Japan's Seventh National Communication under the United Nations Framework Convention on Climate Change

December 2017

The Goverment of Japan

Contents

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Introduction

Prior to the United Nations Framework Convention on Climate Change (UNFCCC) adopted in 1992, Japan formulated "Action Program to Arrest Global Warming" in 1990 and has been taking 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 "Global Warming Prevention Headquarters" at the Cabinet, and comprehensive and systematic measures have been taken under "Act on Promoting Global Warming Countermeasures" and "Kyoto Protocol Target Achievement Plan". As a result of the implementation of those measures, greenhouse gas (GHG) emission reduction target in the first commitment period of the Kyoto Protocol was achieved. Even after the first commitment period of the Kyoto Protocol, GHG emission reduction target for FY (Fiscal Year) 2020 based on the Cancun Agreement adopted at the COP16 was announced at the COP19. In addition, Japan prepared the Intended Nationally Determined Contribution (INDC) stipulated in the COP19 Decision, and Japan has decided on the "Japan's INDC" including the mid-term targets for FY2030 and submitted it to the UNFCCC secretariat. At the 32nd Global Warming Prevention Headquarters held on December 22 2015, "the Action Policy for Global Warming Countermeasures based on the Paris Agreement" was adopted and Japan decided to make steady efforts to achieve the emission reduction target for FY2030 and commit to a long-term and strategic contribution to the reduction of global emissions taking into account that the Paris Agreement set out the 2 degrees goal as a common global goal and aims to achieve a balance between anthropogenic GHG emissions by sources and removals by sinks in the second half of this century. Furthermore, Japan formulated "Plan for Global Warming Countermeasure" based on "Act on Promoting Global Warming Countermeasures", "Government Action Plans" in line with the plan and has been taking the initiative and strengthening the public campaign. In light of this trend, Japan ratified the Paris Agreement in November 2016 and is implementing further measures to combat global warming.

In accordance with the Article 4.1 and 12.1 of the UNFCCC, each Party shall submit National Communication (NC) to the UNFCCC secretariat in order to review the implementation of the commitments related to climate change for each Party under the UNFCCC. Japan has submitted its NCs six times since 1994, and Japan hereby submits its 7th National Communication (NC7).

The structure of this report is in line with the reporting elements prescribed in the UNFCCC reporting guidelines on NCs (Decision 4/CP.5, Annex). This report also refers to the revised draft UNFCCC reporting guidelines on NCs being considered under the Subsidiary Body for Implementation (SBI).

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 FY1990 and FY2015, 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 and Decision 2/CMP.8. Chapter 3 "Policies and Measures" presents information on Japan's policies and measures to achieve its GHG emission reduction targets. Chapter 4 "Projections" describes projections of GHG emissions and removals in FY2020 and FY2030. Chapter 5 "Vulnerability Assessment, Climate Change Impacts, and Adaptation Measures" provides an overview of projected impacts and adaptation activities. Chapter 6 "Financial, Technological and Capacity-building Support" reports information on financial, technological and capacity-building support to developing country Parties provided by Japan in order to support climate change measures in developing countries. Chapter 7 "Research and Systematic Observation" presents information on Japan's research activities and systematic observation related to climate change. Chapter 8 "Education, Training, and Public Awareness" describes information on environmental education and learning, public awareness-raising activities concerning climate change, and support measures for environmental NGOs in Japan.

Executive Summary

Japan's 7th National Communication in accordance with the Article 4.1 and 12.1 of the United Nations Framework Convention on Climate Change (UNFCCC) and the Article 7.2 of the Kyoto Protocol consists of the following eight chapters.

Chapter 1 National Circumstances Relevant to Greenhouse Gas Emissions and Removals

- ✓ The population of Japan as of October 2015 is approximately 127 million. From now on Japan enters into the era of declining population, and it is expected that by 2050 the population of Japan will have decreased to approximately 98 million to 110 million.
- ✓ As of Fiscal Year (FY) 2015 Japan's land area equaled 37.79 million hectares, or 0.3% of the total global land area, of which nearly 80% is accounted for by 24.97 million hectares (66.1%) of forests and 4.32 million hectares (11.4%) of agricultural land.
- ✓ Japan stretches over a great distance from north to south, with its most southern point of the whole land including remote islands located at 20 degrees north latitude, and the most northern point at 46 degrees north latitude. With such a structure, various climate zones exist in the islands of Japan such as subarctic, extratropical and subtropical zone.
- ✓ Japan's GDP for FY2016 is 524 trillion yen and GDP per Capita is 4.13 million yen.
- ✓ The final energy consumption by different sectors in Japan in FY2015 was 43 % for the industrial sector which includes non-energy usage, 32 % for the commercial and residential sector and 23 % for the transport sector.
- ✓ The proportion of electricity source in FY2010 was 29.3% for LNG-thermal, 28.6% for nuclear and 25.0% for coal-thermal. However, due to the Great East Japan Earthquake in 2011, the nuclear power plants in Japan stopped operation and the proportion of the electricity source is significantly changing after FY2011. In FY2015, the proportion of the electricity source was 43.3% for LNG-thermal and 30.6% for coal-thermal.

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Chapter 2 Information on Greenhouse Gas Emissions and Trends

- ✓ Total GHG emissions in FY2015 (excluding LULUCF, including indirect CO_2) were 1,325 million tonnes (in CO_2 eq.). They increased by 4.0% compared to the emissions in FY1990, decreased by 5.3% compared to FY 2005 and decreased by 2.9% compared to the previous year.
- ✓ Between FY1990 and FY2015, CO_2 emissions (excluding LULUCF, including indirect CO_2) increased by 5.9%, CH_4 emissions (excluding LULUCF) decreased by 29.2% and N_2O (excluding LULUCF) decreased by 33.9%.
- ✓ Between Calendar Year (CY) 1990 and CY2015, HFCs emissions increased by 146.1%, PFCs emissions decreased by 49.4%, SF_6 emissions decreased by 83.5% and NF_3 emissions increased 1,651.1%.
- ✓ In FY2015 92.5% of total GHG emissions are accounting with CO_2 emissions. The breakdown of CO_2 emissions shows that fuel combustion accounts for 95.1%, and is followed by industrial processes and product use (3.8%) and waste sectors (1.0%). As for the breakdown of CO_2 emissions within the fuel combustion category, energy industries account for 41.1% and is followed by manufacturing industries and construction at 27.3%, transport at 16.7%, and other sectors at 10.0%. The main driving factor for the increase of CO_2 emissions since FY1990 is the increased solid fuel consumption for electricity power generation.
- ✓ The net removals from Kyoto Protocol Article 3.3 and 3.4 activities in FY2015 were 46.6 million tonnes (in CO_2 eq.).

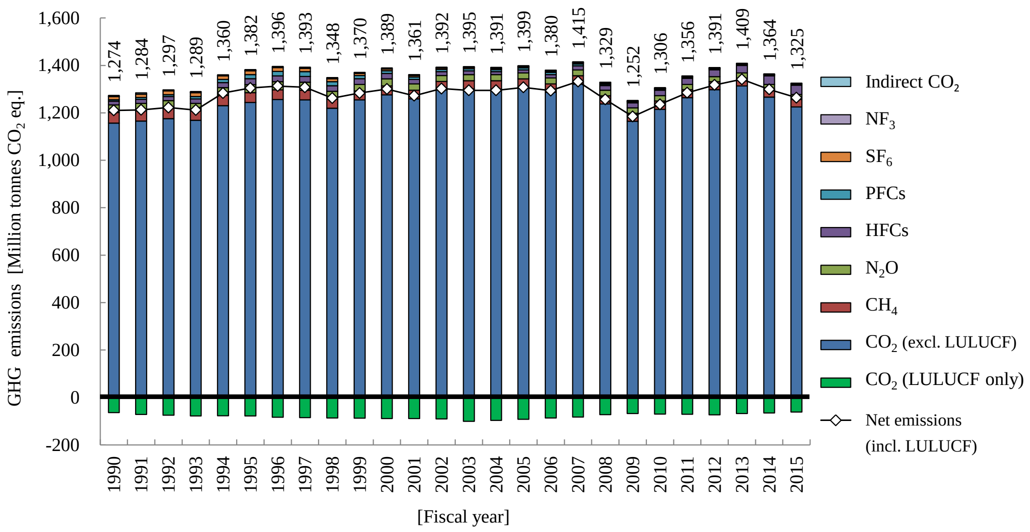


Figure ES- 1 Trends in GHG emissions and removals

Chapter 3 Policies and Measures

(Overall Framework of Promotion of Policies and Measures)

- ✓ In “Basic Environment Law” that defines basic principles regarding environment conservation in Japan and indicates the basic direction of national policy, the proactive promotion regarding ‘Global environment conservation’ is regulated. The national government formulates “Basic Environment Plan” based on Article 15, paragraph 1 in the Law to promote measures related to the environment conservation comprehensively and strategically. In the Plan, the global warming countermeasure is set as one of the important fields for environment policy.
- ✓ Regarding the promotion of global warming countermeasures, “Act on Promotion of Global Warming Countermeasures” is formulated as an individual law. The government established the Plan for Global Warming Countermeasures based on Article 8, paragraph 1, of the Act and the Action Policy for Global Warming Countermeasures based on the Paris Agreement in order for the national government, local governments, businesses and citizens to promote global warming countermeasures in a comprehensive and strategic manner. The Plan for Global Warming Countermeasures is the only general plan regarding global warming in Japan. This plan covers targets for reducing greenhouse gas 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 the global warming countermeasures)

- ✓ Integrated improvement of the environment, economy, and society: Japan promotes global warming countermeasures that would also benefit the comprehensive improvement of environment, economy, and society, utilizing regional resources, technological innovation, and creative ideas, so that the global warming countermeasures would also boost the economy of Japan, create employment, and solve regional problems
- ✓ Steady implementation of measures listed in Japan's NDC: Japan strives for the steady implementation of various policies and measures, such as voluntary approach, regulatory approach, economic approach, and information approach while effectively using their characteristics.
- ✓ Response to the Paris Agreement: Japan communicates and updates its NDC in a five-year cycle, and implements the reporting and reviews related to the progress of implementation and achievement towards the target stipulated in the Paris Agreement.
- ✓ Contribution to reducing the global greenhouse gas emissions through the reinforcement of research and development, and the diffusion of advanced low-carbon technologies: Development of innovative technologies is the key to purse global warming countermeasures and the economic growth at the same time. Japan reinforces the research and development of innovative technologies in promising fields based on the National Energy and Environment Strategy for Technological Innovation towards 2050. Japan also promotes the diffusion of advanced

low-carbon technologies and activities to mitigate global warming through the Joint Crediting Mechanism (JCM) and other efforts.

- ✓ Reform of the awareness of all actors, invoking actions, and reinforcement of cooperation: Japan actively distributes and shares knowledge of exacerbating global warming, specific actions that require greater efforts to achieve the reduction target, and actions that individual citizens must take so that individuals can perceive and understand the necessary information. Japan then trains people who can distribute the necessary information and puts it into practice and implements public campaigns to change awareness at all levels by Japanese citizens to lead them to take action. In addition, Japan encourages individual actors to actively become involved with policies and measures and reinforces cooperation among them by frequently distributing and sharing information concerning the progress of global warming countermeasures.
- ✓ Importance of assessment and review processes (PDCA): To constantly monitor and maintain the effectiveness of the Plan for Global Warming Countermeasures after its establishment, Japan inspects the annual progress of individual measures implemented by the national government based on indexes to evaluate measures and revises the plan when necessary.

(Policies and Measures for Energy-related CO_2)

- ✓ Japan works to realize an energy mix through thorough energy conservation, full use of renewable energy while suppressing the burdens on the people, improvement of the efficiency of thermal power generation, use of nuclear power generations whose safety is approved, and diversification of fuels in different categories by shifting to natural gas in the industry sector based on the policies in the Strategy for Energy Reform. Also Japan strengthens public campaigns to facilitate all types and classes of people to work on mitigating global warming together, change their awareness, and encourage them to make wise choices by selecting low-carbon products, services, and initiatives so that the lifestyles of Japanese people will be appropriate as members of a low-carbon society. In addition the national government, local governments, business operators, and general public participate and cooperate in developing low-carbon cities and regions by building compact cities and reconstructing public transportation networks.
- ✓ In the Industrial Sector, promotion and enhancement of voluntary action plans of industry through steady implementation of Industry’s Action Plans towards a Low-carbon Society and Evaluation and Verification of progress, promotion of introduction of highly energy-efficient equipment and devices, implementation of thorough energy management and promotion of energy efficiency actions through alliance between industry groups have been promoted.
- ✓ In the Commercial and Other Sector, promotion and enhancement of voluntary action plans of industry, improvement of energy efficiency buildings through promotion of mandatory compliance with energy conservation standards targeting new construction, promotion of introduction of highly energy-efficient equipment and devices, implementation of thorough energy management, expansion of holistic and efficient use of Energy have been promoted.
- ✓ In the Residential Sector, development a public campaign through the implementation of “COOL CHOICE” that is intended to encourage the public to choose all possible smart choices to contribute to global warming prevention, such as replacement of products, services and lifestyle which are energy conservative and low-carbon, improvement of energy efficiency of housing through promotion of compliance with energy conservation standards targeting new housing, promotion of introduction of highly energy-efficient equipment and devices, implementation of thorough energy management have been promoted.
- ✓ In the Transport Sector, promotion and enhancement of voluntary actions of industry, implementation of measures concerning vehicles, improvement of traffic flows to reduce CO_2 emissions, greening of vehicle transport operators by promoting the environmentally-friendly usage of vehicles, promotion of public transport utilization and bicycle, Energy Efficiency Improvement and Low carbonization in railways, vessel and aviation, promotion of low-carbonized logistics system through promotion to improve truck transport efficiency and cooperative transport and delivery have been promoted.
- ✓ In the Energy Conversion Sector, promotion and enhancement of voluntary action plans of industry, the maximum introduction of renewable energy, reduction of CO_2 emission intensity and promotion of energy conservation policies in the oil product manufacturing sector have been promoted.

(Policies and Measures for non-Energy-related CO_2)

- ✓ For non-energy-related CO_2, increasing the use of blended cement, diffusion of biomass plastics and reduction of the amount of waste Incineration has been promoted.
- ✓ For Methane (CH_4), measures to reduce CH_4 emissions in relation to Agricultural soil which can reduce in rice cultivation by changing the way organic matter is managed in line with local conditions, including replacing the conventional approach of plowing in rice straw with application of compost, reduction of the amount of wastes in final disposal, adoption of semi-aerobic landfill structure in final waste disposal sites have been promoted.
- ✓ For Nitrous Oxide (N_2O), measures to reduce N_2O in relation to Agricultural soil through lower fertilizer application rates, split-application regimes and slow-release fertilizers, advancement of combustion in sewage sludge incineration facilities, and reduction of the amount of municipal wastes incinerated have been promoted.
- ✓ For fluorinated gases (HFCs, PFCs, SF_6, and NF_3), practical efforts on phasing down of fluorocarbons, promotion of eliminating fluorocarbons and lowering GWP of products, preventing leakage of fluorocarbons from use of refrigeration and air conditioning equipment for business use, recovery and proper disposal of fluorocarbons from refrigeration and air conditioning equipment have been promoted.

(Policies and Measures for Carbon Sink)

- ✓ For forest carbon sink, measures such as proper forest management and conservation designed to achieve the objectives regarding fulfillment of the multiple roles of forests as well as the supply and use of forest products outlined in the "Basic Plan for Forest and Forestry" have been promoted. Through the implementation of these measures, the targeted amount of carbon sinks in forests (about 38 million t-CO_2 or more in FY 2020 and about 27.8 million t-CO_2 in FY 2030) will be achieved. Therefore, while collaborating with various entities including local governments, forest owners, forestry and lumber industries and business operators, and citizens, the following measures including cross-sectoral ones will be comprehensively implemented. Specifically, initiatives such as healthy forest management, promotion of the proper management and conservation of protection forests, development of efficient and stable forest management, promotion of people's participation in forest management and promotion of the use of lumbers and woody biomass" have been promoted.
- ✓ For carbon sinks in agricultural soils, it is proven that the carbon storage in cropland and grassland soils in Japan can be increased by continuous usage of organic matter such as compost and green manure. Thus, carbon stock in the soil of cropland and grasslands is increased by promoting soil development by applying organic matter, such as compost and green manure.
- ✓ For the promotion of urban greening, the actions will be continuously promoted such as urban park maintenance, greening in roads, rivers, and sand control facilities, bays, sewage treatment facilities, public housing, and government buildings, along with the increase of new green spaces on the rooftops of buildings.

(Cross-sectional Strategies)

- ✓ As for cross-section measures to achieve emission reduction targets, the J-Credit Scheme to certify credits that can be used to achieve the Industry's Action Plan toward a Low Carbon Society and carbon offsets, development of public campaigns, and formulation of low-carbon urban/regional structures and socioeconomic systems have been implemented.
- ✓ As for other relevant cross-section measures, realization of hydrogen society, initiatives based on the guidelines for controlling GHG emissions, operation of GHG emissions accounting, reporting and disclosure program, promotion of environmental considerations in business initiatives, promotion of Joint Crediting System (JCM), measures for greening tax scheme and effective utilization for climate change mitigation, greening finance by providing financial supports to mobilize private funds into low-carbon projects, and consideration of domestic emissions trading scheme have been implemented.

Chapter 4 Projections and the Total Effect of Policies and Measures

(Overview)

- ✓ The future level of 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 FY2020 and FY2030 were estimated.
- ✓ The estimated total GHG emissions in FY2020 under a 'with measures' scenario are approximately 1,399 million t-CO_2 equivalent, which are an increase by 0.2% from the base year FY2005 (1,397million ton). They aim at a target of 3.8% or more emission reduction in FY2020 compared to the FY2005 level by implementing additional mitigation measures and using removals from LULUCF sector.
- ✓ The estimated total GHG emissions in FY2030 under a 'with measures' scenario is approximately 1,079 million t-CO_2 equivalent. It is a decrease by 23.4% and 22.7% from FY2013 and FY2005, respectively. Taking into the account the projections of removals (removals from forests (approximately 27.8 million t-CO_2), agricultural soils (approximately 7.9 million t-CO_2) and revegetation (approximately 1.2 million t-CO_2)) in FY2030, they decrease by 26.0% and 25.4% from FY2013 and FY2005, respectively, as shown in Japan's NDC.

Table ES-1 Information on greenhouse gas projections under a 'with measures' scenario

	GHG emissions and removals (kt CO_2 eq)							**GHG emission projections (kt CO_2 eq)**	
	Base year (2005)	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2030**
Sector									
Energy	1,009,693.34	887,029.05	927,209.22	956,559.13	1,011,324.63	947,165.71	967,837.99	1,053,578.32	784,200.00
Transport	235,977.66	204,245.55	244,866.29	253,322.94	235,791.69	217,696.14	206,810.43	194,840.61	165,500.00
Industry/industrial processes	84,728.60	110,451.48	136,418.29	108,173.62	86,721.16	80,158.47	93,020.28	93,001.43	74,800.00
Agriculture	40,015.02	37,635.95	37,158.50	35,322.91	35,227.10	35,885.72	33,666.91	38,723.08	37,500.00
Forestry/LULUCF	-89,643.58	-63,455.06	-77,779.64	-88,809.20	-91,547.81	-70,091.39	-60,939.88	-36,404.03	-25,900.00
Waste management/waste	26,095.94	28,897.43	32,166.79	31,668.20	26,666.91	22,796.30	21,232.21	19,321.96	17,300.00
Gas									
CO_2 emissions including net CO_2 from LULUCF	1,214,416.17	1,157,164.51	1,243,848.87	1,275,777.13	1,307,693.19	1,215,010.75	1,225,239.49	1,261,710.51	971,600.00
CO_2 emissions excluding net CO_2 from LULUCF	1,304,375.96	1,093,427.39	1,165,799.19	1,186,712.02	1,215,898.89	1,144,690.19	1,164,070.04	1,298,375.21	997,800.00
CH_4 emissions including CH_4 from LULUCF	39,029.18	44,223.07	41,637.89	37,666.02	35,279.25	34,855.00	31,294.94	33,988.76	31,700.00
CH_4 emissions excluding CH_4 from LULUCF	38,962.32	44,296.05	41,707.78	37,732.72	35,346.11	34,914.69	31,354.31	33,932.91	31,600.00
N_2O emissions including N_2O from LULUCF	25,760.31	31,517.58	32,860.59	29,561.41	24,829.11	22,318.20	20,829.59	21,762.11	21,300.00
N_2O emissions excluding N_2O from LULUCF	25,510.95	31,726.66	33,060.74	29,750.62	25,008.76	22,487.68	20,999.79	21,557.28	21,100.00
HFCs	12,724.24	15,932.31	25,213.19	22,852.00	12,781.83	23,305.23	39,202.80	38,300.00	21,600.00
PFCs	8,623.35	6,539.30	17,609.92	11,873.11	8,623.35	4,249.54	3,308.10	4,000.00	4,200.00
SF_6	5,063.86	12,850.07	16,447.52	7,031.36	5,053.01	2,423.87	2,121.86	2,400.00	2,700.00
NF_3	1,249.87	32.61	201.09	285.77	1,471.75	1,539.74	571.03	1,000.00	500.00
Total with LULUCF	1,306,866.97	1,268,259.45	1,377,819.08	1,385,046.80	1,395,731.50	1,303,702.34	1,322,567.82	1,363,061.37	1,054,000.00
Total without LULUCF	1,396,510.56	1,204,804.39	1,300,039.44	1,296,237.60	1,304,183.69	1,233,610.94	1,261,627.94	1,399,465.40	1,079,000.00

(Projections result by gas)

- ✓ Energy-related CO_2: The estimated emissions in FY2020 increase by 0.4% (approximately 1,224 million t-CO_2) compared to the emissions in FY2005. A significant reduction is expected in the Transport sector, meanwhile estimated emissions increase in Industry, Commercial and other sectors due to vitalization of economic activities. However, actual emissions in FY2015 shows a reduction by 5.7% (approximately 1,149 million t-CO_2) compared to the emissions in FY2005. It is especially contributed by the reduction in Industry, Transport and Energy conversion sectors. In FY2030, a significant reduction is estimated in Commercial and other, Residential, Energy conversion and Transport sectors. And it is estimated decrease by 25.0% (approximately 924 million t-CO_2) compared to the emissions in FY2013.
- ✓ Non-energy-related CO_2: The estimated emission in FY2020 decrease by 13.0% compared to FY2005 (approximately 74.3 million t-CO_2), and the estimated emissions in FY2030 decrease by 6.7% compared to FY2013 (by 17.0% from FY2005) (approximately 70.8 million t-CO_2). Reduction rate in the IPPU sector is the largest in FY2020, followed by the Waste sector (Excluding 'the Other sector'). In contrast, the largest reduction rate in FY2030 is in the Waste sector, followed by the IPPU sector.

- ✓ Methane (CH_4): The estimated emission in FY2020 decrease by 12.9% compared to FY2005 (approximately 33.9 million t-CO_2 eq.), and the estimated emissions in FY2030 decrease by 12.3% compared to FY2013 (by 18.8% from FY2005) (approximately 31.6 million t-CO_2 eq.). The largest reduction rate is in the waste sector, followed by the fugitive emission from fuels sector in both FY2020 and FY2030.
- ✓ Nitrous oxide (N_2O): The estimated emission in FY2020 decrease by 15.5% compared to FY2005 (approximately 21.6 million t-CO_2 eq.).The estimated emissions in FY2030 decrease by 6.1% compared to FY2013 (by 17.4% from FY2005) (approximately 21.1 million t-CO_2 eq.). Reduction rate in the IPPU sector is the largest, followed by the Waste sector in FY2020. The largest reduction rate in FY2030 is in the Waste sector, followed by the Fuel combustion sector.
- ✓ Fluorinated gases (HFCs, PFCs, SF_6, and NF_3): The estimated emission in CY2020 increase by 64.6% from CY2005 (approximately 45.6 million t-CO_2 eq.). The estimated emissions in CY2030 decrease by 25.1% from CY2013 (increase by 4.5% from CY2005)(approximately 28.9 million t-CO_2 eq.). Since refrigerants in refrigerators and air conditioners have shifted from Hydrochloro-fluorocarbons (HCFCs), which are ozone-depleting substances, to HFCs, it is expected that the emissions of fluorinated gases are projected to increase. The estimated emissions of HFCs in FY2020 increase approximately threefold compared to the emissions in FY2005, meanwhile it will fall below compared to the actual emissions in FY2015. The estimated emissions of HFCs in FY2030 decrease by 32.1% compared to FY2013 with the measures such as eliminating fluorocarbons, lowering GWP and leakage prevention.

(Projections result by sector)

- ✓ Energy sector: The estimated emissions in FY 2020 are an increase of approximately 0.2% compared to FY 2005 (approximately 1,248.4 million t-CO_2 eq.). In FY 2030, it is a decrease of approximately 24.6% compared to FY2013 and by 23.8% compared to FY2005 (approximately 949.7 million t-CO_2 eq.).
- ✓ Industrial Processes and Product Use (IPPU) sector: The estimated emissions in FY 2020 (approximately 93.0 million t-CO_2 eq.) are an increase of approximately 9.8% compared to FY 2005. In FY 2030 (approximately 74.8 million t-CO_2 eq.), it is a decrease of approximately 14.0% level as compared to FY2013 and a decrease by 11.7% compared to FY2005. The main driver of the increase in FY2020 is an increase of emissions in refrigerants sector since refrigerants have shifted from HCFCs, which are ozone-depleting substances, to HFCs. The main factor of the decrease in FY2030 is an emission reduction in 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 lowering GWP.
- ✓ Agriculture sector: The estimated emissions in FY 2020 are a decrease of approximately 3.2% compared to FY 2005 (approximately 38.7 million t-CO_2 eq.). In FY2030, it is a decrease of approximately 5.1% as compared to FY2013 and a decrease by 6.3% compared to FY2005 (approximately 37.5 million t-CO_2 eq.). The main driver of the emission decrease in FY2020 and FY2030 is an emission reduction from rice cultivation by the implementation of emission reduction measures.
- ✓ LULUCF sector: The estimated removals in FY 2020 are approximately 36.4 million t-CO_2. In FY2030, it is approximately 25.9 million t-CO_2. The LULUCF sector covers CO_2 emissions and removals resulting from carbon stock change and non-CO_2 emissions in forest land, cropland, grassland, wetlands, settlements, and other land. Major parts of removals attribute to forest land sinks.
- ✓ Waste sector: The estimated emissions in FY 2020 are a decrease of approximately 26.0% compared to FY 2005 (approximately 19.3 million t-CO_2 eq.). In FY2030, it is a decrease of approximately 20.7% compared to FY2013 and decrease of approximately 33.7% compared to FY2005 (approximately 17.3 million t-CO_2 eq.). Main drivers of the emission decrease in FY2020 and FY2030 are a decrease of 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.

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

(Observation Results and Projections of Climate Change in Japan)

- ✓ The Central Environment Council assessed the impact of climate change in Japan. The results of assessments as "Report on impact assessment of climate change in Japan and future issues (Climate Change Impact Assessment Report)" has been compiled in March, 2015.
- ✓ As the observed climate change, the annual mean temperature in Japan fluctuates on different time scales ranging from years to decades, and it is virtually certain that it has increased from 1898 to 2016, at a rate of 1.19°C per 100 years. For annual precipitation, no long-term trend is evident for the period 1898–2016, but Japan experienced relatively large amounts of rainfall until the mid-1920s from the beginning of the observation, and during the 1950s, and the annual figure has become more variable since the 1970s. Also, the annual number of days with precipitation of ≥ 100 mm has increased from 1901 to 2016. In addition, the annual mean sea surface temperature around Japan has risen by +1.09°C per century, which is greater than the corresponding value for the North Pacific overall (+0.50°C per century). On the other hand, during the period from 1951 to 2016, the numbers of formations show no discernible long-term trend, but have often been lower since the latter half of the 1990s than in previous years.
- ✓ As a projection, the higher the GHG emissions, the more the temperature will increase. Annual precipitation is characterized by a large range of inter-annual variability; changes in both national and regional averages exhibit no clear trend that depends on differences in scenarios; in some cases, the projections are for increases in precipitation, and in other cases, for the decrease, relative to the end of the 20th century. Also, the frequency of heavy rainfall, short-term intense rainfall and the annual number of dry days (days with daily precipitation of less than 1.0 mm) will increase across Japan relative to the end of the 20th century. In addition, sea surface temperature around Japan is projected to increase, and the projected long-term SST trend in the Sea of Japan that is greater than those in the seas south of Japan. Besides, an increasing trend is projected relative to the present in the number of occurrences of strong typhoons, the maximum intensity of typhoons, and rainfall intensity at the time of maximum typhoon intensity.

