333.12	1,175,883.96	1,197,822.00	1,185,562.24	1,217,206.36	1,226,081.18	1,221,889.42
2. Industrial processes and product use	110,970.50	110,970.50	115,469.26	117,301.70	119,488.28	127,026.91	137,224.97	139,412.29	136,454.43	123,697.83	111,057.99	109,148.10	98,125.26	91,229.05	89,815.25	86,440.15
3. Agriculture	37,479.41	37,479.41	37,090.40	37,858.99	37,845.39	37,982.11	37,076.48	36,288.83	36,356.98	35,233.24	35,286.05	35,299.54	34,582.17	34,764.75	34,335.42	34,202.71
4. Land Use, Land-Use Change and Forestryb	-65,316.79	-65,316.79	-73,358.14	-76,780.79	-80,071.86	-79,795.88	-79,203.79	-83,376.09	-84,391.60	-84,535.03	-83,681.55	-84,681.59	-85,245.45	-87,003.47	-97,751.23	-94,197.04
5. Waste	29,559.36	29,559.36	29,523.28	30,689.80	30,276.37	32,794.44	32,972.51	33,177.94	33,589.81	33,183.57	32,620.93	32,356.78	30,690.53	29,641.31	29,323.16	28,458.66
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (including LULUCF)	1,204,584.25	1,204,584.25	1,211,002.71	1,219,432.22	1,211,949.32	1,273,395.04	1,295,511.11	1,304,395.91	1,295,506.88	1,246,912.74	1,271,167.38	1,289,944.83	1,263,714.76	1,285,838.01	1,281,803.77	1,276,793.90

GREENHOUSE GAS EMISSIONS	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year (%)
	kt CO_2 eq																
CO_2 emissions without net CO_2 from LULUCF	1,290,599.51	1,267,623.96	1,303,362.03	1,232,480.69	1,163,375.13	1,215,058.10	1,265,034.86	1,306,182.51	1,315,568.70	1,264,413.25	1,223,605.16	1,203,888.21	1,188,358.95	1,143,411.91	1,106,015.49	1,042,224.02	-10.01
CO_2 emissions with net CO_2 from LULUCF	1,201,607.55	1,183,295.30	1,223,467.82	1,163,383.77	1,097,414.47	1,144,896.01	1,196,746.41	1,235,802.34	1,252,338.20	1,203,184.76	1,166,886.38	1,151,341.57	1,131,725.98	1,087,445.53	1,054,778.52	989,933.20	-9.39
CH_4 emissions without CH_4 from LULUCF	34,738.43	34,230.29	33,659.32	32,910.58	32,409.66	31,982.73	30,782.92	30,140.56	30,093.95	29,598.39	29,255.59	29,211.69	29,021.96	28,654.80	28,474.35	28,394.07	-35.55
CH_4 emissions with CH_4 from LULUCF	34,826.40	34,309.54	33,737.81	33,011.73	32,494.97	32,061.36	30,861.96	30,213.85	30,168.40	29,691.23	29,331.12	29,281.06	29,112.84	28,724.39	28,546.09	28,462.83	-35.55
N_2O emissions without N_2O from LULUCF	25,488.60	25,361.32	24,800.38	23,907.90	23,327.15	22,841.25	22,450.60	22,088.70	22,049.05	21,612.58	21,315.09	20,803.94	21,062.87	20,607.07	20,252.09	19,986.94	-38.23
N_2O emissions with N_2O from LULUCF	25,693.28	25,563.53	25,001.33	24,109.32	23,525.68	23,037.64	22,648.83	22,287.58	22,248.41	21,814.36	21,516.03	21,005.68	21,268.80	20,814.49	20,462.27	20,198.56	-38.05
HFCs	12,783.62	14,631.32	16,715.61	19,299.40	20,942.66	23,326.51	26,118.68	29,376.67	32,120.72	35,801.15	39,280.55	42,641.97	44,954.22	47,043.41	49,732.59	51,725.38	224.66
PFCs	8,637.44	9,012.90	7,930.85	5,757.38	4,057.37	4,259.43	3,765.32	3,444.92	3,286.27	3,362.66	3,308.10	3,375.33	3,515.59	3,487.45	3,422.60	3,474.54	-46.87
Unspecified mix of HFCs and PFCs																	
SF_6	5,027.35	5,202.39	4,708.04	4,150.90	2,419.75	2,398.14	2,222.14	2,207.27	2,075.25	2,038.86	2,075.11	2,158.27	2,070.75	2,054.94	2,001.03	2,028.31	-84.22
NF_3	1,471.75	1,401.31	1,586.80	1,481.04	1,354.16	1,539.74	1,800.38	1,511.85	1,617.24	1,122.87	571.03	634.44	449.78	282.50	261.47	288.83	785.70
Total (without LULUCF)	1,378,746.70	1,357,463.49	1,392,763.03	1,319,987.89	1,247,885.88	1,301,405.90	1,352,174.89	1,394,952.48	1,406,811.18	1,357,949.77	1,319,410.64	1,302,713.83	1,289,434.12	1,245,542.08	1,210,159.62	1,148,122.08	-9.59
Total (with LULUCF)	1,290,047.40	1,273,416.28	1,313,148.27	1,251,193.54	1,182,209.07	1,231,518.83	1,284,163.72	1,324,844.48	1,343,854.48	1,297,015.89	1,262,968.32	1,250,438.30	1,233,097.96	1,189,852.73	1,159,204.58	1,096,111.66	-9.00
Total (without LULUCF, with indirect)	1,382,002.89	1,360,652.46	1,395,797.16	1,322,740.89	1,250,422.28	1,303,870.77	1,354,551.03	1,397,250.73	1,409,116.45	1,360,181.89	1,321,624.02	1,304,886.61	1,291,580.05	1,247,652.00	1,212,221.48	1,150,085.52	-9.83
Total (with LULUCF, with indirect)	1,293,303.59	1,276,605.26	1,316,182.39	1,253,946.53	1,184,745.46	1,233,983.69	1,286,539.85	1,327,142.73	1,346,159.76	1,299,248.01	1,265,181.70	1,252,611.08	1,235,243.89	1,191,962.64	1,161,266.44	1,098,075.10	-9.26

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year (%)
	kt CO_2 eq																
1. Energy	1,228,828.53	1,206,109.34	1,242,277.65	1,174,435.43	1,113,001.36	1,163,126.60	1,213,769.94	1,254,148.13	1,261,682.69	1,211,508.84	1,172,299.61	1,153,530.03	1,137,876.26	1,092,493.31	1,056,289.03	994,360.43	-8.93
2. Industrial processes and product use	87,550.28	90,451.44	89,551.89	85,119.11	77,711.87	81,014.06	82,894.49	85,394.95	89,752.96	92,349.09	93,456.45	96,509.87	99,227.71	100,245.96	101,520.91	101,390.12	-8.63
3. Agriculture	34,618.19	34,446.61	34,806.68	33,688.83	33,494.31	33,719.24	32,980.28	32,611.57	32,846.68	32,433.40	32,198.32	32,209.31	32,316.44	32,103.02	32,074.97	32,185.76	-14.12
4. Land Use, Land-Use Change and Forestryb	-88,699.30	-84,047.21	-79,614.77	-68,794.35	-65,676.82	-69,887.07	-68,011.18	-70,108.00	-62,956.69	-60,933.88	-56,442.32	-52,275.53	-56,336.16	-55,689.36	-50,955.04	-52,010.42	-20.37
5. Waste	27,749.70	26,456.10	26,126.81	26,744.53	23,678.34	23,546.00	22,530.18	22,797.83	22,528.85	21,658.44	21,456.26	20,464.62	20,013.71	20,699.80	20,274.71	20,185.77	-31.71
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (including LULUCF)	1,290,047.40	1,273,416.28	1,313,148.27	1,251,193.54	1,182,209.07	1,231,518.83	1,284,163.72	1,324,844.48	1,343,854.48	1,297,015.89	1,262,968.32	1,250,438.30	1,233,097.96	1,189,852.73	1,159,204.58	1,096,111.66	-9.00

Table A1-2 Emission trends (CO_2) (CTF Table 1(a))

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	kt															
1. Energy	1,078,855.15	1,078,855.15	1,089,330.59	1,098,142.95	1,092,616.62	1,143,586.92	1,155,359.84	1,166,947.88	1,161,575.16	1,127,777.87	1,164,261.30	1,186,296.20	1,174,320.61	1,206,832.27	1,216,001.91	1,211,948.72
A. Fuel combustion (sectoral approach)	1,078,663.47	1,078,663.47	1,089,115.45	1,097,934.74	1,092,404.99	1,143,355.72	1,154,838.29	1,166,377.10	1,160,994.74	1,127,279.16	1,163,721.89	1,185,784.57	1,173,772.37	1,206,307.66	1,215,496.13	1,211,471.59
1. Energy industries	368,529.73	368,529.73	369,427.92	374,332.73	357,045.62	391,464.95	378,904.67	381,468.84	377,451.54	364,973.32	386,943.50	395,494.06	386,561.77	413,439.23	432,549.61	430,228.40
2. Manufacturing industries and construction	349,815.66	349,815.66	346,341.48	341,232.47	342,142.54	350,936.29	357,725.89	361,032.91	357,007.85	332,293.37	336,878.93	346,941.99	341,056.75	346,617.63	344,612.34	344,067.08
3. Transport	202,140.12	202,140.12	213,934.08	220,526.07	224,286.25	233,490.67	242,797.01	249,560.89	251,337.88	249,460.67	253,558.62	253,090.59	257,239.62	253,573.25	249,533.23	243,582.05
4. Other sectors	158,177.97	158,177.97	159,411.97	161,843.47	168,930.58	167,463.81	175,410.71	174,314.45	175,197.47	180,551.80	186,340.85	190,257.93	188,914.23	192,677.55	188,800.95	193,594.06
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	191.68	191.68	215.13	208.21	211.63	231.21	521.56	570.78	580.43	498.71	539.41	511.63	548.24	524.61	505.78	477.14
1. Solid fuels	5.43	5.43	5.07	4.18	3.57	3.11	2.51	2.21	2.07	1.91	1.84	1.66	1.42	0.80	0.69	0.68
2. Oil and natural gas and other emissions from energy production	186.25	186.25	210.07	204.03	208.06	228.10	519.05	568.57	578.36	496.80	537.57	509.97	546.82	523.81	505.09	476.45
C. CO2 transport and storage	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE
2. Industrial processes	65,645.02	65,645.02	66,882.68	66,795.00	65,487.73	67,171.37	67,514.06	68,105.41	65,518.91	59,447.12	59,782.10	60,316.18	59,000.33	56,399.26	55,579.16	55,566.56
A. Mineral industry	49,230.45	49,230.45	50,548.37	50,964.27	50,252.45	51,265.73	51,145.78	51,489.50	48,840.19	43,863.25	43,579.97	43,918.61	42,970.48	40,482.92	40,145.77	39,819.62
B. Chemical industry	7,040.80	7,040.80	7,009.57	6,825.87	6,388.58	6,806.57	7,013.95	7,068.24	7,061.22	6,419.86	6,937.71	6,810.34	6,346.78	6,249.73	6,051.87	6,134.88
C. Metal industry	7,269.33	7,269.33	7,122.01	6,830.80	6,693.30	6,706.01	6,905.93	6,934.20	6,905.17	6,617.66	6,550.95	6,841.86	6,876.99	6,736.41	6,515.15	6,651.20
D. Non-energy products from fuels and solvent use	2,039.82	2,039.82	2,135.93	2,108.69	2,093.72	2,325.96	2,376.55	2,533.61	2,625.98	2,459.62	2,623.91	2,658.70	2,727.25	2,849.53	2,780.16	2,873.74
E. Electronic industry																
F. Product uses as ODS substitutes																
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	64.61	64.61	66.80	65.37	59.68	67.10	71.85	79.85	86.36	86.74	89.57	86.67	78.83	80.66	86.20	87.13
3. Agriculture	608.88	608.88	547.88	493.01	523.52	342.54	359.13	349.62	371.50	376.93	370.29	442.53	367.68	408.14	430.19	402.22
A. Enteric fermentation																
B. Manure management																
C. Rice cultivation																
D. Agricultural soils																
E. Prescribed burning of savannas																
F. Field burning of agricultural residues																
G. Liming	550.24	550.24	527.37	477.14	481.58	292.76	303.53	292.74	303.65	300.00	293.57	332.90	247.35	269.92	246.40	236.30
H. Urea application	58.64	58.64	20.51	15.87	41.94	49.79	55.60	56.88	67.85	76.93	76.73	109.63	120.34	138.22	183.79	165.92
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	-65,667.01	-65,667.01	-73,700.76	-77,116.46	-80,427.33	-80,138.65	-79,529.12	-83,720.06	-84,737.64	-84,847.75	-83,985.59	-84,986.53	-85,553.62	-87,319.59	-98,043.12	-94,495.92
A. Forest land	-79,061.29	-79,061.29	-86,217.56	-86,568.25	-86,915.84	-87,260.76	-87,606.29	-91,277.99	-91,118.26	-90,957.26	-90,797.37	-90,636.97	-90,478.52	-90,317.76	-99,039.71	-98,525.20
B. Cropland	8,957.84	8,957.84	7,916.10	4,269.98	2,572.10	3,293.01	3,923.74	3,098.58	3,930.42	5,091.99	4,981.82	4,027.51	3,551.22	3,038.15	1,477.76	4,455.33
C. Grassland	658.76	658.76	335.93	-540.84	-1,035.18	-656.28	60.84	-618.79	-1,089.84	-1,032.69	-1,336.45	-896.08	-828.92	-791.72	-1,212.76	-621.75
D. Wetlands	90.51	90.51	80.78	253.95	141.00	116.70	358.71	636.99	120.79	484.28	456.25	426.31	387.08	94.99	62.83	56.47
E. Settlements	2,872.53	2,872.53	3,482.93	3,882.56	2,359.46	1,478.46	1,293.12	627.81	391.57	251.10	-96.52	-426.38	-641.05	-1,266.46	-1,367.90	-1,383.03
F. Other land	1,264.65	1,264.65	1,387.44	1,127.19	1,360.65	1,231.96	1,039.92	942.21	1,225.90	924.67	1,012.70	753.84	789.30	754.71	627.02	643.13
G. Harvested wood products	-450.02	-450.02	-686.38	458.95	1,090.48	1,658.27	1,400.84	2,871.13	1,801.78	390.17	1,793.99	1,765.23	1,667.27	1,168.49	1,409.64	879.13
H. Other	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA
5. Waste	13,020.38	13,020.38	13,016.57	14,073.36	13,859.44	16,412.70	16,676.37	17,044.14	17,673.78	17,648.00	17,421.91	17,539.74	16,299.92	15,722.62	15,680.57	15,159.16
A. Solid waste disposal	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE
B. Biological treatment of solid waste																
C. Incineration and open burning of waste	12,317.55	12,317.55	12,330.12	13,374.46	13,178.69	15,710.78	16,008.54	16,403.67	17,018.55	17,038.88	16,769.34	16,883.83	15,669.39	15,145.58	15,164.05	14,652.46
D. Waste water treatment and discharge																
E. Other	702.83	702.83	686.45	698.90	680.75	701.91	667.83	640.47	655.23	609.12	652.58	655.91	630.53	577.05	516.53	506.70
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items:																
International bunkers	30,648.25	30,648.25	32,396.42	32,756.82	34,704.57	35,873.60	37,918.27	30,844.20	35,283.04	37,151.91	35,832.05	36,274.76	33,191.18	36,273.50	37,066.48	38,595.40
Aviation	13,189.32	13,189.32	13,919.12	14,216.76	13,856.19	15,066.49	16,922.99	18,441.91	19,134.37	20,001.55	19,576.46	19,542.61	18,721.34	21,149.32	20,387.64	21,190.20
Navigation	17,458.93	17,458.93	18,477.30	18,540.06	20,848.38	20,807.11	20,995.27	12,402.30	16,148.67	17,150.36	16,255.59	16,732.15	14,469.83	15,124.18	16,678.84	17,405.20
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 emissions from biomass	35,628.86	35,628.86	36,370.67	36,135.95	35,470.72	36,011.77	37,480.39	38,046.00	39,238.53	38,102.97	39,447.04	41,140.96	39,625.60	42,224.13	44,600.07	46,929.73
CO2 captured	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.04
Long-term storage of C in waste disposal sites	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Indirect N2O																
Indirect CO2 (3)	5,548.42	5,548.42	5,371.85	5,097.42	4,876.26	4,865.84	4,767.51	4,797.42	4,631.48	4,243.45	4,238.48	4,305.79	3,857.34	3,599.31	3,449.41	3,359.19
Total CO2 equivalent emissions without land use, land-use change and forestry	1,158,129.44	1,158,129.44	1,169,777.72	1,179,504.32	1,172,487.31	1,227,513.53	1,239,909.40	1,252,447.05	1,245,139.36	1,205,249.92	1,241,835.60	1,264,594.66	1,249,988.54	1,279,362.30	1,287,691.83	1,283,076.66
Total CO2 equivalent emissions with land use, land-use change and forestry	1,092,462.43	1,092,462.43	1,096,076.95	1,102,387.86	1,092,059.98	1,147,374.88	1,160,380.28	1,168,726.99	1,160,401.72	1,120,402.18	1,157,850.02	1,179,608.12	1,164,434.91	1,192,042.71	1,189,648.71	1,188,580.74
Total CO2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	1,163,677.86	1,163,677.86	1,175,149.56	1,184,601.73	1,177,363.57	1,232,379.37	1,244,676.91	1,257,244.47	1,249,770.84	1,209,493.37	1,246,074.08	1,268,900.44	1,253,845.88	1,282,961.61	1,291,141.24	1,286,435.86
Total CO2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	1,098,010.84	1,098,010.84	1,101,448.80	1,107,485.27	1,096,936.24	1,152,240.72	1,165,147.79	1,173,524.41	1,165,033.20	1,124,645.62	1,162,088.49	1,183,913.91	1,168,292.25	1,195,642.02	1,193,098.12	1,191,939.94