(Climate Change Impact Assessments)

- ✓ In the Climate Change Impact Assessment Report, significance, urgency and confidence of climate change impact in Japan was assessed in the seven sectors which are “agriculture, forest/forestry and fisheries”; “water environment/water resources”, “natural ecosystems”, ”natural disasters/coastal areas”, “human health”, “industrial and economic activities” and “life of citizenry/urban life” by the expert judgment based on scientific findings.
- ✓ The Climate Change Impact Assessment Report formulated in Mar. 2015 showed that the impacts of climate change are appearing in Japan, including an increase in temperature and frequency of heavy rainfall, a decrease in number of days with precipitation, and an increase in sea surface temperature, and that due to high temperature, impacts can already be seen, including a decline in quality of agricultural crops, and shifts in the distribution of flora and fauna.
- ✓ The submission also revealed that in the future, there may be further increases in temperature and the frequency of heavy rainfall events, decreases in the number of days with precipitation, and increases in sea surface temperature, as well as increases in the amount of precipitation falling in heavy rainfall events, increases in the maximum intensity of typhoons, and sea-level rise.

(Basic Adaptation Measures)

- ✓ In order to promote systematic and integrated efforts that are coordinated to address these impacts of climate change, the first Adaptation Plan was approved by the Cabinet in November 2015, which establishes the basic principles, such as a vision for society, as well as basic approaches, the basic direction for measures in each sector, basic measures, and international measures. This Adaptation Plan aims to create a secure, safe, and sustainable society that, whatever impacts arise from climate change, is able to minimize or avoid any damage—such as loss of life of citizens, and damage to property, livelihoods, the economy, and the natural environment—and is able to recover quickly. This is to be achieved through facilitating adjustment of social systems and natural systems by promoting measures to adapt to the impacts of climate change.

- ✓ In the Adaptation Plan, the basic adaptation measures in seven sectors which are “agriculture, forest/forestry and fisheries”; “water environment/water resources”, “natural ecosystems”, ”natural disasters/coastal areas”, “human health”, “industrial and economic activities” and “life of citizenry/urban life” are described.

(Progress and Result of Adaptation Action)

- ✓ A trial monitoring for adaptation measures implemented in FY2016 has been conducted in order to consider how to track the progress of adaptation measures. In October 2017, after formulating the Adaptation Plan, the “Inter-Minister Meeting of the relevant ministries and agencies on adaptation for climate change impacts” summarized a “Trial monitoring report for the National Plan for Adaptation to the Impacts of Climate Change”.
- ✓ In the trial monitoring, all measures in the seven sectors (agriculture; forest/forestry; fisheries; water environment/water resources; natural ecosystems; natural disasters/coastal areas; human health; industrial and economic activities; and life of citizenry/urban life) and basic actions are categorized into 56 measure groups, and the progress of all measures implemented in FY2016 has been tracked by the preparation of individual sheet on each measure group by each ministry and agency. Within 56 measures groups, indicator has been set up in the 38 measure groups (but there are some cases that the indicator has been set for only a partial action/project in such measure groups). The quantitative indicator has been set in the 36 measure groups and qualitative indicator has been set in the 13 measure groups.
- ✓ Preparing and publication of the monitoring report will be effectively worked to provide information to citizens as well as will be occasions for each ministry and agency to track the progress of measures in the Adaptation Plan by themselves and to review the measures as needed. Therefore, the monitoring for the Adaptation Plan will be continued to conduct annually in the same manner at the Inter-Minister Meeting, and the progress of the measures will be tracked and published on fiscal year basis.

Chapter 6 Financial, Technological and Capacity-building Support

(Finance)

- ✓ Japan has implemented various support projects to assist developing countries, especially those making efforts to reduce GHG emissions as well as those which are vulnerable to the negative impacts of climate change.
- ✓ In November 2015, at COP21, Japan announced the “Actions for Cool Earth (ACE) 2.0” and committed to provide approximately 1.3 trillion yen of public and private climate finance to developing countries in 2020. Japan continues its efforts toward a goal of mobilizing jointly USD 100 billion per year including both public and private finance by 2020 as the long-term finance.
- ✓ In addition, at the 7th Pacific Islands Leaders Meeting, Japan held “climate change and development forum” and the participants exchanged their views on the ways to use climate finance effectively in Pacific islands. Further, in 2017, in order to establish a decarbonised and a resilient society, Japan announced “Japan’s Assistance initiatives to Address Climate Change 2017”, which shows Japan’s vision and specific programs to accelerate climate change measures and sustainable development in developing countries.
- ✓ Under these efforts, financial support from Japan in two years from 2015 to 2016 has reached approximately USD 23.3 billion (public finance amounted approximately USD 19.5 billion, private finance amounted approximately USD 3.8 billion). Furthermore, at the G20 summit in November 2014, Japan announced USD 1.5 billion contributions to the Green Climate Fund (GCF). After approval of a bill stipulating the necessary measures for the contribution, Japan has signed an agreement with the GCF secretariat to contribute 1.5 billion USD.

(Technology Development and Transfer)

- ✓ In order to contribute to significant global emission reduction through innovation, based upon National Energy and Environment Strategy for Technical Innovation towards 2050 adopted in April 2016, Japan will promote the development of innovative technology with great reduction potential and impact in a long-term perspective. For example, Japan will promote research and development, demonstration, and model projects regarding manufacturing, transporting/storing and utilizing energy carriers such as hydrogen, the future power electronics using gallium nitride (GaN), Carbon Capture and Storage (CCS), and Carbon Capture and Utilization (CCU).

- ✓ Japan will also accelerate innovation through "Innovation for Cool Earth Forum (ICEF)", the global platform to promote discussions and cooperation on innovation in energy and environmental technology among worldwide academic, industrial and public sectors. Furthermore, Japan will promote demonstration projects to create innovations for drastically reconstructing advanced low-carbon technology in accordance with specific characteristics of developing countries. Japan also will create co-innovation projects by incorporating the needs of developing countries and the seeds provided by Japanese industries, taking an initiative of dispatching business missions to developing countries, and accelerate collaboration of private companies and local governments on both sides. Japan will foster further innovation by sharing information on dissemination of innovative technology and its effectiveness.
- ✓ Japan will promote the dissemination of advanced low-carbon technology with public-private partnership through Joint Crediting Mechanism (JCM), in which Japan has established partnerships with 17 partner countries and supported more than 100 projects. Japan will also support both the introduction of waste power generations as one of the environmental infrastructure and waste management system as a package. Japan will support the optimization of existing infrastructure and operation and maintenance (O&M) by private companies thorough utilizing Internet of Things (IoT), which contributes to emission reduction and the visualization of reduction effects. In addition, in order to implement large-scale projects and wider dissemination of low-carbon technology, Japan will enhance collaboration with public finance of, among others, JICA and JBIC, and will enhance capacities and carry out feasibility studies for project formation to improve the 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 will provide support based upon its knowledge and promote understanding of the importance of the programs implemented in developing countries.

(Capacity-Building)

- ✓ In addition, in order 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" reflecting on their challenges and needs, and contribute to global reduction of the GHG emissions. Japan will incorporate the needs of each country and the seeds of technology and know-how acquired by Japanese private 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, further opportunities of co-innovation should be enhanced by visualizing those needs and seeds. It is important to develop institutions and capacities in developing countries and promote the engagement of private companies and local governments for implementing climate change activities. For this purpose, Japan will establish "Partnership to Strengthen Transparency for Co-Innovation (PaSTI)".
- ✓ 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 such as the NDC Partnership.

Chapter 7 Research and Systematic Observation

(Overview)

- ✓ Under the Act on Promotion of Global Warming Countermeasures which set a framework on global warming countermeasures in 1998, the Kyoto Protocol Target Achievement Plan (formulated in April 2005 and altogether revised in August 2008) sets a section on the "promotion of research on climate change and strengthening of observation and monitoring systems" which states that Japan will strengthen comprehensive observation and monitoring systems as a basic measure.
- ✓ In addition, the basic principle in the National Plan for Adaptation to the Impacts of Climate Change (decided by Cabinet in November 2015) states that Japan will continuously enhance scientific knowledge through continuing implementation of observation and monitoring as well as projection and assessment, and promotion of studies and research. Furthermore, the Plan for Global Warming Countermeasures (decided by Cabinet in May 2016) states that Japan will enhance the promotion of research on climate change, and observation and monitoring system as fundamental measures of global warming countermeasures.

- ✓ Japan established the Global Environment Research Fund in 1990 (currently the Environment Research and Technology Development Fund). This fund is 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 medium- and long-term perspectives.

(Research)

- ✓ Concerning important policy issues such as “Ensuring stable energy and improving energy efficiency”, “Addressing global climate change” and “Responding to biodiversity loss” set as a part of “Addressing economic and social challenges” which is one of the four pillars of the Fifth Science and Technology Basic plan, promote science technology innovation to solve the problems.
- ✓ As a part of “Addressing global climate change” mentioned above, promote the building of “Global environment information platform” by taking the global environment information as a big data to solve economic and social challenges caused by climate change.
- ✓ Regarding promising and innovative technologies which have large potential and powerful impact on the reduction of CO_2, identified in the “National Energy and Environment Strategy for Technological Innovation towards 2050” at Council for Science, Technology and Innovation (CSTI), Japan identifies the technology challenges and promotes the development in mid-and-long-term.
- ✓ 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.
- ✓ 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.

(Systematic Observation)

- ✓ Promote comprehensive measures on observation and monitoring of climate change under “Japan’s enforcement policy of earth observation in next decade” based on the “Science and Technology Basic Plan” and the “Earth Observation Promotion Strategy”. In the promotion, bearing in mind Japan’s contribution to the development of GEOSS, Japan ensures the consistency with international observation and monitoring projects in terms of methods and takes care to enable effective data utilization through exchanging outcomes of activities of observation and monitoring organizations each other, such as by utilizing “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 Joint World Meteorological Organization (WMO)/UNESCO Intergovernmental Oceanographic Commission (IOC) Technical Commission for Oceanography and Marine Meteorology (JCOMM), 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 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 participates in 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 satellite, aircrafts, ships, and ground-based observation in cooperation with international organizations and research projects.

Chapter 8 Education, Training, and Public Awareness

(Overview)

- ✓ CO_2 emissions have been consistently 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 that 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 the energy issues closely involved at home education, school education and social education. 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.
- ✓ The Government of Japan will actively provide and share, 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. The Government of Japan will also carry 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.

(Promotion of Environmental Education and Education for Sustainable Development)

- ✓ Based on the Act on promotion of Environmental Conservation Activities though Environmental Education established in June 2011, The government of Japan formulate and implement comprehensive measures for the promotion of the environmental education in which Citizens and Private Organizations, etc. are to make efforts to voluntarily undertake Environmental Conservation Activities, etc.

  Also, the Inter-ministerial Meeting on Education for Sustainable Development (ESD) was set up to promote activities of the measures related to ESD. Following the adoption of the Global Action Programme on ESD (hereinafter “GAP”), which is the follow-up program to “the United Nations Decade of ESD” (2005-2014), the implementation plan of GAP in Japan was formulated in March 2016 and efforts are being made for its systematic implementation.

(Activities for Promoting the Prevention of Global Warming)

- ✓ The Government of Japan will encourage voluntary actions by each individual citizen by strongly appealing to public awareness. This will be done through the appropriate provision of information using diverse methods. In doing so, the government will work 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 will contribute to the limitation of greenhouse gas emissions or the promotion of sink measures.

(Support for Environmental NGOs)

- ✓ 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 while preserving the original intent of their activities.

Chapter 1

National Circumstances Relevant to Greenhouse Gas Emissions and Removals

1.1 Government

1.1.1 Administrative organization

Administrative organization of Japan is as shown in Figure 1-1. It consists of 1 Office and 12 Ministries as of August 2017. Principle 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
	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 administrial 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 suply ・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 polllutions, 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 2017)

Reference: Cabinet Office "Figure of Administrative organization (as of August 2017)", Act for Establishment of each ministry

1.1.2 Budget for Global Warming Countermeasures

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 mid- and long-term low-carbon society. In order to assess the overall government initiatives from budget perspective as well as to enhance linkage among ministry bodies, the plans for the budget amount related to the Global Warming Countermeasure are gathered. The plan for the budget related to the Global Warming Countermeasures per each measure for FY2017 is 432.5 billion yen (53%) for “A. Effect to the reduction of greenhouse gas by 2030”, 56.6 billion yen (7%) for “B. Effect to the reduction of greenhouse gas after 2030”, 290.3 billion yen (36%) for “C. Others that contribute to the reduction of greenhouse gases as a result”, and 38.2 billion yen (5%) for “D. Fundamental measures” (Table 1-1).

Table 1-1 Budget plan for Global Warming Countermeasures related matters in FY2017

(Unit: million yen)

	A	B	C	D
	Those effective for GHG reduction by 2030	Those effective for GHG reduction after 2030	Those contributing to GHG reduction as a result	Basic measures, etc.
Ministry of Economy, Trade and Industry	**134,623**	**36,540**	**115,374**	**4,719**
Ministry of the Environment	**128,306**	**9,900**	**52,560**	**11,759**
Ministry of Agriculture, Forestry and Fisheries	**132,226**	**17**	**59,300**	**2,005**
Ministry of Land, Infrastructure, Transport and Tourism	**18,629**		**27,468**	**2,027**
Ministry of Education, Culture, Sports, Science and Technology		**10,172**	**19,033**	**15,178**
Others	**18,712**		**16,615**	**2,537**
All ministries and offices	**432,496**	**56,629**	**290,349**	**38,225**

Note1: It does not include those that cannot be identified by global warming countermeasures.
Note2: Numbers may not add up due to rounding.
Source: Ministry of the Environment “Budget plan for Global Warming Countermeasures related matters for FY2017”.

The breakdown of the Global Warming Countermeasure related budget per measures per sectors, “Greenhouse gas removal measures” is 237.7 billion yen (29%) and is the largest, followed by “Cross-cutting measures” as 146.8 billion yen (18%), and “Initiatives by Energy Conversion sector” as 120.6 billion yen (15%).

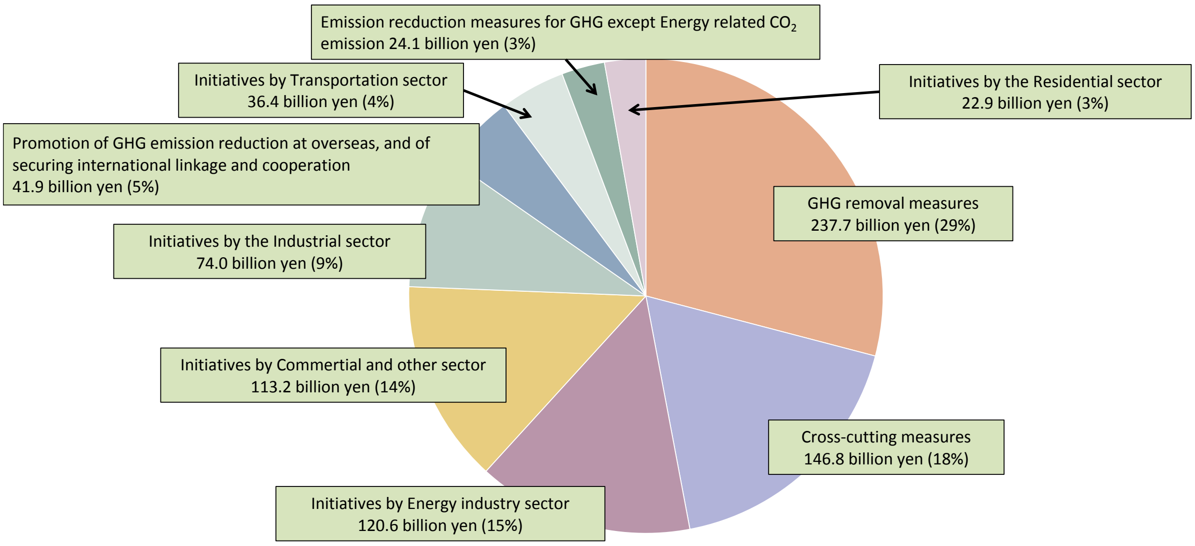


Figure 1-2 Breakdown of the budget plan for Global Warming Countermeasures

Reference: Ministry of the Environment “Budget plan for Global Warming Countermeasures related matters for FY2017”

1.2 Population and Households

1.2.1 Population structure

The population of Japan was approximately 72 million immediately after the Second World War, had consistently been in an increasing trend during the 20th century, reaching over 100 million in 1967. However, the population increase rate slowed down after the 1980s, after reaching 128million in 2008 the population has fallen into a decreasing trend. The population of Japan as of October 2015 is approximately 127 million. According to the Annual Health, Labour and Welfare Report, from now on Japan enters into the era of declining population, forecasted with a rapid decrease. It is expected that by 2050 the population of Japan will have decreased to approximately 98 million to 110 million.

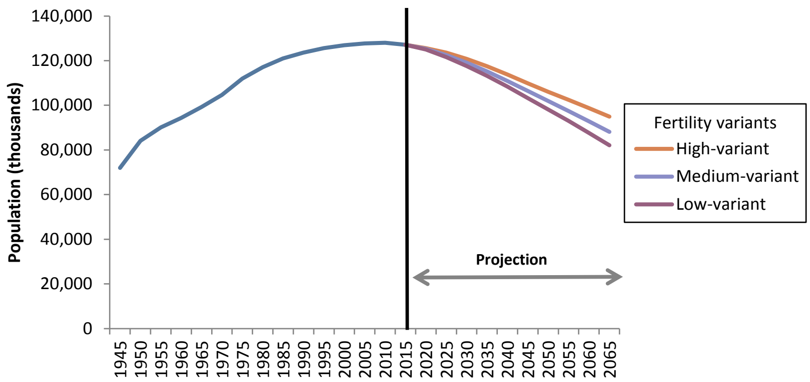


Figure 1-3 Long-term trend in Japan's population (as of October 1st of each year)

Reference: Statistics Bureau, Ministry of Internal Affairs and Communications "National Census" (1945 – 2015)
National Institute of Population and Social Security Research "Population Projections for Japan: 2016 to 2065(medium-mortality)" (after 2016)

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 by the increase in marriages immediately after the Second World War, and by the "Second baby Boomer" which is brought by the births by the first baby boomers, and by the bottom of the pyramid narrowing after then.

When comparing the population structure of 2015 to that of 1990, in 1990 the number of population from age 0 - 64 was approximately 90% of the total population, with a relatively high portion of the younger generation, however, in 2015 the population from age 0 - 64 was approximately 70% of the population, nearly 20 points less compared to that of 1990, and the population is aging.

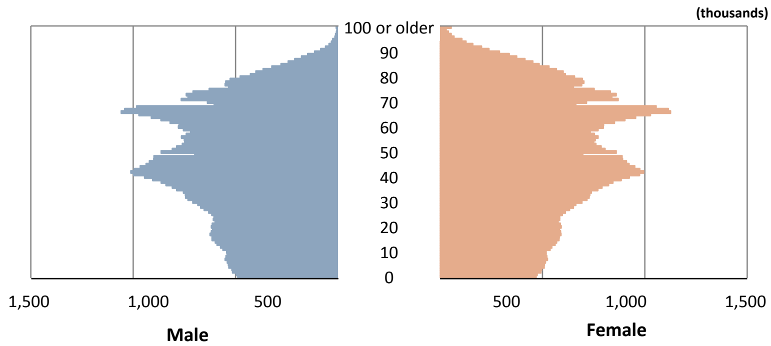


Figure 1-4 Japan's population pyramid (as of October 1st, 2015)

Reference: Ministry of Internal Affairs and Communications "2015 Population Census"

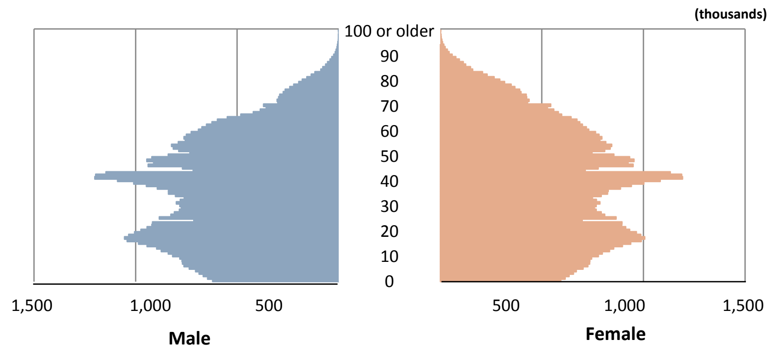


Figure 1-5 Japan's population pyramid (as of October 1st, 1990)

Reference: Ministry of Internal Affairs and Communications "2015 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 the Second World War, however declined rapidly after that and rated lower than the replacement level[1] for the first time in 1956 (2.24 in that year). Since then the total fertility rate has shown a gradual decline, reaching less than 2.00 after 1975. To note, in the recent years, the total fertility rate has continued to increase gradually from 2006, marking 1.44 in 2016.

In the post-war period, the 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, due to the decrease in the number of live births and increase in the number of deaths, the natural changes had fallen negative for the first time in 2005. Although it turned positive in 2006 tentatively, the number of natural changes has been in a downward trend since then.

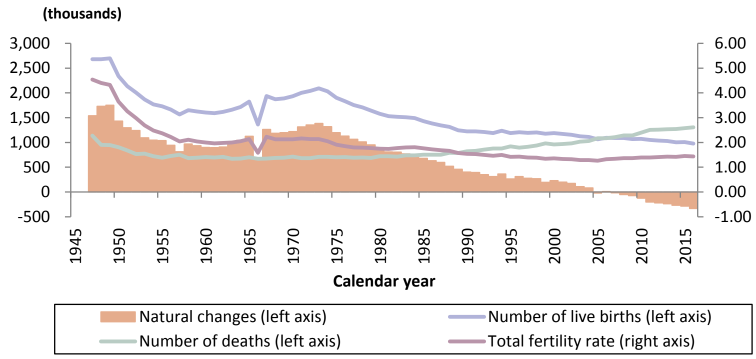


Figure 1-6 Trend in number of live births and deaths, total fertility rate in Japan

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

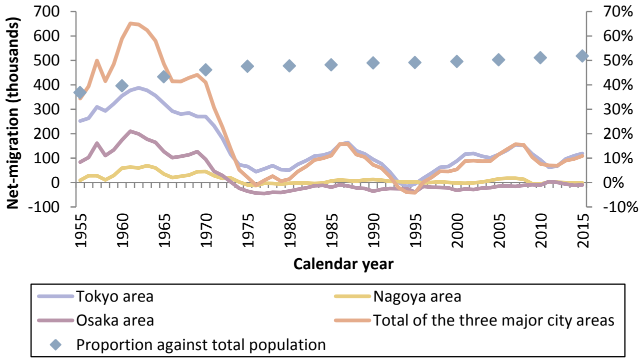
1.2.2 Population distribution

Trends in positive and negative net-migration to the three metropolitan areas are shown in

Figure 1-7. During the 1950s and the 1970s, the positive migration to the three metropolitan areas had greatly exceeded the negative migration, as many of those born in the suburban areas moved out for employment and further education. Soon after, in the mid-1970's and onwards when Japanese economy entered a period of stable growth, the number of the positive migrations to the three metropolitan areas has slowed down. When looking at each metropolitan area, for Nagoya and Osaka area the excess of positive net-migration is close to zero in the long

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

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 the time, accelerating the centralization of the population to Tokyo.



Note1: Tokyo area includes Saitama Prefecture, Chiba Prefecture, Tokyo metropolitan and Kanagawa Prefecture.
Note2: Nagoya area includes Gifu Prefecture, Aichi Prefecture and Mie Prefecture.
Note3: Osaka area includes Kyoto Prefecture, Osaka Prefecture, Hyogo Prefecture, Nara Prefecture.

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 in 2015 it has increased to 51.8%. From this data, population had centralized to metropolitan areas throughout the post-war era. According to the population distribution of Japan as of 2015 (Figure 1-8), centralized population areas with population more than 5,000 persons per square kilometer are mainly the Tokyo, Nagoya and Osaka areas. On the other hand, areas with population less than 100 persons per square kilometer shares the majority of the land, and there are areas with no residents around Hokkaido, Tohoku and Hokuriku area.

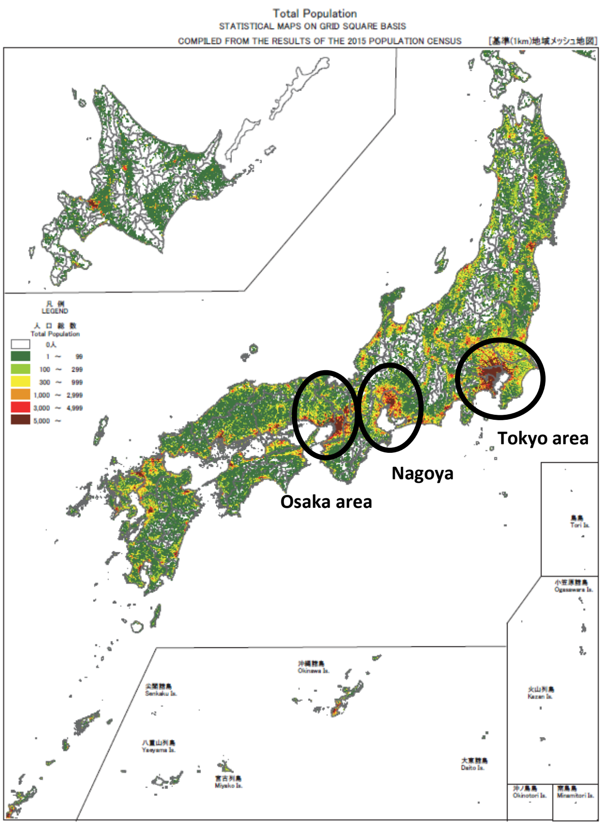


Figure 1-8 Total population (as of October 1st, 2015)

Reference: Ministry of Internal Affairs and Communications "Statistical Maps on Grid Square Basis for 2015 National Census"

1.2.3 Number of households

Number of households in Japan in 2015 was approximately 53 million, an increase by 2.9% compared to 2005. The number of the persons per household in 2015 decreased to 2.33 compared to 2.42 in 2010. After 1970 the number of households continues to grow and the number of the persons per household continues to decrease. These are due to the changes in the household structure such as the shift from big families to nuclear family and the increase of one-person household, as well as a decrease in the number of children from the decrease in the fertility rate.

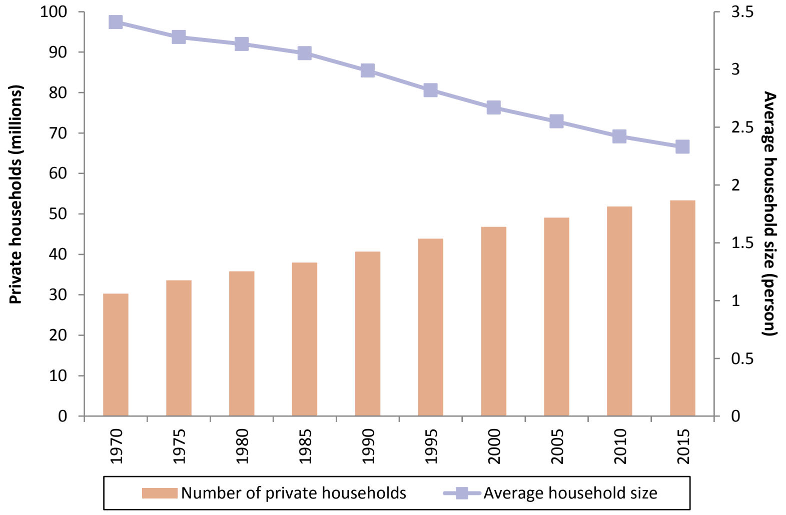


Figure 1-9 Number of households and number of people per household (as of October 1st of each year)

Reference: Ministry of Internal Affairs and Communications "2015 National Census"

As for the change of the number of households with the number of people per household, household of single and 2 people is increasing. Household of 3 people had increased by 2010, but in 2015 turned into a downward trend. Household with more than 4 people is consistently decreasing after 1990.

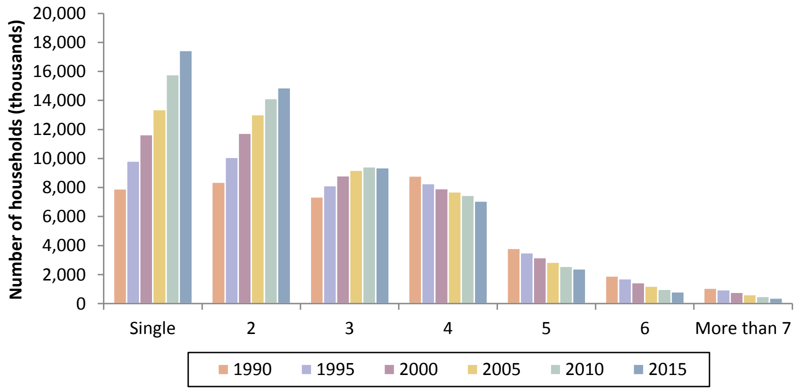


Figure 1-10 Number of household per the number of people per household (as of October 1st of each year)

Reference: Ministry of Internal Affairs and Communications "2015 National Census"

1.3 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 FY2015 Japan's land area equaled 37.79 million hectares, or 0.3% of the total global land area, of which nearly 80% is accounted for by 24.97 million hectares (66.1%) of forests and 4.32 million hectares (11.4%) of agricultural land. Looking at the changes in the land use, compared to FY2010, forests, agriculture and grasslands are declining, as on the other hand the agriculture, marshes and developing areas are increasing.

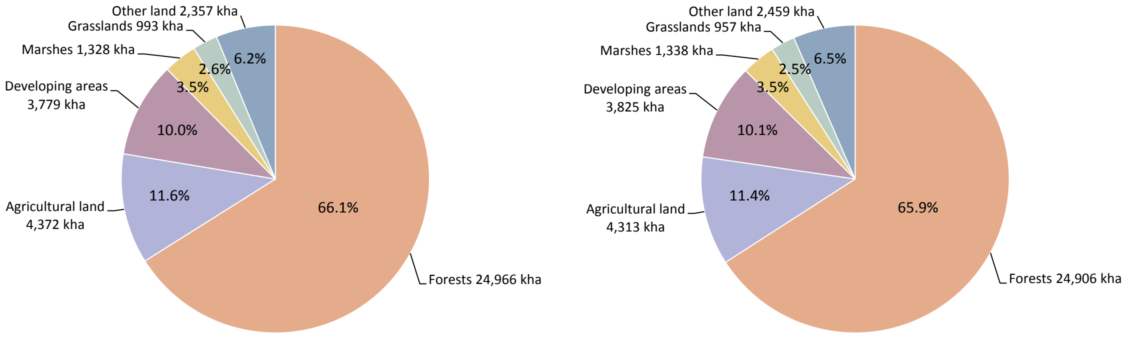


Figure 1-11 Current land use in Japan2 in FY2010 (left figure) and in FY2015 (right figure)

Reference: Ministry of Environment "National Greenhouse Gas Inventory Report"

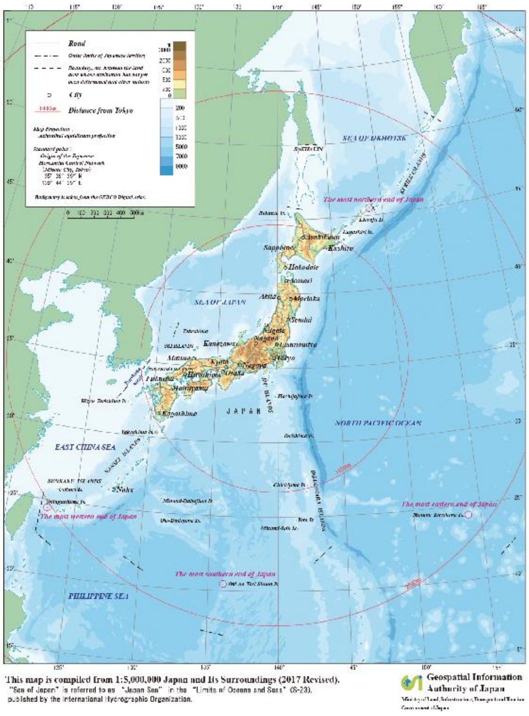


Figure 1-12 Map of Japan

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

2 "Developing areas" 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.

1.4 Climate

1.4.1 Overview of average climate

Japan stretches over a great distance from north to south, with its most southern point of the whole land including remote islands located at 20 degrees north latitude, and the most northern point at 46 degrees north latitude. With such a structure, various climate zones exist in the islands of Japan such as subarctic, extratropical and subtropical zone. The difference in climate, when compared to the latitudes, the difference in temperature is somewhat 5 degrees or so between Hokkaido area and Okinawa area during summer. However, as the seasonal rain front or typhoon often hit the southern part of the country, the precipitation at the southern part of Japan compared to that of the northern part is remarkably high. On the other hand, the average temperature in Okinawa during winter is most of the time above 15 degrees Celsius, whereas in Hokkaido area it often becomes below zero. Therefore the temperature gap within the country during winter is significant, being more than 20 degrees Celsius. Approximately three-fourths of the land of Japan is mountains, and in many areas the mountain stretches divide the islands of Japan to the coastal areas facing the Pacific Ocean or the Sea of Japan. By the orographic rainfalls, climates on the Pacific Ocean side and the Sea of Japan side are significantly different. In winter, seasonal cold winds from Siberia to the coastal areas facing the Sea of Japan result in having more days of snowfall, and in areas near the mountains would have a large amount of snowfall that piles up more than 3 meters high. In the coastal area facing the Pacific Ocean, dry winds blow down along the mountain, bringing more clear days.

Table 1-2 Major Climate Components of Japan3 (the 1981 – 2010 average)

		Latitude	Longitude	Elevation (m)	Average Temperature (°C)		Annual Precipitation (mm)	Total Snow Depth (cm)
					August	February		
Northern Japan	Abashiri	44°01.0’	144°16.7’	37.6	19.6	-6.0	787.6	378
	Nemuro	43°19.8’	145°35.1’	25.2	17.3	-4.3	1,020.8	221
	Suttsu	42°47.7’	140°13.4’	33.4	21.1	-2.1	1,177.1	546
	Yamagata	38°15.3’	140°20.7’	152.5	24.9	0.1	1,163.0	426
	Ishinomaki	38°25.6’	141°17.9’	42.5	23.5	1.2	1,066.9	54
Eastern Japan	Fushiki	36°47.5’	137°03.3’	11.6	26.5	3.0	2,226.0	341
	Choshi	35°44.3’	140°51.4’	20.1	25.2	6.6	1,659.8	1
	Iida	35°31.4’	137°49.3’	516.4	25.1	2.1	1,611.5	57
Western Japan	Sakai	35°32.6’	133°14.1’	2.0	27.0	5.0	1,895.7	103
	Hamada	34°53.8’	132°04.2’	19.0	26.5	6.2	1,663.8	-
	Hikone	35°16.5’	136°14.6’	87.3	27.1	3.9	1,570.9	104
	Miyazaki	31°56.3’	131°24.8’	9.2	27.2	8.6	2,508.5	0
	Tadotsu	34°16.5’	133°45.1’	3.7	28.0	6.1	1,068.4	-
Nansei Islands	Naze	28°22.7’	129°29.7’	2.8	28.4	15.2	2,837.7	0
	Ishigakijima	24°20.2’	124°09.8’	5.7	29.2	19.1	2,106.8	0

Reference: Japan Meteorological Agency “Table of Monthly Climate Statistics”

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

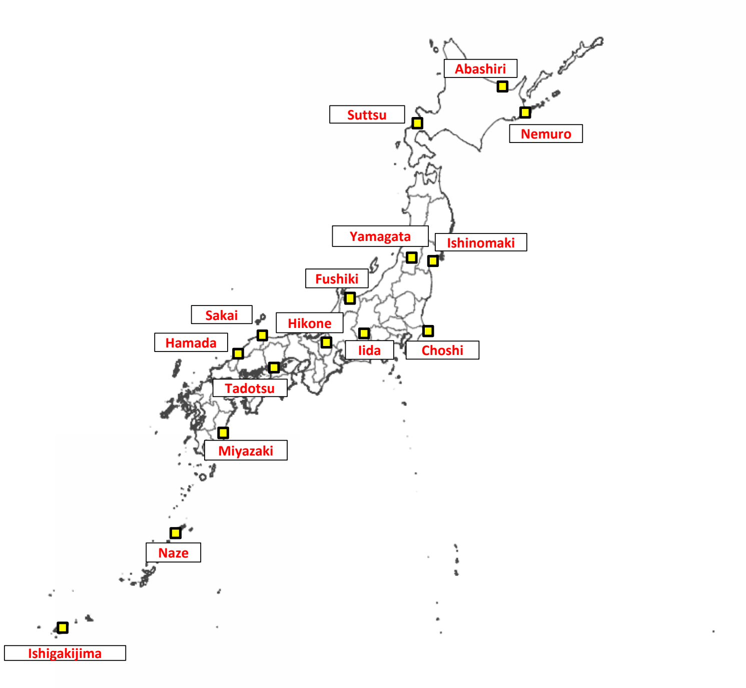


Figure 1-13 Distribution of 15 observation stations in Table 1-2

Reference: Japan Meteorological Agency: "Surface weather observation (as of December 11th, 2017)"

1.4.2 Temperature

Long-term trends of annual mean surface temperature anomalies from 1898 to 2016 in Japan[4] are shown in Figure 1-14. The annual mean temperature anomalies 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 1.19°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 1.11, 1.38, 1.08 and 1.20°C per century, respectively. The temperature anomaly for 2016 is estimated to have been 0.88°C, which is the highest since statistics began in 1898. The high temperatures are 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.

[4] Anomalies are deviations from the baseline (the 1981 – 2010 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.

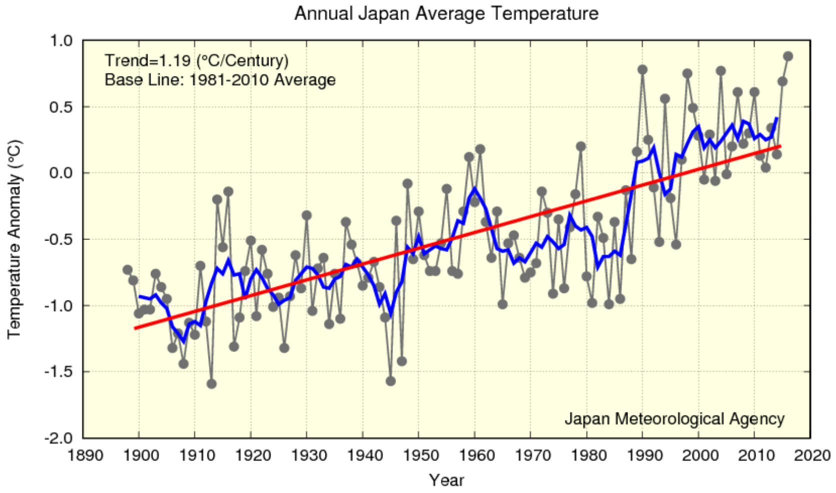


Figure 1-14 Annual surface temperature anomalies in Japan (1898 - 2016)

The thin gray line indicates surface temperature anomaly calculated by 15 observation stations. The blue line indicates the five-year running mean[5], and the red line indicates the long-term linear trend.

Reference: Japan Meteorological Agency "Climate Change Monitoring Report 2016 "(P34 Figure 2.1-3)

Figure 1-15 and Figure 1-16 show long-term trends of extremely high/low-temperature events in Japan[6] from 1901 to 2016. 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 anomalies shown in Figure 1-14.

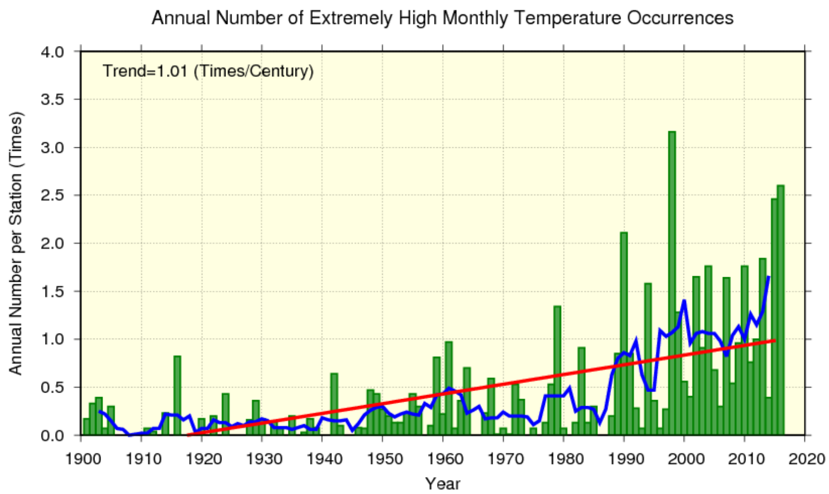


Figure 1-15 Annual number of extremely high monthly mean temperature occurrences (1901 – 2016)

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 2016"（P35 Fig. 2.1-4）

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

6 Here, judgment of extremely high/low temperatures is based on the fourth –highest/ lowest monthly values on records over the 116-year period from 1901 to 2016. The annual occurrences of extremely high/low monthly mean temperatures are derived from 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.

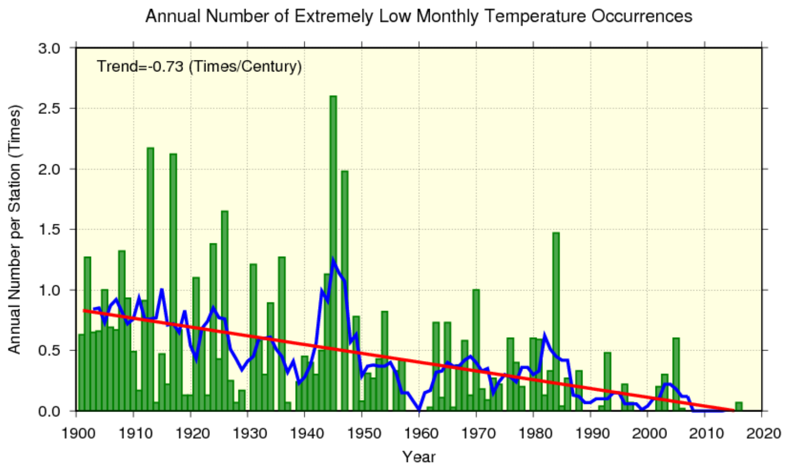


Figure 1-16 Annual number of extremely low monthly mean temperature occurrences

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 2016"（P35 Fig. 2.1-4）

1.4.3 Precipitation

Figure 1-17 shows the long-term trends of annual precipitation anomalies from 1898 to 2016[7]. There is no obvious long-term trend in the annual precipitation anomalies in Japan. The annual figure has become more variable since the 1970s.

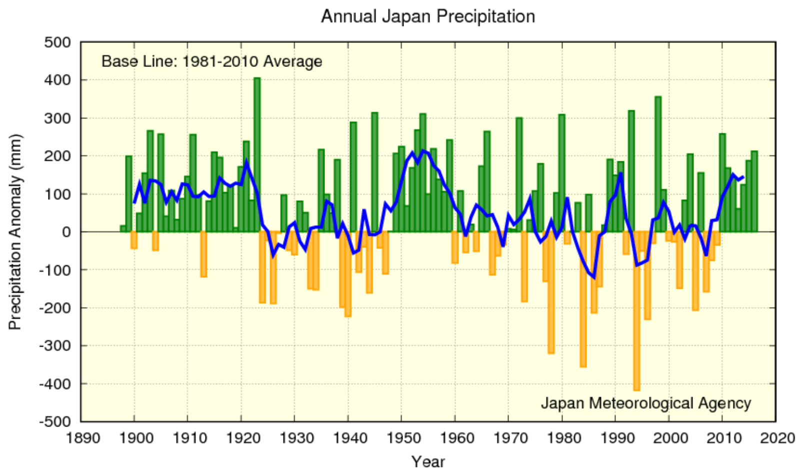


Figure 1-17 Annual anomalies in precipitation in Japan (1898 – 2016)

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

Reference: Japan Meteorological Agency "Climate Change Monitoring Report 2016" (P40, Fig.2.2-2)

[7] In order to analyze the long-term trends of precipitation, more observation stations are needed comparing to that of temperature because there are large variance each area. Precipitation anomalies in Japan are calculated using 51 observation stations whose observation data homogeneity continues for long-term.

Asahikawa, Abashiri, Sapporo, Obihiro, Nemuro, Suttsu, Akita, Miyako, Yamagata, Ishinomaki, Fukuhima, Fuhshiki, 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 1981 to 2010 average) in 51 observation stations described above.

The trends of occurrence of extreme precipitation events in Japan, the number of days with daily precipitation ≥ 200mm and the number of days with daily precipitation ≥ 1.0 mm[8] (Figure 1-18 and Figure 1-19) indicate that the annual number of days with precipitation over 200mm is extremely likely to have increased, whereas for the annual number of days with precipitation ≥ 1.0mm 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.

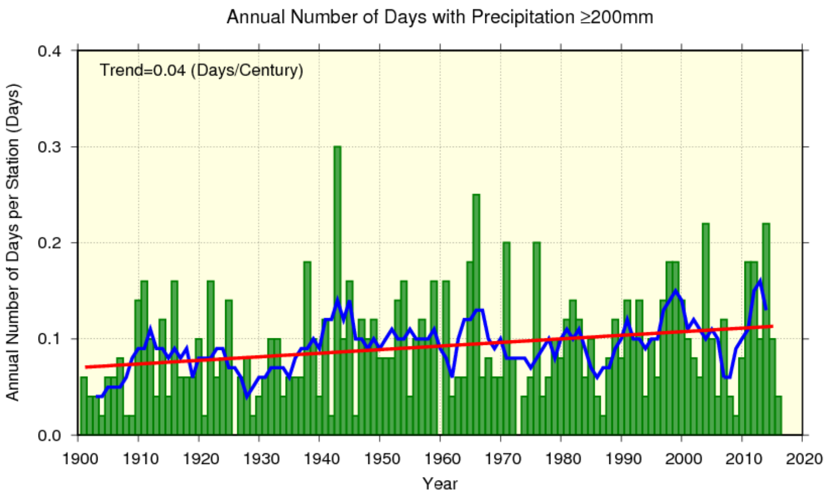


Figure 1-18 Annual number of days with precipitation ≥ 200mm (1901 – 2016)

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 2016”（P43 Fig. 2.2-5）

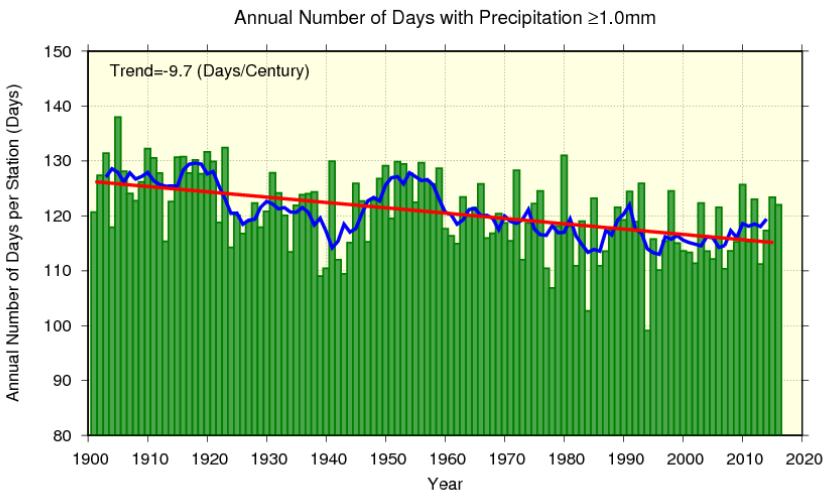


Figure 1-19 Annual number of days with precipitation ≥ 1.0mm (1901 – 2016)

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 2016”（P43 Fig. 2.2-6）

[8] The number of days with daily precipitation ≥ 200mm 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 dividing by the available observation stations number and annual number of days per station.

1.5 Japan’s Economy and Industry

1.5.1 Gross Domestic Production

Japan’s economy grew extremely rapidly in the 1960s, resulting in the significant development of heavy industry, producing such essentials as steel and petrochemical materials. In the 1970s, the impact of oil shock leads to the shift of the industrial structure from basic material to manufacturing and assembly. In the latter half of the 1980s, so-called Bubble economy[9] took over triggered by the increased demand from the increased number of public projects supported by fiscal actions or from the increased funding in circulation. In 1990 when the government and the Bank of Japan implemented preventive measures against inflation, land prices and stock values crashed and so did the Bubble economy; since then Japan’s economy entered a long period of low growth rate. Japan’s economy in the 1990s continued to slow down by the lingering impact of the crash of the Bubble economy, with a negative growth rate of the real gross domestic product[10] against the previous year in FY1993. In FY1995 the growth rate of the real gross domestic product reached over 3%, again in FY1998 turned negative due to the influence of financial crisis in 1997 and 1998.

In the 2000s, the economy gradually recovered as export grew by the depreciation of yen and economic recovery globally. The economy prosperity cycle marked the longest in the post-war era, exceeding the Izanagi boom[11]. Soon after, the financial insecurity, economic slowdown, and inflation of petroleum and material prices started in the United States of America in 2007 affected Japan’s economy to slow down gradually. The growth rate of the real gross domestic product turned negative compared to the previous year for two consecutive reporting periods after the global financial crisis in 2008.

In recent years, business earnings reached the highest level ever, employment and income environment improved, and the positive economic cycle has steadily started to run, expectedly leading to the growth of income and expansion of investment. Supply and demand in the employment market are tightening, and the level of the lack of employment is as equivalent as the era of Bubble economy. On the other hand, demand income that is reflected by the tightened balance of labor supply is increasing yet mildly. Consumer spending accounts for 60% of the GDP lack of momentum after the rise of consumption tax in 2014, compared to the level of improvement of income and employment environment. The trend of commodity price has not faced continuous decrease therefore not in deflation, yet still unable to regain stable growth. Japan’s GDP for FY2016 is 524 trillion yen and GDP per Capita is 4.13 million yen.

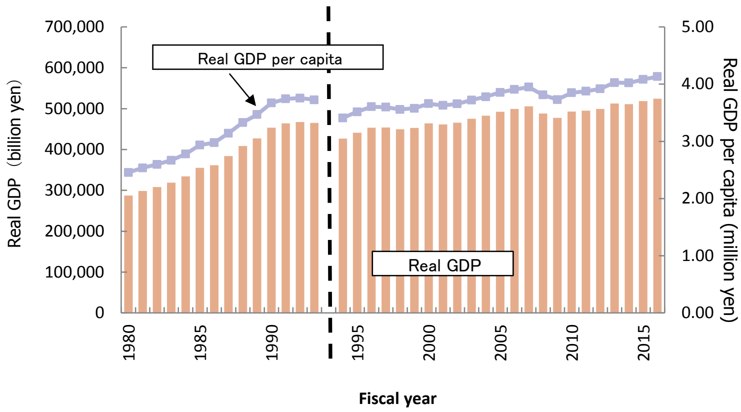


Figure 1-20 Trend of Real GDP[12,13]

Reference: Cabinet Office “National Accounts for 2009 (Benchmark year = 2000)” (FY1980 - FY1993)

Cabinet Office “Quarterly Estimates of GDP for Jul. - Sep. 2017 (The Second Preliminary)(Benchmark year=2011)”

[9] Asset price movement away from theory of price. It indicates Japan’s 11th business cycle.

[10] GDP by chain-linked method (Benchmark year = 2000).

[11] It indicates Japan’s 6th business cycle.

[12] 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.

[13] Real GDP before FY1993 and after FY1994 cannot be connected because the benchmark year of the calculation is different.

(FY1994 - FY2016)

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

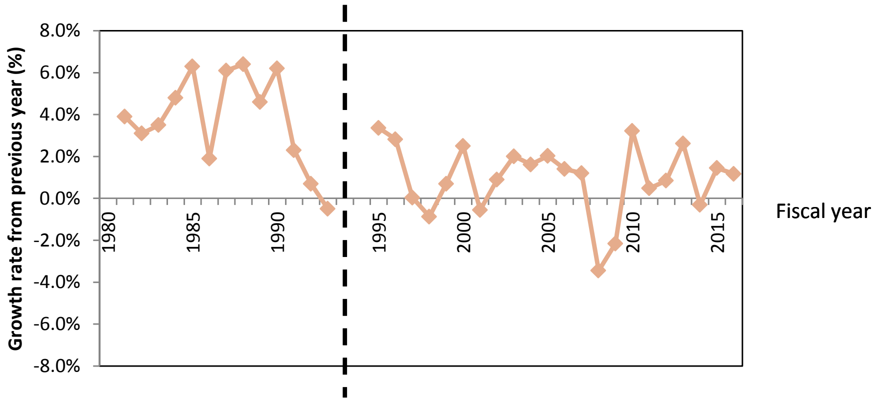


Figure 1-21 Trend in Real GDP growth rate from previous year[14]

Reference: Cabinet Office "National Accounts for 2009 (Benchmark year = 2000)" (FY1981 - FY1993)

Cabinet Office "Quarterly Estimates of GDP for Jul. - Sep. 2017 (The Second Preliminary)(Benchmark year=2011)" (FY1995 - FY2016)

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

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

Japan's industrial structure was affected by the appreciation of Yen which developed from the spring of 1990 to the spring of 1995, accelerated structural transformation, increasing overseas operations of assembly oriented manufacturing industry. Import significantly increased in agriculture, generating severe competition with overseas industry, strengthening business operations by shifting to large-scale operation.

[14] Real GDP before FY1993 and after FY1994 cannot be connected because the benchmark year of the calculation is different.

Japan's trade balance was at a surplus from the 1990s to 2010, turned into a loss in 2011 due to the influences by Great East Japan Earthquake, a major flood in Thailand, yen appreciation and European debt problem. The trade surplus has continued to decrease since then, marking the highest record in trade loss in 2014 by 10.4653 trillion yen. Balance turned into a surplus in 2016, not due to the increase in the export amount but the decrease in import amount.

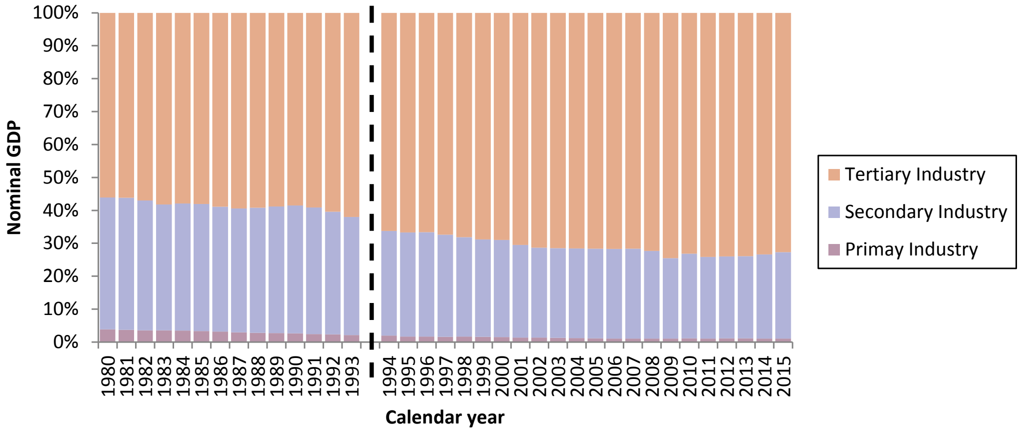


Figure 1-22 Trend in Nominal GDP composition by Industry[15]

Reference: Cabinet Office "National Accounts for 2009 (Benchmark year = 2000)" (CY1980 - CY1993)

Cabinet Office "National Accounts for 2015 (Benchmark year = 2011)" (CY1994 - CY2015)

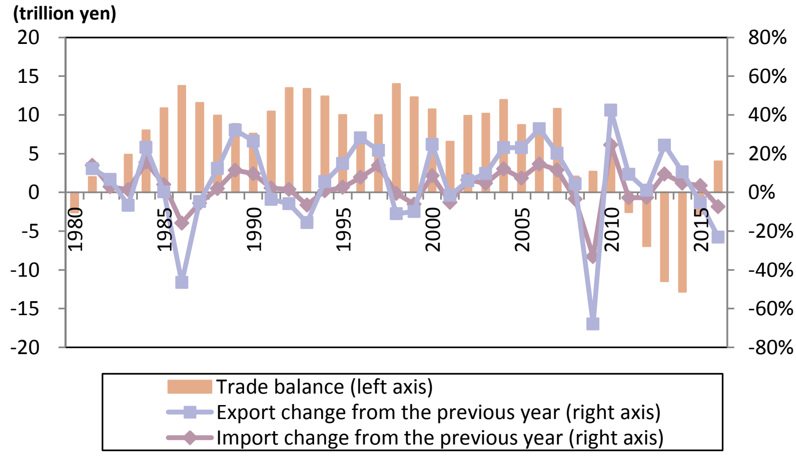


Figure 1-23 Japan's Trade Trend (Calendar year)

Reference: Ministry of Finance "Trade Statistics"

1.5.2 Labor force

Japan's labor force in 2016 was approximately 67 million, increased by 500 thousand compared to the previous year. According to the break down per age-group, the labor force of age 15 to 64 is 59 million, increased by 100 thousand compared to the previous year. On the other hand, labor force for age over 65 reached 7.9 million, increased by 400 thousand compared to the previous year; the growth of the labor force of age over 65 is contributing to the increase of the total labor force.