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
	kt																(%)
1. Energy	1,218,823.64	1,196,284.28	1,232,481.70	1,164,999.53	1,104,001.53	1,154,272.85	1,205,209.62	1,245,609.72	1,253,198.82	1,203,150.31	1,163,883.02	1,145,178.62	1,129,235.96	1,084,216.26	1,048,518.91	986,959.10	-8.52
A. Fuel combustion (sectoral approach)	1,218,315.84	1,195,731.14	1,231,866.03	1,164,434.34	1,103,500.66	1,153,798.28	1,204,732.12	1,245,119.43	1,252,760.16	1,202,701.21	1,163,458.29	1,144,721.49	1,128,799.86	1,083,792.85	1,048,149.93	986,614.57	-8.53
1. Energy industries	449,664.28	440,696.55	490,937.27	471,726.09	441,425.71	473,846.07	534,789.94	581,480.87	583,474.36	553,351.82	527,290.93	522,504.97	508,551.78	471,310.43	449,002.10	436,334.02	18.40
2. Manufacturing industries and construction	334,557.41	332,062.00	330,282.23	301,246.78	284,312.78	301,070.04	300,078.09	299,832.99	304,850.75	297,267.97	288,072.50	274,255.22	269,955.13	267,449.36	259,988.10	233,833.88	-33.16
3. Transport	238,065.17	235,338.11	232,541.03	224,864.80	221,558.79	221,968.63	217,137.95	218,004.15	215,114.76	210,149.13	208,875.30	207,065.85	205,252.65	203,016.26	198,579.09	177,642.74	-12.12
4. Other sectors	196,028.97	187,634.48	178,105.50	166,596.67	156,203.38	156,913.54	152,726.14	145,801.41	149,320.29	141,932.29	139,219.56	140,895.45	145,040.31	142,016.80	140,580.65	138,803.94	-12.25
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	507.81	553.15	615.67	565.20	500.87	474.57	477.50	490.29	438.66	449.10	424.73	457.13	436.10	423.41	368.98	344.53	79.74
1. Solid fuels	0.65	0.63	0.59	0.56	0.56	0.54	0.53	0.52	0.51	0.51	0.50	0.50	0.51	0.45	0.43	0.42	-92.19
2. Oil and natural gas and other emissions from energy production	507.16	552.52	615.09	564.63	500.32	474.03	476.97	489.77	438.15	448.59	424.23	456.63	435.60	422.96	368.55	344.10	84.75
C. CO2 transport and storage	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NE,NO	NE,NO	NO,NE	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE	0.00
2. Industrial processes	56,650.29	57,006.14	56,217.39	51,839.42	46,267.98	47,348.31	47,157.15	47,207.77	48,989.37	48,374.96	46,973.82	46,552.01	47,175.03	46,461.40	45,121.47	42,748.43	-34.88
A. Mineral industry	41,230.07	41,196.76	40,204.20	37,435.96	32,779.39	32,752.23	33,089.34	33,629.28	35,003.54	34,730.79	33,659.06	33,533.50	33,970.64	33,644.91	32,481.03	31,217.21	-36.59
B. Chemical industry	5,794.68	5,874.79	5,966.43	5,107.12	4,872.00	5,427.02	5,103.21	4,652.17	4,786.89	4,683.43	4,590.71	4,300.11	4,484.99	4,220.13	4,347.79	3,671.11	-47.86
C. Metal industry	6,670.49	6,768.25	6,913.09	6,445.93	5,679.94	6,343.77	6,175.83	6,275.75	6,420.50	6,343.31	6,140.84	6,028.90	5,919.37	5,833.21	5,631.67	5,429.70	-25.31
D. Non-energy products from fuels and solvent use	2,864.82	3,078.55	3,046.96	2,777.92	2,864.47	2,748.50	2,700.66	2,550.67	2,684.91	2,526.84	2,486.47	2,582.54	2,689.39	2,657.81	2,561.14	2,343.67	14.90
E. Electronic industry																	
F. Product uses as ODS substitutes																	
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	90.23	87.80	86.71	72.49	72.19	76.79	88.12	99.91	93.53	90.60	96.74	106.95	110.64	105.33	99.84	86.73	34.23
3. Agriculture	410.56	383.48	500.08	439.98	390.10	402.94	414.65	520.16	577.77	551.50	459.40	445.82	486.35	434.76	435.08	425.36	-30.14
A. Enteric fermentation																	
B. Manure management																	
C. Rice cultivation																	
D. Agricultural soils																	
E. Prescribed burning of savannas																	
F. Field burning of agricultural residues																	
G. Liming	231.29	230.36	325.00	305.74	270.15	242.88	246.78	369.97	379.58	362.50	258.75	253.01	293.54	241.96	242.27	232.56	-57.74
H. Urea application	179.27	153.12	175.08	134.24	119.95	160.06	167.88	150.19	198.19	188.99	200.65	192.81	192.81	192.81	192.81	192.81	228.78
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land Use, Land-Use Change and Forestry	-88,991.96	-84,328.66	-79,894.21	-69,096.93	-65,960.67	-70,162.09	-68,288.46	-70,380.18	-63,230.50	-61,228.49	-56,718.78	-52,546.64	-56,632.97	-55,966.37	-51,236.96	-52,290.82	-20.37
A. Forest land	-92,636.04	-86,787.14	-85,529.35	-80,718.62	-75,837.18	-76,344.51	-78,085.38	-77,653.24	-69,967.89	-68,257.90	-63,088.47	-58,544.72	-60,835.48	-59,238.21	-55,243.21	-57,139.48	-27.73
B. Cropland	3,946.97	2,698.82	6,081.82	11,443.20	8,685.12	5,876.22	6,874.89	6,568.83	5,488.39	6,208.36	5,710.35	5,457.45	4,561.11	3,968.82	4,659.72	4,657.20	-48.01
C. Grassland	-283.77	-62.25	-364.61	-81.23	427.38	179.28	776.40	796.06	1,095.96	1,707.48	1,371.88	1,078.12	830.64	591.69	686.95	550.57	-16.42
D. Wetlands	46.54	46.55	82.03	93.20	119.02	112.40	61.63	71.16	23.61	23.67	74.59	74.74	30.70	30.67	26.74	26.89	-70.29
E. Settlements	-936.09	-923.53	-210.75	52.34	-294.87	-381.53	-770.62	-531.78	-423.12	-266.48	151.70	240.23	33.49	131.53	106.24	177.75	-93.81
F. Other land	253.41	219.93	356.58	386.08	314.25	294.55	411.77	316.16	248.12	254.70	270.94	280.61	236.72	289.40	246.68	243.36	-80.76
G. Harvested wood products	617.03	478.97	-309.93	-271.88	625.62	101.50	2,442.87	52.63	304.43	-898.31	-1,209.77	-1,133.06	-1,490.14	-1,740.28	-1,720.07	-807.10	79.35
H. Other	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	14,715.01	13,950.06	14,162.87	15,201.77	12,715.52	13,034.01	12,253.44	12,844.87	12,802.74	12,336.48	12,288.93	11,711.75	11,461.61	12,299.49	11,940.03	12,091.12	-7.14
A. Solid waste disposal	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NE,NO	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
B. Biological treatment of solid waste																	
C. Incineration and open burning of waste	14,208.20	13,427.70	13,601.67	14,671.36	12,201.83	12,507.09	11,729.32	12,316.76	12,198.05	11,719.45	11,663.99	11,092.92	10,824.99	11,626.11	11,357.55	11,490.55	-6.71
D. Waste water treatment and discharge																	
E. Other	506.81	522.36	561.20	530.41	513.69	526.91	524.13	528.10	604.69	617.03	624.93	618.83	636.62	673.37	582.48	600.58	-14.55
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items:																	
International bunkers	40,883.54	38,383.50	36,650.20	34,259.78	30,233.94	30,732.99	31,095.50	32,027.88	32,993.64	31,706.36	33,495.03	35,007.84	35,105.03	36,483.10	36,591.39	24,743.83	-19.27
Aviation	21,336.33	19,964.61	18,358.58	17,517.99	15,372.73	16,295.33	18,249.69	19,140.10	19,498.79	19,024.56	19,138.76	20,051.86	21,057.34	21,667.40	21,709.25	8,319.92	-36.92
Navigation	19,547.22	18,418.88	18,291.61	16,741.79	14,861.21	14,437.66	12,845.81	12,887.78	13,494.86	12,681.80	14,356.28	14,955.98	14,047.69	14,815.69	14,882.14	16,423.92	-5.93
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CO2 emissions from biomass	51,776.11	53,122.02	55,953.40	53,321.07	50,388.60	53,858.09	53,126.54	53,845.90	54,844.53	54,906.98	55,402.65	55,630.82	60,739.41	61,454.62	65,925.40	64,513.23	81.07
CO2 captured	0.00	0.36	0.37	NO	NO	NO	NO	NO	NO	NO	NO	29.22	126.80	79.58	64.51	NO	0.00
Long-term storage of C in waste disposal sites	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
Indirect N2O																	
Indirect CO2 (3)	3,256.19	3,188.98	3,034.13	2,753.00	2,536.39	2,464.87	2,376.13	2,298.24	2,305.27	2,232.12	2,213.38	2,172.78	2,145.93	2,109.92	2,061.86	1,963.44	-64.61
Total CO2 equivalent emissions without land use, land-use change and forestry	1,290,599.51	1,267,623.96	1,303,362.03	1,232,480.69	1,163,375.13	1,215,058.10	1,265,034.86	1,306,182.51	1,315,568.70	1,264,413.25	1,223,605.16	1,203,888.21	1,188,358.95	1,143,411.91	1,106,015.49	1,042,224.02	-10.01
Total CO2 equivalent emissions with land use, land-use change and forestry	1,201,607.55	1,183,295.30	1,223,467.82	1,163,383.77	1,097,414.47	1,144,896.01	1,196,746.41	1,235,802.34	1,252,338.20	1,203,184.76	1,166,886.38	1,151,341.57	1,131,725.98	1,087,445.53	1,054,778.52	989,933.20	-9.39
Total CO2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	1,293,855.70	1,270,812.93	1,306,396.16	1,235,233.69	1,165,911.53	1,217,522.97	1,267,410.99	1,308,480.76	1,317,873.97	1,266,645.38	1,225,818.54	1,206,060.98	1,190,504.88	1,145,521.82	1,108,077.35	1,044,187.46	-10.27
Total CO2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	1,204,863.74	1,186,484.28	1,226,501.95	1,166,136.77	1,099,950.86	1,147,360.88	1,199,122.54	1,238,100.58	1,254,643.47	1,205,416.89	1,169,099.75	1,153,514.35	1,133,871.91	1,089,555.45	1,056,840.38	991,896.64	-9.66

Table A1-3 Emission trends (CH_4) (CTF Table 1(b))

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	kt															
1. Energy	258.26	258.26	244.26	210.30	188.34	178.53	166.15	153.12	143.92	135.36	132.90	127.82	115.89	93.30	91.47	95.32
A. Fuel combustion (sectoral approach)	53.96	53.96	53.78	53.34	54.06	53.86	55.24	55.57	52.49	50.44	50.32	50.93	48.29	48.59	49.38	54.15
1. Energy industries	18.37	18.37	17.82	16.55	16.48	16.10	16.01	15.71	13.20	12.37	12.24	10.53	8.36	8.21	8.21	9.27
2. Manufacturing industries and construction	14.39	14.39	14.29	14.19	14.37	14.76	15.14	15.84	15.15	13.69	13.33	14.82	14.36	15.23	16.62	17.42
3. Transport	11.65	11.65	11.94	12.09	11.95	12.08	12.36	12.63	12.75	12.55	12.55	12.48	12.25	11.86	11.27	10.54
4. Other sectors	9.55	9.55	9.73	10.50	11.26	10.92	11.73	11.39	11.39	11.83	12.20	13.10	13.33	13.29	13.28	16.91
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	204.30	204.30	190.48	156.96	134.28	124.67	110.91	97.55	91.44	84.92	82.58	76.89	67.60	44.72	42.08	41.18
1. Solid fuels	195.79	195.79	181.42	147.90	124.91	115.14	100.79	87.40	80.91	74.59	72.15	65.98	56.78	33.13	30.23	28.98
2. Oil and natural gas and other emissions from energy production	8.51	8.51	9.06	9.07	9.37	9.52	10.12	10.14	10.53	10.33	10.42	10.91	10.82	11.58	11.86	12.20
C. CO_2 transport and storage																
2. Industrial processes	2.42	2.42	2.33	2.20	2.09	2.23	2.34	2.22	2.20	2.10	2.08	2.17	2.07	2.11	2.01	2.15
A. Mineral industry																
B. Chemical industry	1.50	1.50	1.46	1.35	1.29	1.40	1.48	1.35	1.33	1.34	1.31	1.37	1.32	1.32	1.22	1.34
C. Metal industry	0.92	0.92	0.87	0.85	0.80	0.83	0.85	0.87	0.87	0.77	0.77	0.80	0.75	0.79	0.79	0.81
D. Non-energy products from fuels and solvent use	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE
E. Electronic industry																
F. Product uses as ODS substitutes																
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	1,000.34	1,000.34	994.01	1,029.63	1,026.75	1,048.10	1,027.44	1,004.04	1,009.85	969.15	973.07	967.96	950.33	956.03	937.82	937.86
A. Enteric fermentation	376.92	376.92	384.40	386.98	382.86	376.97	372.74	368.72	367.08	364.69	362.93	358.65	360.54	358.00	354.04	346.75
B. Manure management	133.18	133.18	133.90	133.80	130.97	127.40	126.58	125.63	124.31	122.34	121.24	118.45	117.70	117.26	115.47	112.64
C. Rice cultivation	485.17	485.17	471.02	503.99	508.50	539.10	523.68	505.36	514.25	478.09	484.96	487.02	468.28	477.09	464.80	475.09
D. Agricultural soils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	5.08	5.08	4.69	4.86	4.41	4.63	4.44	4.33	4.21	4.02	3.94	3.84	3.81	3.69	3.51	3.38
G. Liming																
H. Urea application																
I. Other carbon-containing fertilizers																
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry	4.21	4.21	4.03	3.87	4.71	4.34	3.86	4.75	4.98	3.81	3.52	3.61	3.78	4.13	3.32	3.69
A. Forest land	0.40	0.40	0.30	0.21	1.14	0.84	0.41	1.35	1.63	0.51	0.25	0.37	0.59	0.97	0.19	0.57
B. Cropland	1.95	1.95	1.93	1.91	1.90	1.88	1.87	1.85	1.84	1.82	1.82	1.81	1.79	1.78	1.77	1.75
C. Grassland	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
D. Wetlands	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE	NO,NA, NE
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products																
H. Other	1.26	1.26	1.21	1.16	1.09	1.03	0.99	0.95	0.92	0.89	0.87	0.84	0.80	0.79	0.77	0.76
5. Waste	501.32	501.32	497.58	496.26	488.37	481.63	470.83	460.13	447.84	433.19	419.89	407.17	393.39	380.13	366.65	352.24
A. Solid waste disposal	380.39	380.39	377.66	377.27	371.43	367.03	357.51	348.34	337.63	325.11	313.14	301.94	290.92	279.62	267.89	255.29
B. Biological treatment of solid waste	2.16	2.16	2.14	2.14	2.15	2.13	2.14	2.14	2.15	2.14	2.15	2.16	2.18	2.77	3.26	3.36
C. Incineration and open burning of waste	1.11	1.11	1.09	1.11	1.11	1.16	1.18	1.20	1.00	0.95	0.94	0.82	0.67	0.97	0.83	0.75
D. Waste water treatment and discharge	117.66	117.66	116.69	115.74	113.69	111.30	110.00	108.45	107.06	104.98	103.66	102.25	99.62	96.78	94.66	92.84
E. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total CH_4 emissions without CH_4 from LULUCF	1,762.35	1,762.35	1,738.18	1,738.39	1,705.54	1,710.48	1,666.75	1,619.51	1,603.81	1,539.80	1,527.94	1,505.12	1,461.68	1,431.58	1,397.94	1,387.57
Total CH_4 emissions with CH_4 from LULUCF	1,766.56	1,766.56	1,742.21	1,742.26	1,710.26	1,714.82	1,670.61	1,624.25	1,608.79	1,543.61	1,531.46	1,508.73	1,465.46	1,435.72	1,401.27	1,391.26
Memo items:																
International bunkers	1.75	1.75	1.85	1.85	2.08	2.08	2.11	1.31	1.67	1.77	1.68	1.73	1.50	1.59	1.73	1.80
Aviation	0.09	0.09	0.10	0.10	0.10	0.11	0.12	0.13	0.14	0.14	0.14	0.14	0.13	0.15	0.14	0.15
Navigation	1.65	1.65	1.75	1.75	1.98	1.97	1.99	1.17	1.53	1.63	1.54	1.59	1.37	1.44	1.58	1.65
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass																
CO_2 captured																
Long-term storage of C in waste disposal sites																
Indirect N_2O																
Indirect CO_2																

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
	kt																(%)
1. Energy	98.36	100.36	100.45	97.67	92.69	94.27	81.86	81.89	78.34	77.40	78.42	82.32	85.35	81.08	78.75	77.74	-69.90
A. Fuel combustion (sectoral approach)	57.33	59.28	59.93	58.44	54.64	57.46	45.86	46.60	44.42	43.90	45.80	49.35	51.99	50.53	49.73	50.07	-7.21
1. Energy industries	9.94	10.50	10.68	10.82	10.31	10.79	11.60	12.02	9.57	9.00	11.07	14.16	15.60	14.96	14.19	16.07	-12.53
2. Manufacturing industries and construction	17.68	18.82	20.35	20.24	19.94	21.52	17.55	18.58	19.82	20.74	21.04	21.59	22.53	22.70	22.71	21.50	49.37
3. Transport	9.88	9.25	8.68	7.89	7.33	6.97	6.63	6.38	6.03	5.70	5.47	5.29	5.09	4.94	4.75	4.22	-63.82
4. Other sectors	19.83	20.70	20.21	19.49	17.05	18.20	10.09	9.63	9.01	8.46	8.22	8.31	8.77	7.93	8.07	8.29	-13.18
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
B. Fugitive emissions from fuels	41.02	41.09	40.52	39.23	38.06	36.81	35.99	35.29	33.92	33.51	32.62	32.97	33.36	30.55	29.02	27.67	-86.46
1. Solid fuels	28.15	27.54	25.90	24.95	24.48	23.99	23.40	23.08	22.59	22.78	21.95	21.61	22.18	19.95	19.11	18.76	-90.42
2. Oil and natural gas and other emissions from energy production	12.88	13.54	14.63	14.28	13.57	12.82	12.59	12.21	11.33	10.73	10.67	11.37	11.18	10.60	9.91	8.91	4.73
C. CO_2 transport and storage																	
2. Industrial processes	2.15	2.18	2.04	1.99	2.05	2.16	2.15	1.85	1.85	1.72	1.94	1.73	1.71	1.62	1.65	1.52	-37.06
A. Mineral industry																	
B. Chemical industry	1.35	1.37	1.21	1.27	1.43	1.45	1.43	1.13	1.13	1.01	1.27	1.07	1.01	0.91	1.00	0.95	-36.40
C. Metal industry	0.80	0.82	0.82	0.72	0.62	0.71	0.72	0.72	0.73	0.71	0.67	0.66	0.70	0.71	0.65	0.57	-38.12
D. Non-energy products from fuels and solvent use	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	0.00
E. Electronic industry																	
F. Product uses as ODS substitutes																	
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
3. Agriculture	950.15	942.99	934.57	922.60	923.85	919.96	895.80	881.01	892.59	884.00	877.77	881.61	880.28	877.00	878.92	883.53	-11.68
A. Enteric fermentation	346.03	345.05	346.93	343.47	339.19	328.08	326.17	318.13	309.47	301.74	301.36	299.23	299.77	298.60	302.53	305.32	-19.00
B. Manure management	112.05	109.40	107.31	105.36	103.82	101.48	101.30	99.62	97.12	95.40	95.28	93.74	94.21	94.24	95.00	95.48	-28.31
C. Rice cultivation	488.64	485.21	477.10	470.65	477.81	487.45	465.42	460.44	483.11	484.06	478.44	485.96	483.73	481.57	478.81	480.18	-1.03
D. Agricultural soils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
F. Field burning of agricultural residues	3.43	3.32	3.23	3.11	3.02	2.94	2.91	2.83	2.88	2.80	2.68	2.68	2.58	2.60	2.57	2.56	-49.66
G. Liming																	
H. Urea application																	
I. Other carbon-containing fertilizers																	
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land use, land-use change and forestry	3.52	3.17	3.14	4.05	3.41	3.15	3.16	2.93	2.98	3.71	3.02	2.77	3.64	2.78	2.87	2.75	-34.66
A. Forest land	0.43	0.12	0.10	1.02	0.41	0.20	0.25	0.08	0.16	0.91	0.24	0.05	0.93	0.10	0.20	0.10	-74.03
B. Cropland	1.75	1.73	1.72	1.71	1.70	1.69	1.67	1.65	1.64	1.62	1.60	1.59	1.58	1.57	1.56	1.55	-20.75
C. Grassland	0.59	0.58	0.59	0.59	0.61	0.59	0.61	0.61	0.60	0.62	0.62	0.59	0.59	0.59	0.59	0.59	0.12
D. Wetlands	NO,NA,NE	NO,NA,NE	NO,NA,NE	NO,NA,NE	NO,NA,NE	NO,NA,NE	NO,NA,NE	NO,NA,NE	NO,NA,NE	NE,NA,NO	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	0.00
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Harvested wood products																	
H. Other	0.75	0.74	0.73	0.72	0.69	0.67	0.63	0.59	0.58	0.56	0.55	0.54	0.53	0.53	0.52	0.51	-59.89
5. Waste	338.88	323.68	309.32	294.17	277.79	262.92	251.51	240.87	230.97	220.82	212.10	202.81	193.54	186.49	179.66	172.96	-65.50
A. Solid waste disposal	243.18	230.67	218.94	205.33	193.15	180.61	170.67	162.15	154.04	145.24	137.64	129.75	123.62	117.36	111.69	106.17	-72.09
B. Biological treatment of solid waste	3.82	3.94	3.81	4.28	4.24	3.71	4.09	4.05	4.01	4.00	4.07	4.12	3.59	3.56	3.29	3.27	51.41
C. Incineration and open burning of waste	0.70	0.65	0.60	0.57	0.51	0.46	0.43	0.45	0.48	0.41	0.41	0.37	0.41	0.42	0.40	0.41	-63.04
D. Waste water treatment and discharge	91.18	88.42	85.97	83.99	79.90	78.15	76.32	74.22	72.45	71.17	69.98	68.57	65.93	65.14	64.29	63.12	-46.36
E. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total CH_4 emissions without CH_4 from LULUCF	1,389.54	1,369.21	1,346.37	1,316.42	1,296.39	1,279.31	1,231.32	1,205.62	1,203.76	1,183.94	1,170.22	1,168.47	1,160.88	1,146.19	1,138.97	1,135.76	-35.55
Total CH_4 emissions with CH_4 from LULUCF	1,393.06	1,372.38	1,349.51	1,320.47	1,299.80	1,282.45	1,234.48	1,208.55	1,206.74	1,187.65	1,173.24	1,171.24	1,164.51	1,148.98	1,141.84	1,138.51	-35.55
Memo items:																	
International bunkers	2.01	1.89	1.86	1.71	1.52	1.48	1.35	1.36	1.35	1.26	1.42	1.48	1.40	1.48	1.48	1.53	-12.34
Aviation	0.15	0.14	0.13	0.12	0.11	0.12	0.13	0.14	0.13	0.13	0.13	0.14	0.14	0.15	0.15	0.06	-38.62
Navigation	1.86	1.75	1.73	1.59	1.41	1.37	1.22	1.22	1.21	1.13	1.29	1.34	1.26	1.33	1.33	1.47	-10.86
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CO_2 emissions from biomass																	
CO_2 captured																	
Long-term storage of C in waste disposal sites																	
Indirect N_2O																	
Indirect CO_2																	

Table A1-4 Emission trends (N_2O) (CTF Table 1(c))