Comparing the ratio of labor force per age group, in 1975 the ratio of the labor force for age over 65 accounted for 4.6%, increased to 11.8% in 2016. Labor force structure indicates a trend in aging, as similarly indicated in the

[15] GDP before CY1993, and after CY1994 cannot be connected because the benchmark year of the calculation is different.

population structure.

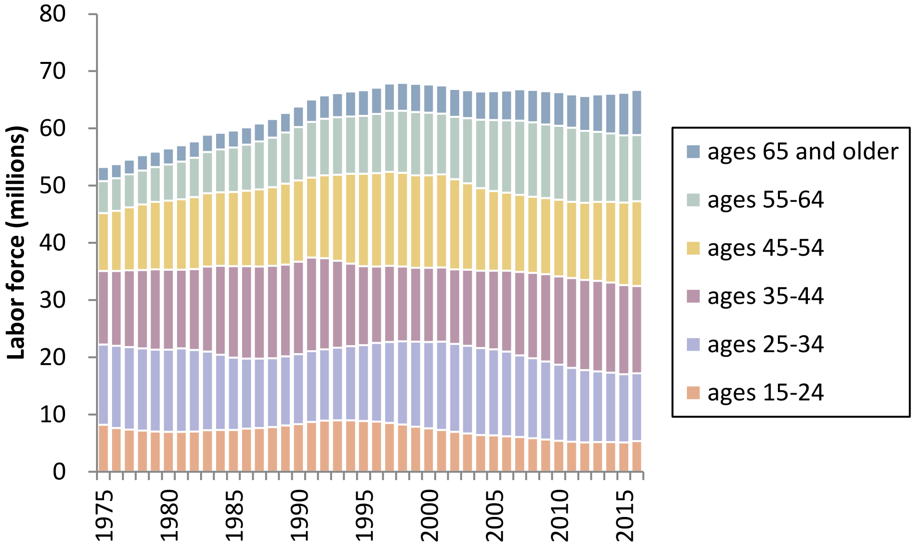


Figure 1-24 Trends in Labor Force (annual mean)

Reference: Ministry of internal Affairs and Communications “2017 Labour Force Survey”

1.6 Energy

1.6.1 Energy balance flow

Energy balance flow of Japan in FY2015 is shown in Figure 1-25. The primary energy self-sufficiency in Japan was 19,800 PJ in FY2015. The loss in energy conversion or during transport, and the consumption at energy conversion sector was 6,300 PJ. Deducting the energy conversion/conversion loss of the primary energy self-sufficiency the final energy consumption of Japan in FY2015 is 13,500PJ.

From the flow of each primary energy indicates that many of the nuclear and renewable energy are converted and consumed for electricity. On the other hand the natural gas is converted to electricity and also a large portion is converted to city gas by adjusting the calorific value. Relatively small portion of petroleum is converted to electricity; instead majority is consumed as gasoline, transport fuel such as diesel, oil products such as heating and heavy oil, and as ingredient for petrochemical such as naphtha. Majority of the usages of the coals are converted to electricity and ingredients for coking coals for steel manufacturing.

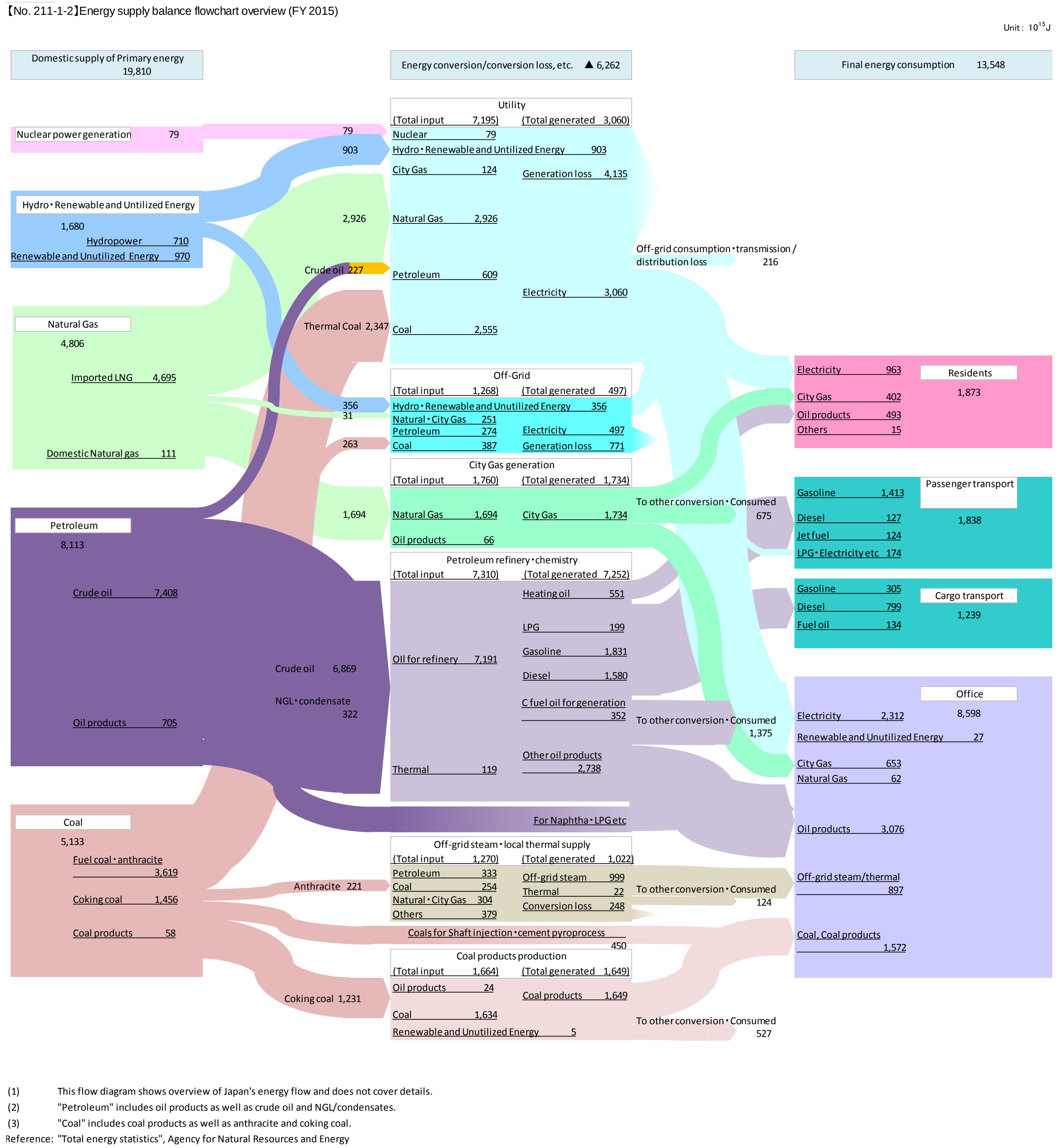
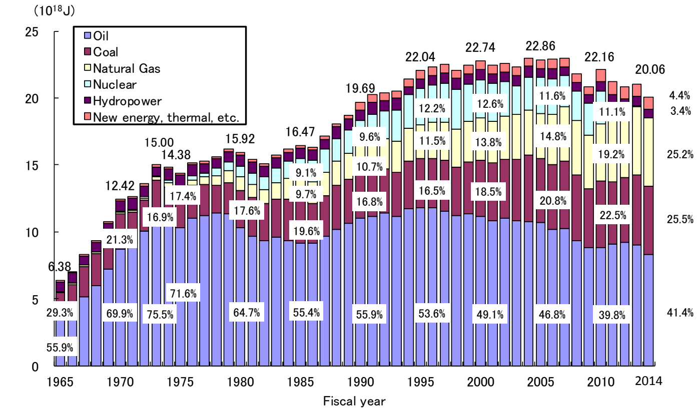


Figure 1-25 Overview of Japan's Energy Balance Flow (FY2015)

Reference: Agency for Natural Resource and Energy "Energy White Paper 2017"

1.6.2 Primary energy supply per fuel and self-sufficiency

The volume of primary energy per fuel is shown in Figure 1-26. Before the 1960s domestic coal was Japan's primary energy supply mainly. Soon after the domestic coal lost price competitiveness, therefore Japan started to rely heavily on cheaper petroleum from the Middle East. However, when the second oil crisis hit in the 1970s petroleum dependent policy and measures were replaced with promoted introduction of nuclear power, natural gas and coals, accelerating development of new energies. Consequently the portion of petroleum in the domestic primary supply which was 75.5% in 1973 as the oil crisis had declined to 41.4% by FY2015.



Note1: Calculation method has been changed after FY1990.
Note2: 'New energy, thermal, etc.' includes photovoltaics, wind power, biomass, thermal, etc.

Figure 1-26 Primary Energy Supply

Reference：Agency for Natural Resource and Energy "Energy White Paper 2017"

The energy self-sufficiency of Japan (Figure 1-27) in FY1960 was 58.1%, mainly using plenty of domestic natural resources such as coal or hydropower. Entering the High Economic Growth period the self-sufficiency dropped to approximately 10% as the energy demand in Japan increased and as the energy supply efficiency decreased significantly influenced by the change of fuels from coal to petroleum. Soon after the supply efficiency, increased by the operation of nuclear power plant however, due to 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 FY2015 the self-sufficiency recovered to 7.0% with the introduction of new energy and restart of nuclear power plants.

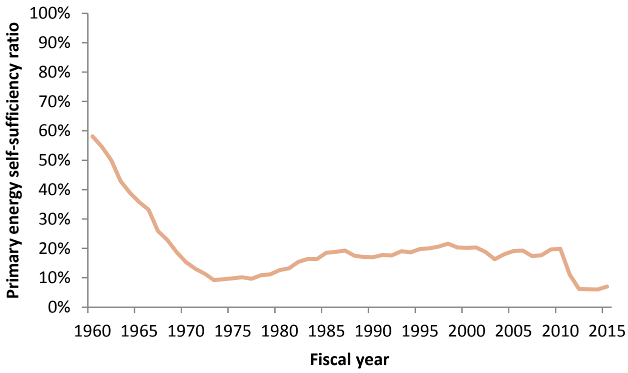


Figure 1-27 Primary Self-Sufficiency

Reference: IEA "World Energy Balances 2016"

1.6.3 Energy Consumption

Final energy consumption continued to increase significantly with the Japanese economy's rapid growth until the 1970s. It then leveled off following the two oil shocks of the 1970s, followed by a period represented by a downward trend. A strong economy and relatively lower crude oil prices in the late 1980s, however, pushed consumption to increase again, after which it has nearly leveled off since FY2000.

These trends can be summarized for different consumption sectors as follows. Until the first oil shock in 1973 (Phase I), energy consumption in the industrial, commercial and residential, and transport sectors grew rapidly. From FY1973 until FY1986, 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 cost. From FY1986 until FY2000, the strong economy and drop in crude oil prices in the latter half of the 1980s boosted energy consumption in all four sectors. From FY2001 onward, energy consumption in the industrial and transport sectors has decreased overall as a result of environmental awareness, but energy consumption in the commercial and residential sector has continued to increase. However, after the Great East Japan Earthquake, energy consumption in industrial, commercial and residential sector decreased due to the further implementation of energy-saving efforts. In FY2015, the proportion of the final energy consumption was 43 % for the industrial sector which includes non-energy usage, 32 % for the commercial and residential sector and 23 % for the transport sector.

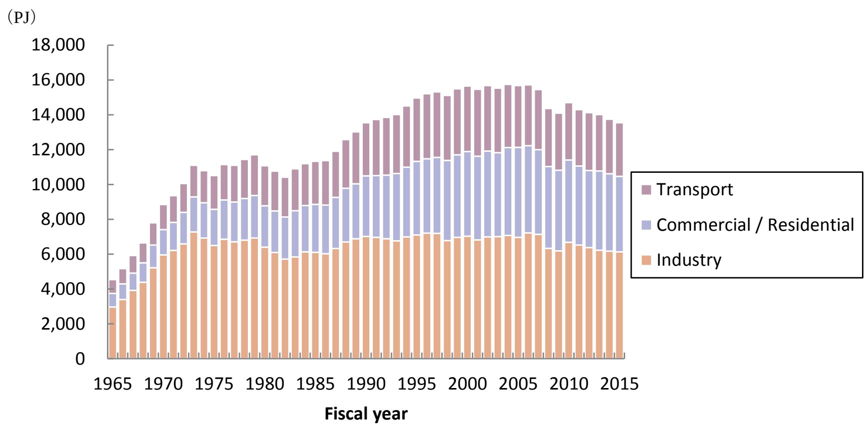


Figure 1-28 Trends in final energy consumption

Reference: Agency for Natural Resource and Energy “General Energy Statistics”

1.6.4 Total Primary Energy Supply per Capital and Total Primary Energy Supply per GDP

Japan’s total primary energy supply per capita as of FY2015 is 165 × 10^9 J, and has been declining in recent years.

Japan’s total primary energy supply per GDP increased during the 1960s, but has decreased significantly since 1970s. This was a result of the introduction of world-leading energy-saving facilities and technologies brought about by the oil shock. Levels remained generally static during the 1980s to 1990s. This was due to the significant contribution of the industrial sector’s extensive investments in energy-saving reductions, which had already shown a marked decrease in energy input per unit of output, as well as increased energy consumption in the commercial, residential, and transport sectors in line with the public’s pursuit of a more comfortable and affluent standard of living. In the 2000s, amounts declined overall in response to changes in the industrial sector’s structure and a shift to reductions in the transport sector.

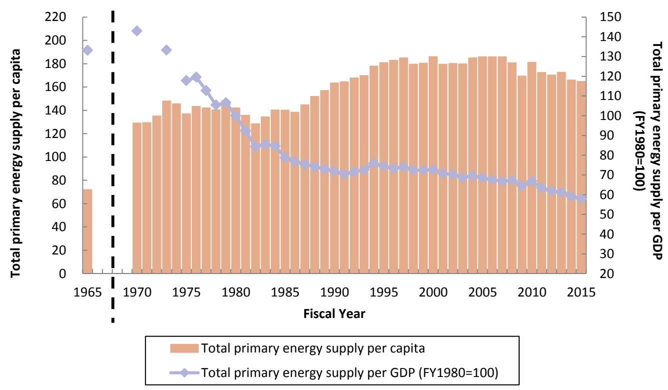


Figure 1-29 Total Primary Energy Supply per Capita and Total Primary Energy Supply per GDP

Reference: Based on the data from ‘Agency for Natural Resources and Energy, “General Energy Statistics;” Cabinet Office, “National Accounts for 2015 (Benchmark year = 2011);” Ministry of Internal Affairs and Communications, “Population Census” and “The Annual Report on Current Population Estimates”

1.6.5 Total electricity per source

Japan's total electricity per source is shown in Figure 1-30. Total electricity was 740 billion kWh in FY1990, and the demand increased as electrification developed, reaching 1,030 billion kWh in 2007. Soon after, demand was limited as a consequence of global financial crisis and the Great East Japan Earthquake, and the total electricity decreased to 870 kWh for FY2015. Looking at the ratio of electricity source, in FY1990 the oil-fired thermal accounted for the largest as 28.7%, followed by nuclear power as 27.3%. Soon after, the portion of petroleum declined as Japan departed from oil dependence from the Middle East, leading to increase of portion in coal-fired thermal and nuclear power. In FY2010, LNG-thermal accounted for 29.3%, 28.6% for nuclear and 25.0% for coal-thermal, and these three sources accounted for more than 80% of the total electricity. However, due to the Great East Japan Earthquake in 2011 the nuclear power plants in Japan stopped operation; the proportion of the electricity source is significantly changing after FY2011. In FY2015, the proportion of the electricity source was 43.3% for LNG-thermal and 30.6% for coal-thermal

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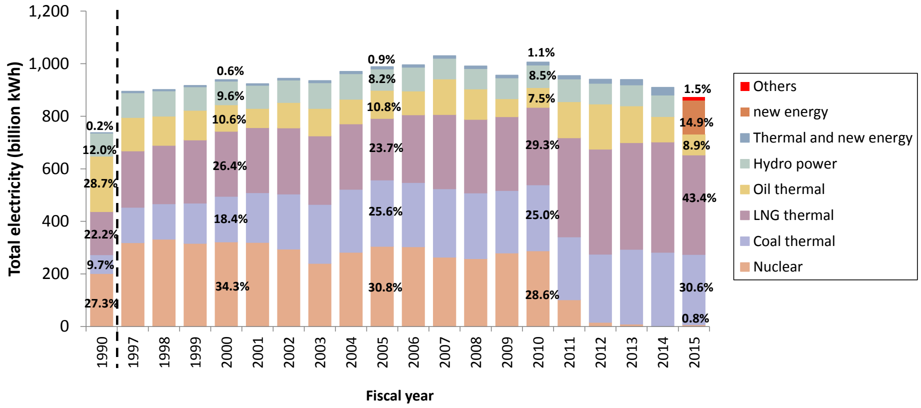


Figure 1-30 Electricity per source and CO_2 Emission[16, 17, 18]

Reference: Agency for Natural Resources and Energy "Outline of Power Development" (before FY2008)
The Federation of Electric Power Companies of Japan "Environmental Action Plan" (FY2009 – FY 2014)
The Electric Power Council for a Low Carbon Society "Effort on Global Warming Countermeasures" (FY2015)

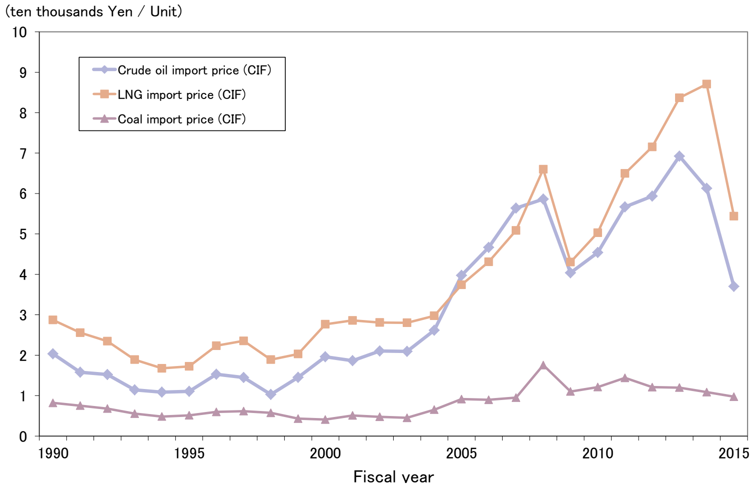
1.6.6 Prices

Crude oil import prices (CIF) shifted stable in the 1990s; prices skyrocketed in the 2000s due to the strong growth of oil demand in the developing countries and increasing geopolitical risks in the Middle East. Soon after prices continued to rise until FY2013, temporarily falling due to the slowdown in the oil demand by the financial crisis worldwide in FY2009. In FY2014, crude oil prices fell dramatically by the excess supply caused by the slowdown in the oil demand in the developing countries, increased oil production by the oil countries motivated by the high oil price, and steady growth of shale oil production. Japan's LNG import prices (CIF) is linked to crude oil, therefore its trend resembles that of crude oil prices. Level of coal import prices (CIF) remains lower than crude oil and LNG, steadily growing after the 2000s.

16 Before FY2014 was calculated by generating end power of the Federation of Electric Power Companies of Japan (10 companies) and in 2015, transmission end power was calculated using 39 companies that have already started business of the social council members (42 companies).

17 "Renewable" in FY2015 include hydroelectric power.

18 "Others" in FY2015 indicates unknown electric type.



Note: Unit of crude oil is kiloliter and the units, both LNG and Coal are kilo tone.

Figure 1-31 Fuel import price (CIF)

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

1.7 Transport

1.7.1 Passenger Transport

Domestic passenger traffic grew significantly throughout the period of rapid economic growth as a result of the popularization of automobiles, improvements in the transport system and network expansion. Growth during the Bubble economy was prominent, recording 42.2% increase in FY1989 against FY1980.

Transport, traffic of buses, railways and passenger ships reduced 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 for 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, stopped declining and remained steady after FY2012 as the aircraft traffic grew by the introduction of LCC (Low Cost Carrier) services.

Passenger cars account for 56.8% and railways 30.8%, reaching almost 90% of the total passenger traffic in FY2015.

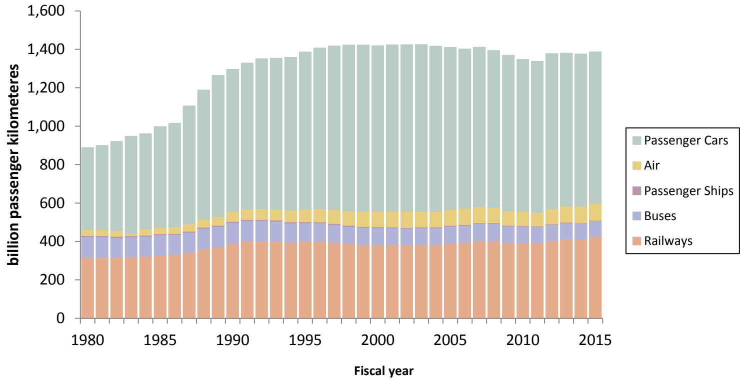


Figure 1-32 Trend in Passenger Traffic[19]

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", "Annual Statistical Report on Shipping"

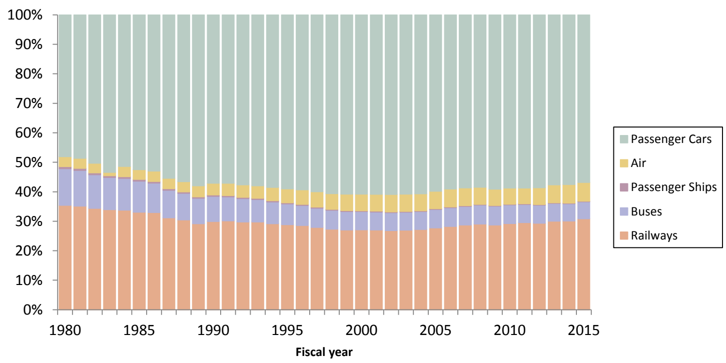


Figure 1-33 Modal shares of domestic passenger traffic

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", "Annual Report on Shipping"

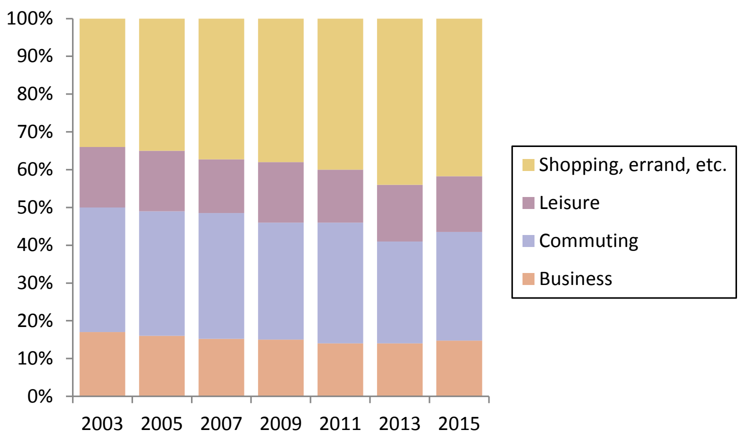


Figure 1-34 Main purpose of main driver

Reference: Ministry of Land, Infrastructure, Transport and Tourism "2016 White Paper"

[19] Traffic volume of passenger ships in FY2015 is deferred.

1.7.2 Freight Transport

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

In the 1990s after the Bubble economy crashed, domestic freight transport, mainly railways, coastal shipping and air, turned generally flat or declined. As a total the freight transport growth remained steady with the contribution of increase in the motor vehicle traffic.

In the first half of the 2000s trend in the growth had not changed dramatically, however in FY2008 dropped significantly for 2 consecutive fiscal years as a consequence of the global financial crisis. In FY2010 the freight transport increased as the economy recovered temporarily, and in FY2011 to FY2012, the motor vehicle freight transport reduced by the Great East Japan Earthquake along with lack of truck drivers. The freight transport volume continued to decrease until FY2012 hitting the lowest level ever and continues to remain so since then.

The share of the freight transport in FY2015 was 50.4% for motor vehicle, 44.1% for coastal shipping, 5.3% for railways, 0.3% for air. Motor vehicle and coastal shipping account for more than 90% of total freight transport.

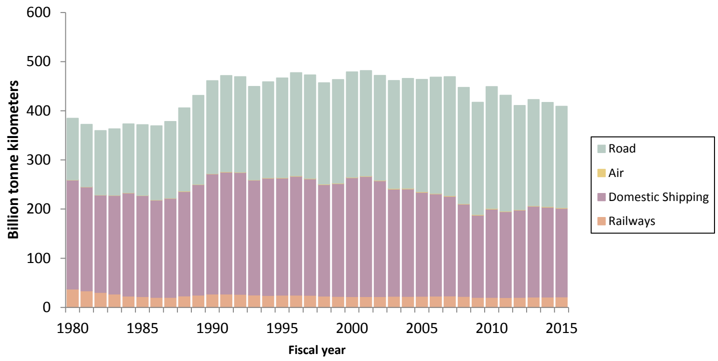


Figure 1-35 Trend in Domestic Freight Traffic

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", "Annual Report on Shipping"

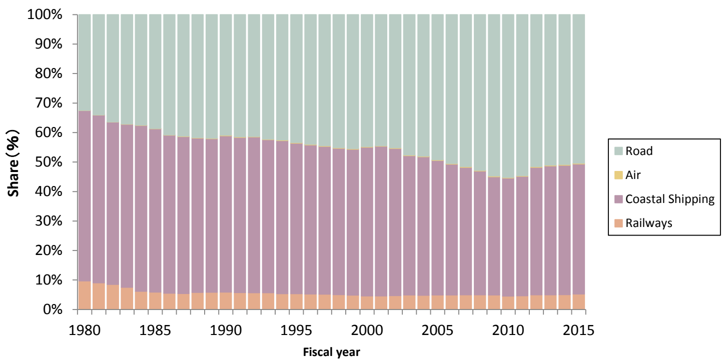


Figure 1-36 Trend in Domestic Freight Modal Share

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", "Annual Report on Shipping"

1.7.3 Motor Vehicle Traffic

This section focuses on the trend of the number of motor vehicle owned and the traffic of motor vehicle, as motor vehicle accounts for a large share in passenger traffic and freight transport.

The number of motor vehicle owned was increasing as a total during the 1990s, specifically with passenger cars as motorization advanced. Number of small trucks owned on the other hand turned into declining trend upon the abolishment of the preferential taxation against freight vehicles since 1989 when the consumption tax was introduced. In the 2000s, the growth of the number of passenger vehicles owned slowed down and remained steady due to the increased population of the seniors and as a consequence of migration of the population to urban areas where passenger vehicle ownership is relatively low. The “Eco-car” subsidy by the government implemented in 2010 and 2012 lead to the recovery of the number of motor vehicles owned, mainly with the passenger vehicles.

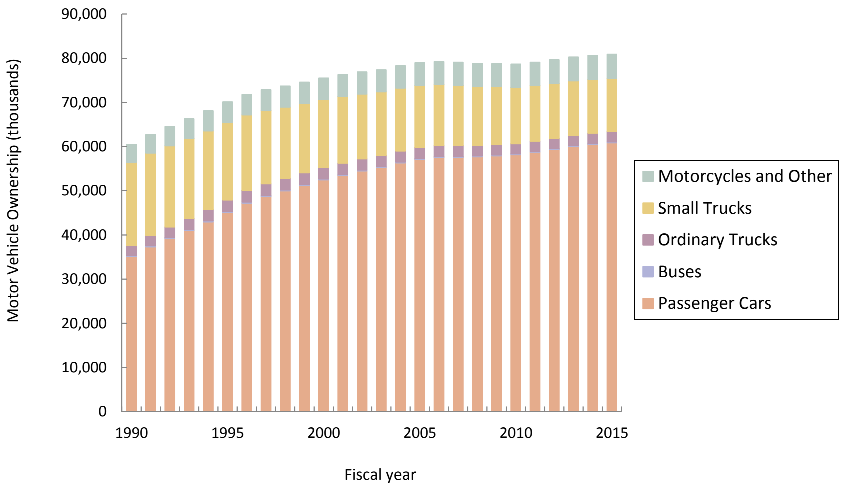


Figure 1-37 Trend in Motor Vehicle Ownership[20]

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

Motor vehicle traffic was constantly increasing until FY2003 but turned into declining trend since FY2004 as the freight traffic volume reduced, and at around the same period the traffic of private cars started to decline, caused mainly by the rise of gasoline price from the rise of crude oil price, as well as the increase in the usage of private cars for a short distance.

[20] “Passenger cars” includes lightweight cars. “Small trucks” includes 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.

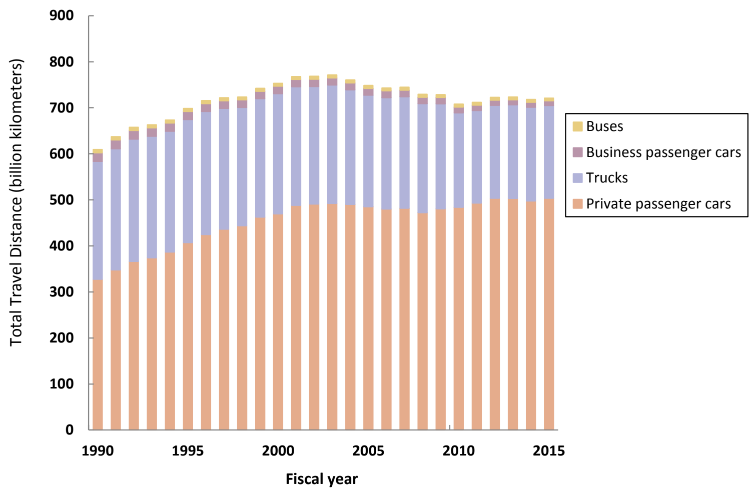


Figure 1-38 Trend in Vehicle Total Travel Distance

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

※1: Since the survey and counting methods used in the "Annual Statistical Report on Automobile Transport" changed in October 2010, the data before FY2009 has a gap compared to the data after FY2010. Therefore, the data after FY2010 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."

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

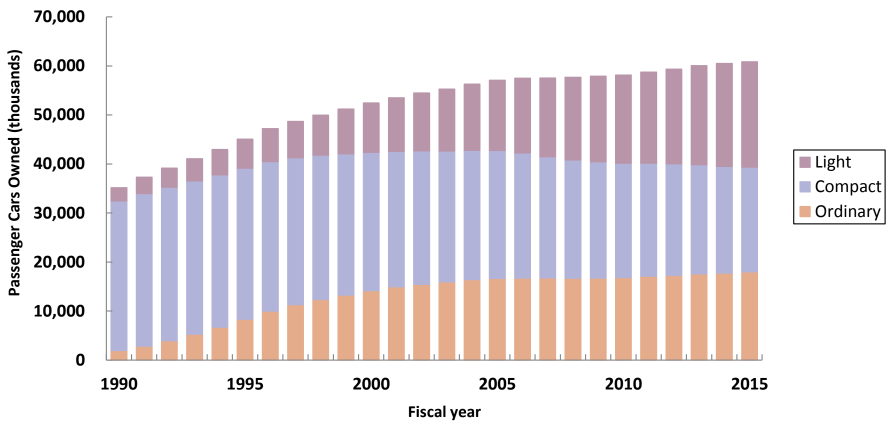


Figure 1-39 Ownership of Passenger Cars (Ordinary, Compact, and Lightweight)

Reference: Automobile Inspection and Registration Association, "Car ownership by category," "Car Ownership"

1.8 Houses and Commercial Facilities

1.8.1 Number of houses

As of October 1st, 2013 the total number of houses has reached 60.63 million (52.10 million residing) for a total of 52.46 million households. As a result, the number of houses per household has reached 1.16, representing a continuing improvement. When the houses are counted from the age, the housing stock built before the 1980s is 13.69 million, accounting for approximately 30% of the total. The housing stock built after 2000 is 12.77 million and is approximately 30% of the total. The ratio of the structure is, for houses built before the 1970s, house accounts for 76.0%, rented (apartment) accounts for 14.8%. For houses after 2000, the ratio of house decreased to 47.4%, and the rented (apartment) increased to 36.0%.

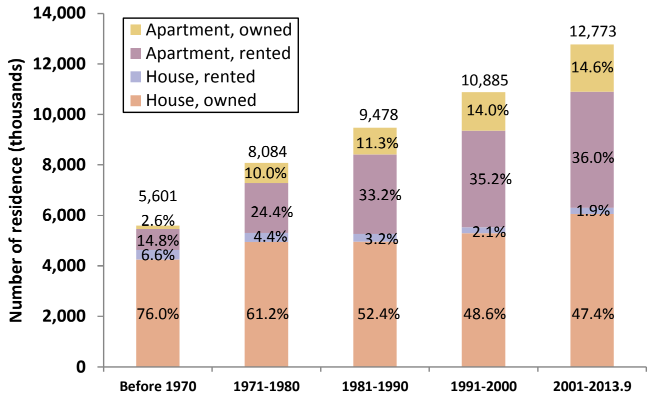


Figure 1-40 Housing stock per age as of FY 2013

Reference: Ministry of Internal Affairs and Communications “2013 Housing and Land Survey”

1.8.2 Floor Space per Household

The average area of floor space per household is demonstrating a steady improvement overall, to 94.42 square meters in 2013 compared to that of 77.14 square meters in 1973. But when the details are analyzed, the floor space per home increased compared to 1973 for both owned and rented, however a stark contrast can be seen between owned houses (122.32 square meters) and rented houses (45.95 square meters), illustrating the prominence of small rented houses.

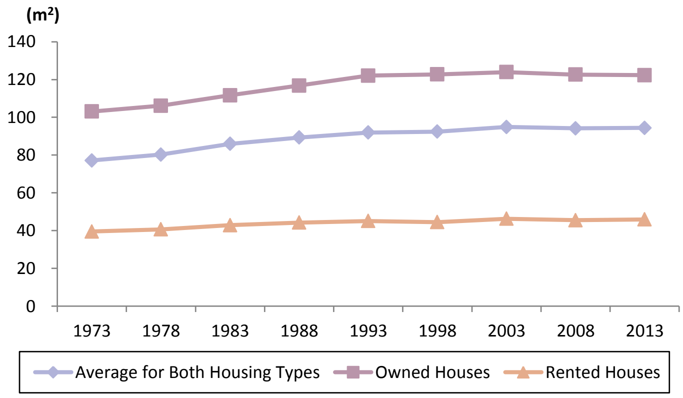


Figure 1-41 Floor Space Area per House in Japan

Reference: Ministry of Internal Affairs and Communications, “2013 Housing and Land Survey of Japan”

1.8.3 Floor space per 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 employment. 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 FY1965, it has increased at an average of 4.1% annually until FY1999. However, between FY2000 and FY2015 the annual rate of increase has been in decline, with an annual mean of 0.9%.

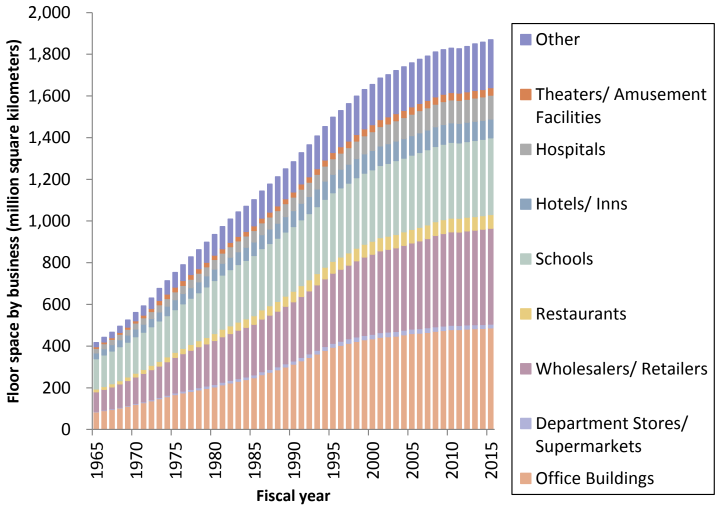


Figure 1-42 Change in the Amount of Floor Space in the Commercial Sector by Business Type

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

1.9 Waste

1.9.1 Sound Material-Cycle Society

From the 1960s to around 1990, Japan faced many issues such as increasing amount of waste along with the increased income and pollution from rapid industrialization. Despite measures such as to build basic systems for waste processing or emission control strategy for hazardous substances took in place, amount of waste continued to increase even after 1990. Land of Japan is small and insufficiency of landfill space has become a major issue. As a solution, 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 to environment in product designing and production process, a voluntary collection of waste by business operators, and building of recycling process. In the 2000s, Basic Act for Establishing a Sound Material-Cycle Society was formulated to develop sound material-cycle society with firm realization of 3R (Reduce, Reuse, Recycle) and proper waste processing.

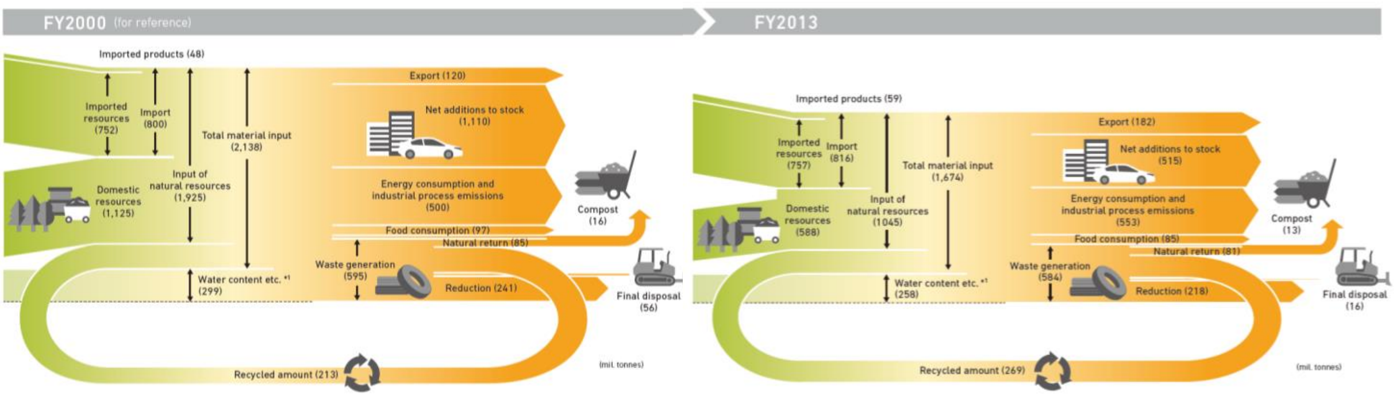


Figure 1-43 Material Flow in Japan

Reference: Ministry of the Environment "Annual Report on the environment in Japan 2017"

Quantitative target by FY2020 for resource productivity[21] (input), cyclical use rate[22] (recycling), and final disposal amount (output) by FY2020 are set in the Fundamental Plan for Establishing a Sound Material-Cycle Society. Target for resource productivity is 460 thousand Yen/t by FY2020, 378 thousand Yen/t in FY2014, which is approximately 52% increase compared to FY2000. Cyclical use rate is targeted as 17% in FY2020, and for FY2014 it was an increase by 5.8 points compared to FY2000 (Figure 1-45). Final disposal amount is targeted as 17 million tons in FY2020, and in FY2014 it was 74% less than FY2000.

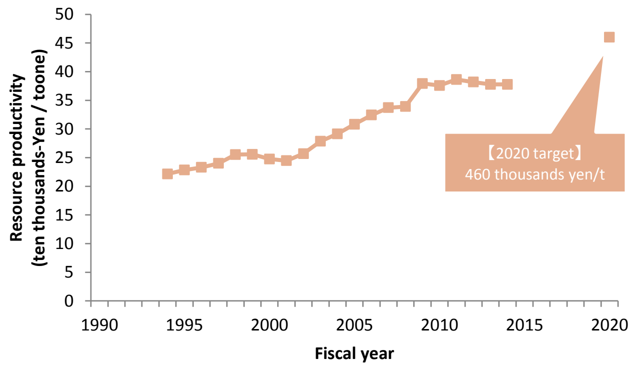


Figure 1-44 Resource productivity

Reference: Ministry of the Environment “Annual White Paper on the Environment in Japan 2017”

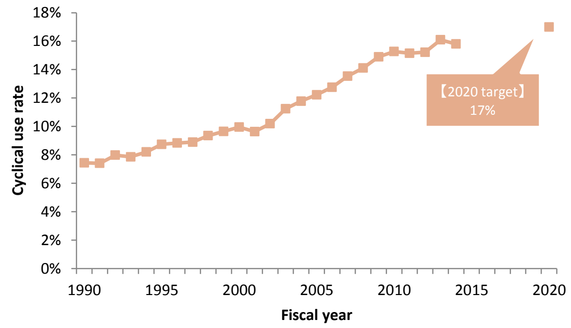


Figure 1-45 Cyclical use rate

Reference: Ministry of the Environment “Annual White Paper on the Environment in Japan 2017”

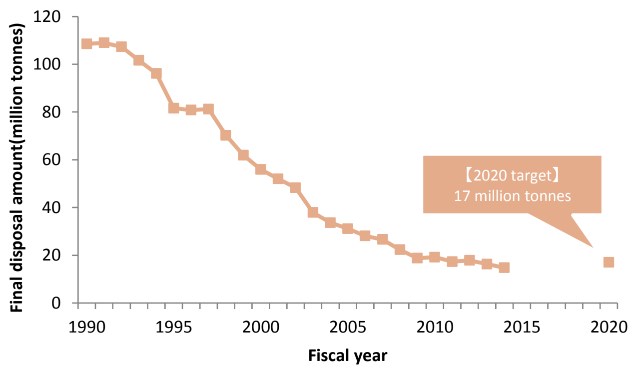


Figure 1-46 Final disposal amount

Reference: Ministry of the Environment “Annual White Paper on the Environment in Japan 2017”

[21] Resource productivity is calculated by GDP per resource-input

[22] Recycling utilization rate is calculated by circulation usage per domestic-input

1.9.2 Municipal Solid Waste

Japan's Final disposal amount of municipal solid waste and final disposal amount per person per day is shown in Figure 1-47. The volume of total and per person per day rapidly increased from around 1985 in along with the economy rise during the Bubble period. In the 1990s after the Bubble economy crashed the increase continued mildly, and turned to 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 industrial structure and economy fluctuation. Waste volume per person per day in FY2015 was 939g/ (person/day), marking the lowest number.

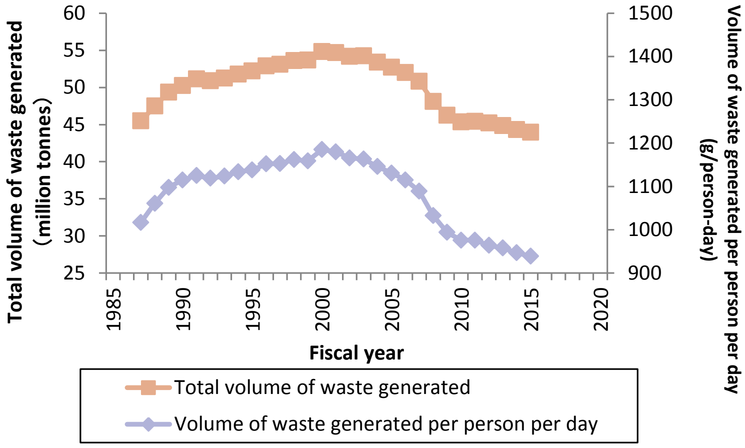


Figure 1-47 Final disposal amount and final disposal amount per person per day

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 FY2015, the amount of disposal was 417 million tons.

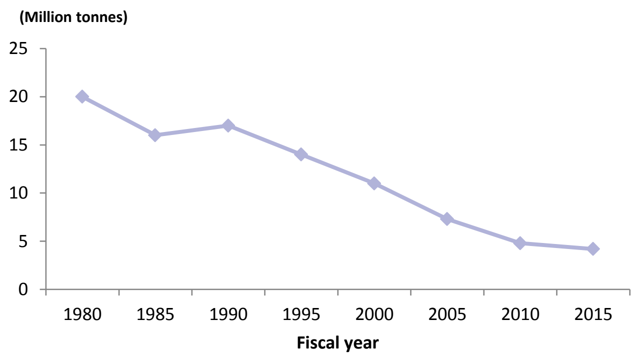


Figure 1-48 Disposal and reduction of municipal waste

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

1.9.3 Industrial Waste

Volume of Industrial waste in Japan is shown in Figure 1-49. Since 1990, the volume of Japan's industrial waste has not seen major changes, and had remained on the same level. Total industrial waste in FY2014 is 393 million tons, increased by 8 million tons compared to FY2013.

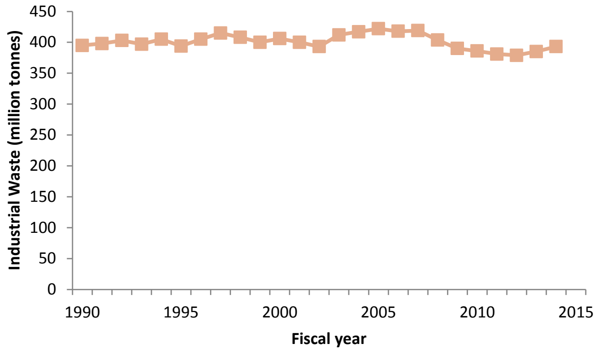


Figure 1-49 Volume of Industrial Waste

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

Similar to the trend of municipal solid waste, disposal of industrial waste has significantly reduced as the volume of waste reduction increased (Figure 1-50). Disposal of industrial waste in FY2014 was 10 million tons, achieving 85% reduction compared to FY1980.

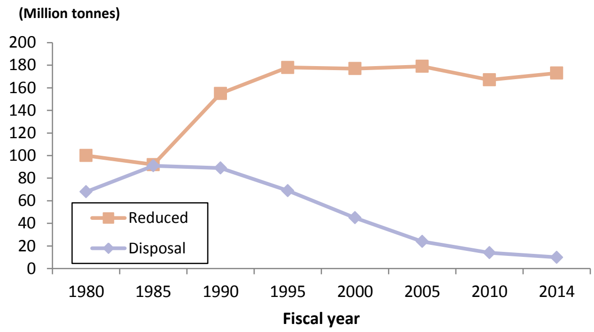


Figure 1-50 Industrial waste disposal and reduction

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

1.10 Agriculture

1.10.1 Farming

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 entities are small (approximately 2.7 hectares). Furthermore, the cultivated area has been decreasing each year, and in 2016, it had fallen about 15% from the 1990 level, to 4.47 million hectares. Aging of farmers and lack of labor force caused uncultivated lands. This trend remains current.

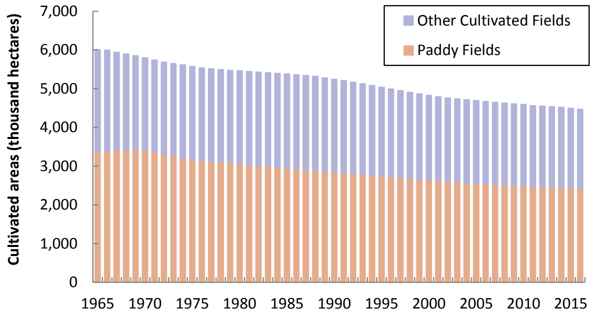


Figure 1-51 Changes in Cultivated Areas

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

1.10.2 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 currently covers about 25 million hectares, or about 70%, of Japan's national land area. 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 forest[23] has amounted to approximately 4.9 billion cubic meters in FY 2012, which is more than double compared to the level in FY1966.

Meanwhile, the demand for wood in Japan has recently declined to about 75 million cubic meters per year. However, the domestic wood supply is increasing slightly, and the ratio of domestically-produced wood supply to the total domestic demand in 2015 was approximately 33%.

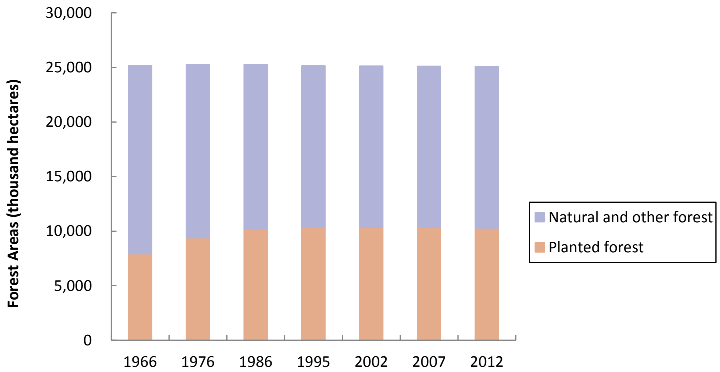


Figure 1-52 Trends in forested area

Reference: Forestry Agency "State of Forest Resources"

[23] Total Volume of the trunk.

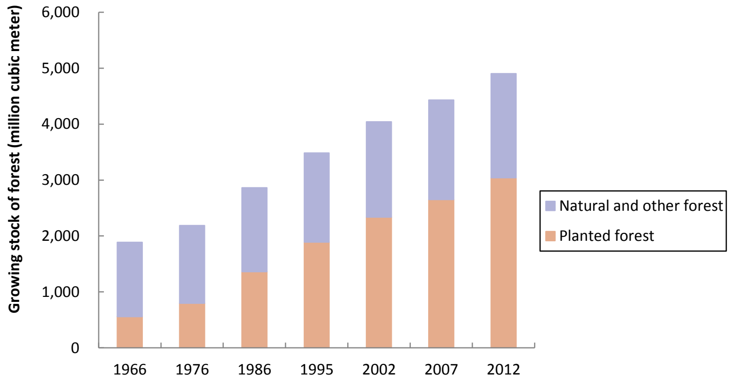


Figure 1-53 Trends in forested growing stock

Reference: Forestry Agency “State of Forest Resources”

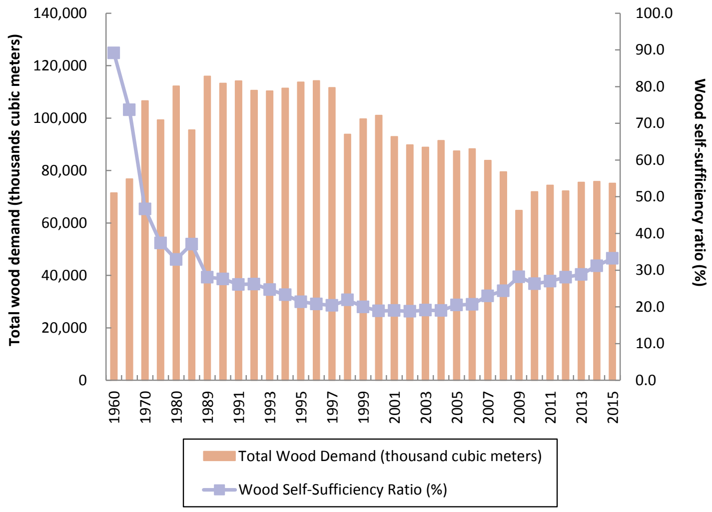


Figure 1-54 Trends in total wood demand and wood self-sufficiency ratio

Reference: Forestry Agency “Demand and Supply of Woods”

Chapter 2

Information on Greenhouse Gas Emissions and Trends

2.1 Description of GHG Emissions and Removals

2.1.1 Overview of Greenhouse Gas Inventory

2.1.1.1 Background Information on Japan's Greenhouse Gas Inventory

Japan reported the greenhouse gas (GHG) inventories, which contain the information on emissions and removals of GHGs, including indirect GHGs and SOx in Japan for FY1990 to FY2015[24], on the basis of Articles 4 and 12 of the United Nations Framework Convention on Climate Change (UNFCCC) and Decision 2/CMP.8.

Estimation methodologies of GHG inventories are required to be in line with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines) which was 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 inventory, Japan also applies the 2013 Supplement to the 2006 IPCC Guidelines: Wetlands (Wetlands Guidelines) and the 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (KP Supplement (2013)).

Japan's national inventory is reported in accordance with the UNFCCC Reporting Guidelines on Annual Inventories (Decision 24/CP.19, hereinafter referred to as the UNFCCC Inventory Reporting Guidelines) decided by the Conference of the Parties.

2.1.1.2 Brief General Description of Methodologies

The methodology used in the estimation of GHG emissions or removals is basically 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.

Results of the actual measurements or estimates based on research conducted in Japan are used to determine the emissions factors (country-specific emissions factors). The default values given in the 2006 IPCC Guidelines are used for estimation of emissions, which are assumed to be quite low (e.g., "1.B.2.a.ii fugitive emissions from fuel (oil and natural gas" (CO_2 and CH_4))) etc.

2.1.1.3 Sectors

Japan's national GHG inventory is composed of 7 gases: CO_2; CH_4; N_2O; HFCs; PFCs; SF_6; and NF_3 and of 5 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 and fugitive emissions from fuels. Fuel combustion 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 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 (Carbon Dioxide), CH_4 (Methane), N_2O (Nitrous Oxide), NOx (Nitrogen Oxide), CO (Carbon Monoxide), and NMVOC (Non-Methane Volatile Organic Compounds) 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

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

transformations in 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 emission from solvent production and uses such 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 to 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 greenhouse gas (GHG) emissions and removals resulting from land use such as forestry activities and land-use change. Japan classifies its national land into six categories—forest land, 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 been occurred, in accordance with the 2006 IPCC Guidelines; a default value of 20 years was used when distinguishing the 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) in forest land, direct N_2O emissions from N fertilization in forest land, CH_4 and N_2O emissions from drainage of organic soils, N_2O emissions from nitrogen mineralization resulting from 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 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 other[25] in accordance with treatment processes. "Waste" to be covered in this sector is the waste as defined in the 2006 IPCC Guidelines. Waste sector estimates GHG emissions from not only incineration and disposal of municipal and industrial waste, which are defined by the "Waste Disposal and Public Cleansing Law", but also energy or material use of recycled materials.

2.1.2 Trends in GHG Emissions and Removals

Total GHG emissions in FY2015[26] (excluding LULUCF[27] , including indirect CO_2[28], definition omitted below) were 1,325

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[25] Data for some emission source categories in the waste sector are complemented by estimation, 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] Abbreviation of "Land Use, Land-Use Change and Forestry"

million tonnes (in CO_2 eq.). They increased by 4.0% compared to the emissions in FY1990, decreased by 5.3% compared to FY 2005 and decreased by 2.9% compared to the previous year.