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	kt															
1. Energy	22.08	22.08	22.96	23.36	23.78	24.62	26.60	27.24	27.93	27.42	27.85	27.95	28.00	26.98	26.15	25.36
A. Fuel combustion (sectoral approach)	22.07	22.07	22.95	23.36	23.77	24.61	26.59	27.23	27.93	27.41	27.85	27.95	28.00	26.98	26.15	25.36
1. Energy industries	2.98	2.98	3.05	3.02	3.14	3.32	4.54	4.69	4.86	4.88	5.23	5.41	6.00	6.16	6.30	6.34
2. Manufacturing industries and construction	4.23	4.23	4.48	4.62	4.98	5.42	5.73	5.93	6.26	5.99	6.13	6.30	6.27	6.33	6.27	6.32
3. Transport	12.55	12.55	13.02	13.27	13.16	13.40	13.77	14.02	14.16	13.83	13.76	13.41	12.86	12.03	11.16	10.23
4. Other sectors	2.31	2.31	2.40	2.44	2.49	2.48	2.55	2.59	2.65	2.72	2.73	2.82	2.86	2.46	2.42	2.47
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
1. Solid fuels	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
2. Oil and natural gas and other emissions from energy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. CO_2 transport and storage																
2. Industrial processes	33.26	33.26	31.65	31.54	30.64	34.26	33.94	37.31	39.33	34.99	14.16	22.55	11.27	10.81	10.97	11.49
A. Mineral industry																
B. Chemical industry	32.28	32.28	30.44	30.14	29.24	32.76	32.43	35.84	37.91	33.66	12.86	21.30	10.02	9.55	9.69	10.27
C. Metal industry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Non-energy products from fuels and solvent use	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE
E. Electronic industry																
F. Product uses as ODS substitutes																
G. Other product manufacture and use	0.98	0.98	1.21	1.40	1.40	1.49	1.51	1.46	1.42	1.33	1.29	1.25	1.25	1.26	1.27	1.22
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	39.81	39.81	39.24	39.01	39.10	38.38	37.02	36.37	36.04	35.66	35.53	35.77	35.09	35.09	35.10	34.75
A. Enteric fermentation																
B. Manure management	14.14	14.14	14.19	14.15	13.92	13.60	13.31	13.12	13.08	12.90	12.82	12.92	12.92	13.04	13.19	13.22
C. Rice cultivation																
D. Agricultural soils	25.53	25.53	24.92	24.74	25.07	24.66	23.60	23.14	22.85	22.66	22.61	22.75	22.07	21.95	21.82	21.44
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	0.13	0.13	0.12	0.13	0.11	0.12	0.12	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.09	0.09
G. Liming																
H. Urea application																
I. Other carbon containing fertlizers																
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry	0.82	0.82	0.81	0.80	0.80	0.79	0.77	0.76	0.74	0.73	0.72	0.72	0.72	0.71	0.70	0.69
A. Forest land	0.40	0.40	0.40	0.40	0.41	0.41	0.41	0.41	0.42	0.41	0.41	0.41	0.41	0.41	0.41	0.41
B. Cropland	0.10	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.04
C. Grassland	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
D. Wetlands	NO,NA, NE,IE	NO,NA, NE,IE	NO,NA, NE,IE	NO,NA, NE,IE	NO,NA, NE,IE	NO,NA, NE,IE	NO,NA, NE,IE	NO,NA, NE,IE	NO,NA, NE,IE	NO,NA, NE,IE	NO,NA, NE,IE	NO,NA, NE,IE	NO,NA, NE,IE	NO,NA, NE,IE	NO,NA, NE,IE	NO,NA, NE,IE
E. Settlements	NO,NA, IE	NO,NA, IE	NO,NA, IE	NO,NA, IE	NO,NA, IE	NO,NA, IE	NO,NA, IE	NO,NA, IE	NO,NA, IE	NO,NA, IE	NO,NA, IE	NO,NA, IE	NO,NA, IE	NO,NA, IE	NO,NA, IE	NO,NA, IE
F. Other land	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05
G. Harvested wood products																
H. Other	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
5. Waste	13.44	13.44	13.65	14.13	14.12	14.57	15.19	15.54	15.84	15.79	15.78	15.56	15.29	14.82	15.02	15.08
A. Solid waste disposal																
B. Biological treatment of solid waste	0.61	0.61	0.60	0.60	0.60	0.60	0.60	0.60	0.61	0.60	0.60	0.61	0.61	0.78	0.92	0.94
C. Incineration and open burning of waste	4.83	4.83	4.96	5.41	5.41	5.94	6.40	6.81	7.05	7.06	7.30	7.23	7.00	6.41	6.40	6.37
D. Waste water treatment and discharge	8.01	8.01	8.09	8.12	8.11	8.03	8.18	8.13	8.19	8.13	7.87	7.72	7.67	7.63	7.70	7.76
E. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total direct N_2O emissions without N_2O from LULUCF	108.59	108.59	107.49	108.04	107.64	111.83	112.75	116.45	119.14	113.87	93.32	101.83	89.65	87.70	87.24	86.67
Total direct N_2O emissions with N_2O from LULUCF	109.41	109.41	108.31	108.84	108.44	112.61	113.51	117.21	119.89	114.60	94.05	102.55	90.36	88.42	87.94	87.37
Memo items:																
International bunkers	0.85	0.85	0.89	0.90	0.96	0.99	1.05	0.86	0.98	1.03	0.99	1.01	0.92	1.01	1.03	1.07
Aviation	0.37	0.37	0.39	0.40	0.39	0.43	0.48	0.52	0.54	0.57	0.55	0.55	0.53	0.60	0.58	0.60
Navigation	0.47	0.47	0.50	0.50	0.57	0.56	0.57	0.34	0.44	0.47	0.44	0.45	0.39	0.41	0.45	0.47
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass																
CO_2 captured																
Long-term storage of C in waste disposal sites																
Indirect N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indirect CO_2																

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
	kt																(%)
1. Energy	25.32	24.55	24.45	23.47	22.42	21.80	21.86	21.78	21.90	21.56	21.66	21.12	21.83	20.97	19.47	18.31	-17.06
A. Fuel combustion (sectoral approach)	25.32	24.55	24.44	23.47	22.42	21.80	21.86	21.78	21.89	21.55	21.66	21.12	21.83	20.97	19.47	18.31	-17.04
1. Energy industries	7.10	7.09	7.27	7.14	6.99	6.95	7.61	7.68	7.91	7.88	8.01	7.57	8.20	7.60	6.31	6.25	109.39
2. Manufacturing industries and construction	6.27	6.14	6.37	6.17	5.92	5.79	5.77	5.83	5.91	5.78	5.82	5.61	5.61	5.52	5.38	4.97	17.60
3. Transport	9.45	8.85	8.41	7.89	7.34	6.89	6.55	6.29	6.05	5.87	5.77	5.68	5.64	5.58	5.47	4.87	-61.19
4. Other sectors	2.49	2.46	2.40	2.27	2.17	2.17	1.93	1.97	2.02	2.03	2.06	2.26	2.39	2.28	2.30	2.22	-3.97
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
B. Fugitive emissions from fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-73.69
1. Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-76.28
2. Oil and natural gas and other emissions from energy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-26.42
C. CO_2 transport and storage																	
2. Industrial processes	9.82	10.55	7.86	8.53	8.79	7.01	5.96	5.37	5.43	5.39	4.02	3.71	3.42	2.94	3.16	3.65	-89.04
A. Mineral industry																	
B. Chemical industry	8.58	9.22	6.73	7.53	7.92	6.08	5.06	4.34	4.22	3.28	2.68	2.27	2.01	1.70	1.85	2.22	-93.11
C. Metal industry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
D. Non-energy products from fuels and solvent use	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	0.00
E. Electronic industry																	
F. Product uses as ODS substitutes																	
G. Other product manufacture and use	1.23	1.33	1.13	1.00	0.87	0.92	0.91	1.03	1.20	2.10	1.35	1.44	1.41	1.24	1.31	1.42	45.76
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
3. Agriculture	35.08	35.20	36.72	34.17	33.58	34.62	34.13	33.78	33.40	32.83	32.87	32.63	32.96	32.70	32.44	32.46	-18.46
A. Enteric fermentation																	
B. Manure management	13.61	13.93	14.22	14.38	14.58	14.34	14.21	13.87	13.32	12.98	12.86	12.77	12.93	12.78	12.82	12.90	-8.80
C. Rice cultivation																	
D. Agricultural soils	21.38	21.18	22.42	19.71	18.92	20.21	19.84	19.84	20.00	19.77	19.94	19.79	19.97	19.85	19.55	19.49	-23.65
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
F. Field burning of agricultural residues	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	-49.66
G. Liming																	
H. Urea application																	
I. Other carbon containing fertlizers																	
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land use, land-use change and forestry	0.69	0.68	0.67	0.68	0.67	0.66	0.67	0.67	0.67	0.68	0.67	0.68	0.69	0.70	0.71	0.71	-13.62
A. Forest land	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.42	0.42	0.42	0.44	0.44	0.44	0.44	9.34
B. Cropland	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	-65.31
C. Grassland	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-0.65
D. Wetlands	NO,NA,NE,IE	NO,NA,NE,IE	NO,NA,NE,IE	NO,NA,NE,IE	NO,NA,NE,IE	NO,NA,NE,IE	NO,NA,NE,IE	NO,NA,NE,IE	NO,NA,NE,IE	NE,NA,NO,IE	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	0.00
E. Settlements	NO,NA,IE	NO,NA,IE	NO,NA,IE	NO,NA,IE	NO,NA,IE	NO,NA,IE	NO,NA,IE	NO,NA,IE	NO,NA,IE	NA,NO,IE	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	0.00
F. Other land	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.03	0.03	0.03	-55.51
G. Harvested wood products																	
H. Other	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-59.89
5. Waste	15.31	14.81	14.20	14.06	13.48	13.22	13.39	13.19	13.26	12.76	12.97	12.36	12.46	12.54	12.90	12.65	-5.88
A. Solid waste disposal																	
B. Biological treatment of solid waste	1.07	1.11	1.07	1.20	1.19	1.04	1.15	1.14	1.12	1.12	1.14	1.15	1.00	0.99	0.92	0.91	50.48
C. Incineration and open burning of waste	6.59	6.19	5.69	5.46	5.27	5.08	5.09	5.11	5.15	4.77	5.03	4.40	4.78	4.88	4.94	4.72	-2.09
D. Waste water treatment and discharge	7.65	7.52	7.44	7.39	7.03	7.10	7.14	6.94	6.99	6.86	6.80	6.80	6.69	6.68	7.03	7.02	-12.42
E. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total direct N_2O emissions without N_2O from LULUCF	85.53	85.11	83.22	80.23	78.28	76.65	75.34	74.12	73.99	72.53	71.53	69.81	70.68	69.15	67.96	67.07	-38.23
Total direct N_2O emissions with N_2O from LULUCF	86.22	85.78	83.90	80.90	78.95	77.31	76.00	74.79	74.66	73.20	72.20	70.49	71.37	69.85	68.67	67.78	-38.05
Memo items:																	
International bunkers	1.13	1.07	1.02	0.95	0.84	0.85	0.86	0.89	0.88	0.85	0.90	0.94	0.94	0.98	0.98	0.65	-23.12
Aviation	0.60	0.57	0.52	0.50	0.44	0.46	0.52	0.54	0.54	0.52	0.53	0.55	0.58	0.60	0.60	0.23	-38.62
Navigation	0.53	0.50	0.50	0.45	0.40	0.39	0.35	0.35	0.35	0.32	0.37	0.38	0.36	0.38	0.38	0.42	-10.86
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CO_2 emissions from biomass																	
CO_2 captured																	
Long-term storage of C in waste disposal sites																	
Indirect N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
Indirect CO_2																	

Table A1-5 Emission trends (HFCs, PFCs, SF_6 and NF_3) (CTF Table 1(d))

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	kt															
	22,471.61	22,471.61	24,856.54	25,384.52	29,071.82	34,495.10	42,889.82	42,919.27	44,477.84	40,357.65	37,513.44	34,740.84	29,354.16	25,447.75	25,095.90	21,651.78
Emissions of HFCs - (kt CO_2 equivalent)	15,932.31	15,932.31	17,349.61	17,767.22	18,129.02	21,051.64	25,212.86	24,597.77	24,436.43	23,741.69	24,367.38	22,850.63	19,460.88	16,234.18	16,227.35	12,421.07
HFC-23	1.08	1.08	1.17	1.19	1.13	1.24	1.45	1.33	1.26	1.18	1.21	1.06	0.80	0.52	0.43	0.09
HFC-32	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00	0.01	0.02	0.05	0.08	0.14	0.21
HFC-41	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
HFC-43-10mee	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA
HFC-125	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00	0.01	0.02	0.05	0.08	0.14	0.22
HFC-134	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
HFC-134a	0.00	0.00	NO,IE,NA	0.08	0.63	1.30	2.01	2.79	3.49	3.87	4.05	4.31	4.38	4.61	4.76	4.32
HFC-143	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
HFC-143a	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-152	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
HFC-152a	0.00	0.00	NO,NA	0.00	0.01	0.01	0.01	0.01	0.00	NO,NA	NO,NA	0.02	0.08	0.16	0.40	0.84
HFC-161	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
HFC-227ea	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.04
HFC-236cb	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
HFC-236ea	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
HFC-236fa	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
HFC-245ca	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
HFC-245fa	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	0.19
HFC-365mfc	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	0.00	0.08
Unspecified mix of HFCs - (kt CO_2 equivalent)	2.24	2.24	NO,IE,NA	67.54	440.93	768.60	876.60	877.75	854.74	763.92	705.37	899.09	1,141.08	1,510.75	2,356.16	3,542.91
Emissions of PFCs - (kt CO_2 equivalent)	6,539.30	6,539.30	7,506.92	7,617.29	10,942.80	13,443.46	17,676.95	18,321.50	20,041.41	16,615.96	13,146.06	11,890.21	9,893.28	9,213.57	8,868.55	9,230.71
CF_4	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00
C_2F_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_3F_8	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA
C_4F_{10}	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
$c\text{-}C_4F_8$	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA
C_5F_{12}	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
C_6F_{14}	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00	0.00	0.00
C10F18	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
c-C3F6	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
Unspecified mix of PFCs - (kt CO_2 equivalent)	6,335.64	6,335.64	7,336.00	7,502.73	10,837.28	13,338.18	17,506.37	18,160.35	19,896.03	16,495.12	13,074.82	11,846.70	9,855.58	9,177.57	8,831.96	9,194.74
Unspecified mix of HFCs and PFCs - (kt CO_2 equivalent)																
Emissions of SF_6 - (kt CO_2 equivalent)	12,850.07	12,850.07	14,206.04	15,635.82	15,701.97	15,019.96	16,447.52	17,022.19	14,510.54	13,224.10	9,176.62	7,031.36	6,066.02	5,735.48	5,406.31	5,258.70
SF_6	0.56	0.56	0.62	0.69	0.69	0.66	0.72	0.75	0.64	0.58	0.40	0.31	0.27	0.25	0.24	0.23
Emissions of NF_3 - (kt CO_2 equivalent)	32.61	32.61	32.61	32.61	43.48	76.09	201.09	192.55	171.06	188.13	315.27	285.77	294.81	371.48	416.10	486.04
NF_3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
	kt																(%)
	21,421.05	23,644.22	24,646.46	25,056.78	25,000.04	27,585.94	29,883.99	32,821.58	35,406.99	39,163.81	42,588.66	46,017.30	48,469.81	50,530.86	53,155.19	55,199.92	145.64
Emissions of HFCs - (kt CO_2 equivalent)	12,783.62	14,631.32	16,715.61	19,299.40	20,942.66	23,326.51	26,118.68	29,376.67	32,120.72	35,801.15	39,280.55	42,641.97	44,954.22	47,043.41	49,732.59	51,725.38	224.66
HFC-23	0.04	0.06	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	-99.07
HFC-32	0.30	0.39	0.49	0.61	0.72	0.84	1.01	1.20	1.41	1.68	2.00	2.32	2.61	2.88	3.17	3.47	100.00
HFC-41	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
HFC-43-10mee	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	NO,NE,IE,NA	0.00
HFC-125	0.30	0.40	0.50	0.62	0.74	0.86	1.04	1.23	1.40	1.58	1.75	1.89	1.99	2.03	2.10	2.13	100.00
HFC-134	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
HFC-134a	3.59	2.91	2.84	2.85	2.83	2.78	2.64	2.63	2.64	2.59	2.54	2.48	2.45	2.32	2.28	2.24	239,294.71
HFC-143	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
HFC-143a	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.06	100.00
HFC-152	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
HFC-152a	1.22	1.41	1.44	1.68	1.58	1.30	1.26	0.99	0.68	0.52	0.42	0.37	0.39	0.33	0.23	0.10	268,150.00
HFC-161	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
HFC-227ea	0.05	0.04	0.04	0.05	0.04	0.03	0.03	0.03	0.03	0.02	0.03	0.04	0.04	0.05	0.05	0.06	100.00
HFC-236cb	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
HFC-236ea	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
HFC-236fa	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
HFC-245ca	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
HFC-245fa	0.48	0.67	0.85	0.93	1.01	1.11	1.24	1.36	1.47	1.58	1.67	1.80	1.92	2.01	2.05	2.02	100.00
HFC-365mfc	0.17	0.25	0.32	0.36	0.41	0.48	0.56	0.61	0.67	0.72	0.76	0.80	0.82	0.85	0.88	0.87	100.00
Unspecified mix of HFCs - (kt CO_2 equivalent)	4,826.92	6,722.74	8,786.08	10,353.97	11,995.32	13,794.72	15,890.35	18,209.99	20,057.77	22,848.50	25,457.26	27,983.45	29,628.11	31,463.49	33,680.24	35,300.55	1,573,767.11
Emissions of PFCs - (kt CO_2 equivalent)	8,637.44	9,012.90	7,930.85	5,757.38	4,057.37	4,259.43	3,765.32	3,444.92	3,286.27	3,362.66	3,308.10	3,375.33	3,515.59	3,487.45	3,422.60	3,474.54	-46.87
CF_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	0.00
C_2F_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	0.00
C_3F_8	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	0.00
C_4F_{10}	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
$c\text{-}C_4F_8$	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	NO,IE,NA	0.00
C_5F_{12}	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
C_6F_{14}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NO,NA	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	100.00
C10F18	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
c-C3F6	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
Unspecified mix of PFCs - (kt CO_2 equivalent)	8,601.30	8,976.33	7,893.84	5,719.50	4,027.52	4,229.93	3,734.27	3,423.06	3,260.11	3,350.51	3,300.28	3,354.52	3,496.06	3,448.18	3,374.09	3,418.07	-46.05
Unspecified mix of HFCs and PFCs - (kt CO_2 equivalent)	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
Emissions of SF_6 - (kt CO_2 equivalent)	5,027.35	5,202.39	4,708.04	4,150.90	2,419.75	2,398.14	2,222.14	2,207.27	2,075.25	2,038.86	2,075.11	2,158.27	2,070.75	2,054.94	2,001.03	2,028.31	-84.22
SF_6	0.22	0.23	0.21	0.18	0.11	0.11	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	-84.22
Emissions of NF_3 - (kt CO_2 equivalent)	1,471.75	1,401.31	1,586.80	1,481.04	1,354.16	1,539.74	1,800.38	1,511.85	1,617.24	1,122.87	571.03	634.44	449.78	282.50	261.47	288.83	785.70
NF_3	0.09	0.08	0.09	0.09	0.08	0.09	0.10	0.09	0.09	0.07	0.03	0.04	0.03	0.02	0.02	0.02	785.70

Annex I Chapter 2

Quantified Economy-Wide Emission Reduction Targets

This chapter provides information on Japan's quantified economy-wide emission reduction targets.

2.1 Emission reduction target for 2020

Japan's greenhouse gas emission reduction and removal target is a 3.8% or more emission reduction in fiscal year (FY) 2020 compared to the FY 2005 level. This target was resubmitted to the UNFCCC secretariat on May 13, 2016.

For the LULUCF sector, Japan will use net removals by LULUCF activities in accordance with the accounting rule under the second commitment period of the Kyoto Protocol by continually implementing the necessary policies and measures. Of them, the targets for the amount of net removals by forest carbon sinks and revegetation are to ensure approximately 38 Mt CO_2 or more and 1.2 Mt CO_2, respectively. The amount of net removals by carbon sinks in agricultural soils from cropland management and grazing land management is estimated at approximately 7.7 Mt CO_2.

Japan establishes and implements the Joint Crediting Mechanism (JCM) in order both to appropriately evaluate contributions from Japan to GHG emission reductions or removals in a quantitative manner achieved through the diffusion of low carbon technologies, products, systems, services, and infrastructure, as well as implementation of mitigation actions in developing countries, and to use them to achieve Japan's emission reduction target.

The details of Japan's emission reduction target for 2020 are the following.

[Base year] (CTF Table 2(a))

Base year	FY 2005
Emission reduction target	3.8% or more of base year
Period for reaching target	FY 2020

[Gases, sectors covered and GWP] (CTF Table 2(b), (c))

Gases covered	Base year for each gas	GWP values
CO_2	FY 2005	IPCC Fourth Assessment Report (AR4)
CH_4	FY 2005	IPCC Fourth Assessment Report (AR4)
N_2O	FY 2005	IPCC Fourth Assessment Report (AR4)
HFCs	Calendar Year (CY) 2005	IPCC Fourth Assessment Report (AR4)
PFCs	CY 2005	IPCC Fourth Assessment Report (AR4)
SF_6	CY 2005	IPCC Fourth Assessment Report (AR4)
NF_3	CY 2005	IPCC Fourth Assessment Report (AR4)

Sector covered	Energy Transport Industrial Processes Agriculture LULUCF Waste

[Approach to counting emissions and removals from the LULUCF sector] (CTF Table 2(d))

LULUCF in base year level and target	Base year: Excluded Target year: Included	The GHG emission level of the base year is calculated based on the national total GHG emissions without LULUCF in FY 2005. The GHG emission level in the target year (FY 2020) consists of the national total GHG emissions without LULUCF and the LULUCF contribution calculated based on the LULUCF accounting approach explained below. (This is the same reporting approach under the Kyoto Protocol)
Contribution of LULUCF is calculated using	Activity-based approach The LULUCF contribution is the net removals by specific LULUCF activities accounted in accordance with the LULUCF rule and modality under the second commitment period of the Kyoto Protocol. For forest carbon sinks (contains Afforestation/Reforestation, Deforestation and Forest Management [FM] activities), the contribution is the annual average of net removals accounted for the period of FY 2013-2020, from the lands where activities have been implemented since FY1990 (For FM activities, the upper limit of removals equivalent to 3.5% of total GHG emissions (excluding LULUCF) in 1990 is applied based on the LULUCF rule for the second commitment period of the Kyoto Protocol.). These lands are identified in line with the IPCC 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (KPSG). The FMRL is set as zero with the narrow approach[74] adopted for the FM land, and technical correction to the FMRL constructed from the historical trend of HWP emissions and removals is applied. Carbon sinks in agricultural soils from cropland management, grazing land management, and revegetation are accounted based on the net-net approach comparing with the net emissions and/or removals in the reference year (FY 1990) and the target year (FY 2020).	

[Market based mechanisms] (CTF Table 2(e)I, II)

Possible scale of contributions of market-based mechanisms under the Convention (Estimated ktCO_2 eq.)	CERs	0
	ERUs	0
	AAUs	0
	Carry-Over units	0
	Other mechanism units under the Convention	0
Possible scale of contributions of other market-based mechanisms (Estimated ktCO_2 eq.)	JCM	0

[Other information] (CTF Table 2(f))

Other information	–

[74] The narrow approach is one of the methods to assume the contribution of net emissions and removals resulted from mitigation actions. In this approach, human induced contribution of forest removals is assumed not from the removals of a whole managed forest but from forests where forest management practices have been implemented since the specific year.