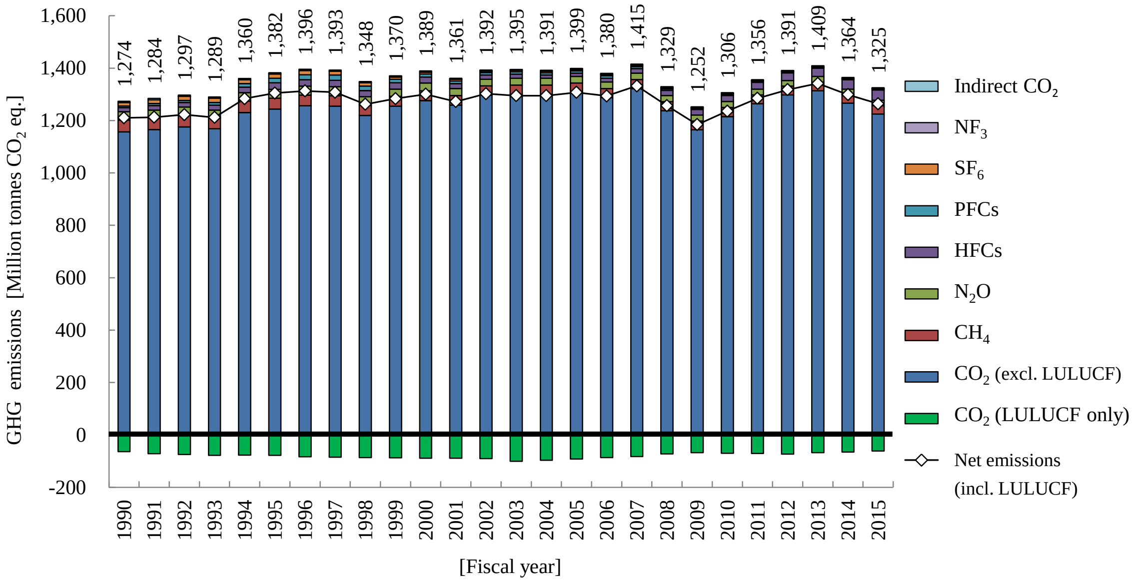

Figure 2-1 Trends in GHG emissions and removals in Japan

CO_2 emissions in FY2015 were 1,225 million tonnes (excluding LULUCF, excluding indirect CO_2, definition omitted below), accounting for 92.5% of total GHG emissions. They increased by 5.9% since FY1990, decreased by 6.3% compared to FY2005 and decreased by 3.3% compared to the previous year. CO_2 removals[29] in FY2015 were 61.2 million tonnes, which were equivalent to 4.6% of total GHG emissions. They decreased by 4.0% since FY1990, by 33.4% compared to FY2005 and by 6.4% compared to the previous year. CH_4 emissions in FY2015 (excluding LULUCF) were 31.3 million tonnes (in CO_2 eq.), accounting for 2.4% of total GHG emissions. They decreased by 29.2% since FY1990, by 11.3% compared to FY2005 and by 2.4% compared to the previous year. N_2O in FY2015 (excluding LULUCF) were 20.8 million tonnes (in CO_2 eq.), accounting for 1.6% of total GHG emissions. They decreased by 33.9% since FY1990, by 16.1% compared to FY2005 and by 0.6% compared to the previous year. HFCs emissions in CY2015 were 39.2 million tonnes (in CO_2 eq.), accounting for 3.0% of total GHG emissions. They increased by 146.1% since CY1990, by 206.7% compared to CY2005 and by 9.6% compared to the previous year. PFCs emissions in CY2015 were 3.3 million tonnes (in CO_2 eq.), accounting for 0.2% of total GHG emissions. They decreased by 49.4% since CY1990, by 61.6% compared to CY2005 and by 1.6% compared to the previous year. SF_6 emissions in CY2015 were 2.1 million tonnes (in CO_2 eq.), accounting for 0.2% of total GHG emissions. They decreased by 83.5% since CY1990, decreased by 58.0% compared to CY2005 and increased by 2.7% compared to the previous year. -NF_3 emissions in CY2015 were 0.6 million tonnes (in CO_2 eq.), accounting for 0.04% of total GHG emissions. They increased 1,651.1% since CY1990, decreased by 61.2% compared to CY2005 and decreased by 49.1% compared to the previous year. Indirect CO_2 emissions in FY2015 were 2.1 million tonnes (in CO_2 eq.), accounting for 0.2% of total GHG emissions. They decreased by 59.4% since FY1990, decreased by 30.5% compared to FY2005 and increased by 1.9% compared to the previous year.

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[28] 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 value in CO_2 equivalent of these emissions. However, emissions of derived from combustion origin and biomass origin of CO, CH_4 and NMVOC are excluded to avoid double counting and/or by concept of carbon neutral.

[29] Since the inventory to be submitted under the UNFCCC reports all GHG emissions and removals from the LULUCF sector, these values do not correspond to emissions and removals under the Kyoto Protocol.

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

[Million tonnes CO_2 eq.]	GWP	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CO_2 (excl. LULUCF) *1	1	1,157.2	1,165.6	1,175.8	1,168.9	1,230.2	1,243.8	1,256.7	1,254.6	1,219.6	1,254.6
CO_2 (incl. LULUCF) *1	1	1,093.4	1,093.9	1,100.9	1,091.1	1,153.2	1,165.8	1,173.5	1,169.5	1,133.1	1,167.6
CO_2 (LULUCF only)	1	-63.7	-71.7	-74.8	-77.8	-77.0	-78.0	-83.2	-85.1	-86.5	-87.0
CH_4 (excl. LULUCF)	25	44.2	43.0	43.8	39.7	43.1	41.6	40.4	39.7	37.8	37.7
CH_4 (incl. LULUCF)	25	44.3	43.1	43.9	39.8	43.2	41.7	40.5	39.8	37.9	37.8
N_2O (excl. LULUCF)	298	31.5	31.2	31.4	31.3	32.6	32.9	34.0	34.8	33.2	27.0
N_2O (incl. LULUCF)	298	31.7	31.4	31.6	31.5	32.8	33.1	34.2	35.0	33.4	27.2
HFCs	HFC-134a: 1,430 etc.	15.9	17.3	17.8	18.1	21.1	25.2	24.6	24.4	23.7	24.4
PFCs	PFC-14: 7,390 etc.	6.5	7.5	7.6	10.9	13.4	17.6	18.3	20.0	16.6	13.1
SF_6	22,800	12.9	14.2	15.6	15.7	15.0	16.4	17.0	14.5	13.2	9.2
NF_3	17,200	0.03	0.03	0.03	0.04	0.1	0.2	0.2	0.2	0.2	0.3
Indirect CO_2	1	5.3	5.1	4.9	4.6	4.6	4.5	4.5	4.4	4.0	4.0
Gross Total (excluding LULUCF, excluding indirect CO_2)		1,268.3	1,278.9	1,292.0	1,284.7	1,355.5	1,377.8	1,391.2	1,388.1	1,344.3	1,366.3
Net Total (including LULUCF, excluding indirect CO_2)		1,204.8	1,207.5	1,217.4	1,207.1	1,278.8	1,300.0	1,308.2	1,303.3	1,258.1	1,279.5
Gross Total (excluding LULUCF, including indirect CO_2)		1,273.6	1,284.0	1,296.9	1,289.3	1,360.1	1,382.3	1,395.7	1,392.5	1,348.4	1,370.3
Net Total (including LULUCF, including indirect CO_2)		1,210.1	1,212.6	1,222.3	1,211.8	1,283.4	1,304.5	1,312.7	1,307.7	1,262.2	1,283.5

[Million tonnes CO_2 eq.]	GWP	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
CO_2 (excl. LULUCF) *1	1	1,275.8	1,259.0	1,296.1	1,301.1	1,300.2	1,307.7	1,287.1	1,321.7	1,237.3	1,164.7
CO_2 (incl. LULUCF) *1	1	1,186.7	1,169.9	1,205.6	1,200.8	1,203.2	1,215.9	1,200.8	1,238.8	1,164.9	1,096.5
CO_2 (LULUCF only)	1	-89.1	-89.1	-90.5	-100.3	-96.9	-91.8	-86.3	-82.9	-72.4	-68.2
CH_4 (excl. LULUCF)	25	37.7	36.6	35.9	34.5	35.5	35.3	34.8	35.0	34.7	33.8
CH_4 (incl. LULUCF)	25	37.7	36.7	36.0	34.5	35.6	35.3	34.8	35.1	34.8	33.9
N_2O (excl. LULUCF)	298	29.6	26.0	25.4	25.2	25.2	24.8	24.8	24.2	23.3	22.7
N_2O (incl. LULUCF)	298	29.8	26.2	25.6	25.4	25.4	25.0	25.0	24.4	23.4	22.9
HFCs	HFC-134a: 1,430 etc.	22.9	19.5	16.2	16.2	12.4	12.8	14.6	16.7	19.3	20.9
PFCs	PFC-14: 7,390 etc.	11.9	9.9	9.2	8.9	9.2	8.6	9.0	7.9	5.7	4.0
SF_6	22,800	7.0	6.1	5.7	5.4	5.3	5.1	5.2	4.7	4.2	2.4
NF_3	17,200	0.3	0.3	0.4	0.4	0.5	1.5	1.4	1.6	1.5	1.4
Indirect CO_2	1	4.1	3.6	3.4	3.3	3.2	3.1	3.0	2.9	2.6	2.4
Gross Total (excluding LULUCF, excluding indirect CO_2)		1,385.0	1,357.3	1,389.0	1,391.7	1,388.3	1,395.7	1,376.9	1,411.9	1,326.0	1,250.0
Net Total (including LULUCF, excluding indirect CO_2)		1,296.2	1,268.5	1,298.8	1,291.6	1,291.6	1,304.2	1,290.8	1,329.1	1,253.9	1,182.0
Gross Total (excluding LULUCF, including indirect CO_2)		1,389.1	1,360.9	1,392.4	1,395.0	1,391.5	1,398.8	1,379.9	1,414.8	1,328.6	1,252.4
Net Total (including LULUCF, including indirect CO_2)		1,300.3	1,272.1	1,302.2	1,294.9	1,294.8	1,307.3	1,293.9	1,332.0	1,256.5	1,184.4

[Million tonnes CO_2 eq.]	GWP	2010	2011	2012	2013	2014	2015	Changes in emissions/removals (2015)	
								1990	Previous year
CO_2 (excl. LULUCF) *1	1	1,215.0	1,263.8	1,298.2	1,313.7	1,266.6	1,225.2	5.9%	-3.3%
CO_2 (incl. LULUCF) *1	1	1,144.7	1,192.9	1,224.5	1,246.0	1,201.2	1,164.1	6.5%	-3.1%
CO_2 (LULUCF only)	1	-70.3	-71.0	-73.7	-67.7	-65.4	-61.2	-4.0%	-6.4%
CH_4 (excl. LULUCF)	25	34.9	33.8	33.0	32.7	32.1	31.3	-29.2%	-2.4%
CH_4 (incl. LULUCF)	25	34.9	33.9	33.0	32.7	32.1	31.4	-29.2%	-2.5%
N_2O (excl. LULUCF)	298	22.3	21.8	21.4	21.4	20.9	20.8	-33.9%	-0.6%
N_2O (incl. LULUCF)	298	22.5	22.0	21.5	21.6	21.1	21.0	-33.8%	-0.5%
HFCs	HFC-134a: 1,430 etc.	23.3	26.1	29.3	32.1	35.8	39.2	146.1%	9.6%
PFCs	PFC-14: 7,390 etc.	4.2	3.8	3.4	3.3	3.4	3.3	-49.4%	-1.6%
SF_6	22,800	2.4	2.2	2.2	2.1	2.1	2.1	-83.5%	2.7%
NF_3	17,200	1.5	1.8	1.5	1.6	1.1	0.6	1651.1%	-49.1%
Indirect CO_2	1	2.3	2.3	2.2	2.2	2.1	2.1	-59.4%	1.9%
Gross Total (excluding LULUCF, excluding indirect CO_2)		1,303.7	1,353.3	1,389.0	1,406.9	1,361.9	1,322.6	4.3%	-2.9%
Net Total (including LULUCF, excluding indirect CO_2)		1,233.6	1,282.6	1,315.6	1,339.4	1,296.8	1,261.6	4.7%	-2.7%
Gross Total (excluding LULUCF, including indirect CO_2)		1,306.0	1,355.6	1,391.2	1,409.0	1,364.0	1,324.7	4.0%	-2.9%
Net Total (including LULUCF, including indirect CO_2)		1,236.0	1,284.8	1,317.8	1,341.6	1,298.9	1,263.8	4.4%	-2.7%

*1 Excluding indirect CO_2

*2 LULUCF: Land Use, Land-Use Change and Forestry

2.1.3 Trends in GHG Emissions and Removals by Gas

2.1.3.1 CO_2

(1) Trends in CO_2 Emissions

CO_2 emissions in FY2015 were 1,225 million tonnes, accounting for 92.5% of total GHG emissions. They increased by 5.9% since FY1990, decreased by 6.3% compared to FY2005 and decreased by 3.3% compared to the previous year.

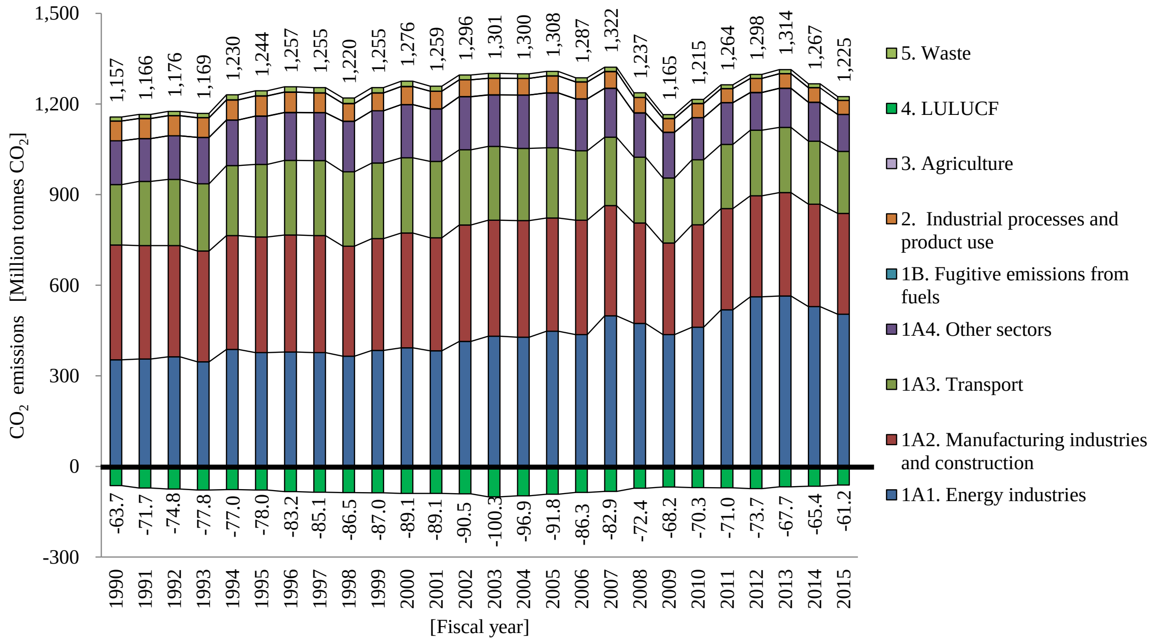


Figure 2-2 Trends in CO_2 emissions

The breakdown of CO_2 emissions in FY2015 shows that fuel combustion accounts for 95.1%, and is followed by industrial processes and product use (3.8%) and waste sectors (1.0%). As for the breakdown of CO_2 emissions within the fuel combustion category, energy industries account for 41.1% and is followed by manufacturing industries and construction at 27.3%, transport at 16.7%, and other sectors[30] at 10.0%. The main driving factor for the decrease in CO_2 emissions compared to the previous year is the CO_2 emissions from electricity power generation in the energy industries sector.

By looking at the changes in emissions by sector, emissions from fuel combustion in the energy industries increased by 42.9% since FY1990, increased by 12.5% compared to FY2005 and decreased by 4.7% compared to the previous year. The main driving factor for the increase compared to the emissions in FY1990 is the increased solid fuel consumption for electricity power generation. Emissions from manufacturing industries and construction decreased by 12.2% since FY1990, by 10.9% compared to FY2005 and by 1.5% compared to the previous year. Emissions from transport increased by 2.4% compared to FY1990, decreased by 11.9% compared to FY2005 and decreased by 1.7% compared to the previous year. The main driving factor for the increase compared to the emissions in FY1990 is the increase in emissions from passenger vehicles, compensating for the decrease in emissions from freight transportation. Emissions from other sectors decreased by 15.7% since FY1990, by 32.5% compared to FY2005 and by 5.0% compared to the previous year.

CO_2 removals in FY2015 were 61.2 million tonnes, which were equivalent to 4.6% of total GHG emissions. They decreased by 4.0% since FY1990, by 33.4% compared to FY2005 and by 6.4% compared to the previous year.

[30] It covers emissions from commercial/institutional, residential and agriculture/forestry/fishing.

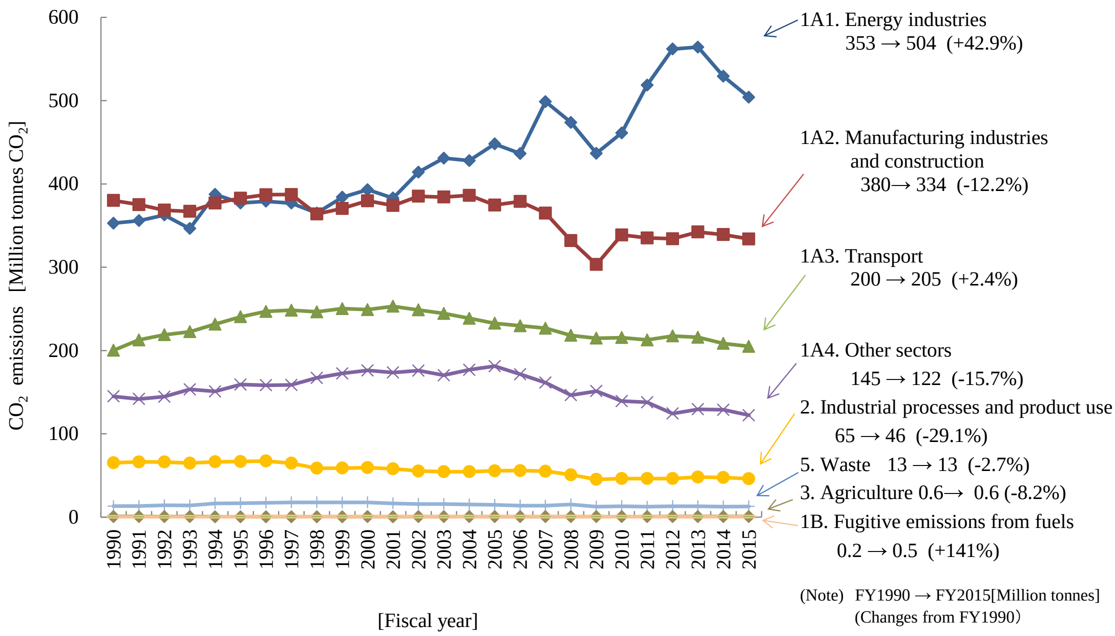


Figure 2-3 Trends in CO_2 emissions by sector/subsector

(Figures in brackets indicate relative increase or decrease to the FY1990 values)

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

[Thousand tonnes CO_2]

Category	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1A. Fuel combustion	1,078,111	1,159,485	1,197,823	1,236,530	1,216,506	1,251,853	1,170,228	1,106,006	1,154,746	1,204,229	1,237,814	1,251,717	1,205,606	1,165,286
1A1. Energy industries	352,783	377,029	393,060	447,939	436,480	498,751	473,839	436,771	461,182	518,617	561,892	564,207	529,229	504,113
Public electricity and heat production	300,173	318,716	334,091	382,776	374,109	428,020	399,444	360,397	383,264	444,491	490,981	495,626	468,199	443,897
Petroleum refining	37,150	41,766	47,377	50,884	49,775	48,426	46,987	47,307	49,627	46,429	45,144	47,454	41,798	42,123
Manufacture of solid fuels and other energy industries	15,460	16,546	11,592	14,279	12,596	22,305	27,409	29,067	28,290	27,698	25,767	21,128	19,232	18,093
1A2. Manufacturing industries and construction	380,140	382,895	379,700	374,649	378,848	364,920	331,854	303,284	338,812	335,113	334,158	342,281	339,109	333,942
Iron and steel	167,331	155,182	163,244	172,177	179,462	173,629	148,781	139,438	159,485	153,689	159,085	164,755	165,326	160,299
Non-ferrous metals	8,409	7,080	5,536	5,389	5,640	5,536	4,942	4,389	3,073	3,177	3,159	3,398	3,463	3,143
Chemicals	63,684	73,044	65,825	59,926	59,299	58,858	54,003	55,790	55,741	54,606	52,244	57,063	52,627	52,100
Pulp, paper and print	28,247	33,041	32,272	30,010	29,233	28,117	25,707	23,538	24,011	25,056	23,261	25,027	24,871	25,304
Food processing, beverages and tobacco	17,039	19,828	23,810	25,905	24,862	23,003	23,887	17,666	24,818	24,494	23,298	17,813	17,836	18,204
Non-metallic minerals	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Other	95,430	94,720	89,013	81,242	80,352	75,777	74,534	62,463	71,685	74,091	73,112	74,225	74,987	74,892
1A3. Transport	200,215	240,453	249,014	232,727	229,663	226,722	218,193	214,764	215,467	212,651	217,436	215,803	208,505	204,952
Domestic aviation	7,162	10,278	10,677	10,799	11,178	10,876	10,277	9,781	9,193	9,001	9,524	10,149	10,173	9,899
Road transportation	178,442	214,684	222,613	208,267	205,124	203,061	196,002	193,931	194,956	192,661	196,765	194,172	186,929	183,785
Railways	935	822	711	647	623	594	604	590	574	555	554	540	524	524
Domestic navigation	13,675	14,669	15,012	13,014	12,739	12,191	11,310	10,462	10,745	10,434	10,594	10,942	10,879	10,743
1A4. Other sectors	144,973	159,108	176,049	181,216	171,515	161,459	146,342	151,187	139,285	137,847	124,327	129,425	128,762	122,279
Commercial/institutional	80,186	86,868	102,040	109,061	103,365	94,445	83,597	89,123	73,851	74,603	61,620	69,342	70,845	66,719
Residential	58,366	68,310	71,037	69,614	65,479	64,553	60,897	59,611	62,883	60,670	60,039	57,660	55,501	53,201
Agriculture/forestry/fishing	6,421	3,931	2,972	2,540	2,671	2,461	1,847	2,453	2,551	2,574	2,669	2,423	2,416	2,359
1A5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1B. Fugitive emissions from fuels	192	521	512	508	553	616	565	501	475	477	490	438	449	462
1C. CO_2 transport and storage	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
2. Industrial processes and product use	65,126	66,774	59,357	55,644	55,893	55,093	50,793	45,235	46,316	46,227	46,288	48,034	47,434	46,156
3. Agriculture	609	359	443	411	383	500	440	390	403	415	520	578	559	559
4. LULUCF	-63,737	-78,050	-89,065	-91,794	-86,321	-82,946	-72,357	-68,168	-70,321	-70,965	-73,655	-67,703	-65,361	-61,169
5. Waste	13,127	16,709	17,642	14,601	13,763	13,652	15,264	12,554	13,071	12,468	13,045	12,919	12,553	12,776
Total (including LULUCF)	1,093,427	1,165,799	1,186,712	1,215,899	1,200,778	1,238,767	1,164,934	1,096,517	1,144,690	1,192,851	1,224,503	1,245,983	1,201,240	1,164,070
Total (excluding LULUCF)	1,157,165	1,243,849	1,275,777	1,307,693	1,287,099	1,321,713	1,237,291	1,164,685	1,215,011	1,263,816	1,298,158	1,313,686	1,266,601	1,225,239

*1 Excluding indirect CO_2

*2 LULUCF: Land Use, Land-Use Change and Forestry

(2) CO_2 Emissions Per Capita, CO_2 Emissions Per Unit of GDP

CO_2 emissions per capita in FY2015 were 9.64 tonnes. They increased by 3.0% since FY1990 and decreased by 3.2% compared to the previous year.

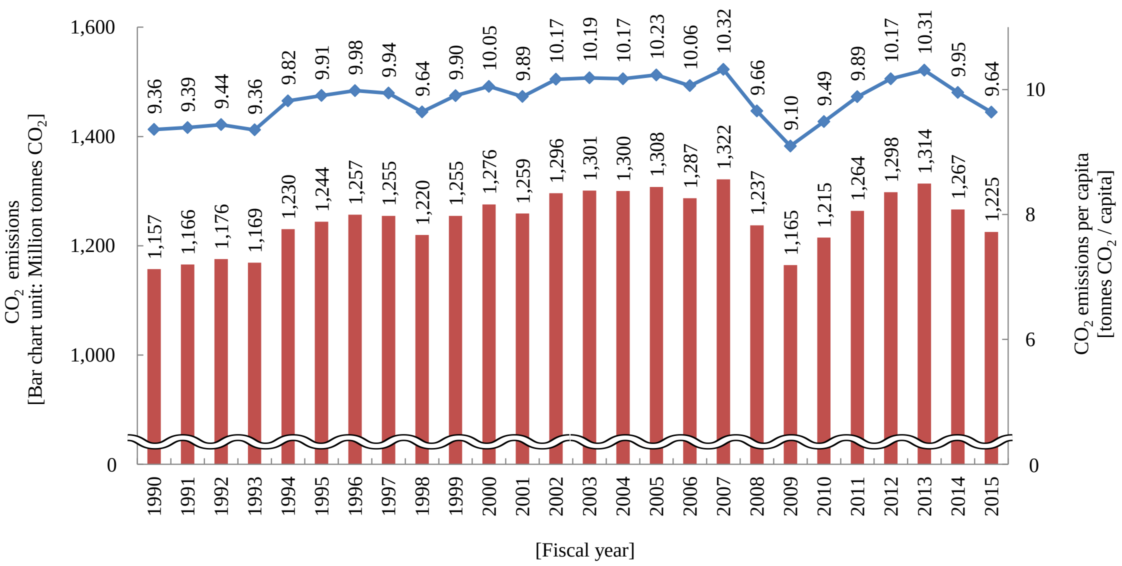


Figure 2-4 Trends in total CO_2 emissions and CO_2 emissions per capita

Source of population data: Ministry of Internal Affairs and Communications, Statistics Bureau, Population Census and Annual Report of Population Estimates

CO_2 emissions per unit of GDP (million yen) in FY2015 were 2.31 tonnes. They decreased by 14.0% since FY1990 and by 4.1% compared to the previous year.

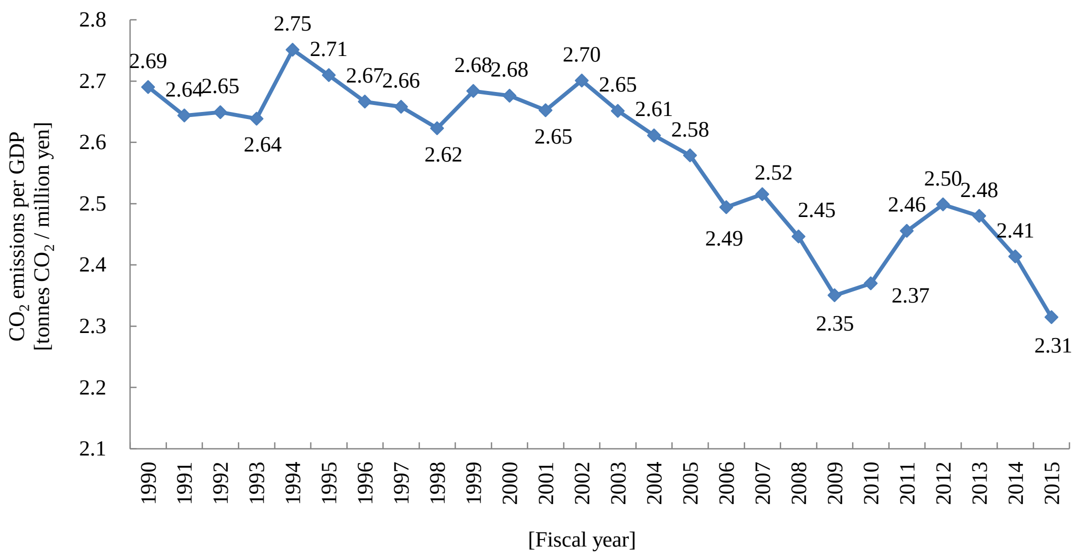


Figure 2-5 Trend in CO_2 emissions per unit of GDP

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

2.1.3.2 CH_4

CH_4 emissions in FY2015 were 31.4 million tonnes (in CO_2 eq., including LULUCF), accounting for 2.4% of total GHG emissions. They decreased by 29.2% since FY1990, by 11.3% compared to FY2005 and by 2.5% compared to the previous year. Their decrease since FY1990 is mainly a result of a 58.3% decrease in emissions from the waste sector (solid waste disposal).

Breakdown of the FY2015 emissions shows that the largest source is rice cultivation accounting for 44%. It is followed by enteric fermentation (23%) and solid waste disposal (10%).

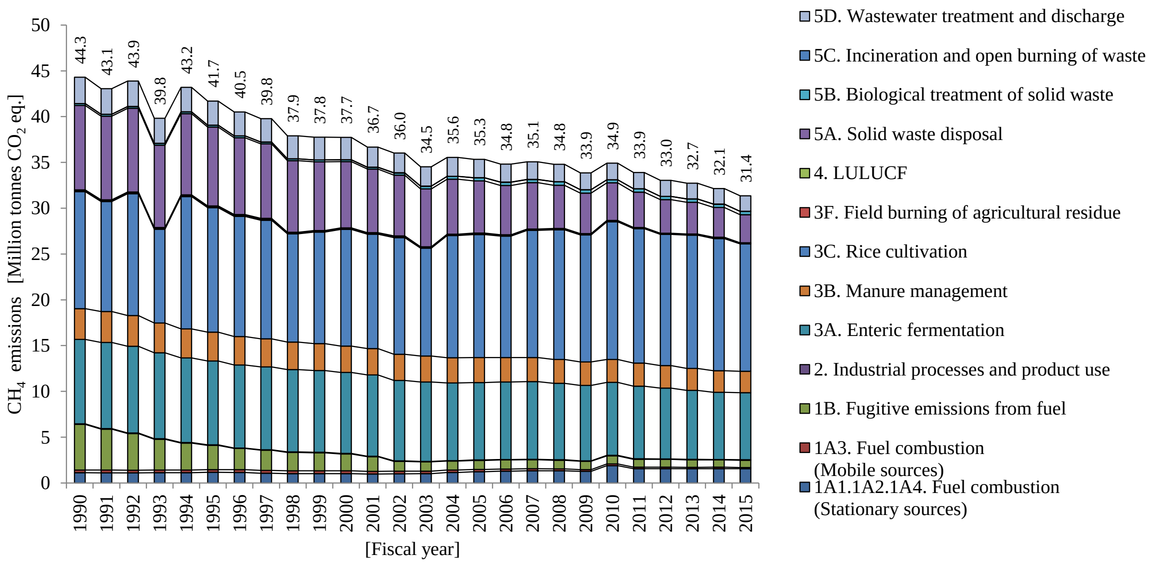


Figure 2-6 Trends in CH_4 emissions

Table 2-3 Trends in CH_4 emissions

[Thousand tonnes CO_2 eq.]

Category	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1A. Fuel combustion	1,419	1,460	1,336	1,480	1,524	1,557	1,534	1,451	2,071	1,720	1,729	1,707	1,713	1,691
1A1. Energy industries	431	403	256	221	218	275	316	313	348	370	397	324	306	286
1A2. Manufacturing industries and construction	441	437	427	522	569	576	551	546	600	480	495	510	540	539
1A3. Transport	291	309	312	248	233	219	200	187	178	170	164	156	148	143
1A4. Other sectors	255	311	342	489	505	487	467	405	944	700	672	717	719	723
1B. Fugitive emissions from fuels	4,973	2,647	1,836	976	982	975	947	916	885	867	851	816	806	788
1B1. Solid fuels	4,760	2,394	1,563	655	644	609	590	577	564	552	545	533	538	521
1B2. Oil and natural gas and other emissions	213	253	273	322	339	366	357	339	321	315	305	283	268	268
2. Industrial processes and product use	61	58	54	54	55	51	50	51	54	54	46	46	43	48
3. Agriculture	25,479	26,017	24,563	24,704	24,486	25,080	25,184	24,742	25,591	25,192	24,593	24,564	24,198	23,648
3A. Enteric fermentation	9,228	9,156	8,839	8,441	8,461	8,476	8,353	8,240	7,966	7,928	7,736	7,528	7,343	7,335
3B. Manure management	3,353	3,146	2,879	2,733	2,676	2,634	2,596	2,564	2,511	2,512	2,461	2,399	2,348	2,335
3C. Rice cultivation	12,771	13,605	12,749	13,445	13,266	13,890	14,157	13,863	15,041	14,680	14,325	14,565	14,437	13,908
3F. Field burning of agricultural residue	127	111	96	86	83	81	78	76	74	73	71	72	70	70
4. LULUCF	73	70	67	67	59	58	81	65	60	61	56	58	76	59
5. Waste	12,291	11,455	9,877	8,065	7,715	7,350	7,006	6,641	6,254	6,007	5,763	5,541	5,308	5,120
5A. Solid waste disposal	9,221	8,619	7,236	5,703	5,383	5,080	4,717	4,413	4,107	3,861	3,655	3,459	3,252	3,063
5B. Biological treatment of solid waste	195	191	194	340	350	337	380	377	329	362	359	356	355	356
5C. Incineration and open burning of waste	16	18	16	17	16	14	14	12	12	11	12	12	11	11
5D. Wastewater treatment and discharge	2,860	2,628	2,432	2,006	1,967	1,919	1,895	1,839	1,806	1,772	1,738	1,714	1,690	1,690
Total (including LULUCF)	44,296	41,708	37,733	35,346	34,821	35,072	34,800	33,868	34,915	33,901	33,038	32,733	32,145	31,354
Total (excluding LULUCF)	44,223	41,638	37,666	35,279	34,762	35,013	34,719	33,802	34,855	33,840	32,982	32,675	32,068	31,295

* LULUCF: Land Use, Land-Use Change and Forestry

2.1.3.3 N_2O

N_2O emissions in FY2015 were 21.0 million tonnes (in CO_2 eq., including LULUCF), accounting for 1.6% of total GHG emissions. They decreased by 33.8% since FY1990, by 16.1% compared to FY2005 and by 0.5% compared to the previous year. Their decrease since FY1990 is mainly a result of a 83.7% decrease in emissions from industrial processes and product use (e.g. adipic acid production in the chemical industry). There is a sharp decline in emissions from the industrial processes and product use from FY1998 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 FY2000 because of a decrease in the removal efficiency due to the failure of the machine; the emissions decreased again in FY2001 with the resumption of normal operation.

Breakdown of the FY2015 emissions shows that the largest source is agricultural soils accounting for 26%. It is followed by fuel combustion (stationary sources) (22%) and manure management (19%).

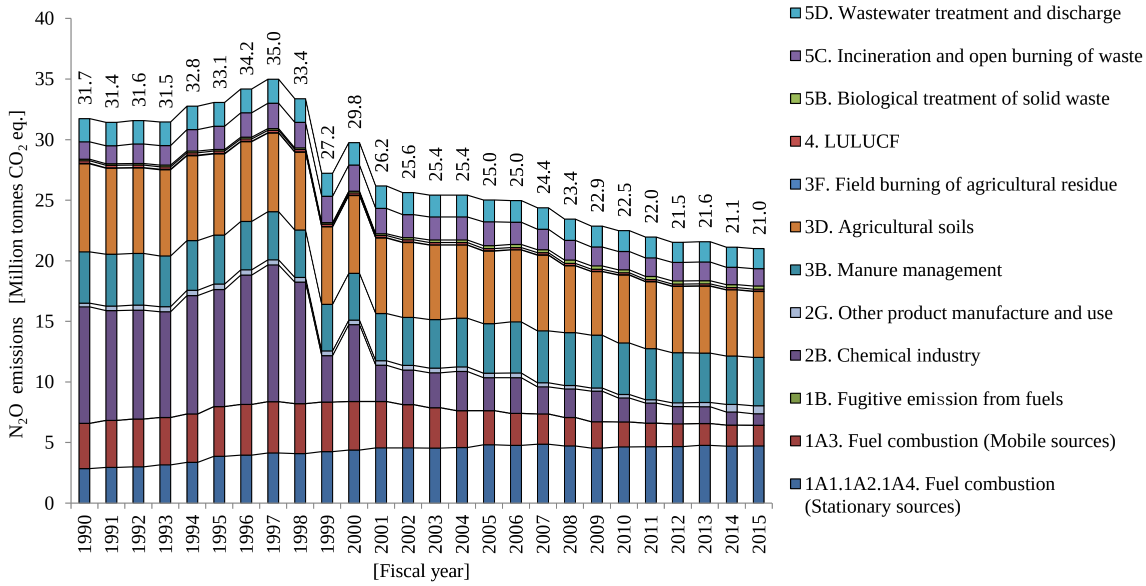


Figure 2-7 Trends in N_2O emissions

Table 2-4 Trends in N_2O emissions

[Thousand tonnes CO_2 eq.]

Category	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1A. Fuel combustion	6,580	7,962	8,375	7,622	7,401	7,358	7,059	6,714	6,685	6,599	6,536	6,561	6,431	6,421
1A1. Energy industries	1,197	1,737	2,056	2,442	2,425	2,489	2,442	2,356	2,374	2,559	2,574	2,620	2,554	2,565
1A2. Manufacturing industries and construction	1,394	1,816	1,991	2,009	1,997	2,042	1,967	1,851	1,875	1,815	1,837	1,873	1,865	1,884
1A3. Transport	3,739	4,104	3,997	2,817	2,637	2,499	2,348	2,186	2,051	1,948	1,871	1,801	1,743	1,716
1A4. Other sectors	249	304	331	354	343	328	302	321	386	277	254	267	269	256
1B. Fugitive emissions from fuels	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2. Industrial processes and product use	9,911	10,114	6,720	3,093	3,339	2,564	2,647	2,777	2,270	1,931	1,737	1,748	1,704	1,612
2B. Chemical industry	9,620	9,665	6,348	2,726	2,944	2,228	2,350	2,518	1,995	1,661	1,429	1,389	1,078	944
2G. Other product manufacture and use	291	449	371	368	395	336	297	259	275	270	308	359	627	668
3. Agriculture	11,548	10,782	10,318	10,113	10,172	10,569	9,902	9,636	9,892	9,754	9,639	9,621	9,475	9,460
3B. Manure management	4,249	4,038	3,867	4,093	4,206	4,282	4,358	4,369	4,264	4,215	4,130	4,062	4,001	3,985
3D. Agricultural soils	7,259	6,710	6,421	5,993	5,941	6,261	5,520	5,243	5,605	5,517	5,487	5,537	5,453	5,454
3F. Field burning of agricultural residue	39	34	30	26	26	25	24	23	23	22	22	22	22	22
4. LULUCF	209	200	189	180	177	175	174	171	169	169	167	168	171	170
5. Waste	3,479	4,003	4,149	4,001	3,884	3,700	3,655	3,562	3,471	3,502	3,439	3,471	3,335	3,337
5B. Biological treatment of solid waste	139	137	139	243	250	241	271	269	236	259	257	254	254	254
5C. Incineration and open burning of waste	1,435	1,905	2,155	1,963	1,843	1,694	1,629	1,571	1,517	1,524	1,528	1,542	1,433	1,434
5D. Wastewater treatment and discharge	1,905	1,961	1,855	1,795	1,791	1,765	1,754	1,722	1,719	1,718	1,654	1,675	1,648	1,648
Total (including LULUCF)	31,727	33,061	29,751	25,009	24,973	24,366	23,438	22,861	22,488	21,955	21,518	21,568	21,116	21,000
Total (excluding LULUCF)	31,518	32,861	29,561	24,829	24,796	24,191	23,264	22,690	22,318	21,786	21,351	21,400	20,945	20,830

* LULUCF: Land Use, Land-Use Change and Forestry

2.1.3.4 HFCs

HFCs emissions in CY2015[31] were 39.2 million tonnes (in CO_2 eq.), accounting for 3.0% of total GHG emissions. They increased by 146.1% since CY1990, by 206.7% compared to CY2005 and by 9.6% compared to the previous year. Their increase since CY1990 is mainly a result of an increase in emissions from refrigeration and air conditioning (+35.8 million tonnes CO_2 eq.) due to the substituting HCFC (an ozone-depleting substance), despite a decrease in emissions of HFC-23 -15.9 million tonnes CO_2 eq. 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 of May 20, 1988).

Breakdown of the CY2015 emissions shows that the largest source is refrigerants of refrigeration and air conditioning equipment accounting for 91%. It is followed by foam blowing agents (6%).

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

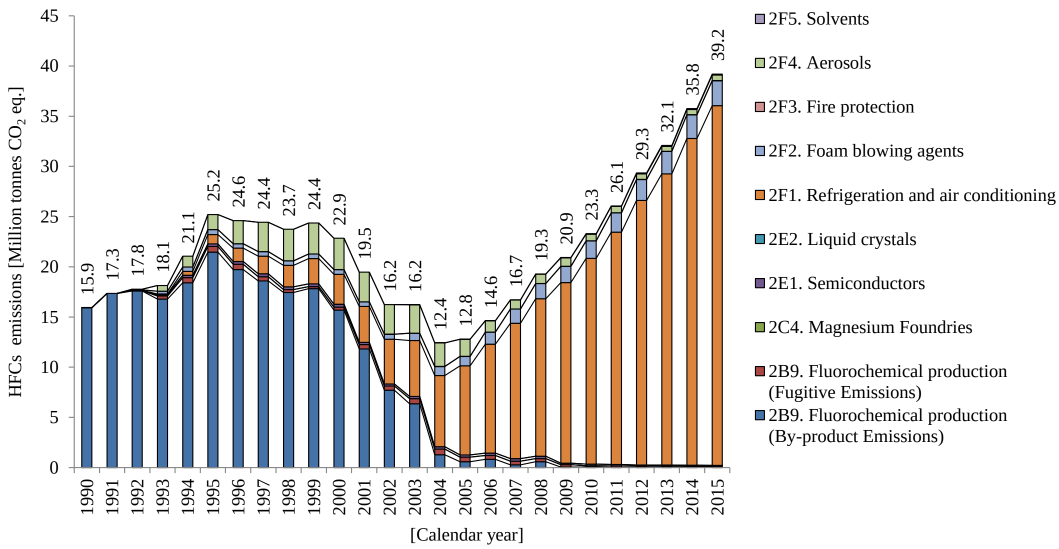


Figure 2-8 Trends in HFCs emissions

Table 2-5 Trends in HFCs emissions

[Thousand tonnes CO_2 eq.]

Category	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2B9. Fluorochemical production	15,930	22,019	15,984	1,035	1,198	632	900	284	181	168	138	147	124	113
By-product Emissions	15,929	21,460	15,688	586	831	275	593	50	53	16	18	16	24	30
Fugitive Emissions	2	559	296	449	367	357	306	234	128	151	120	131	101	83
2C4. Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	1	1	1	1
2E. Electronics industry	1	271	285	227	246	266	237	152	168	145	124	112	115	115
2E1. Semiconductors	1	271	283	224	243	263	234	150	165	142	122	109	113	113
2E2. Liquid crystals	0.001	0.3	2	3	3	3	3	2	3	3	2	2	2	2
2F. Product uses as substitutes for ODS	1	2,923	6,583	11,519	13,184	15,809	18,148	20,501	22,956	25,757	29,085	31,834	35,525	38,974
2F1. Refrigeration and air conditioning	NO	925	2,977	8,876	10,854	13,468	15,686	17,998	20,483	23,140	26,354	29,008	32,536	35,833
2F2. Foam blowing agents	1	497	484	937	1,194	1,429	1,510	1,608	1,749	1,923	2,081	2,229	2,373	2,484
2F3. Fire protection	NO	NO	5	7	7	8	8	8	8	8	9	9	9	9
2F4. Aerosols	NO	1,502	3,117	1,695	1,123	895	931	845	666	634	561	489	503	540
2F5. Solvents	NO	NO	NO	4	5	10	14	42	50	52	81	99	104	108
Total	15,932	25,213	22,852	12,782	14,627	16,707	19,285	20,937	23,305	26,071	29,349	32,095	35,766	39,203

2.1.3.5 PFCs

PFCs emissions in CY2015 were 3.3 million tonnes (in CO_2 eq.), accounting for 0.2% of total GHG emissions. They decreased by 49.4% since CY1990, by 61.6% compared to CY2005 and by 1.6% compared to the previous year. Their decrease since CY1990 is mainly a result of a decrease in emissions from the solvents (-66.7%).

Breakdown of the CY2015 emissions shows that the largest source is semiconductor manufacture accounting for 48%. It is followed by solvents such as those for washing metals (46%) and fugitive emissions from fluorochemical production (PFCs) (3%).

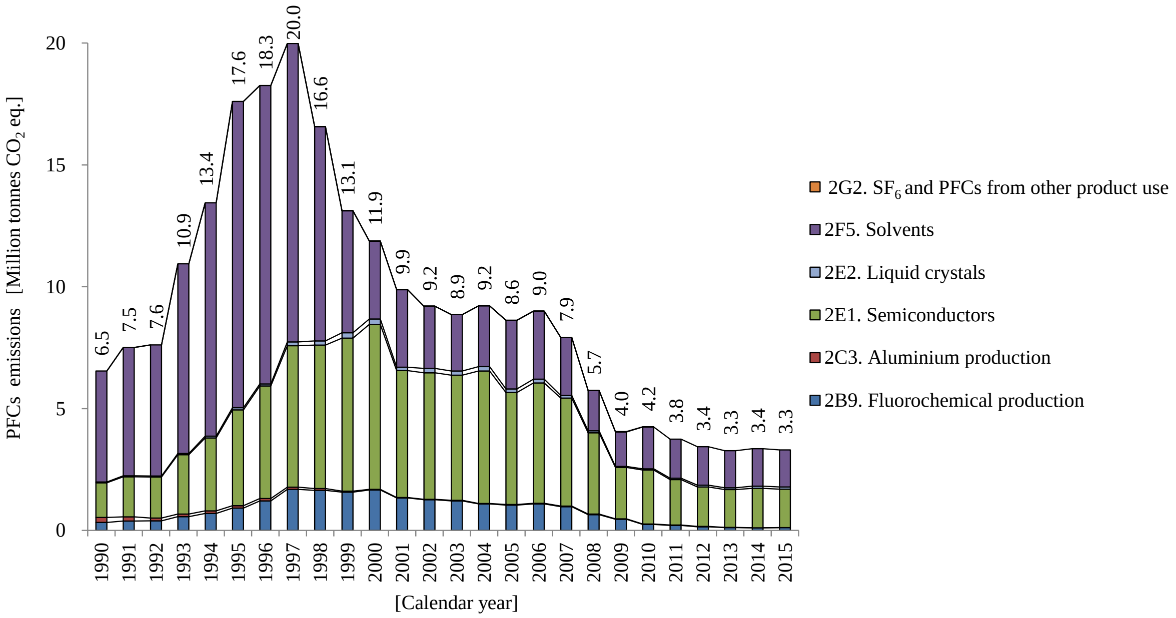


Figure 2-9 Trends in PFCs emissions

Table 2-6 Trends in PFCs emissions

[Thousand tonnes CO_2 eq.]

Category	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2B9. Fluorochemical production	331	914	1,661	1,041	1,091	977	649	459	248	206	148	111	107	115
2C3. Aluminium production	204	104	26	22	22	22	22	16	15	15	13	10	2	0
2E. Electronics industry	1,455	4,020	6,986	4,746	5,092	4,540	3,422	2,148	2,261	1,922	1,692	1,631	1,707	1,669
2E1. Semiconductors	1,423	3,933	6,771	4,594	4,935	4,433	3,339	2,109	2,214	1,863	1,624	1,556	1,617	1,582
2E2. Liquid crystals	31	87	214	152	158	107	83	39	46	59	68	76	90	86
2F5. Solvents	4,550	12,572	3,200	2,815	2,793	2,377	1,648	1,420	1,721	1,605	1,583	1,518	1,537	1,517
2G2. SF_6 and PFCs from other product use	NO	NO	NO	0.3	0.6	1.4	2	3	4	6	NO	10	9	8
Total	6,539	17,610	11,873	8,623	8,999	7,917	5,743	4,047	4,250	3,755	3,436	3,280	3,361	3,308

2.1.3.6 SF_6

SF_6 emissions in CY2015 were 2.1 million tonnes (in CO_2 eq.), accounting for 0.2% of total GHG emissions. They decreased by 83.5% since CY1990, decreased by 58.0% compared to CY2005 and increased by 2.7% compared to the previous year. Their decrease since CY1990 is mainly a result of a decrease in electrical equipment, due to an enhancement of gas management system such as gas recovery largely in electric power companies (-92.5%).

Breakdown of the CY2015 emissions shows that the largest source is other product use (e.g. accelerator, etc.) accounting for 40%. It is followed by electrical equipment (29%) and magnesium production (11%).

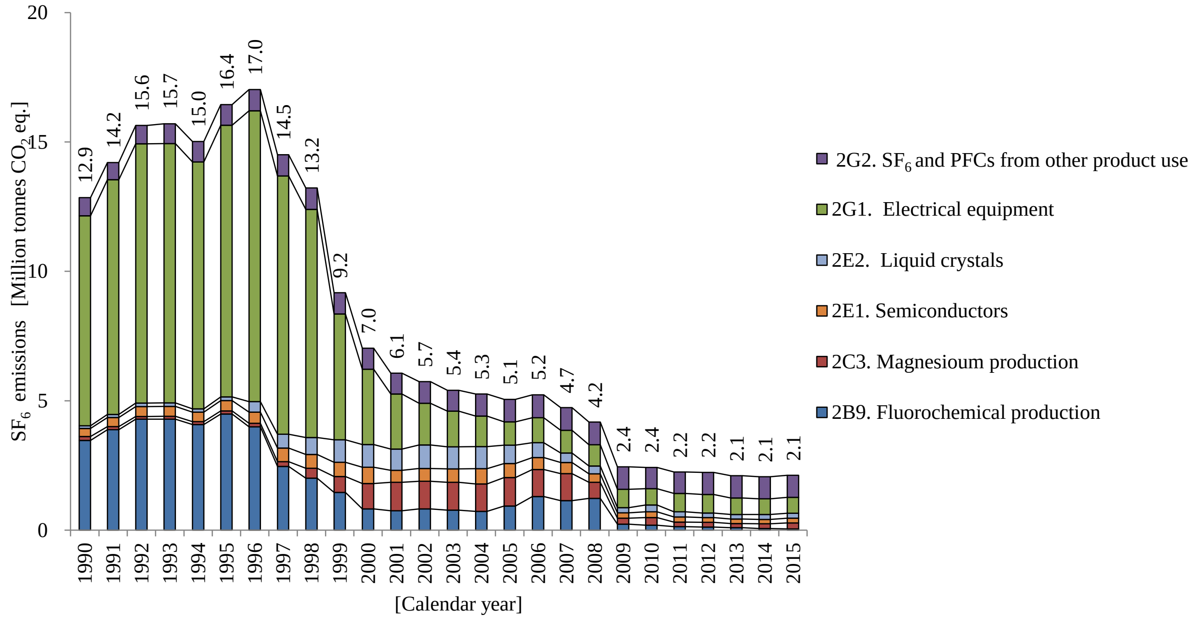


Figure 2-10 Trends in SF_6 emissions

Table 2-7 Trends in SF_6 emissions

[Thousand tonnes CO_2 eq.]

Category	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2B9. Fluorochemical production	3,471	4,492	821	930	1,303	1,144	1,229	233	189	132	123	93	62	52
2C3. Magnesium production	147	114	980	1,104	1,041	1,039	622	228	294	182	182	160	182	228
2E. Electronics industry	419	542	1,506	1,252	1,036	796	625	410	494	394	356	351	366	375
2E1. Semiconductors	309	400	629	540	463	431	329	211	225	196	184	181	175	184
2E2. Liquid crystals	110	142	877	712	572	366	296	199	269	198	172	170	191	191
2G. Other product manufacture and use	8,814	11,300	3,724	1,767	1,849	1,754	1,701	1,576	1,447	1,539	1,573	1,498	1,455	1,466
2G1. Electrical equipment	8,112	10,498	2,910	899	967	880	828	711	622	707	719	643	602	610
2G2. SF_6 and PFCs from other product use	702	802	815	867	882	875	873	865	825	832	855	855	854	856
Total	12,850	16,448	7,031	5,053	5,229	4,733	4,177	2,447	2,424	2,248	2,235	2,102	2,065	2,122

2.1.3.7 NF_3

NF_3 emissions in CY2015 were 0.6 million tonnes (in CO_2 eq.), accounting for 0.04% of total GHG emissions. They increased by 1,651.1% since CY1990, decreased by 61.2% compared to CY2005 and decreased by 49.1% compared to the previous year. The increase since CY1990 is mainly a result of an increase in fugitives from fluorocarbon production (NF_3) (by 14,391.7% compared to CY1990).

Breakdown of the CY2015 emissions shows that the largest source is fluorochemical production accounting for 71%. It is followed by semiconductor manufacture (25%) and liquid crystal manufacture (4%).

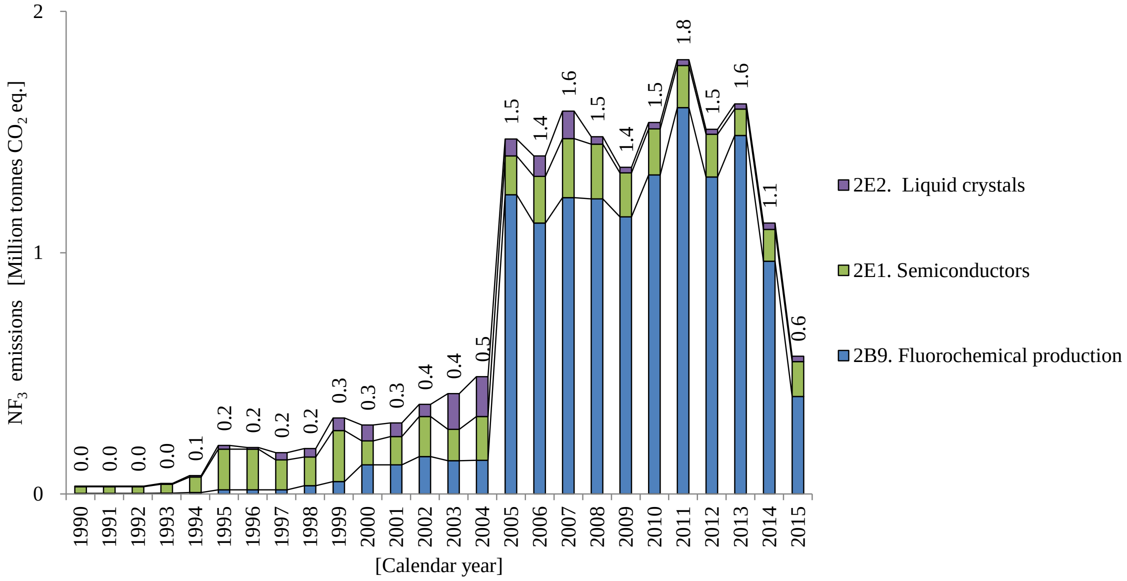


Figure 2-11 Trends in NF_3 emissions

Table 2-8 Trends in NF_3 emissions

[Thousand tonnes CO_2 eq.]

Category	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2B9. Fluorochemical production	3	17	120	1,240	1,123	1,228	1,223	1,149	1,323	1,601	1,314	1,486	965	404
2E. Electronics industry	30	184	165	232	278	359	258	205	217	199	198	131	158	167
2E1. Semiconductors	27	168	100	161	193	245	227	182	191	175	177	110	132	145
2E2. Liquid crystals	3	16	66	71	85	114	31	23	26	24	21	21	26	22
Total	33	201	286	1,472	1,401	1,587	1,481	1,354	1,540	1,800	1,512	1,617	1,123	571

2.1.3.8 Indirect CO_2

Indirect CO_2[32] emissions in FY2015 were 2.1 million tonnes (in CO_2 eq.), accounting for 0.2% of total GHG emissions. They decreased by 59.4% since FY1990, decreased by 30.5% compared to FY2005 and increased by 1.9% compared to the previous year. Their decrease since FY1990 is due to the decrease in indirect CO_2 emissions derived from NMVOC from the use of paint by promoting the use of low VOC paint and VOC removing apparatus.

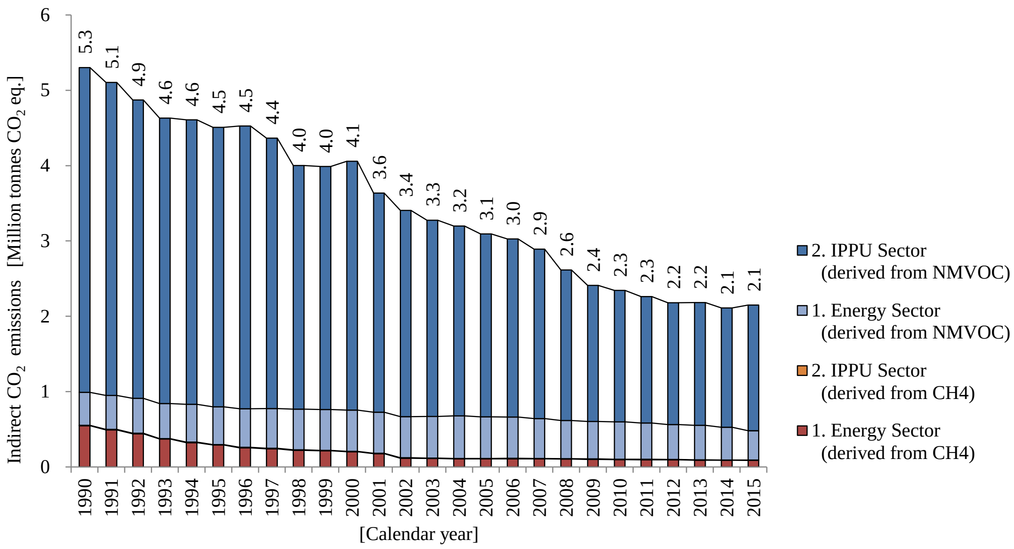


Figure 2-12 Trends in Indirect CO_2 emissions

[32] 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.

Table 2-9 Trends in Indirect CO_2 emissions

[Thousand tonnes CO_2 eq.]