2.2 Emission reduction target for 2030 (Nationally Determined Contribution (NDC))

2.2.1 Japan's emission reduction target for 2030

Japan's GHG emission reduction target under the Paris Agreement is a reduction of 46% in fiscal year (FY) 2030 from its FY 2013 levels, setting an ambitious target that is aligned with the long-term goal of achieving net zero by 2050. Furthermore, Japan will continue strenuous efforts in its challenge to meet the lofty goal of cutting its emissions by 50%. This target was submitted to the UNFCCC on October 22, 2021, as the update of Japan's Nationally Determined Contribution (NDC).[75]

Table A2-1 Targets and estimates by greenhouse gases and other classifications[*1]

(Unit : Mt-CO_2)

	Targets and estimates in FY 2030[*1]	FY 2013
Greenhouse gas emissions and removals	760	1,408
Energy-related CO_2	677	1,235
Industry	289	463
Commercial and others	116	238
Residential	70	208
Transport	146	224
Energy conversion*[2]	56	106
Non-energy-related CO_2	70.0	82.3
Methane (CH_4)	26.7	30.0
Nitrous oxide (N_2O)	17.8	21.4
Four gases incl. alternative CFC[*3]	21.8	39.1
Hydrofluorocarbons (HFCs)	14.5	32.1
Perfluorocarbons (PFCs)	4.2	3.3
Sulfur hexafluoride (SF_6)	2.7	2.1
Nitrogen trifluoride (NF_3)	0.5	1.6
Greenhouse gas removals	-47.7	–
Joint Crediting Mechanism (JCM)	Japan aims to contribute to international emission reductions and removals at the level of a cumulative total of approximately 100 Mt-CO_2 by FY 2030 through public-private collaborations. Japan will appropriately count the acquired credits to achieve its NDC.	

*1: Figures of target (or estimates in the case of energy-related CO_2).

*2: Excluding statistical discrepancy from power and heat allocation. For that reason, the total sum of the actual results by each sector is not equal to the emissions of energy-related CO_2.

*3: Figures for the four kinds of greenhouse gases of HFCs, PFCs, SF_6, and NF_3 are calendar year values.

2.2.2 Information to facilitate clarity, transparency and understanding of NDC

Information for clarity, transparency and understanding of NDC (Decision 4/CMA1 and Annex I), as referred to in Decision 1/CP.21, paragraph 28 is outlined below (For details, see Japan's NDC submitted to the UNFCCC secretariat on October 22, 2021[75]).

[75] Japan's Nationally Determined Contribution (NDC) <https://unfccc.int/sites/default/files/NDC/2022-06/JAPAN_FIRST%20NDC%20%28UPDATED%20SUBMISSION%29.pdf>

Quantifiable information on the reference point (including, as appropriate, a base year)	
Base year	FY 2013
Quantifiable information on the reference indicators in the base year and the target year	The total emissions in the base year of FY 2013 amount to 1,408 Mt-CO_2 (based on the National Greenhouse Gas Inventory Report of Japan [the GHG inventory], submitted to the UNFCCC Secretariat in April 2021 [final figures for FY 2019]). Japan aims to reduce its greenhouse gas emissions by 46%, equivalent to reducing emissions to 760 Mt-CO_2, in FY 2030 from its FY 2013 levels. Furthermore, Japan will continue strenuous efforts in its challenge to meet the lofty goal of cutting its emission by 50% from its FY 2013 levels.
Information on the circumstances under which the Party may update the values of the reference indicators	The methods of estimation and the emissions in the base year are subject to further updates, depending on, among others, the progress of future international negotiations on estimating and accounting rules, the revision of various statistical data for annually reported figures, and the review on estimation methods.
Time frames and/or periods for implementation	
Time frame and/or period for implementation	From April 1, 2021, to March 31, 2031
Whether it is a single-year or multi-year target	Single year target (FY 2030)
Scope and coverage	
Sectors	All sectors and categories (Energy [Fuel Combustion (Energy industries, Manufacturing industries and Construction, Transport, Commercial/Institutional, Residential, Agriculture/Forestry/Fishing, and Other), Fugitive emissions from fuels, CO_2 transport and storage], Industrial processes and product use, Agriculture, Land Use, Land-Use Change, and Forestry (LULUCF), Waste)
Gases	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3
Percentage of coverage	100%
Assumptions and methodological approaches, including those for estimating and accounting for anthropogenic greenhouse gas emissions and, as appropriate, removals:	
Assumptions and methodological approaches	Methods of estimations are in line with the *Guidelines for National Greenhouse Gas Inventories* prepared by the IPCC, and adopted by the COP. The metrics used for the total GHG emissions and removals (CO_2 equivalent) is the global warming potentials of a 100-year time horizon, which were presented in the *IPCC Fourth Assessment Report*. Removals by measures for forest and other carbon sinks sector are accounted for in line with approaches equivalent to those under the Kyoto Protocol. These methods of estimation are subject to change depending on the progress of future international negotiations on estimating and accounting rules.

	IPCC methodologies and metrics used for estimating anthropogenic greenhouse gas emissions and removals	Methods of estimations are in line with the Guidelines for National Greenhouse Gas Inventories prepared by the IPCC, and adopted by the COP. The metrics used for the total GHG emissions and removals (CO_2 equivalent) is the Global Warming Potentials of a 100-year time horizon which were presented in the IPCC Fourth Assessment Report. These methods of estimation are subject to change depending on the progress of future international negotiations on estimating and accounting rules.
	Approach to addressing emissions and subsequent removals from natural disturbances on managed lands	In Japan, rules to exclude emissions from natural disturbances are not applied.
	Approach used to account for emissions and removals from harvested wood products	Japan estimates emissions and removals from annual carbon stock changes of harvested wood products based on the production approach.
	Approach used to address the effects of age-class structure in forests	In Japan, removals by forests are estimated with consideration given to the difference in amounts of carbon accumulation due to age-class structure.
	The intention to use voluntary cooperation under Article 6 of the Paris Agreement	Japan will establish and implement the Joint Crediting Mechanism (JCM) in order to quantitatively evaluate contributions of Japan to greenhouse gas emission reductions and removals which are achieved through the diffusion of, among others, leading decarbonizing technologies, products, systems, services, and infrastructures as well as through the implementation of measures in developing countries and others, and in order to use such contributions to achieve Japan’s NDC. By doing so, through public-private collaborations, Japan aims to secure accumulated emission reductions and removals at the level of approximately 100 Mt-CO_2 by FY 2030. Japan will appropriately count the acquired credits to achieve its NDC. With regard to the JCM that Japan has initiated for establishment, Japan secures environmental integrity and the avoidance of double-counting in line with the international rules, including the Paris Agreement. Also, based on its experience in the JCM, Japan intends to lead international discussions, thereby contributing to the development of appropriate international rules for the use of market mechanisms. Furthermore, Japan will also make proactive efforts in the area of international cooperation to promote decarbonization and to improve resilience in developing countries and others, including from developing policies and institutional platforms to promoting sector- and city-level efforts as well as facilitating technology diffusion.

2.3 Long-term goal for 2050

On October 26, 2020, then Prime Minister Suga Yoshihide declared in his policy speech at the Diet that "by 2050 Japan will aim to reduce greenhouse gas emissions to net zero, that is, to realize a carbon-neutral, decarbonized society." Subsequently, on October 22, 2021, the Cabinet decided on the *Long-Term Strategy as a Growth Strategy Based on the Paris Agreement*, which outlines the basic approach toward net zero by 2050 and submitted it to the UNFCCC secretariat as a long-term low greenhouse gas emission development strategy under Article 4.19 of the Paris Agreement.[76]

This 2050 carbon neutrality was newly positioned as a basic principle of the *Act on Promotion of the Global Warming Countermeasures*, which was amended in May 2021.

[76] https://unfccc.int/sites/default/files/resource/Japan_LTS2021.pdf

Annex I Chapter 3

Progress in Achievement of Quantified Economy-wide Emission Reduction Targets

3.1 Mitigation actions and their effects

Information on mitigation actions to achieve the Japan's 2020 emission reduction target and 2030 emission reduction target under the Paris Agreement are reported in Chapter 3 (Policies and Measures) of Japan's NC8. Chapter 3 of NC8 presents the overall framework and basic approach for promoting global warming countermeasures in Japan, as well as an overview of each policy and measure and its progress by sector. In addition, an overview of each policy and measure, including its expected emission reductions, is reported in Table 3-3 in Chapter 3 (CTF Table 3). Furthermore, information on the assessment of the socioeconomic consequences of response measures is also included.

3.2 Progress towards quantified economy-wide emission reduction targets

The information on the estimates of emissions and removals, the use of units from the market-based mechanisms, and land use, land-use change, and forestry activities between FY 2010 and FY 2020 related to the progress in the achievement of quantified economy-wide emission reduction target of Japan is the follows.

Total GHG emissions in FY 2020 (excluding LULUCF) were 1,150 $MtCO_2$ eq. If the contribution from LULUCF activities (47.9 $MtCO_2$[77]) are taken into account, they are 1,102 $MtCO_2$ eq. which are 20.3% below compared to the emissions in the base year (FY2005) (1,382 $MtCO_2$ eq.). The reductions of emissions from the base year are over the emission reduction target for FY 2020, which is -3.8% or more compared to FY 2005, and Japan successfully achieved its emission reduction target for FY2020.

Credits acquired by the government of Japan through the Joint Crediting Mechanism (JCM) by the end of FY 2020 were not used towards the achievement of the emission reduction target for FY 2020. Of the emissions reductions realized through the JCM by FY 2020, the government of Japan has cancelled about 80 $ktCO_2$ eq.[78] of credits, which contributed to global emission reductions.

[77] The values for afforestation/reforestation and deforestation among forest sinks are the average for FY 2013-2020, the values for forest management are the upper limit of removals equivalent to 3.5% of total GHG emissions in FY 1990, and the values for agricultural soil sinks (part of cropland management and grazing land management) and promotion of urban greening (revegetation) are calculated from the difference between the net removals for FY 1990 and the FY 2020.

[78] 78,363 tonnes (as of the end of March 2022)

Table A3-1 Reporting of progress (CTF Table 4, partially changed)

	Year	Base year (FY2005)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total emissions excluding LULUCF	*(kt CO_2eq)*	1,382,003	1,303,871	1,354,551	1,397,251	1,409,116	1,360,182	1,321,624	1,304,887	1,291,580	1,247,652	1,212,221	1,150,086
Contribution from LULUCF	*(kt CO_2eq)*	NA	NA	NA	NA	-54,331	-53,569	-51,988	-50,058	-51,361	-51,143	-46,626	-47,946
Quantity of units from market based mechanisms under the Convention	*(number of units)*	0	0	0	0	0	0	0	0	0	0	0	0
	(kt CO_2eq)	0	0	0	0	0	0	0	0	0	0	0	0
Quantity of units from other market based mechanisms	*(number of units)*	0	0	0	0	0	0	0	0	0	0	0	0
	(kt CO_2eq)	0	0	0	0	0	0	0	0	0	0	0	0
Total emissions including contribution from LULUCF	*(kt CO_2eq)*	0	0	0	0	0	0	0	0	0	0	0	1,102,139
Change from the base year	*(%)*	0	0	0	0	0	0	0	0	0	0	0	**-20.3%**

Note: LULUCF contribution in FY2020 is not the value for FY2020 alone, but the value used to achieve the emission reduction target for FY2020 (the average value for FY 2013-2020 for afforestation/reforestation and deforestation; the upper limit of 3.5% of total emissions in FY 1990 for forest management; the difference of the net removals in FY2020 and in the FY1990 for cropland management, grazing land management, and revegetation). The LULUCF contribution in each year for FY 2013-2020 is based on annual accounting quantities. See footnotes in Table 3A-2 below for further details about the accounting rules applied.

Table A3-2 Further information on mitigation actions relevant to the counting of emissions and removals from the LULUCF sector in relation to activities under Article 3, Paragraphs 3 and 4, of the Kyoto Protocol (CTF Table 4(a)II, partially changed)

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	*Base year*	*Net emissions/removals*									*Accounting Parameters*	*Accounting Quantity for commitment period*	*Values used for the asessement of emission reduction target for 2020*	*Explanation*
		2013	2014	2015	2016	2017	2018	2019	2020	Total				
	(kt CO_2 eq)													
A. Article 3.3 activities														
A.1. Afforestation/reforestation		-1,478	-1,483	-1,486	-1,488	-1,465	-1,375	-1,316	-1,245	-11,336		-11,336	-1,417	Average between FY2013 and FY2020
Excluded emissions from natural disturbances		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	
Excluded subsequent removals from land subject to natural disturbances		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	
A.2. Deforestation		2,005	2,007	2,317	2,316	1,827	1,819	1,683	1,696	15,669		15,669	1,959	Average between FY2013 and FY2020
B. Article 3.4 activities														
B.1. Forest management										-370,363		-382,808		Since the total removals from forest management for FY 2013-2020 exceeded the upper limit which is 3.5% of total GHG emissions in FY1990, this value is not be used for the assessment of the achievement of the emission reduction target for FY2020.
Net emissions/removals		-51,174	-51,512	-49,255	-46,642	-46,353	-45,229	-41,259	-38,939	-370,363				
Excluded emissions from natural disturbances		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA		
Excluded subsequent removals from land subject to natural disturbances		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA		
Any debits from newly established forest (CEF-ne)		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA		
Forest management reference level (FMRL)											0			
Technical corrections to FMRL*1		1,044	1,220	1,366	1,499	1,635	1,762	1,899	2,019	12,446	1,556			Annual TC values are added in order to provide annual progress more exactly.
Forest management cap											355,669	-355,669	-44,459	Use the 3.5% upper limit of the total GHG emissions in FY1990 (Average per single year)
B.2. Carbon sinks in agricultural soils (mineral soils in Cropland management)*2	5,942	4,056	4,766	4,228	3,980	3,187	2,571	3,218	3,162	29,167		-19,147	-2,779	Difference between FY2020 and the base year (FY1990) (Net-net approach)
B.3. Carbon sinks in agricultural soils (mineral soils in Grazing land management)*2	465	861	1,450	1,171	891	714	484	625	495	6,691		4,151	30	Difference between FY2020 and the base year (FY1990) (Net-net approach)
B.4. Revegetation	-80	-1,230	-1,249	-1,270	-1,287	-1,310	-1,325	-1,350	-1,360	-10,381		-9,743	-1,280	Difference between FY2020 and the base year (FY1990) (Net-net approach)
B.5. Wetland drainage and rewetting (not elected)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	
Total: Emissions and removals of each year*3	6,327	-46,960	-46,022	-44,295	-42,232	-43,399	-43,054	-38,400	-36,191					
Total: Accounting quantity for each year*4		-54,331	-53,569	-51,988	-50,058	-51,361	-51,143	-46,626	-44,537				**-47,946**	Total of above

Note: This table is modified from CTF Table 4(a)II about the following points in order to provide the exact annual progress of LULUCF activities and the archievement of Japan's 2020 target.

*1; In CTF Table 4(a)II, only the annual average of TC to FMRL for the whole period (1,556) is shown. Annual TC value in each year is added in order to provide annual progress of FM accounted removals more exactly.

*2: In Japan's 2020 target, carbon sinks in agricultural soils cover carbon stock changes in mineral soils in CM and GM lands only. Therefore, the figures in this table are not net annual emisisons and removals from whole CM and GM reported in CTF Table 4(a)II, but those from mineral soils of GM and CM.

*3: Cumulation of annual emissions and removals in each activity. For FM, the emission reduction amount originated from the TC (= reference level of HWP) is added.

*4: Cumulation of annual accounting quantiry in each activity. The accounting quantities for AR and D are based on annual net emissions and removals. Those for FM are based on annual net removals and annual emission reduction amount originated from the TC. Those for carbon sinks in agricultural soils and revegetation are based on net-net accounting comparing the net emissions and removals in 1990 and those in each year. The FM Cap is not applied to annual accounting quantity because this is applied for the total net removals for the whole period.

Table A3-3 Information on the use of units from the market-based mechanisms (CTF Table 4(b))

Units of market based mechanisms			*Year* 2019	2020
Kyoto Protocol units	*Kyoto Protocol units*	*(number of units)*	0	0
		(kt CO_2 eq)	0	0
	AAUs	*(number of units)*	0	0
		(kt CO_2 eq)	0	0
	ERUs	*(number of units)*	0	0
		(kt CO_2 eq)	0	0
	CERs	*(number of units)*	0	0
		(kt CO_2 eq)	0	0
	tCERs	*(number of units)*	0	0
		(kt CO_2 eq)	0	0
	lCERs	*(number of units)*	0	0
		(kt CO_2 eq)	0	0
Other units	*Units from market-based mechanisms under the Convention*	*(number of units)*	0	0
		(kt CO_2 eq)	0	0
	Units from other market-based mechanisms	*(number of units)*	0	0
		(kt CO_2 eq)	0	0
	JCM	*(number of units)*	0	0
		(kt CO2eq)	0	0
Total		*(number of units)*	0	0
		(kt CO_2 eq)	0	0

Annex I Chapter 4

Projections

This chapter presents Japan's GHG emissions projections towards its emission reduction target for FY 2030.

Japan has estimated projections under *a with measures scenario*. The national total GHG emissions (excluding the net GHG removals by the LULUCF sector) in FY 2030 under a *with measures scenario* are projected to be approximately 813 Mt CO_2 eq., which is a decrease of 42% from the base year (FY 2013) of Japan's emission reduction target for FY 2030. Taking into account the projections for the GHG removals contribution of the LULUCF sector (removals by forest carbon sinks [approximately 38 Mt CO_2], carbon sinks in agricultural soils [approximately 8.5 MtCO_2], and urban greening [approximately 1.2 Mt CO_2]) and the Joint Crediting Mechanism (JCM) in FY 2030, the projected total GHG emissions for FY 2030 will be a reduction of 46% from the FY 2013. This is expected to achieve Japan's emission reduction target for FY 2030 (-46% compared to FY 2013).

Further information on Japan's emissions projections (by sector and by gas) is contained in Chapter 4 of Japan's NC8. Information on methodology of projections and changes since the previous national communication and biennial report is also contained in chapter 4 of Japan's NC8.

Table A4-1 Key assumptions on the macro frame (key parameters and assumptions) (CTF Table 5)

Key underlying assumptions		Historical											Projected	
Assumption	**Unit**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2025**	**2030**
Real GDP	trillion(2015)yen	430.86	462.18	485.62	515.13	512.06	539.41	543.48	553.17	554.55	550.13	527.39	NE	660.00
Population	thousands	123,611	125,570	126,926	127,768	128,057	127,095	126,933	126,706	126,443	126,167	126,146	NE	119,125
Household	10^3 households	41,797	44,831	48,015	51,102	53,783	56,951	57,477	58,008	58,527	59,072	59,497	NE	58,120
Crude steel production	Mt	112	100	107	113	111	104	105	105	103	98	83	NE	90
Cement production	Mt	87	92	80	70	51	54	54	55	56	53	50	NE	56
Ethylene production	Mt	5.8	6.9	7.6	7.5	7.0	6.8	6.3	6.5	6.2	6.3	6.0	NE	5.7
Paper and paperboard production	Mt	28	30	32	31	27	26	26	26	26	25	23	NE	22
Commercial floor area	10^6 m^2	1,286	1,500	1,657	1,758	1,829	1,870	1,885	1,893	1,903	1,911	1,922	NE	1,965
Passenger transport volume	10^9 passenger-km	1,295	1,385	1,417	1,409	1,348	1,394	1,414	1,437	1,454	1,438	1,067	NE	1,360
Freight transport volume	10^9 t-km	486	497	513	503	492	445	452	453	448	444	388	NE	420

- The actual values compiled from *National Accounts of Japan* (Jul.-Sep. 2022 (The 2nd preliminary)) (Cabinet Office) (GDP for FY 1990 is a reference value based on a simplified retrospective method.), *Population Estimates* (Ministry of Internal Affairs and Communications) (The data for the years the census was conducted are based on the census population.), *Counts of population, vital events and households derived from Basic Resident Registration* (Ministry of Internal Affairs and Communications), *Current Survey of Production* (Ministry of Economy, Trade and Industry), *Survey on Motor Vehicle Transport* (Ministry of Land, Infrastructure, Transport and Tourism), *Handbook of Japan's & World Energy & Economic Statistics* (The Institute of Energy Economics, Japan), and other sources.
- Projections compiled from *Economic and Fiscal Projections for Medium to Long Term Analysis* (July 2021) (Cabinet Office), *Medium projection* (National Institute of Population and Social Security Research), *Outlook for energy supply and demand in FY 2030 relevant material* (November 2021) (Agency for Natural Resources and Energy), and other sources.
- "NE" (Not Estimated) means that emissions are not estimated, and the macro frame is not set.

Table A4-2 Information on greenhouse gas projections under a *with measures* scenario (CTF Table 6(a))

	GHG emissions and removals (kt CO_2 eq)								GHG emission projections (kt CO_2 eq)	
	Base year (2013)	1990	1995	2000	2005	2010	2015	2019	2020	2030
Sector										
Energy	1,044,605.83	885,721.08	920,230.74	940,422.23	987,698.74	938,930.52	961,568.68	855,961.07	815,161.07	552,000.00
Transport	217,069.43	206,170.68	247,210.19	257,399.77	241,129.79	224,196.07	210,730.93	200,327.96	179,199.36	146,200.00
Industry/industrial processes	89,521.83	110,970.50	137,224.97	109,148.10	87,550.28	81,014.06	93,456.45	101,520.91	101,390.12	65,500.00
Agriculture	32,137.87	37,479.41	37,076.48	35,299.54	34,618.19	33,719.24	32,198.32	32,074.97	32,185.76	31,700.00
Forestry/LULUCF	-63,059.81	-65,316.79	-79,203.79	-84,681.59	-88,699.30	-69,887.07	-56,442.32	-50,955.04	-52,010.42	-39,800.00
Waste management/waste	22,553.65	29,559.36	32,972.51	32,356.78	27,749.70	23,546.00	21,456.26	20,274.71	20,185.77	15,800.00
Indirect CO_2	2,302.62	5,548.42	4,767.51	4,305.79	3,256.19	2,464.87	2,213.38	2,061.86	1,963.44	2,100.00
Gas										
CO_2 emissions including net CO_2 from LULUCF	1,252,029.23	1,092,462.43	1,160,380.28	1,179,608.12	1,201,607.55	1,144,896.01	1,166,886.38	1,054,778.52	989,933.20	704,800.00
CO_2 emissions excluding net CO_2 from LULUCF	1,315,342.66	1,158,129.44	1,239,909.40	1,264,594.66	1,290,599.51	1,215,058.10	1,223,605.16	1,106,015.49	1,042,224.02	744,900.00
CH_4 emissions including CH_4 from LULUCF	30,110.77	44,164.00	41,765.26	37,718.14	34,826.40	32,061.36	29,331.12	28,546.09	28,462.83	26,800.00
CH_4 emissions excluding CH_4 from LULUCF	30,040.85	44,058.76	41,668.85	37,627.97	34,738.43	31,982.73	29,255.59	28,474.35	28,394.07	26,700.00
N_2O emissions including N_2O from LULUCF	21,589.32	32,603.54	33,827.14	30,560.60	25,693.28	23,037.64	21,516.03	20,462.27	20,198.56	18,000.00
N_2O emissions excluding N_2O from LULUCF	21,405.62	32,358.55	33,598.22	30,345.83	25,488.60	22,841.25	21,315.09	20,252.09	19,986.94	17,800.00
HFCs	32,120.72	15,932.31	25,212.86	22,850.63	12,783.62	23,326.51	39,280.55	49,732.59	51,725.38	14,500.00
PFCs	3,286.27	6,539.30	17,676.95	11,890.21	8,637.44	4,259.43	3,308.10	3,422.60	3,474.54	4,200.00
SF_6	2,075.25	12,850.07	16,447.52	7,031.36	5,027.35	2,398.14	2,075.11	2,001.03	2,028.31	2,700.00
NF_3	1,617.24	32.61	201.09	285.77	1,471.75	1,539.74	571.03	261.47	288.83	500.00
Indirect CO_2	2,302.62	5,548.42	4,767.51	4,305.79	3,256.19	2,464.87	2,213.38	2,061.86	1,963.44	2,100.00
Total with LULUCF	1,345,131.42	1,210,132.67	1,300,278.62	1,294,250.62	1,293,303.59	1,233,983.69	1,265,181.70	1,161,266.44	1,098,075.10	774,000.00
Total without LULUCF	1,408,191.23	1,275,449.45	1,379,482.41	1,378,932.21	1,382,002.89	1,303,870.77	1,321,624.02	1,212,221.48	1,150,085.52	813,000.00

- The values for FY 2020 in the column of GHG emission projections are not projected values but actual values.
- Projected emissions of the transport sector for FY 2030 include CO_2 emissions from electricity consumption in railways that should be included in the energy sector in the national GHG inventory under the UNFCCC.
- For FY 2030, the total does not match the sum of each sector because of rounding.
- The values in the base year (2013) are those when the emission reduction target was decided (the values in the national GHG inventory submitted in FY 2021).
- The projection in FY 2030 for Forestry/LULUCF sector in this table represents the annual net removals based on the scope of the national GHG inventory, however, a part of the estimation scope is slightly different from the current national GHG inventory. This projection is different from the GHG removals contribution (approximately 47.7 Mt CO_2) set out in the NDC.
- CO_2 emissions from energy use of waste are counted in the energy sector in this table, but they are counted in the waste sector in the following chapters in accordance with the emission categories for the projections.

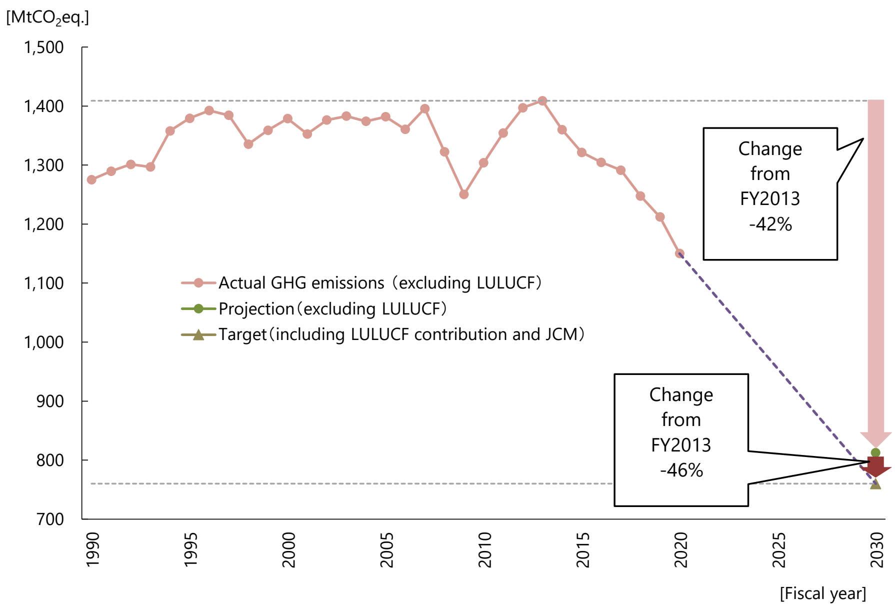


Figure A4-1 Greenhouse gas projections under a *with measures* scenario

Annex I Chapter 5

Financial, Technological and Capacity-Building Support

In this chapter, Japan reports information on financial, technical, and capacity-building support to developing countries.

Further information on financial, technical, and capacity-building support to developing countries is presented in Chapter 6 of Japan's NC8.

5.1 Finance

5.1.1 Overview

Japan has provided a variety of climate change support through multilateral and bilateral frameworks to support the implementation of the Paris Agreement by developing countries.

Under the "Actions for Cool Earth 2.0 (ACE 2.0)" announced at COP21 in 2015, Japan made a commitment to provide approximately 1.3 trillion yen per year of both public and private climate finance to developing countries in 2020. This commitment was achieved in 2020 according to Japan's latest climate finance figures.

Japan's climate change support to developing countries during the two-year period from 2019 to 2020 reached approximately 24.5 billion USD (public finance amounted to approximately 20.7 billion USD, private finance amounted to approximately 3.8 billion USD). Regarding the Green Climate Fund (GCF), Japan, in addition to its contributions of 1.5 billion USD to the GCF for initial resource mobilization (2015-2018), has committed to make contributions of up to1.5 billion USD for the First Replenishment (2020-2023) of the GCF. Based on these achievements, a new climate finance commitment from 2021 was announced by former Prime Minister Suga at the G7 Cornwall Summit in June 2021 to provide climate assistance for developing countries totaling 6.5 trillion yen in public and private over the five years from 2021 to 2025. In addition, at COP26 in November 2021, Prime Minister Kishida announced up to USD 10 billion USD over the five years from 2021 and 2025 on top of the 6.5 trillion yen announced at the G7 Cornwall Summit in order to take the initiative in fulfilling the financial gap in the annual 100 billion USD joint mobilization goal of climate finance by developed countries. Furthermore, as part of these financial commitments, Japan announced at COP26 that it would double its support for adaptation, totaling approximately 1.6 trillion yen in public and private financial support for adaptation over the five years from 2021 to 2025.

As a major developed country, Japan will continue to support actions to address climate change in developing countries by steadily implementing its financial commitments.

5.1.2 Public financial support

■ Overview

The total amount of public financial support in 2019 is approximately 1,154.9 billion yen (10.6 billion USD) with approximately 103.2 billion yen (950 million USD) through multilateral channels and approximately 1,051.7 billion yen (9.6 billion USD) through bilateral and regional channels.

The total amount of public financial support in 2020 was approximately 1,091.4 billion yen (10.2 billion USD) with approximately 99.8 billion yen (930 million USD) through multilateral channels and approximately 991.6 billion yen (9.3 billion USD) through bilateral and regional channels.

Table A5-1 Provision of public financial support: summary information in 2019 (CTF Table 7)

Allocation channels	Year									
	Japanese yen - JPY					USD				
	Core/ general	Climate-specific				Core/ general	Climate-specific			
		Mitigation	Adaptation	Cross-cutting	Other		Mitigation	Adaptation	Cross-cutting	Other
Total contributions through multilateral channels:	252,788.49	442.49	0.00	102,802.42	0.00	2,318.95	4.06	0.00	943.05	0.00
Multilateral climate change funds	23,676.67	0.00	0.00	38,083.60	0.00	217.20	0.00	0.00	349.36	0.00
Other multilateral climate change funds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral financial institutions, including regional development banks	212,123.95	0.00	0.00	61,648.11	0.00	1,945.91	0.00	0.00	565.53	0.00
Specialized United Nations bodies	16,987.88	442.49	NE	3,070.70	NE	30.98	4.06	NE	28.17	NE
Total contributions through bilateral, regional and other channels		957,543.31	90,657.82	3,452.02			8,784.00	831.65	31.67	
Total	**252,788.49**	**957,985.80**	**90,657.82**	**106,254.44**	**0.00**	**2,318.95**	**8,788.05**	**831.65**	**974.72**	**0.00**

Footnotes
The unit of JPY is "million yen" and the unit of USD is "million dollars".
The exchange rate: 109.010 JPY/USD (2019). 106.775JPY/USD(2020)

Table A5-2 Provision of public financial support: summary information in 2020 (CTF Table 7)

Allocation channels	Year									
	Japanese yen - JPY					USD				
	Core/ general	Climate-specific				Core/ general	Climate-specific			
		Mitigation	Adaptation	Cross-cutting	Other		Mitigation	Adaptation	Cross-cutting	Other
Total contributions through multilateral channels:	111,146.11	759.24	0.00	99,042.02	0.00	1,040.94	7.11	0.00	927.58	0.00
Multilateral climate change funds	23,676.67	0.00	0.00	79,355.23	0.00	221.74	0.00	0.00	743.20	0.00
Other multilateral climate change funds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral financial institutions, including regional development banks	76,839.32	320.33	0.00	18,778.55	0.00	719.64	3.00	0.00	175.87	0.00
Specialized United Nations bodies	10,630.12	438.91	NE	908.24	NE	11.37	4.11	NE	8.51	NE
Total contributions through bilateral, regional and other channels		412,712.03	536,198.30	42,653.72			3,865.71	5,022.35	399.52	
Total	**111,146.11**	**413,471.27**	**536,198.30**	**141,695.73**	**0.00**	**1,040.94**	**3,872.82**	**5,022.35**	**1,327.10**	**0.00**

Footnotes
The unit of JPY is "million yen" and the unit of USD is "million dollars".
The exchange rate: 109.010 JPY/USD (2019). 106.775JPY/USD(2020)

■ Contribution by channels

Public financial support through multilateral channels in 2019 is approximately 103.2 billion yen (950 million USD) of which approximately 38.1 billion yen (350 million USD) was provided to multilateral climate change funds, approximately 61.6 billion yen (570 million USD) to multilateral financial institutions, and approximately 3.5 billion yen (30 million USD) to specialized United Nations bodies.

Public financial support through multilateral channels in 2020 was approximately 99.8 billion yen (930 million USD) of which approximately 79.4 billion yen (740 million USD) was provided to multilateral climate change funds, approximately 19.1 billion yen (180 million USD) to multilateral financial institutions, and approximately 1.3 billion yen (10 million USD) to specialized United Nations bodies.

Table A5-3 Contribution through multilateral channels in 2019 (CTF Table 7(a))

Donor funding	Total amount				Status	Funding source	Financial instrument	Type of support	Sector
	Core/general		Climate-specific						
	Japanese yen - JPY	USD	Japanese yen - JPY	USD					
Total contributions through multilateral channels	252,788.49	2,318.95	103,244.91	947.11					
Multilateral climate change funds	23,676.67	217.20	38,083.60	349.36					
1. Global Environment Facility	23,676.67	217.20	19,651.63	180.27	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund	0.00	0.00	0.00	0.00	-	-	-	-	-
3. Special Climate Change Fund	0.00	0.00	0.00	0.00	-	-	-	-	-
4. Adaptation Fund	0.00	0.00	0.00	0.00	-	-	-	-	-
5. Green Climate Fund			18,329.41	168.14	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
6. UNFCCC Trust Fund for Supplementary Activities			102.56	0.94	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
7. Other multilateral climate change funds	0.00	0.00	0.00	0.00					
Multilateral financial institutions, including regional development banks	212,123.95	1,945.91	61,648.11	565.53					
1. World Bank	40,501.32	371.54	13,770.45	126.32	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. International Finance Corporation	0.00	0.00	0.00	0.00	-	-	-	-	-
3. African Development Bank	0.00	0.00	0.00	0.00	-	-	-	-	-
4. Asian Development Bank	0.00	0.00	0.00	0.00	-	-	-	-	-
5. European Bank for Reconstruction and Development	0.00	0.00	0.00	0.00	-	-	-	-	-
6. Inter-American Development Bank	0.00	0.00	0.00	0.00	-	-	-	-	-
7. Other	171,622.63	1,574.38	47,877.67	439.20					
(1) International Development Association	114,609.57	1,051.37	35,528.97	325.92	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(2) African Development Fund	12,878.99	118.15	4,250.07	38.99	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(3) Asian Development Fund	34,343.60	315.05	5,494.98	50.41	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(4) Inter-American Investment Corporation	795.40	7.30	174.99	1.61	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(5) Multilateral Investment Fund	8,995.07	82.52	2,428.67	22.28	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
(6) World Bank Partnership for Market Implementation	0.00	0.00	0.00	0.00	-	-	-	-	-
Specialized United Nations bodies	16,987.88	155.84	3,513.19	32.23					
1. United Nations Development Programme	7,038.23	64.57	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. United Nations Environment Programme	348.28	3.19	136.26	1.25	Disbursed	Other(ODA/OOF)	Grant	Cross-cutting	Cross-cutting
3. Other	9,601.37	88.08	3,376.93	30.98					
(1) United Nations Framework Convention on Climate Change			383.04	3.51	Disbursed	Other(ODA/OOF)	Grant	Cross-cutting	Cross-cutting
(2) Climate Technology Center Network			125.28	1.15	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
(3) Intergovernmental Panel on Climate Change			27.46	0.25	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
(4) IPCC Task Force on National Greenhouse Gas Inventories / Technical Support Unit			150.00	1.38	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
(5) The Multilateral Fund for the Implementation of the Montreal Protocol	2,659.32	24.40	141.21	1.30	Disbursed	ODA	Grant	Mitigation	Energy
(6) International Fund for Agricultural Development	6,246.27	57.30	2,248.66	20.63	Committed	ODA	Non-concessional loan	Cross-cutting	Agriculture
(7) United Nation Office for Disaster Risk Reduction	566.88	5.20	NE	NE	Disbursed	ODA	Grant	Adaptation	Cross-cutting
(8) International Renewable Energy Agency			301.28	2.76	Disbursed	Other(ODA/OOF)	Grant	Mitigation	Energy
(9) International Tropical Timber Organization	128.91	1.18	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Forestry

Abbreviations: ODA = official development assistance, OOF = other official flows.

Footnotes
The unit of JPY is "million Yen". The unit of USD is "million dollars"

(1) The exchange rate: 109.010 JPY/USD (2019). 106.775JPY/USD(2020)

(2) The climate-specific share of the core contributions is calculated based on the climate-specific imputed shares published on a year-by-year basis by the OECD Development Assistance Committee.

(3) The contribution to the Green Climate Fund in 2019 is the encashed amount of the promissory notes which were issued during the Initial Resource Mobilization period. The contribution to the Green Climate Fund in 2020 is the sum of the encashed amount of the promissory notes which were issued for the Initial Resource Mobilization and the amount of the promissory note which was issued in 2020 for the GCF-1.

(4) Values converted from Japanese Yen to USD using the exchange rate above may not match the total USD amount reported due to rounding.

Table A5-4 Contribution through multilateral channels in 2020 (CTF Table 7(a))

Donor funding	Total amount				Status	Funding source	Financial instrument	Type of support	Sector
	Core/general		Climate-specific						
	Japanese yen - JPY	USD	Japanese yen - JPY	USD					
Total contributions through multilateral channels	111,146.11	1,040.94	99,801.25	934.69					
Multilateral climate change funds	23,676.67	221.74	79,355.23	743.20					
1. Global Environment Facility	23,676.67	221.74	19,651.63	184.05	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund	0.00	0.00	0.00	0.00	-	-	-	-	-
3. Special Climate Change Fund	0.00	0.00	0.00	0.00	-	-	-	-	-
4. Adaptation Fund	0.00	0.00	0.00	0.00	-	-	-	-	-
5. Green Climate Fund			59,546.92	557.69	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
6. UNFCCC Trust Fund for Supplementary Activities			156.67	1.47	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
7. Other multilateral climate change funds	0.00	0.00	0.00	0.00					
Multilateral financial institutions, including regional development banks	76,839.32	719.64	19,098.88	178.87					
1. World Bank	0.00	0.00	0.00	0.00	-	-	-	-	-
2. International Finance Corporation	1,882.12	17.63	564.64	5.29	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
3. African Development Bank	4,883.76	45.74	1,758.15	16.47	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
4. Asian Development Bank	0.00	0.00	0.00	0.00	-	-	-	-	-
5. European Bank for Reconstruction and Development	0.00	0.00	0.00	0.00	-	-	-	-	-
6. Inter-American Development Bank	0.00	0.00	0.00	0.00	-	-	-	-	-
7. Other	70,073.44	656.27	16,776.09	157.12					
(1) International Development Association	19,132.00	179.18	6,122.24	57.34	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(2) African Development Fund	16,101.08	150.79	5,635.38	52.78	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(3) Asian Development Fund	34,343.60	321.64	4,464.67	41.81	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(4) Inter-American Investment Corporation	496.76	4.65	233.48	2.19	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(5) Multilateral Investment Fund	0.00	0.00	0.00	0.00	-	-	-	-	-
(6) World Bank Partnership for Market Implementation			320.33	3.00	Disbursed	OOF	Grant	Mitigation	Cross-cutting
Specialized United Nations bodies	10,630.12	99.56	1,347.15	12.62					
1. United Nations Development Programme	7,031.46	65.85	NE	NE	Disbursed	ODA	Grant		
2. United Nations Environment Programme	318.39	2.98	133.47	1.25	Disbursed	Other(ODA/OOF)	Grant	Cross-cutting	Cross-cutting
3. Other	3,280.27	30.72	1,213.68	11.37					
(1) United Nations Framework Convention on Climate Change			277.97	2.60	Disbursed	Other(ODA/OOF)	Grant	Cross-cutting	Cross-cutting
(2) Climate Technology Center Network			320.07	3.00	Disbursed	Other(ODA/OOF)	Grant	Cross-cutting	Cross-cutting
(3) Intergovernmental Panel on Climate Change			26.73	0.25	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
(4) IPCC Task Force on National Greenhouse Gas Inventories / Technical Support Unit			150.00	1.40	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
(5) The Multilateral Fund for the Implementation of the Montreal Protocol	2,604.79	24.40	138.31	1.30	Disbursed	ODA	Grant	Mitigation	Energy
(6) International Fund for Agricultural Development	0.00	0.00	0.00	0.00	-	-	-	-	-
(7) United Nation Office for Disaster Risk Reduction	564.64	5.29	NE	NE	Disbursed	ODA	Grant	Adaptation	Cross-cutting
(8) International Renewable Energy Agency			300.60	2.82	Disbursed	Other(ODA/OOF)	Grant	Mitigation	Energy
(9) International Tropical Timber Organization	110.83	1.04	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Forestry

Abbreviations: ODA = official development assistance, OOF = other official flows.

Footnotes
The unit of JPY is "million Yen". The unit of USD is "million dollars"

(1) The exchange rate: 109.010 JPY/USD (2019). 106.775JPY/USD(2020)

(2) The climate-specific share of the core contributions is calculated based on the climate-specific imputed shares published on a year-by-year basis by the OECD Development Assistance Committee.

(3) The contribution to the Green Climate Fund in 2019 is the encashed amount of the promissory notes which were issued during the Initial Resource Mobilization period. The contribution to the Green Climate Fund in 2020 is the sum of the encashed amount of the promissory notes which were issued for the Initial Resource Mobilization and the amount of the promissory note which was issued in 2020 for the GCF-1.

(4) Values converted from Japanese Yen to USD using the exchange rate above may not match the total USD amount reported due to rounding.

Public support through bilateral and regional channels in 2019 was approximately 1,051.7 billion yen (9.6 billion USD) of which approximately 957.5 billion yen (8.8 billion USD) was for mitigation, approximately 90.7 billion yen (830 million USD) for adaptation, and approximately 3.5 billion yen (30 million USD) for cross-cutting.

Public financial support through bilateral and regional channels in 2020 was approximately 991.6 billion yen (9.3 billion USD) of which approximately 412.7 billion yen (3.9 billion USD) was for mitigation, approximately 536.2 billion yen (5 billion USD) for adaptation, and approximately 42.7 billion yen (400 million USD) for cross-cutting.

Table A5-5 Contribution through bilateral and regional channels

	Japanese yen - JPY				USD			
	Total	Type of support			Total	Type of support		
		Mitigation	Adaptation	Cross-cutting		Mitigation	Adaptation	Cross-cutting
2019	1,051,653	957,543	90,658	3,452	9,647	8,784	832	32
2020	991,564	412,712	536,198	42,654	9,288	3,866	5,022	400

The unit of JPY is "million Yen". The unit of USD is "million dollars"

(1) The exchange rate: 109.010 JPY/USD (2019). 106.775JPY/USD(2020)

(2) Values converted from Japanese Yen to USD using the exchange rate above may not match the total USD amount reported due to rounding.

5.1.3 Mobilization of private finance

In order to further promote action on climate change, Japan has been working to establish a mechanism to leverage private investment by using public finance. Co-financing by the Japan Bank for International Cooperation (JBIC) with the private sector and trade insurance by Nippon Export and Investment Insurance (NEXI) are examples of using private finance. Private finance also plays an important role in tackling climate change as its total amount was more than 3.8 billion USD in 2019 and 2020.

Further information on financial support is presented in section 6.4 of Japan's NC8.

5.2 Technology development and transfer

Japan will contribute to solving the climate change problem all over the world through the development of technologies in the environment and energy fields (Innovation) and by taking a leadership role in the international diffusion of the technologies (Application) based on proactive diplomatic initiatives for countering global warming, which is called the Actions for Cool Earth Japan as announced in November 2013.

Japan will deepen the discussions for driving innovation through the Innovation for Cool Earth Forum (ICEF), which aims to be the global platform to promote discussions and cooperation on innovation among the worldwide academic, industrial and public sectors. Also, Japan will promote demonstration projects to create innovations for drastically redeveloping advanced low-carbon technology in accordance with the specific characteristics of developing countries. Japan will also create co-innovation projects by incorporating the needs of developing countries and the seeds provided by Japanese industries, while taking the initiative in dispatching business missions to developing countries and accelerating the collaboration of private companies and local governments on both sides. Furthermore, Japan will foster further innovation by sharing information on the dissemination of innovative technology to developing countries and its effectiveness.

Regarding the implementation of adaptation projects in developing countries, Japan will support adaptation projects based on the priorities and needs of each country, while diversifying the financial resources, including mobilization of private finance, through collaboration with Japanese cooperation organizations or governmental financial institutions, including the Japan International Cooperation Agency (JICA), JBIC, and NEXI,

Japan has been promoting the global application of existing low-carbon and decarbonizing technologies. Accelerating the diffusion of such technologies and verifying the reduction effect from the technologies through the Joint Crediting Mechanism (JCM) etc., which has implemented more than 200 GHG emission reduction projects, will realize further emission reductions of greenhouse gases and new economic growth simultaneously.

Detailed information on Japan’s projects on the provision of technology development and transfer support is shown in Table A5-6.

Further information on technology development and transfer support is presented in section 6.5 of Japan’s NC8.

Table A5-6 Information on provision of technology development and transfer support (CTF Table 8)

No.	Recipient country and/or region	Targeted area	Measures and activities related to technology transfer	Sector	Source of the funding for technology transfer	Activities undertaken by	Status	Additional information
1	Angola	Mitigation	Feasibility Study on Overseas Deployment of High-Quality Energy Infrastructure in FY2020: "Feasibility Study on Power Supply Expansion at Malembo Power Plant in Cabinda, Angola"	Energy	Public	Private and Public	Implemented	In the state of Cabinda producing 60% of Angola's crude oil, the operating rate of the state's only gas power plant has dropped significantly due to a decline in the associated gas supply following the drop in crude oil production. Therefore, a feasibility study is conducted to strengthen the power plant.
2	Bangladesh	Mitigation	Feasibility Study on Overseas Deployment of High-Quality Energy Infrastructure in FY2020: "Study on Improvement of Operational Efficiency of Thermal Power Plants in Bangladesh"	Energy	Public	Private and Public	Implemented	Study the feasibility for proposing the restoration of power output and efficiency through the rehabilitation of existing thermal power plants and the improvement of power plant operational efficiency by taking advantage of Japan's high-quality infrastructure and systems.
3	Brazil	Mitigation	Distributed Solar Power Generation System Project	Energy	Private and Public	Private and Public	Implemented	Promote the wider use of distributed solar power generation systems
4	Cambodia, Philippines	Mitigation	Development and demonstration of a model for introducing electrified vehicles to Asia by reusing key hybrid vehicle (HV) components	Transport	Private and Public	Private and Public	Implemented	Design, manufacture and demonstrate electrified vehicles by reusing key hybrid vehicle components.
5	Ecuador	Mitigation	Project for Supporting the Advancement of Energy Matrix Transition	Energy	Public	Private and Public	Planned	Promote initiatives to expand access to renewable energy and stable power supply, and for energy saving, through the implementation of the expansion and enhancement of the power transmission and distribution network and an energy saving program.
6	Eritrea	Mitigation	Feasibility Study on Overseas Deployment of High-Quality Energy Infrastructure in FY2020: "Domestic Power Supply Development Project in Eritrea"	Energy	Public	Private and Public	Implemented	Eritrea's infrastructure is aging due to the country's long conflicts, including the war of independence and border disputes with Ethiopia. This project conducts a survey on the development of power supply, which is a living infrastructure, to formulate a power supply development plan.
7	India, Indonesia, Uzbekistan, Saudi Arabia, Thailand, China, Philippines, Vietnam, Malaysia, Republic of South Africa	Mitigation	International Energy Demonstration Project	Energy	Public	Private and Public	Implemented	Contribute to solving foreign energy problems through a demonstration of Japanese technology and systems for energy conservation. Contribute to ensuring energy security by reducing energy consumption through the dissemination of technology.

No.	Recipient country and/or region	Targeted area	Measures and activities related to technology transfer	Sector	Source of the funding for technology transfer	Activities undertaken by	Status	Additional information
8	Indonesia	Mitigation	Demonstration of Low-Cost, Low-Carbon Pavement Technology Using Recycled Asphalt Waste in Indonesia	Water and sanitation	Private and Public	Private and Public	Implemented	With the aim of reducing the cost and environmental impact of road pavement construction in Indonesia, a demonstration is conducted to adapt the technology to Indonesia with the goal of promoting asphalt recycling technology.
9	Indonesia	Mitigation	Demonstration of Support for Low Carbon Transportation and Improvement of Logistics Efficiency by Improving Fuel Consumption of Trucks with the Indonesian Safety Recorder	Cross-cutting	Private and Public	Private and Public	Implemented	Jointly develop, with our Indonesian subsidiary, the technology of Data-Tech's Safety Recorder (SR), an on-board device that has a proven track record in Japan of improving fuel efficiency and accident rates through eco-driving, at a cost suitable for local use.
10	Indonesia	Mitigation	Demonstration Project on CO2 Free Autonomous Hydrogen Energy Supply System Development in Islands Area	Energy	Public	Private and Public	Implemented	In order to introduce and disseminate a self-sustaining hydrogen energy supply system (H2One ™) to remote islands in Indonesia, in this project H2One is introduced to the BPPT demonstration site and the technical demonstrations of a coordinated control with diesel generators is conducted.
11	Indonesia	Mitigation	Feasibility Study on CCS Demonstration in Gundih Gas Field in Indonesia	Energy	Public	Private and Public	Implemented	The study on Carbon dioxide Capture and Storage (CCS) in Gundih gas field, Central Java Province, Indonesia started in 2011 as a SATREPS project supported by JICA-JST. After 5 year-international joint research, the study continued under the support of Asia Development Bank (ADB) and completed the basic investigation. Based on these past study, further studies toward the CCS demonstration in Gundih gas field started in June 2020 by JANUS, J-POWER and Bandung Institute of Technology (ITB) (Hereinafter referred to as "Study Team") under the financial support of Ministry of Economy, Trade and Industry, Japan.
12	Indonesia	Mitigation	Prospective Research on JCM CCUS on South Sumatra and Central/Eastern Java in the Republic of Indonesia	Energy	Public	Private and Public	Implemented	The following items are studied: JCM CCUS related policies in Indonesia, study regarding JCM CCUS promotion in Upstream oil and gas sector in the Republic of Indonesia (Indonesia), design parameter study for CO2 pretreatment and transportation and CO2 storage monitoring.

No.	Recipient country and/or region	Targeted area	Measures and activities related to technology transfer	Sector	Source of the funding for technology transfer	Activities undertaken by	Status	Additional information
13	Indonesia	Mitigation	The business feasibility evaluation of "CO2 disposal technology from the high-concentration CO2 in natural gas and producing high value-added products"	Energy	Public	Private and Public	Implemented	It would be possible to make new policy proposals for energy that can contribute to society from a clean perspective by providing the technology we are developing. This technology can also be applied to the dispose of CO2 emitted from coal-fired power generation only with only certain adjustments. Therefore, this research conducted a research and examination of related policies, systems, and regulations toward low carbonization in line with JCM.
14	Indonesia	Mitigation	Co-benefits projects for wastewater treatment in the agricultural industry in Indonesia	Agriculture	Public	Private and Public	Implemented	Based on the Memorandum of Understanding between the Ministry of the Environment Japan and the Indonesia side (FY2015), this project aims to promote Co-benefits approach (efficiently reducing water pollutants and greenhouse gases) and others including pollution control in the agricultural and fishery industry, capacity building for the Indonesian officials.
15	Indonesia	Mitigation	Feasibility Study on Overseas Deployment of High-Quality Energy Infrastructure in FY2020: "Study on Offshore Natural Gas Power Plant and LNG Distribution Chain in Eastern Indonesia"	Energy	Public	Private and Public	Implemented	Indonesia is promoting power generation using its domestic natural gas, which is cheaper and more environmentally friendly, as an alternative to imported diesel. This project studies and promotes commercialization an offshore LNG plant and LNG delivery chain infrastructure development and operation project, taking advantage of Japan's advanced technological capabilities.
16	Indonesia	Mitigation	Feasibility Study on Overseas Deployment of High-Quality Energy Infrastructure in FY2020: "Study on Promotion of Advanced Natural Gas Utilization in Java, Indonesia"	Energy	Public	Private and Public	Implemented	The project aims to establish an integrated gas supply model in Indonesia, and to realize advanced utilization of natural gas and its widespread use in the entire Java Island. To this end, this project collects information that will help stimulate demand, and conduct a survey to localize the know-how related to energy services that contribute to stable operations and energy conservation, which is currently being conducted in Japan.
17	Indonesia	Mitigation	Feasibility Study on Overseas Deployment of High-Quality Energy Infrastructure in FY2020: "Study on Project Formation of New Hydro Power Plant in Indonesia"	Energy	Public	Private and Public	Implemented	Conduct a study to evaluate the technical, natural/social environmental, commercial, and other significant risks for promising new hydropower development sites in Indonesia and conduct a design study based on the evaluation results.

No.	Recipient country and/or region	Targeted area	Measures and activities related to technology transfer	Sector	Source of the funding for technology transfer	Activities undertaken by	Status	Additional information
18	Indonesia, Vietnam, Thailand	Mitigation	Demonstration of Combined Control of High-Performance Ventilation, Air Conditioning, and Showcases in Asian Supermarkets	Industry	Private and Public	Private and Public	Planned	Renovate and demonstrate cooperatively controlling a dehumidifying air supply device (desiccant), an indirect cooling device, an air conditioner and a showcase in supermarkets, to drastically reduce showcases and air conditioning energy
19	Kenya	Mitigation	The Project for the Improvement of Power Distribution System in and around Nakuru City and around Mombasa City	Energy	Public	Private and Public	Planned	Improvement of Power Distribution System
20	Malaysia	Mitigation	Feasibility Study of GHG Reduction by Torrefaction and Co-firing Technology on Decayed Biomass including EFB	Energy	Public	Private and Public	Implemented	Investigate appropriate measurements to produce and co-fire biomass black pellet from empty fruit bunches as agricultural residue which contribute to GHG reduction in coal-fired power plants in Malaysia. Policy proposals to support the measurements are also to be made to Malaysian governmental institutions taking into account similar policies in Japan.
21	Maldives	Mitigation	Development of a Self-Sustaining Hybrid Power Generation Control System for Small-Scale Remote Islands	Cross-cutting	Private and Public	Private and Public	Implemented	Develop hybrid control technology to expand the adoption of natural energy on remote islands where diesel power is the main source of power.
22	Mexico	Mitigation	Photovoltaic Power Generation Project in Mexico	Energy	Public	Private and Public	Implemented	Increase the supply of electricity, promote renewable energy, and diversify power sources in Mexico
23	Mexico	Mitigation	Feasibility Study on Overseas Deployment of High-Quality Energy Infrastructure in FY2020: "Feasibility Study on Renewable Energy Supply to Industrial Parks through Distributed Solar Power Generation Project in Mexico"	Energy	Public	Private and Public	Implemented	Conduct a study on the feasibility of introducing a distributed solar power generation system in an industrial park in Mexico and supplying clean power derived from renewable energy to companies in the industrial park as part of their infrastructure services.
24	Mongolia	Mitigation	Co-benefits projects for air pollution control in Mongolia	Cross-cutting	Public	Private and Public	Implemented	Based on the Memorandum of Understanding between the Ministry of the Environment Japan and the Mongolia side (FY2018), this project aims to promote Co-benefits approach (efficiently reducing air pollutants and greenhouse gases) and others including dissemination of the low-carbon Heat-Only Boiler (HOB), implementation of the on-site trainings, promoting the potential JCM projects.

No.	Recipient country and/or region	Targeted area	Measures and activities related to technology transfer	Sector	Source of the funding for technology transfer	Activities undertaken by	Status	Additional information
25	Mongolia	Mitigation	Demonstration of Hybrid Geothermal/Solar Hybrid Heat Pump System for Extremely Cold Regions	Energy	Private and Public	Private and Public	Planned	In Ulaanbaatar, an extremely cold region, a ground-source/solar heat pump system combining a ground-source heat pump and solar heat, which has been used as heating equipment in Japan and other countries, will be renovated and demonstrated as an alternative to a heating facility using coal combustion.
26	Mongolia, Palau, Mexico, Philippines, Vietnam, Thailand, Maldives, Indonesia, Chile, Ethiopia, Cambodia	Mitigation	JCM Model Project	Cross-cutting	Public	Private and Public	Planned	Financial support for projects that introduce facilities and equipment to reduce CO2 emissions. JCM credits are issued along to emission reductions realized by projects. In FY2019, 22 projects were selected.
27	Mozambique	Mitigation and Adaptation	The Project for Installation of Solar Power for Metoro Operating Theatre, Laboratory and Maternity Ward	Energy	Public	Private and Public	Implemented	Installation of solar panels and batteries for Operational theatre, Laboratory, and Maternity ward of Metoro Health Center to realize exclusive and sustainable electricity supply.
28	Multiple countries in Asia	Mitigation	JCM Pre-Demonstration Study and Demonstration Project	Energy	Public	Private and Public	Planned	Demonstration program with particular focus on advanced technologies to be demonstrated.
29	Multiple countries in Asia	Adaptation	Technical Feasibility Study	Agriculture	Public	Private and Public	Implemented	Study on feasibility of agricultural and rural development technology in Asia
30	Multiple countries in Asia	Adaptation	study on the longevity planning of agricultural water utilization facilities	Agriculture	Public	Private and Public	Implemented	Study on the longevity planning of agricultural water utilization facilities in Asia
31	Multiple countries in Asia	Adaptation	Study of Application for Advanced Technology to Irrigation and Drainage System	Agriculture	Public	Private and Public	Implemented	Study of Application for Advanced Technology to Irrigation and Drainage System in Asia
32	Myanmar	Mitigation	Infrastructure Development Project in Thilawa Area (Phase 3)	Energy	Public	Private and Public	Planned	Strengthen the electricity supply capacity of Myanmar by additionally installing the combined cycle facilities to Thilawa Thermal Power Plant.
33	Myanmar	Adaptation	Construction of two submersible bridges to improve rural road traffic during rainy season, along with holding two workshops to transfer submersible bridge technology to Myanmar engineers so that they can plan, design, build and maintain the submersible bridges.	Transport	Public	Private and Public	Implemented	Construction of two submersible bridges to improve rural road traffic during rainy season, along with holding two workshops to transfer submersible bridge technology to Myanmar engineers so that they can plan, design, build and maintain the submersible bridges.

No.	Recipient country and/or region	Targeted area	Measures and activities related to technology transfer	Sector	Source of the funding for technology transfer	Activities undertaken by	Status	Additional information
34	Myanmar	Mitigation	Feasibility Study on Overseas Deployment of High-Quality Energy Infrastructure in FY2020: "Study on Stable Electricity Supply Using Triple Hybrid Power Generation System in the Southern Region of Myanmar"	Energy	Public	Private and Public	Implemented	A triple hybrid power generation system (an independent power supply system combining solar power, storage batteries, and engines) will be introduced as a distributed power source to realize a low-carbon society and provide a stable, high-quality power supply at off-grid areas in the southern part of Myanmar.
35	Myanmar	Mitigation	Feasibility Study on Overseas Deployment of High-Quality Energy Infrastructure in FY2020: "Feasibility Study on Hydropower Project Formation at Hydropotential Sites in Myanmar"	Energy	Public	Private and Public	Implemented	A feasibility of hydropower development projects in Myanmar is investigated and evaluated by developing power generation plans and facility plans and examining economic feasibility for promising hydropower development sites among the hydropower potential sites in Myanmar.
36	Nigeria	Mitigation and Adaptation	The Project for Provision of Solar Power System for Poly General Hospital in Enugu North Local Government Area in Enugu State	Energy	Public	Private and Public	Implemented	Provision of Solar Power System to Poly General Hospital
37	Pakistan	Mitigation	The Project for Installation of electricity facilities in Mandi Bahauddin district, Punjab	Energy	Public	Private and Public	Implemented	Installation of electricity facilities in Mandi Bahauddin district, Punjab
38	Philippines	Mitigation	Development and Demonstration of a Microgrid System for Remote Islands Using a High Wind Speed Vertical Magnus-type Wind Power Generator	Energy	Private and Public	Private and Public	Implemented	Development and demonstration of economically-optimized microgrid technology, and development and demonstration of a vertical-axis Magnus-type vehicle with high wind resistance is carried out. In addition, remote monitoring technology to train local personnel to maintain and manage the system is utilized.
39	Philippines	Mitigation	Improving traffic jams by optimizing vehicle allocation in the Philippine public transportation system and utilizing renewable energy sources for low carbon transportation	Cross-cutting	Private and Public	Private and Public	Implemented	In order to contribute to reducing traffic jams and CO2 emissions from transportation, a fleet of 65 EVs over a period of three years using a vehicle dispatch optimization system and renewable energy to demonstrate the effectiveness of the system and renewable energy-derived electricity are operated
40	Philippines	Mitigation	Demonstration Project on Autonomous Micro-Grid Technology to Maximize the Use of Renewable Energy in Island Areas (Feasibility Study stage)	Energy	Public	Private and Public	Implemented	Achieve the stabilization of small-scale systems and power generation cost reductions by introducing a 2.1 MW microgrid that combines renewable energy (wind and solar), storage batteries, and EMS in northern Batanes and autonomously coordinating with existing diesel power generation (DG).

No.	Recipient country and/or region	Targeted area	Measures and activities related to technology transfer	Sector	Source of the funding for technology transfer	Activities undertaken by	Status	Additional information
41	Philippines	Mitigation	Feasibility Study on Overseas Deployment of High-Quality Energy Infrastructure in FY2020: "Feasibility Study on Electric Power Business Using Renewable Energy Hybrid Technology in the Philippines"	Energy	Public	Private and Public	Implemented	Utilizing the renewable energy hybrid technology developed through the NEDO project in Niijima-island and Shikinejima-island, this project conducts proposals and detailed surveys in specific target areas for the commercialization of renewable energy IPP in off-grid areas and investigate the possibility of business development in the on-grid electricity market using this technology.
42	Philippines, Philippines	Mitigation	Demonstration of a High-Humidity Portable Container Refrigerator System for Building Smart Cold Chains for Fruits, Vegetables and Flowers in Developing Countries	Cross-cutting	Private and Public	Private and Public	Implemented	A newly developed cooling unit that achieves low temperatures and high humidity and keeps fruits, vegetables and flowers fresh for an overwhelmingly long period of time will be converted into a container refrigerator.
43	Philippines, Vietnam, Thailand, Indonesia, Chile, Lao PDR, Saudi Arabia, Myanmar	Mitigation	JCM Model Project	Energy	Public	Private and Public	Implemented	Financial support for projects that introduce facilities and equipment to reduce CO2 emissions. JCM credits are issued along to emission reductions realized by projects. In FY2020, 25 projects were selected.
44	Qatar	Mitigation	Al Kharsaa Solar PV Project	Energy	Private and Public	Private and Public	Implemented	SIRAJ(1) will build, own and operate an 800MW solar PV plant in Al Kharsaa, located approximately 80km to the west of Doha, the capital of Qatar. The electricity produced by the plant will be sold to Qatar General Electricity and Water Corporation for 25 years. The project is the first large-scale solar PV project in Qatar.
45	Saudi Arabia	Mitigation	Energy Management System Demonstration Project in Huraymila, Saudi Arabia for Hybrid Renewables and Storage Batteries (Feasibility Study stage)	Energy	Public	Private and Public	Implemented	Build a renewable energy-based EMS consisting of solar / wind power generation and hybrid power storage equipment, and to achieve the system stabilization and power generation cost reduction in the Flymira area of Saudi Arabia.
46	Saudi Arabia	Mitigation	Demonstration on ammonia supply chain between Japan and Saudi Arabia that utilizes CO2-EOR/CCUS	Energy	Public	Private and Public	Implemented	Create a business environment for the widespread application of private-sector-led CCUS projects that utilize JCM and other systems, in the Kingdom of Saudi Arabia (KSA), by engaging in CCUS project formation in the respective countries or regions.

No.	Recipient country and/or region	Targeted area	Measures and activities related to technology transfer	Sector	Source of the funding for technology transfer	Activities undertaken by	Status	Additional information
47	Saudi Arabia, Philippines, Indonesia, Thailand	Mitigation	Study on the infrastructure development project for acquisition of JCM credits	Energy	Public	Private and Public	Planned	Clarify the issues and usefulness for promoting the introduction and diffusion of our country's low-carbon technologies and products in partner countries, the potential for medium- to long-term reduction of greenhouse gas emissions in the partner countries, and the policies and systems necessary for the diffusion of such technologies and products in the partner countries. Also, encourage governmental bodies in the partner countries to introduce and diffuse the technologies and products in collaboration with the Ministry of Economy, Trade and Industry.
48	Tanzania	Adaptation	Study of improving the efficiency of agricultural water use in Africa	Agriculture	Public	Private and Public	Implemented	Study of improving the efficiency of agricultural water use in Africa
49	Thailand	Mitigation	Development and demonstration of an optimal compressor operation service using IoT in the Kingdom of Thailand	Cross-cutting	Private and Public	Private and Public	Implemented	IoT devices have been installed in compressors at a factory in Thailand, and the data uploaded to the cloud will be analyzed in Japan. The analysis results are used to propose operational optimization, thereby reducing energy consumption and CO2 emissions, as well as improving the energy-saving capabilities of facility managers in the field with regard to the compressors.
50	Thailand	Mitigation	Demonstration Project on Improved Power Generation using Digital Technologies at the MAE MOH Power Plant	Energy	Public	Private and Public	Implemented	Improve power generation efficiency and reliability of power generation facilities by introducing advanced digital solutions through AI/big data analysis at the Mae Moh Thermal Power Plant Unit 11 and 13 (300 MW each) operated by EGAT and consequently to reduce greenhouse gas emissions due to improvement of fuel efficiency.
51	Thailand	Mitigation	Demonstration Project for Low-Carbonized Operation of a Power Grid Utilizing Online Voltage-var (Q) Optimal Control "OPENVQ" with ICT	Energy	Public	Private and Public	Implemented	Reduce greenhouse gas emissions through more sophisticated and more efficient power system operations by introducing OPENVQ in EGAT's transmission network.

No.	Recipient country and/or region	Targeted area	Measures and activities related to technology transfer	Sector	Source of the funding for technology transfer	Activities undertaken by	Status	Additional information
52	Thailand	Mitigation	Feasibility study of GHG emission reduction by Advanced Control for District Cooling Plant	Energy	Public	Private and Public	Implemented	Energy saving activities for Chilled Water Plants for air conditioning in large buildings in Thailand mainly consist of introduction of high-efficiency equipment, and efficiency improvement by operational optimization has hardly been implemented. Azbil will examine the GHG reduction effect by introducing Advanced Control for District Cooling Plants and policy proposals that will contribute to the dissemination of District Cooling Plants in Thailand.
53	Thailand	Mitigation	Introduction and demonstration of non-interlocking flow control system technology to existing water-cooled air conditioning systems in buildings such as hospitals in Thailand	Industry	Private and Public	Private and Public	Planned	In order to popularize the load linked flow control system "Eco Vision" in Thailand, which has a substantial record of energy saving in water-cooled air conditioning systems, this product will be demonstrated to adapt it to the operational status of existing water-cooled air conditioning systems in Thailand and determine the specifications of this product.
54	Thailand, Vietnam	Mitigation	Financial support for collection and destruction of HFCs using JCM	Cross-cutting	Public	Private and Public	Planned	A project of financial support for proper collection and destruction of HFCs without releasing them into the air in developing countries.
55	UAE, Saudi Arabia	Mitigation	Promoting to disseminate higher energy efficient air conditioners in the Middle East	Energy	Public	Private and Public	Implemented	Make policy proposal for implementing the performance evaluation standard (ISO 16358-1) linking with the energy saving labeling program and promoting energy efficient inverter air conditioners by quantifying the potential reductions of energy and GHG emissions brought by energy efficient inverter air conditioners with actual measurement data.
56	United Arab Emirates	Mitigation	Warsan Waste-to-Energy Project	Energy	Private	Private and Public	Implemented	Dubai Waste Management Company P.S.C., formed by ITOCHU Corporation, Hitachi Zosen Corporation, Dubai Holding Commercial Operations Group LLC, Dubal Holding LLC, N.V. BESIX S.A. and Tech Group Dubai, for a waste-to energy project in Dubai, the United Arab Emirates. The project, under a 35-year concession period with Dubai Municipality, aims to build and operate a waste-to-energy plant in the Warsan area to treat 1.9 million tonnes of solid waste annually.
57	Uzbekistan, Philippines, Myanmar, Democratic Republic of Congo	Mitigation and Adaptation	Project for disseminating techniques of forest restoration in developing countries	Other	Public	Private and Public	Implemented	Research and analysis of techniques that can contribute to forest revitalization at degraded land and dissemination to the government in developing countries.

No.	Recipient country and/or region	Targeted area	Measures and activities related to technology transfer	Sector	Source of the funding for technology transfer	Activities undertaken by	Status	Additional information
58	Vietnam	Mitigation and Adaptation	The Project for Renovation of Phuc Yen Primary school Ban Buoc Brach and Introduction of Small Hydroelectric Generator in Tuyen Quang Province.	Energy	Public	Private and Public	Implemented	Creating a safe and stable learning environment and providing source of electricity for pupils and teachers
59	Vietnam	Mitigation	Feasibility study of low-carbon reginal power supply system in Vietnam	Energy	Public	Private and Public	Implemented	By utilizing the modular system based on the rice husk power generation system (1.8 MW), which is the first project of the JCM equipment business in Myanmar, and the remote monitoring and control technology by IoT, a distributed system that can flexibly respond to cost reductions and regional conditions will be built. While considering business development utilization the FIT system, a system for a reginal electric power business using the electric power wheeling system and aim for widespread use throughout ASEAN will be proposed.
60	Vietnam	Mitigation	Feasibility Study on Overseas Deployment of High-Quality Energy Infrastructure in FY2020: "Feasibility Study on Solar Power Generation Project at Existing Hydropower Plant in Vietnam"	Energy	Public	Private and Public	Implemented	A feasibility study is conducted for the development of a renewable energy collaborative power generation project by an existing hydropower plant and a new floating solar power plant, with the aim of effectively utilizing water resources and reducing carbon dioxide emissions, targeting an existing hydropower plant in operation in Vietnam.
61	Vietnam	Adaptation	Development of technologies to enhance the functions of forests for disaster prevention and mitigation in developing countries	Other	Public	Private and Public	Planned	Development of technologies and training for Japanese forest engineers to enhance the functions of forests for disaster prevention and mitigation in developing countries.

5.3 Capacity-building

To accelerate climate change measures and sustainable development in developing countries, Japan will collaborate with them by utilizing its advanced technology and know-how, create co-innovation that reflects their challenges and needs, and contribute to the global reduction of GHG emissions. Japan will incorporate the needs of each country and the seeds of technology and know-how acquired by private Japanese companies and local governments and promote the creation of specific projects to find solutions that lead to co-innovation among Japan and developing countries.

Regarding capacity-building support for adaptation, Japan will support the consolidation and dissemination of information on climate risk, the establishment of risk evaluation methods, and the development of national adaptation plans in developing countries.

Regarding the capacity-building support for mitigation, Japan will support institutional and capacity development to develop concrete plans and measures as well as a review of progress. Japan will provide such support by using its experience and know-how and collaborating with JICA, the National Institute for Environmental Studies (NIES), etc.

Regarding the capacity-building support for transparency, Japan provides institutional and capacity development to establish policies and systems to achieve the emission reduction target through the Partnership to Strengthen Transparency for Co-Innovation (Partnership to Strengthen Transparency for co-Innovation: PaSTI), and the Workshop on Greenhouse Gas (GHG) Inventories in Asia (WGIA) to support Asian countries to improve the accuracy of their GHG inventories and to facilitate the enhancement of cooperative relationships.

Detailed information on Japan's projects of capacity-building support is shown in Table A5-7.

Further information on capacity-building support is presented in section 6.6 of Japan's NC8.

Table A5-7 Information on provision of capacity-building support (CTF Table 9)

No.	Recipient country and/or region	Targeted area	Programme or project title	Description of programme or project
1	ASEAN Member Countries	Adaptation	Development of the Report on the State of Climate Change in ASEAN Region	Develop a regional ASEAN report on climate change to promote development of a harmonized approach to measuring, reporting and verifying greenhouse gas emissions related to the national reporting requirements under UNFCCC.
2	ASEAN Member Countries	Adaptation	Strengthening ASEAN's Collective Response Capacity through the Enhancement of the Capacity Building of the Regional ASEAN Emergency Response and Assessment Team (ASEAN-ERAT) (2020 – 2022)	Strengthen ASEAN-ERAT capacities to further enhance a coordinated response to disaster emergencies as well as to provide sound technical support to the National Disaster Management Organizations (NDMOs).
3	ASEAN Member Countries	Adaptation	ASEAN VOLUNTEERS: Community Based Disaster Risk Reduction and Preparedness	Bring together the youth from ASEAN to collaborate in addressing the risks of climate change and natural disasters in vulnerable communities across ASEAN.
4	ASEAN Member Countries	Multiple Areas	Promotion of the cooperation between ASEAN Smart City Network (ASCN) and Japan by the 2nd High-Level Meeting in Japan	Organize the 2nd ASEAN-Japan Smart Cities Network High-Level Meeting to contribute to the advancement of the ASEAN Smart City Network (ASCN) initiative.
5	ASEAN Member Countries	Multiple Areas	Carbon Footprint of Renewable Energy for ASEAN Countries	Provide better understanding and practical knowledge and methodology on Carbon Footprint (CF) and Life Cycle Assessment (LCA) and help ASEAN Member States (AMSs) to develop Life Cycle Inventory (LCI) database and appropriate measures to address the problem of climate change.
6	ASEAN Member Countries	Adaptation	ASEAN Cultural Heritage Digital Archive (ACHDA) – Phase 2	Support the ASEAN Member States' digitization of their cultural heritage collections to strengthen the resiliency of AMS's cultural institutions from man-made and natural disasters by preserving the records of their heritage.
7	Asia, Oceania	Adaptation	Project for Capacity Building on Climate Change Impact Assessments and Adaptation Planning in the Asia-Pacific Region	Based on the experience and knowledge of climate change impact assessment conducted in the process of preparing Japan's National Adaptation Plan, we hold capacity building workshops on climate change impact assessment and adaptation plan formulation for Asia-Pacific countries.
8	Asia, Oceania	Adaptation	Research and considering project to expand Japanese adaptation technologies to developing countries in international funds	In order to gain knowledge on project formation utilizing international funds such as the Green Climate Fund (GCF), project planning and proposal creation using the Philippines as a model are proceeded.
9	Asia, Oceania	Adaptation	Global Adaptation Network, Asia-Pacific Adaptation Network	Sharing knowledge of adaptation through the Global Adaptation Network and Asia-Pacific Adaptation Network
10	Asia/Pacific	Mitigation	The 17th Workshop on Greenhouse Gas Inventories in Asia (WGIA17)	WGIA has been held ad organized by the Ministry of the Environment of Japan, National Institute for Environmental Studies and hose countries' governments since 2003 for the purpose of the quality improvement of Greenhouse gas inventories in Asian countries and promotion of regional cooperation.
11	Bangladesh	Adaptation	School-based Capacity Building for Enhanced Disaster Risk Reduction in Dhaka North City Corporation	Increase DRR capacity of schools and communities in Dhaka North City Corporation so that the people can protect themselves in disasters and also reduce disaster risks in their daily life.

No.	Recipient country and/or region	Targeted area	Programme or project title	Description of programme or project
12	Bangladesh	Adaptation	Capacity Building Project for the establishment and Sustainable Management of a Multi sector Platform for Disaster Management in Bangladesh	To establish A-PAD Bangladesh National Platform for reducing disaster risk, its preparedness and management through partnerships among private sectors, NGOs, local government and local community in Bangladesh. This National Platform mobilize resources and networks and services, and support strengthen its capacity to provide rapid and effective emergency support in the event of disasters. This project help to overcome social vulnerability by strengthening its disaster management capacity and achieving sustainable development through making disaster resilient society.
13	Brazil	Mitigation	Project for Supporting the Sustainable Forest Products Industry	Promote the sustainable forest products industry of the Federative Republic of Brazil and thereby help mitigate the impact of global climate
14	Cambodia, Lao PDR, Vietnam, Myanmar	Mitigation	Project for promoting forest conservation in developing countries	Development and improvement of the guidelines required for the implementation on REDD+ projects in Joint Crediting Mechanism (JCM).
15	Cambodia, Myanmar	Mitigation	Project for utilizing forest knowledge in developing countries	Utilize Japanese technology and knowledge in promoting sustainable use of forest resources in developing countries.
16	Cambodia, Myanmar, Kenya, Uganda	Mitigation	Mitigation potential of global actions to enhance forest carbon stocks	Support the identification of global land suitability for Afforestation and Reforestation (AR) and land use planning in order to promote AR in developing countries.
17	Cambodia, Myanmar, Peru	Mitigation	Project to accelerate REDD-plus activities by private sector	Development of technologies and provision of information to encourage private companies to implement REDD+ activities.
18	China	Mitigation	Co-benefit project for air pollution control in China and other Asian countries	Based on the Memorandum of Understanding between the Ministry of the Environment Japan and the China side (FY2018), this project aims to promote the inter-city cooperation for capacity building and policy-making supports on Co-benefits approach (air pollution control and carbon reduction) in major cities in Asia, including China, so to reduce the transboundal air pollution in Japan.
19	China	Mitigation	Co-Benefit Model Project for Air Pollution Control in China	Based on the agreement of the Japan-China Environment Ministers' Bi-Meeting at the TEMM20 in 2018, this project aims to promote co-benefit air pollution control in China through technical studies and evaluations, specifically contribute to improving the air environment and the benefits of reducing air pollutants to greenhouse gas countermeasures in response to the China's three-year blue sky protection victory plan.
20	China	Mitigation	Co-benefits project for air pollution control in China and other Asian countries	Based on the Memorandum of Understanding between the Ministry of the Environment Japan and the China side (FY2018), this project aims to promote the inter-city cooperation to support capacity building and policy-making on Co-benefits approach (efficiently reducing air pollutants and greenhouse gases) in major cities in Asia, including China, so to reduce the transboundal air pollution to Japan.
21	China	Mitigation	Co-benefits project for low-carbon society in China	Based on the Memorandum of Understanding between the Ministry of the Environment Japan and the China side (FY2016), this project aims to strengthen the national environmental pollution countermeasures and greenhouse gas emission reduction in China so to reduce the transboundal air pollution to Japan, through model projects installing co-benefits technologies, formulating guidelines, capacity building.

No.	Recipient country and/or region	Targeted area	Programme or project title	Description of programme or project
22	Egypt, Jordan	Adaptation	Urgent interventions to Build Socio-Ecological System Resilience to National Hazard in MENA Region	Manage the Risk of Natural Hazards and Strengthen the Social Capital
23	Fiji, Samoa	Adaptation	Impact Assessment Project of Climate Change in Pacific Region	Evaluate the long-term risks of cyclone-derived high waves and storm surges with the long-term goal of establishing an effective climate change impact assessment method that utilizes satellite data and hazard map systems.
24	Global	Mitigation	Enhancing knowledge and capacity around forest related legislation and timber legality	Support measures to improve forest-related legislation and strengthen enforcement capabilities to build governance, including the eradication of illegal logging
25	Guatemala	Mitigation	Implementing mechanisms to improve traceability in the forest production chain in Guatemala	In order to improve the transparency of the forest product supply chain in five states with large amounts of timber production and processing, the project proposed logging procedures and forest planning for small-scale forest owners and encouraged companies to register in the supply chain database system.
26	India	Multiple Areas	Project for Community-Based Forest Management and Livelihoods Improvement in Meghalaya	Restore and conserve natural resources within the villages by sustainable forest management, livelihood improvement, and institutional strengthening, thereby contributing to conservation of environment, biodiversity, and uplifting of socio-economic conditions of people in the State of Meghalaya.
27	Indonesia	Adaptation	Impact Assessment Project of Climate Change in Indonesia for Local Adaptation Planning	Conducted climate change impact assessment in collaboration with Indonesian government agencies and research institutes with a view to formulating regional adaptation plans that form part of Indonesia's National Adaptation Action Plan (RAN-API), adaptation information Build a platform (I-PLAT).
28	Indonesia	Mitigation	Co-benefits projects for wastewater treatment in the agricultural industry in Indonesia	Based on the Memorandum of Understanding between the Ministry of the Environment Japan and the Indonesia side (FY2015), this project aims to promote Co-benefits approach (water pollution control and carbon reduction) and pollution control in the agricultural and fishery industry: survey and analysis of environmental management, capacity building for the Indonesian officials, policy proposals.
29	Indonesia	Mitigation	Co-benefits project for low-carbon society in China	Based on the Memorandum of Understanding between the Ministry of the Environment Japan and the China side (FY2016), this project aims to strengthen China's environmental pollution countermeasures and greenhouse gas emission reduction measures so to reduce the transboundal air pollution in Japan: selecting model project technologies for the installation of co-benefit technology, formulating model business proposals, capacity building.
30	Indonesia	Adaptation	Disaster Resilience Promotion and Management Program Loan	Support the implementation of disaster related policies and strategies of the Republic of Indonesia through policy dialogue, thereby contributing to strengthening the capacity to deal with natural disasters.

No.	Recipient country and/or region	Targeted area	Programme or project title	Description of programme or project
31	Indonesia	Adaptation	Flood Control Sector Loan (Phase 2)	Mitigate flood damage in provincial cities by improving flood control infrastructure and flood damage management capacity, thereby contributing to disaster preparedness of communities and adaptation of climate change.
32	Indonesia	Adaptation	Project for Strengthening Disaster Management and Response Capacities by Enhancing Multi-Sectoral Cooperation	Strengthen multisector network for disaster response and to establish a disaster network model in the 2 target provinces. Specific focus will be given to improving the function of A-PAD Indonesia as a national platform and facilitating active participation of private sector by utilizing the disaster management model of tourism industry.
33	Indonesia	Adaptation	Sustainable Lake Management	Capacity building on sustainable lake management
34	Indonesia	Adaptation	Training on lake water quality improvement	Training on lake water quality improvement
35	Indonesia, Cambodia, Sri Lanka, Thailand, Korea, China, Nepal, Philippines, Vietnam, Malaysia, Myanmar, Lao PDR	Adaptation	Water Environment Partnership in Asia	The network of governmental officials in Asia to improve water environmental governance
36	Indonesia, Malaysia, Myanmar, Thailand, Vietnam, India, China, Brazil, Saudi Arabia, Brunei, Cambodia, Lao PDR, Philippines, Singapore	Mitigation	Capacity Building program on Energy Efficiency	Support developing institutional arrangements in emerging countries such as ASEAN and India by providing training programs in Japan and dispatching experts to such countries, thus enabling policy makers to promote energy efficiency.
37	Indonesia, Thailand, Philippines, Vietnam, Malaysia, Cambodia, Sri Lanka	Mitigation	the strategic global promotion of high efficiency non-fluorocarbons appliances	This project collects information to identify possible partner countries of the Initiative on Fluorocarbons Life Cycle Management (IFL), promotes actions throughout fluorocarbons lifecycle, formulates strategies for market penetration of high-efficient non-fluorocarbons equipment and rule-making in developing countries, and organize capacity building training.
38	Indonesia, Vietnam, Philippines	Mitigation	Support for Improving Transparency in Developing Countries under the Paris Agreement	Support for improving the transparency of greenhouse gas emissions from private sector activities in the subject countries
39	Indonesia, Vietnam, Philippines	Mitigation	Support for Improving Transparency in Developing Countries under the Paris Agreement	Support for improving the transparency of greenhouse gas emissions from private sector activities in the subject countries
40	Iran	Adaptation	Environmental Workshop on Dust and Sand Storm	Capacity development workshop on dust and sand storm
41	Kenya	Adaptation	Capacity Building for Maritime Disaster Management and Response to Peace and Security threats within Kenya	Mitigate the risk of disasters and violent conflict in the maritime and border areas of Kenya and build institutional capacities to address maritime disasters, radicalization and community conflicts
42	Kenya, Ethiopia, Palau, Maldives	Mitigation	JCM Capacity Building and Project Support in Africa and Island Countries	Support capacity building and project formulation for JCM implementation in Africa and island countries.
43	Kenya, Ethiopia, Palau, Maldives	Mitigation	JCM Capacity Building and Project Support in Africa and Island Countries	Support capacity building and project formulation for JCM implementation in Africa and island countries.
44	Lao PDR, Uganda, Philippines	Mitigation	Discovering projects for Climate Technology Center and Network (CTCN)	CTCN (Climate Technology Centre Network) and capacity building to improve access to funds for developing countries.

No.	Recipient country and/or region	Targeted area	Programme or project title	Description of programme or project
45	Lao PDR, Vietnam, Philippines, Thailand	Mitigation	Discovering projects for Climate Technology Center and Network (CTCN)	CTCN (Climate Technology Centre Network), GCF (Green Climate Fund) case formation, and capacity building to improve access to funds for SIDS.
46	Malawi	Adaptation	Project for community based irrigation capacity development JICA partnership programme 2011-2016	Dispatching expert team consisting of Miyagi government staffs and others in order to verify activities situation and project achievements made through on-site inspection.
47	Malaysia	Mitigation	Urban Development project through decarbonized transportation using bio-fuel and Zero Carbon City development project through dissemination of renewable energy	Toyama City, a "FutureCity" and an "SDGs FutureCity" (as promulgated by the Japanese government) is promoting international cooperation for the achievement of a decarbonized society to fully play its part as an environmental advanced city. To that end, Toyama City has signed a cooperation agreement with Iskandar Area (Johor State, Malaysia) and Kota Kinabalu City (Capital of Sabah State, North of Borneo Island, Malaysia) for the use of renewable energy and the revitalization of public transport. Through this City-to-City Collaboration Project between Toyama city and the city's companies who owns decarbonization technologies, the aim is to conduct: - an urban development project focused on low-carbon public transportation using biofuels - a renewable energy diffusion project focused on small scale hydropower Throughout this project, support for policies and institution building will be provided and propositions will be made to execute the project smoothly. Support will also be provided to select and implement JCM candidate projects, including making propositions for future JCM projects.
48	Mexico, Chile, Costa Rica	Mitigation	JCM Capacity Building and Project Support in Latin America	Provide capacity building and project formulation support for JCM implementation in Latin America.
49	Mexico, Chile, Costa Rica	Mitigation	JCM Capacity Building and Project Support in Latin America	Provide capacity building and project formulation support for JCM implementation in Latin America.
50	Mongolia	Adaptation	Impact Assessment Project of Climate Change in Mongolia	Implemented climate change impact assessment support in collaboration with Mongolian government agencies and research institutes with a view to formulating a national adaptation plan for Mongolia. The developed cold damage prediction system will be collaborated with JICA to support the formation of projects with GCF funds.
51	Mongolia	Mitigation	Co-benefits projects for air pollution control in Mongolia	Based on the Memorandum of Understanding between the Ministry of the Environment Japan and the Mongolia side (FY2018), this project aims to promote air pollution control and Co-benefits approach (air pollution control and carbon reduction) : acceleration on updating the Heat-Only Boiler (HOB), implementation of the on-site trainings, promoting the potential JCM projects.
52	Mongolia, Bangladesh, Vietnam, Lao PDR, Cambodia, Myanmar	Mitigation	JCM Capacity Building and Project Support in Asia	Collect and provide information on the utilization of international market mechanisms, and support capacity building and project formulation for JCM implementation in the Asian region.
53	Mongolia, Bangladesh, Vietnam, Lao PDR, Cambodia, Myanmar	Mitigation	JCM Capacity Building and Project Support in Asia	Collect and provide information on the utilization of international market mechanisms, and support capacity building and project formulation for JCM implementation in the Asian region.
54	Multiple countries in Africa	Adaptation	Capacity building in promoting food value chain	A research for the impact of COVID-19 in Africa and others

No.	Recipient country and/or region	Targeted area	Programme or project title	Description of programme or project
55	Multiple countries in Africa	Mitigation	Capacity building for the implementation of "Legal and Sustainable Supply Chains (LSSC)" by stakeholders in the Congo Basin countries	The project raised awareness of the use of legal and sustainable timber and conducted capacity building for verification of legality and sustainability among government officials and timber related companies, through utilizing training materials developed by ITTO on legal and sustainable timber supply chains in the Congo Basin countries.
56	Multiple countries in Africa, India	Adaptation	Capacity building in promoting food value chain	Practical agricultural training for invited young farmers of Asian countries. The training is implemented for about 10 months at Japanese core farms who have excellent technique and management know-how.
57	Multiple countries in Asia	Multiple Areas	10th East Asia Summit High-level Seminar on Sustainable Cities	Seminar for Sustainable Cities
58	Multiple countries in East Asia	Adaptation	Capacity Building Project for Farmers' Organizations to Support the Development of Food Value Chain in ASEAN Countries	Enhance the capacity of target farmers' organizations in collaboration with Japanese food related companies in ASEAN countries.
59	Multiple countries in Eastern Sub-Saharan Africa	Adaptation	Strengthening Disaster Prevention Approaches in Eastern Africa	Support the Development and Integration of disaster prevention approaches
60	Multiple countries in the Pacific	Adaptation	WCPFC Project on Capacity Building in Fisheries Statistics, Regulation and Enforcement for Small Island Developing States	Assist developing States Members in improving their capacities in (a) data collection and reporting of their fisheries and associated activities, and (b) establishment of fisheries regulation and its effective enforcement.
61	Multiple regions	Adaptation	ICCAT-JAPAN capacity-building assistance project (JCAP-2)	Improvement of the performance of monitoring and data collection, reinforcement of tuna fishery management, feedback of data for effective management and improved stock assessment.
62	Multiple regions	Adaptation	Capacity Building Project for Farmers' Organizations to Support the Development of Food Value Chain in Asia and Africa	Foster/strengthen farmer's organizations and agricultural cooperatives, promote agribusiness by rural women and develop human resource for building up Food Value Chain involving marketing agricultural products in an organized manner.
63	Multiple regions	Multiple Areas	Contribution for the International Institute for Applied Systems Analysis (IIASA)	IIASA's research on climate change, cross-border air pollution, future prediction of SLCPs emissions, and the development of analytical models for co-benefits (efficiently reducing air pollutants and greenhouse gases) are expected to contribute to Japan's national benefits. Therefore, we continuously support their research activities.
64	Multiple regions	Multiple Areas	Contribution for the Clean Air Asia (CAA)	CAA, hundreds of cities and countries in Asia join, is one of the largest platform in Asia for supporting urban planning including clean air action plan and climate action plan, promoting installation of co-benefits type environmental technologies, etc.
65	Multiple regions	Adaptation	World Bank Tokyo Disaster Risk Management (DRM) Hub	Provision of technical assistance utilizing Japan's knowledge on disaster prevention through World Bank Tokyo Disaster Risk Management (DRM) Hub
66	Multiple regions	Adaptation	Japanese Funds-in-Trust for Scientific Programme on Global Challenges in Asia and the Pacific Region	Support scientific projects on global challenges in Asia and the Pacific Region implemented by UNESCO
67	Multiple regions	Multiple Areas	Group on Earth Observation (GEO)	An international framework for promoting the Global Earth Observation System (GEOSS), which is a comprehensive Earth observation system consisting of multiple observation systems, including satellite, ocean, and ground-based observations.

No.	Recipient country and/or region	Targeted area	Programme or project title	Description of programme or project
68	Multiple small island countries in the Pacific	Mitigation	Workshop on Financing for Renewable Energy in Small Island Developing States	In collaboration with the International Renewable Energy Agency (IRENA), a workshop will be held for AEs (certification bodies) for SIDS of the Green Climate Fund (GCF) to discuss access to finance and human resource development on renewable energy deployment.
69	Myanmar	Mitigation	Strengthening SFM standards and timber legality framework in Myanmar	Contribute to the achievement of decreasing illegal logging and improving sustainable forest management in Myanmar through strengthening national certification systems of forest management and chain of custody as well as a timber legality verification system.
70	Nepal	Adaptation	Capacity Building on Disaster Risk Reduction in Kathmandu City through the Collaboration with Citizens and Local Government	In cooperation with kathmandu metropolitan City (KMC) and its' citizens, the project aims at promoting community-based disaster prevention activities based on the experiences and know-how of Japan.
71	Nepal	Adaptation	Rehabilitating School and Building School Resilience to Disaster in Sindhupalchowk, Nepal Phase II	Foster and strengthen the capacity of public schools in Sindhupalchowk District in safeguarding children from natural disasters. To achieve this goal, ChidFund Japan, in partnership with local partner NGOs, provides multifaceted support to schools, school Management Committees (SMCs), and government officials by constructing sesmic-resistant classrooms, conducting training on disaster risk reduction and Child Protection in Emergencies (CPiR), and developing School Safety Plan which integrates earthquake drills in school.
72	Philippines	Adaptation	Study for promoting Japanese adaptation technology by using climate change finance	Technical cooperation on climate change adaptation plan
73	Philippines	Mitigation	Zero Carbon Development in Quezon City (Energy Saving Air Conditioning System (Fluorocarbons Management Plan))	A model project for renewing existing air conditioning system to energy saving air conditioning system with proper management of fluorocarbon in Quezon city's governmental buildings will be investigated. Possible needs in schools, hospitals, shopping malls, etc. and future project schemes including JCM Model Project will also be explored. In addition, Osaka City will share their experiences and knowledge on environmental measures and fluorocarbon treatment for supporting Quezon City.
74	Philippines, Peru	Multiple Areas	Enhancing community resilience to climate change in mountain watersheds	Enhance community resilience to natural disasters and economic crisis by strengthening capacities of institutions and communities on the risk-based watershed management approach for forest and land use management and improving local populations' livelihoods.
75	South Sudan	Multiple Areas	Building resilience of vulnerable farmers, pastoralist and IDPs to natural disasters under changing climatic conditions in South Sudan	Help vulnerable farmers, pastoralist and internally displaced persons build resilience to natural disasters under changing climatic conditions in South Sudan.

No.	Recipient country and/or region	Targeted area	Programme or project title	Description of programme or project
76	Sri Lanka	Adaptation	Project to Promote Public-Private Partnerships and Strengthen Emergency Response Capacity in Disaster Response in Sri Lanka	A-PAD SL has strengthened the network function in case of a disaster between stakeholders in multi-sector over time. The partners of APAD-SL include private sectors, the government, CSOs and NGOs, while we strengthen the relationship directly with the local government in the Provinces. We conduct disaster management workshops for private sectors, particularly for MSME. For the actual disaster response, we respond to the disasters such as flood, drought, or pandemic infections, and commit deeply with the assistance of public/private partnership during in a multi-hazardous situation. Having given the training by the specialists in case of a disaster, the capacity of which one can perform has increased heavily to the extent where efficient SAR rescue leaders will be produced as a result. We will also continue expanding our network in the disaster response communities overseas.
77	Sri Lanka, Zambia	Adaptation	Efficient Agricultural Water Use and Management Enhancement in Paddy Fields	The Ministry of Agriculture, Forestry and Fisheries of Japan contributes the fund to FAO for promoting the utilization and dissemination of Japan's knowledge, experience, and technology in paddy field agriculture.
78	Thailand	Adaptation	Project for Development of Information Infrastructure in Thailand for Adaptation Planning	Establish a cooperative cooperation system by government agencies, research institutes, international organizations, etc. in Thailand, organize climate risk information, provide support for financing, cooperate for operation of adaptation plans and construction of information infrastructure.
79	Thailand	Adaptation	Support for Adaptation cooperation of AIT RRC.AP	Support for Adaptation cooperation including capacity buildings of AIT RRC.AP
80	Thailand, Indonesia, India, Mexico, etc.	Mitigation	Human resources development program for promoting export of low-carbon technologies	By raising developing local human resources for the overseas production bases of Japanese companies, we promote the overseas expansion of energy-saving technologies from Japan, improve the efficiency of energy use in emerging countries industry, and contribute to reduction of greenhouse gases emissions.
81	Thailand, Indonesia, Vietnam, Bangladesh, Malaysia	Multiple Areas	Support for the establishment of systems to promote the deployment of decarbonization and low-carbon technologies in developing countries	Support the development and implementation of low carbon development scenarios for the country and cities.
82	Thailand, Indonesia, Vietnam, etc.	Mitigation	Human resources development program for promoting export of low-carbon technologies	By raising developing local human resources for the overseas production bases of Japanese companies, the overseas expansion of energy-saving technologies from Japan, improve the efficiency of energy use in emerging countries industry is promoted to reduction of greenhouse gases emissions.
83	Thailand, Indonesia, Vietnam, Lao PDR, Bhutan	Multiple Areas	Support for the establishment of systems to promote the deployment of decarbonization and low-carbon technologies in developing countries	Support the development and implementation of low carbon development scenarios for the country and cities.
84	Uzbekistan, China, Vietnam, Argentina, Brazil, Chile, Indonesia, Thailand, Malaysia, Kenya, Ethiopia, Djibouti, India	Mitigation	Capacity Building program on New energy	Support developing institutional arrangements in emerging countries such as ASEAN and India by providing training programs in Japan and dispatching experts to such countries, thus enabling policy makers to introduce clean technologies, including geothermal, renewable integration, hydrogen, and micro-grid technologies.

No.	Recipient country and/or region	Targeted area	Programme or project title	Description of programme or project
85	Vietnam	Mitigation	Project to Promote the Formation of an Autonomous Decarbonized Society through City-to-City Collaboration between Hiroshima Prefecture and Soc Trang Province, Vietnam	Support the creation of a decarbonized and low-carbon society in Soc Trang Province and neighboring regions while supporting business development of companies in Hiroshima by implementing mainly the following activities. 1. Establishing a mechanism to continuously create projects through the establishment of the "Hiroshima-Soc Trang City to City Collaboration Council". 2. Capacity building on the know-how of Hiroshima Prefecture to introduce community-based renewable energy 3. Implementation of FS by companies in Hiroshima Prefecture that possess decarbonization and low-carbon technologies
86	Vietnam, Lao PDR, Cambodia	Adaptation	Impact Assessment Project of Climate Change in Vietnam	Establish a cooperative cooperation system by government agencies and research institutes in Vietnam, carry out climate change impact assessments targeting vulnerable fields (assuming agriculture, natural disasters, etc.) in specific areas, and cooperate toward the formulation of national adaptation plans.
87	Vietnam, Philippines, Thailand, Malaysia, Indonesia, Vietnam	Mitigation	Formulating cooperation strategies of reducing fluorocarbons emissions in developing countries	This project collects information to identify needs and gaps of developing countries in Asia, where their domestic institutions on fluorocarbons management are underdeveloped, and provides supports to update domestic laws and regulations, schemes and institutional arrangements on management of fluorocarbons and climate mitigation with these countries in efforts to response to the Kigali Amendment of the Montreal Protocol and the Paris Agreement.
88	Zambia	Adaptation	Strengthening access to quality of integrated TB prevention, management in high TB/HIV burden community in Lusaka, Zambia	Increase number of presumptive TB cases screened for TB while maintaining high treatment outcome among TB patients in Zambia through strengthening patient-centered integrated TB prevention, early diagnosis and care & support at 7 public health facilities.
89	Vietnam, Myanmar, Tanzania, Indonesia, Cameroon, Cambodia	Multiple Areas	Project for promoting sustainable forest management in developing countries	In order to promote sustainable forest management, develop and disseminate business models that create economic value through forest conservation by private businesses in developing countries.

Annex II Acronyms and Abbreviations

	Terms	Definition
A	AAUs	Assigned Amount Units
	ACE	Actions for Cool Earth
	ADB	Asian Development Bank
	AETI	Asia Energy Transition Initiative
	AFD	French Development Agency
	AI	Artificial Intelligence
	ALOS	Advanced Land Observing Satellite
	AMICAF	Analysis and Mapping of Impacts under Climate Change for Adaptation and Food Security
	APAN	Asia Pacific Adaptation Network
	A-PLAT	Climate Change Adaptation Information Platform
	APN	Asia-Pacific Network for Global Change Research
	AP-PLAT	Asia-Pacific Climate Change Adaptation Information Platform
	AR4	IPCC Fourth Assessment Report
	ARGO	Advanced Ocean Observing System
	ASEAN	Association of Southeast Asian Nations
	AWGCC	ASEAN Working Group for Climate Change
B	BAT	Best Available Technology
	BAU	Business As Usual
	BCP	Business Continuity Plan
	BEMS	Building Energy Management System
	BR	Biennial Report
	BRT	Bus Rapid Transit
	BSRN	Baseline Surface Radiation Network
C	CASBEE	Comprehensive Assessment System for Built Environment Efficiency
	CCAC	Climate and Clean Air Coalition to Reduce Short-lived Climate Pollutants
	CCPL	Climate Change Program Loan
	CCS	Carbon Capture and Storage
	CCU	Carbon Capture and Utilization
	CCUS	Carbon dioxide Capture, Utilization and Storage
	CDM	Clean Development Mechanism
	CEOS	Committee on Earth Observation Satellites
	CERs	Certified Emission Reductions
	CFC	Chlorofluorocarbon
	CH_4	Methane
	CII	Rating of fuel efficiency performance
	CITC	Climate Change International Technical and Training Center
	CLT	Cross-laminated Timber

	Terms	Definition
	CMIP	Coupled Model Intercomparison Project
	CMP	Conference of the Parties serving as the Meeting of the Parties
	CNG	Compressed Natural Gas
	CO	Carbon monoxide
	CO_2	Carbon dioxide
	CO_2 eq.	CO_2 equivalent
	COP	Conference of Parties
	CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
	CPR	Cloud Profiling Radar
	CRF	Common Reporting Format
	CSTP	Council for Science, Technology and Innovation
	CTF	Common Tabular Format
	CY	Calendar Year
D	DAC	Development Assistance Committee
	DES	Data Exchange Standard
	DESD	Decade of Education for Sustainable Development
	DIAS	Data Integration and Analysis System
	DPR	Dual-frequency Precipitation Radar
	DRR	Disaster Risk Reduction
	DX	Digital transformation
E	EbA	Ecosystem-based Adaptation
	EC	Electronic Commerce
	Eco-DRR	Ecosystem-based Disaster Risk Reduction
	EE&C	Energy efficiency and conservation
	EEXI	Energy efficiency regulations for existing ships
	EFs	Emission factors
	EMS	Eco-drive Management Systems
	EMS	Energy Management System
	ERIA	Economic Research Institute for ASEAN and East Asia
	ERT	Expert Review Team
	ERUs	Emission Reduction Units
	ESCO	Energy Service Company
	ESD	Education for Sustainable Development
	ESG	Environmental, Social, Governance
	EST	Environmentally Sustainable Transport
	ETC	Electronic Toll Collection System
	EV	Electric Vehicle
F	FAO	Food and Agriculture Organization of the United Nations
	FCV	Fuel Cell Vehicle

	Terms	Definition
	FM	Forest Management
	FMRL	Forest Management Reference Level
	FEMS	Factory Energy Management System
	FIT	Feed-in Tariff
	FIP	Feed-in Premium
	FSA	Financial Services Agency
	FSB	Financial Stability Board
	FY	Fiscal Year
G	GAN	Global Adaptation Network
	GAW	Global Atmosphere Watch
	GAP	Global Action Programme on Education for Sustainable Development
	GCF	Green Climate Fund
	GCOM-C	Global Change Observation Mission-Climate
	GCOM-W	Global Change Observation Mission-Water
	GCOS	Global Climate Observing System
	GDP	Gross Domestic Product
	GEF	Global Environment Facility
	GEMS	Global Environmental Monitoring System
	GEO	Group of Earth Observations
	GEOSS	Global Earth Observation System of Systems
	GHG	Greenhouse Gas
	GIO	Greenhouse Gas Inventory Office
	GLOBE	Global Learning and Observations to Benefit the Environment
	GM	Grazing Land Management
	GOSAT	Greenhouse gases Observing SATellite
	GOSAT-GW	Global Observing SATellite for Greenhouse gases and Water cycle
	GOOS	Global Ocean Observing System
	GRA	Global Research Alliance
	GSN	GCOS Surface Network
	GSMaP	Global Satellite Mapping of Precipitation
	GPM	Global Precipitation Measurement
	GPU	Ground Power Unit
	GUAN	GCOS Upper-Air Network
	GWP	Global Warming Potential
H	HCFCs	Hydrochlorofluorocarbons
	HFCs	Hydrofluorocarbons
	HEMS	Home Energy Management System
	HP	Heat pump
	HV	Hybrid Vehicle

	Terms	Definition
	HWP	Harvested Wood Products
I	ICAO	International Civil Aviation Organization
	ICA-RUS	Integrated Climate Assessment - Risks, Uncertainties and Society
	ICEF	Innovation for Cool Earth Forum
	ICT	Information and Communication Technology
	IDC	Internet data center
	IEA	International Energy Agency
	IFL	Initiative on Fluorocarbons Life cycle Management
	IFRS	the International Financial Reporting Standards
	IGFC	Integrated coal gasification fuel cell combined cycle
	IGES	Institute for Global Environmental Strategies
	IMO	International Maritime Organization
	INDC	Intended Nationally Determined Contribution
	IoT	Internet of Things
	IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
	IPCC	Intergovernmental Panel on Climate Change
	IPPU	Industrial Processes and Product Use
	IRENA	International Renewable Energy Agency
	ISMS	Information Security Management System
	ISO	International Organization for Standardization
	ITS	Intelligent Transport System
	ITL	International Transaction Log
	ITTO	International Tropical Timber Organization
J	JAIF	Japan-ASEAN Integration Fund
	JAXA	Japan Aerospace Exploration Agency
	JBIC	Japan Bank of International Cooperation
	JCLP	Japan Climate Leaders Partnership
	JCM	Joint Crediting Mechanism
	JICA	Japan International Cooperation Agency
	JIRCAS	Japan International Research Center for Agricultural Sciences
	JJ-FAST	JICA-JAXA Forest Early Warning System in the Tropics
	JNGI	Japanese National GHG Inventory
K	KP	Kyoto Protocol
	KPI	Key Performance Indicator
L	LCCM	Life Cycle Carbon Minus
	LCC	Low Cost Carrier
	LCEM	Life Cycle Energy Management
	LED	Light Emitting Diode
	LNG	Liquefied Natural Gas

	Terms	Definition
	LRT	Light Rail Transit
	LULUCF	Land-Use, Land-Use Change and Forestry
M	MaaS	Mobility as a Service
	MAFF	Ministry of Agriculture, Forestry and Fisheries
	MDBs	Multilateral Development Banks
	METI	Ministry of Economy, Trade and Industry
	MEXT	Ministry of Education, Culture, Sports, Science and Technology
	MHLW	Ministry of Health, Labour and Welfare
	MIC	Ministry of Internal Affairs and Communications
	MLIT	Ministry of Land, Infrastructure, Transport and Tourism
	MOE	Ministry of the Environment
	MOF	Ministry of Finance
	MOFA	Ministry of Foreign Affairs
	MRV	Measurement, Reporting and Verification
N	N_2O	Nitrous oxide
	NbS	Nature-based Solutions
	NEDO	New Energy and Industrial Technology Development Organization
	NETIS	Ministry of Land, Infrastructure, Transport and Tourism's database on new technologies
	NEXI	Nippon Export and Investment Insurance
	NC	National Communication
	NDC	Nationally Determined Contribution
	NEB	Non-Energy Benefit
	NF_3	Nitrogen trifluoride
	NGO	Non-Governmental Organization
	NIES	National Institute for Environmental Studies
	NIR	National Inventory Report
	NMVOC	Non-methane volatile organic compounds
	NOx	Nitrogen oxides
	NPA	National Police Agency
	NPO	Non-Profit Organization
	NTA	National Tax Agency
O	O&M	Operation and Maintenance
	ODA	Official Development Assistance
	ODS	Ozone Depleting Substance
	OECD	Organization for Economic Co-operation and Development
	OGReS	One Gateway GHG Reporting System
	OOF	Other Official Flow
	OTEC	Ocean Thermal Energy Conversion
P	PaSTI	Partnership to Strengthen Transparency for co-Innovation

	Terms	Definition
	PDCA	Plan–Do–Check–Act
	PFCs	Perfluorocarbons
	PHEV	Plug-in Hybrid Electric Vehicle)
	PMI	Partnership for Market Implementation
	PPA	Power Purchase Agreement
Q	QA/QC	Quality Assurance / Quality Control
	QAWG	Quality Assurance Working Group
R	RBP	Result-based Payment
	REDD+	Reducing Emissions from Deforestation and Forest Degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
	RMUs	Removal Unit
	RV	Revegetation
S	SAF	Sustainable aviation fuel
	SATREPS	Science and Technology Research Partnership for Sustainable Development
	SDGs	Sustainable Development Goals
	SEF	Standard Electronic Format
	SF_6	Sulfur hexafluoride
	SIDS	Small Island Developing States
	SLCPs	Short-lived Climate Pollutants
	SO_2	Sulfur dioxide
	SOx	Sulfur oxides
	SPM	Summary for Policymakers
	SPREP	Secretariat of the Pacific Regional Environment Programme
T	TCFD	Task Force on Climate-related Financial Disclosures
U	UN	United Nations
	UNDP	United Nations Development Programme
	UNDESD	United Nations Decade of Education for Sustainable Development
	UNEP	United Nations Environment Programme
	UNESCO	United Nations Educational, Scientific and Cultural Organization
	UNICEF	United Nations Children’s Fund
	UNIDO	United Nations Industrial Development Organization
	UNFCCC	United Nations Framework Convention on Climate Change
	USC	Ultra-SuperCritical thermal power generation
	USD	United States Dollar
V	VOC	Volatile Organic Compounds
	VVVF	Variable Voltage Variable Frequency
W	WB	World Bank
	WBGT	Wet-Bulb Globe Temperatures
	WCRP	World Climate Research Programme

	Terms	Definition
	WDCGG	World Data Centre for Greenhouse Gases
	WG	Working Group
	WGIA	Workshop on Greenhouse Gas Inventories in Asia
	WMO	World Meteorological Organization
	WTO	World Trade Organization
Z	ZEB	(Net) Zero Energy Building
	ZEH	(Net) Zero Energy House

Notation Key	Definition
NO	Not Occurring
NE	Not Estimated
NA	Not Applicable
IE	Included Elsewhere
C	Confidential

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