Emission Source	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Derived from CH_4	554	298	208	113	114	113	110	106	103	101	99	95	93	92
1. Energy Sector	547	291	202	107	108	107	104	101	97	95	94	90	89	87
2. IPPU Sector	7	6	6	6	6	6	5	6	6	6	5	5	5	5
Derived from NMVOC	4,747	4,210	3,850	2,979	2,911	2,777	2,506	2,304	2,240	2,160	2,082	2,088	2,017	2,058
1. Energy Sector	437	501	547	552	549	531	506	498	494	481	463	458	433	390
2. IPPU Sector	4,310	3,709	3,303	2,427	2,363	2,247	1,999	1,806	1,745	1,679	1,619	1,630	1,584	1,668
Total	5,301	4,508	4,058	3,092	3,025	2,890	2,615	2,410	2,343	2,261	2,181	2,183	2,111	2,150

2.1.4 Trends in GHG Emissions and Removals by Sectors

The breakdown of GHG emissions and removals in FY2015 by sector[33] shows that energy (excluding indirect CO_2, definition omitted below) accounts for 88.7% of total GHG emissions. It is followed by industrial processes and product use (excluding indirect CO_2, definition omitted below) (7.0%), agriculture (2.5%), waste (1.6%), and indirect CO_2 emissions (0.2%).

Removals by LULUCF in FY2015 were equivalent to 4.6% of total GHG emissions.

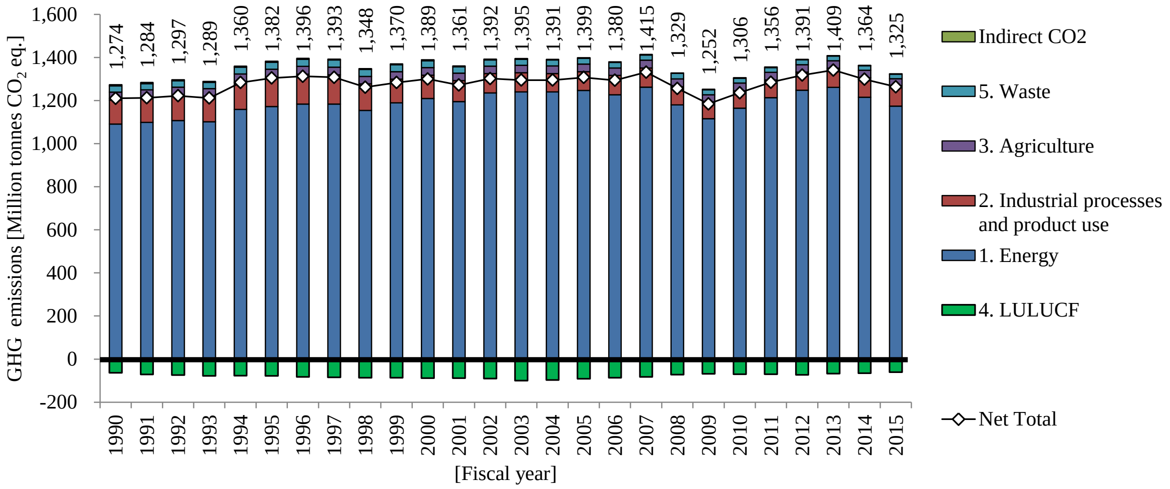


Figure 2-13 Trends in GHG emissions and removals by sector

[33] As indicated in the *2006 IPCC Guidelines* and the CRF.

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

[Million tonnes CO_2 eq.]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1. Energy[*1]	1,091.3	1,098.4	1,107.3	1,101.4	1,158.7	1,172.1	1,183.8	1,183.7	1,154.5	1,189.4
2. Industrial processes and product use[*1]	110.5	114.8	116.7	118.9	126.3	136.4	138.5	135.6	122.8	110.1
3. Agriculture	37.6	36.9	38.1	34.9	38.5	37.2	36.4	36.0	34.7	34.8
4. LULUCF[*2]	-63.5	-71.4	-74.6	-77.5	-76.7	-77.8	-82.9	-84.8	-86.2	-86.8
5. Waste	28.9	28.8	30.0	29.5	32.0	32.2	32.4	32.8	32.4	31.9
Indirect CO_2	5.3	5.1	4.9	4.6	4.6	4.5	4.5	4.4	4.0	4.0
Gross Total (excluding LULUCF, excluding indirect CO_2)	1,268.3	1,278.9	1,292.0	1,284.7	1,355.5	1,377.8	1,391.2	1,388.1	1,344.3	1,366.3
Net Total (including LULUCF, excluding indirect CO_2)	1,204.8	1,207.5	1,217.4	1,207.1	1,278.8	1,300.0	1,308.2	1,303.3	1,258.1	1,279.5
Gross Total (excluding LULUCF, including indirect CO_2)	1,273.6	1,284.0	1,296.9	1,289.3	1,360.1	1,382.3	1,395.7	1,392.5	1,348.4	1,370.3
Net Total (including LULUCF, including indirect CO_2)	1,210.1	1,212.6	1,222.3	1,211.8	1,283.4	1,304.5	1,312.7	1,307.7	1,262.2	1,283.5

[Million tonnes CO_2 eq.]	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1. Energy[*1]	1,209.9	1,195.5	1,235.0	1,240.6	1,240.1	1,247.1	1,227.0	1,262.4	1,180.3	1,115.6
2. Industrial processes and product use[*1]	108.2	97.2	90.2	88.8	85.6	86.7	89.5	88.7	84.2	76.8
3. Agriculture	35.3	34.9	35.1	34.0	35.2	35.2	35.0	36.1	35.5	34.8
4. LULUCF[*2]	-88.8	-88.8	-90.2	-100.1	-96.7	-91.5	-86.1	-82.7	-72.1	-67.9
5. Waste	31.7	29.8	28.7	28.4	27.5	26.7	25.4	24.7	25.9	22.8
Indirect CO_2	4.1	3.6	3.4	3.3	3.2	3.1	3.0	2.9	2.6	2.4
Gross Total (excluding LULUCF, excluding indirect CO_2)	1,385.0	1,357.3	1,389.0	1,391.7	1,388.3	1,395.7	1,376.9	1,411.9	1,326.0	1,250.0
Net Total (including LULUCF, excluding indirect CO_2)	1,296.2	1,268.5	1,298.8	1,291.6	1,291.6	1,304.2	1,290.8	1,329.1	1,253.9	1,182.0
Gross Total (excluding LULUCF, including indirect CO_2)	1,389.1	1,360.9	1,392.4	1,395.0	1,391.5	1,398.8	1,379.9	1,414.8	1,328.6	1,252.4
Net Total (including LULUCF, including indirect CO_2)	1,300.3	1,272.1	1,302.2	1,294.9	1,294.8	1,307.3	1,293.9	1,332.0	1,256.5	1,184.4

[Million tonnes CO_2 eq.]	2010	2011	2012	2013	2014	2015
1. Energy[*1]	1,164.9	1,213.9	1,247.4	1,261.2	1,215.0	1,174.6
2. Industrial processes and product use[*1]	80.2	82.1	84.6	88.9	91.5	93.0
3. Agriculture	35.9	35.4	34.8	34.8	34.2	33.7
4. LULUCF[*2]	-70.1	-70.7	-73.4	-67.5	-65.1	-60.9
5. Waste	22.8	22.0	22.2	21.9	21.2	21.2
Indirect CO_2	2.3	2.3	2.2	2.2	2.1	2.1
Gross Total (excluding LULUCF, excluding indirect CO_2)	1,303.7	1,353.3	1,389.0	1,406.9	1,361.9	1,322.6
Net Total (including LULUCF, excluding indirect CO_2)	1,233.6	1,282.6	1,315.6	1,339.4	1,296.8	1,261.6
Gross Total (excluding LULUCF, including indirect CO_2)	1,306.0	1,355.6	1,391.2	1,409.0	1,364.0	1,324.7
Net Total (including LULUCF, including indirect CO_2)	1,236.0	1,284.8	1,317.8	1,341.6	1,298.9	1,263.8

*1 Excluding indirect CO_2
*2 LULUCF: Land Use, Land-Use Change and Forestry

2.1.4.1 Energy

Emissions from the energy sector in FY2015 were 1,175 million tonnes (in CO_2 equivalents). They increased by 7.6% since FY1990, decreased by 5.8% compared to FY2005 and decreased by 3.3% compared to the previous year.

Breakdown of the FY2015 emissions shows that CO_2 from fuel combustion accounts for 99.2%. The largest source within fuel combustion[34] is solid fuel CO_2, which accounted for 38.5%, and is then followed by liquid fuel CO_2 (37.8%) and gaseous fuel CO_2 (21.5%).

[34] Fuel types are categorized in accordance with classification indicated in the *2006 IPCC Guidelines* and the CRF.

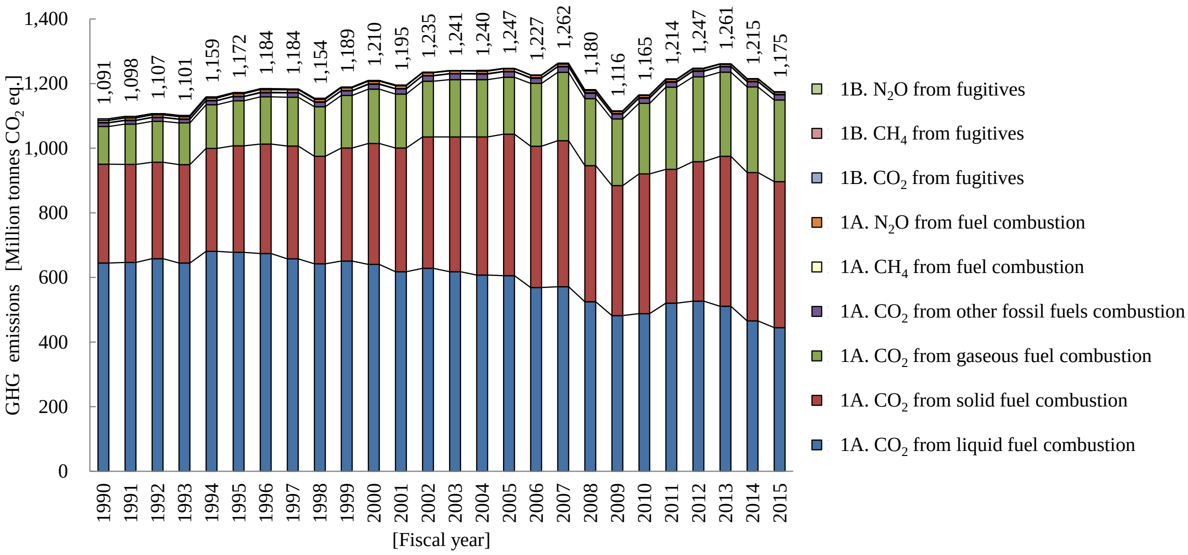


Figure 2-14 Trends in GHG emissions from the energy sector

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

[Thousand tonnes CO_2 eq.]

Source category	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1A. Fuel combustion	1,086,110	1,168,907	1,207,535	1,245,632	1,225,431	1,260,768	1,178,821	1,114,172	1,163,502	1,212,548	1,246,078	1,259,985	1,213,750	1,173,397
Liquid fuel CO_2	644,730	677,734	640,355	605,901	569,135	571,149	525,131	481,800	488,214	520,447	526,948	510,800	465,362	444,545
Solid fuel CO_2	305,968	329,370	374,429	437,445	437,076	451,963	420,978	402,354	432,060	414,290	431,427	464,277	459,230	451,918
Gaseous fuel CO_2	116,536	139,951	167,825	176,128	194,146	211,905	207,523	206,203	218,823	253,920	262,639	260,226	265,039	252,728
Other fossil fuels (Waste) CO_2	10,878	12,431	15,214	17,057	16,149	16,836	16,597	15,649	15,649	15,571	16,800	16,414	15,975	16,095
CH_4	1,419	1,460	1,336	1,480	1,524	1,557	1,534	1,451	2,071	1,720	1,729	1,707	1,713	1,691
N_2O	6,580	7,962	8,375	7,622	7,401	7,358	7,059	6,714	6,685	6,599	6,536	6,561	6,431	6,421
1B. Fugitive emissions from fuel	5,165	3,169	2,347	1,484	1,536	1,591	1,512	1,417	1,360	1,345	1,341	1,255	1,255	1,251
CO_2	192	521	512	508	553	616	565	501	475	477	490	438	449	462
CH_4	4,973	2,647	1,836	976	982	975	947	916	885	867	851	816	806	788
N_2O	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
1C. CO_2 transport and storage	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
Total	1,091,275	1,172,076	1,209,882	1,247,116	1,226,967	1,262,359	1,180,333	1,115,589	1,164,862	1,213,893	1,247,419	1,261,239	1,215,005	1,174,648

2.1.4.2 Industrial Processes and Product Use

Emissions from the industrial processes and product use sector in FY2015 were 93.0 million tonnes (in CO_2 eq.). They decreased by 15.8% since FY1990, increased by 7.3% compared to FY2005 and increased by 1.7% compared to the previous year.

The breakdown of GHG emissions from this sector in FY2015 shows that the largest source is HFCs emissions from product uses as ODS substitutes accounting for 42%. It is followed by the mineral industry emissions such as CO_2 emissions from cement production (36%) and CO_2 emissions from the metal industry (6%).

Despite the increase in HFCs compare to FY1990, emissions from the industrial processes and product use sector decreased in the same period. The main driving factors for decrease are 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 the clinker production declined, the decrease in N_2O emissions from adipic acid production (chemical industry) as the N_2O abatement equipment came on stream.

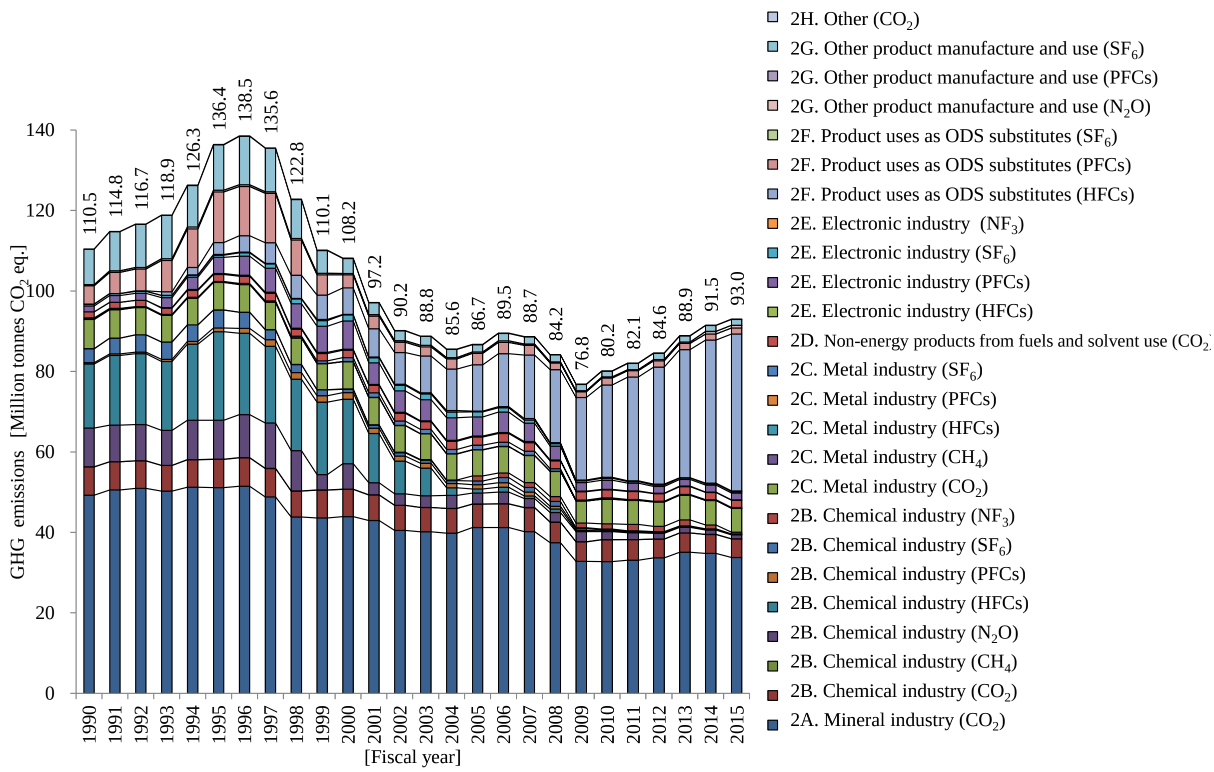


Figure 2-15 Trends in GHG emissions from the industrial processes sector

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

Category	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2A. Mineral industry (CO_2)	49,219	51,131	43,899	41,220	41,192	40,200	37,432	32,776	32,748	33,091	33,661	35,054	34,795	33,782
2B. Chemical industry	36,431	44,157	31,779	12,797	13,564	12,202	11,486	9,547	9,396	8,904	7,829	8,039	7,046	6,251
CO_2	7,039	7,013	6,810	5,791	5,871	5,962	5,103	4,869	5,423	5,100	4,648	4,784	4,685	4,591
CH_4	37	37	34	34	34	30	32	36	36	36	28	28	25	32
N_2O	9,620	9,665	6,348	2,726	2,944	2,228	2,350	2,518	1,995	1,661	1,429	1,389	1,078	944
HFCs	15,930	22,019	15,984	1,035	1,198	632	900	284	181	168	138	147	124	113
PFCs	331	914	1,661	1,041	1,091	977	649	459	248	206	148	111	107	115
SF_6	3,471	4,492	821	930	1,303	1,144	1,229	233	189	132	123	93	62	52
NF_3	3	17	120	1,240	1,123	1,228	1,223	1,149	1,323	1,601	1,314	1,486	965	404
2C. Metal industry	7,646	7,088	7,766	7,642	7,651	7,776	6,898	5,728	6,427	6,181	6,276	6,358	6,296	6,179
CO_2	7,273	6,850	6,740	6,496	6,568	6,695	6,237	5,468	6,101	5,965	6,061	6,170	6,093	5,934
CH_4	23	21	20	20	20	21	18	15	18	18	18	18	18	17
HFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	1	1	1	1
PFCs	204	104	26	22	22	22	22	16	15	15	13	10	2	0
SF_6	147	114	980	1,104	1,041	1,039	622	228	294	182	182	160	182	228
2D. Non-energy products from fuels and solvent use (CO_2)	1,531	1,709	1,822	2,047	2,175	2,149	1,949	2,051	1,968	1,995	1,842	1,944	1,781	1,765
2E. Electronic industry	1,904	5,016	8,941	6,457	6,652	5,960	4,542	2,916	3,140	2,661	2,370	2,225	2,346	2,326
HFCs	1	271	285	227	246	266	237	152	168	145	124	112	115	115
PFCs	1,455	4,020	6,986	4,746	5,092	4,540	3,422	2,148	2,261	1,922	1,692	1,631	1,707	1,669
SF_6	419	542	1,506	1,252	1,036	796	625	410	494	394	356	351	366	375
NF_3	30	184	165	232	278	359	258	205	217	199	198	131	158	167
2F. Product uses as ODS substitutes	4,551	15,496	9,783	14,334	15,977	18,187	19,796	21,922	24,677	27,363	30,668	33,352	37,062	40,491
HFCs	1	2,923	6,583	11,519	13,184	15,809	18,148	20,501	22,956	25,757	29,085	31,834	35,525	38,974
PFCs	4,550	12,572	3,200	2,815	2,793	2,377	1,648	1,420	1,721	1,605	1,583	1,518	1,537	1,517
SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G. Other product manufacture and use	9,105	11,749	4,096	2,135	2,245	2,091	2,001	1,838	1,727	1,815	1,881	1,867	2,091	2,142
N_2O	291	449	371	368	395	336	297	259	275	270	308	359	627	668
PFCs	NO	NO	NO	0.3	1	1	2	3	4	6	NO	10	9	8
SF_6	8,814	11,300	3,724	1,767	1,849	1,754	1,701	1,576	1,447	1,539	1,573	1,498	1,455	1,466
2H. Other (CO_2)	64	72	87	90	88	86	72	71	76	76	76	82	80	83
Total	110,451	136,418	108,174	86,721	89,543	88,652	84,177	76,848	80,158	82,087	84,602	88,922	91,497	93,020

2.1.4.3 Agriculture

Emissions from the agriculture sector in FY2015 were 33.7 million tonnes (in CO_2 eq.). They decreased by 10.5% since FY1990, by 4.4% compared to FY2005 and by 1.7% compared to the previous year.

Breakdown of the FY2015 emissions from this sector shows that the largest source is CH_4 emissions from rice cultivation accounting for 41%. It is followed CH_4 emissions from enteric fermentation (22%), and N_2O emissions from the agricultural soils (16%) as a result of the nitrogen-based fertilizer applications.

The main driving factor for the decrease in emissions since FY1990 is the decrease in CH_4 emissions from enteric fermentation due to the decrease in the number of cattle, and the decrease in N_2O emissions from the agricultural soils, because the amount of nitrogen fertilizers applied and organic fertilizers from livestock manure applied had decreased.

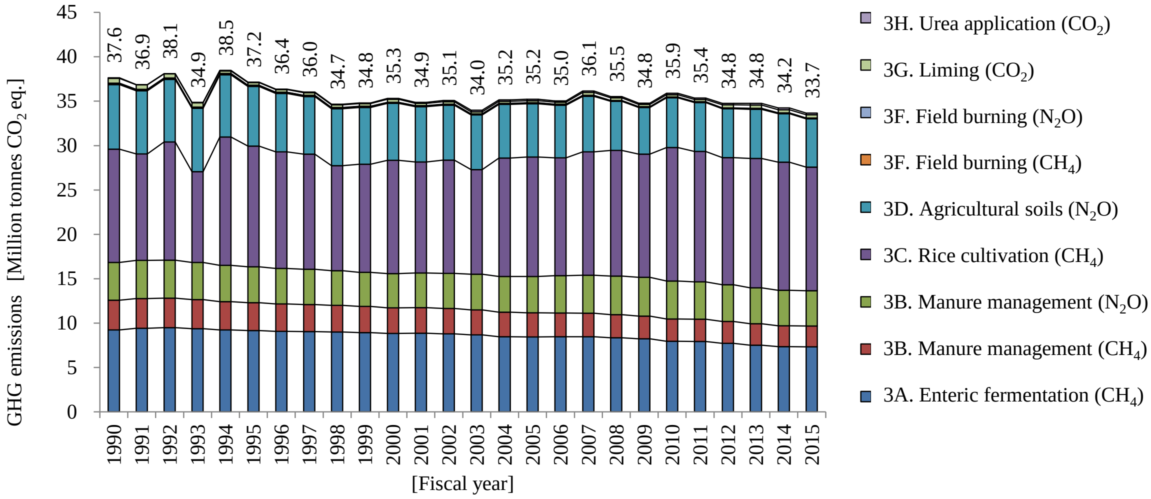


Figure 2-16 Trends in GHG emissions from the agriculture sector

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

[Thousand tonnes CO_2 eq.]

Category	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
3A. Enteric fermentation (CH_4)	9,228	9,156	8,839	8,441	8,461	8,476	8,353	8,240	7,966	7,928	7,736	7,528	7,343	7,335
3B. Manure management	7,602	7,183	6,746	6,826	6,881	6,916	6,955	6,934	6,774	6,726	6,592	6,461	6,349	6,319
CH_4	3,353	3,146	2,879	2,733	2,676	2,634	2,596	2,564	2,511	2,512	2,461	2,399	2,348	2,335
N_2O	4,249	4,038	3,867	4,093	4,206	4,282	4,358	4,369	4,264	4,215	4,130	4,062	4,001	3,985
3C. Rice cultivation (CH_4)	12,771	13,605	12,749	13,445	13,266	13,890	14,157	13,863	15,041	14,680	14,325	14,565	14,437	13,908
3D. Agricultural soils (N_2O)	7,259	6,710	6,421	5,993	5,941	6,261	5,520	5,243	5,605	5,517	5,487	5,537	5,453	5,454
3F. Field burning of agricultural residues	166	145	126	112	109	106	102	99	96	95	93	94	92	92
CH_4	127	111	96	86	83	81	78	76	74	73	71	72	70	70
N_2O	39	34	30	26	26	25	24	23	23	22	22	22	22	22
3G. Liming (CO_2)	550	304	333	231	230	325	306	270	243	247	370	380	370	370
3H. Urea application (CO_2)	59	56	110	179	153	175	134	120	160	168	150	198	189	189
Total	37,636	37,158	35,323	35,227	35,042	36,149	35,526	34,768	35,886	35,360	34,752	34,763	34,233	33,667

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

Net removals (including CO_2, CH_4 and N_2O emissions) from the LULUCF sector in FY2015 were 60.9 million tonnes (in CO_2 eq.). They decreased by 4.0% since FY1990, by 33.4% compared to FY2005 and by 6.4% compared to the previous year. The declining trend in removals in recent years is largely due to the maturity of Japanese forests. The emissions from cropland and settlements have decreased since FY1990, because the land-use conversions to those land-use categories decreased due to economic depression and the decline of agriculture.

Breakdown of the FY2015 emissions and removals from this sector shows that the largest sink was removals in forest land accounting for 63.1 million tonnes, 104% of this sector's net total emissions/removals.

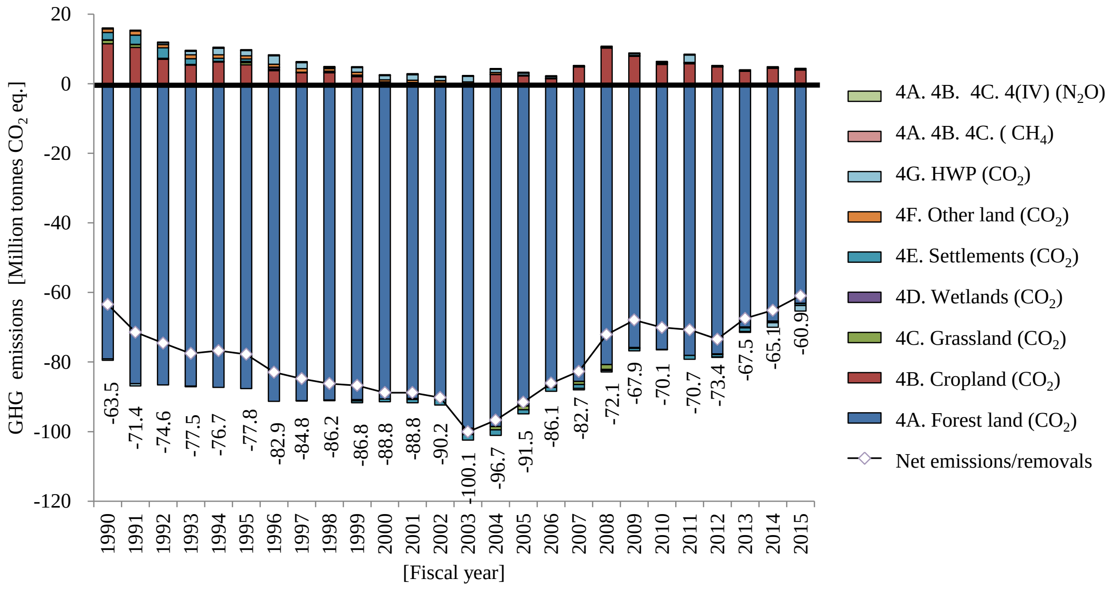


Figure 2-17 Trends in GHG emissions and removals from the LULUCF sector

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

[Thousand tonnes CO_2 eq.]

Category	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
4A. Forest land	-78,942	-87,480	-90,511	-92,531	-86,688	-85,425	-80,606	-75,732	-76,245	-77,980	-77,547	-69,837	-68,103	-62,953
CO_2	-79,074	-87,612	-90,642	-92,665	-86,813	-85,550	-80,756	-75,865	-76,372	-78,108	-77,671	-69,964	-68,252	-63,085
CH_4	10	10	9	11	3	2	26	10	5	6	2	4	23	6
N_2O	122	122	122	123	122	122	124	122	122	122	122	123.0	125.7	125.5
4B. Cropland	11,599	5,521	199	2,344	1,476	4,896	10,349	7,973	5,621	5,819	4,901	3,677	4,506	4,046
CO_2	11,506	5,437	123	2,275	1,409	4,830	10,285	7,909	5,559	5,757	4,840	3,616	4,446	3,986
CH_4	61	57	55	54	54	53	53	53	53	52	52	52	51	51
N_2O	33	27	20	15	14	13	12	11	10	10	9	9	9	9
4C. Grassland	1,032	683	43	-1,021	-491	-926	-1,329	-233	-139	201	-179	-191	-81	-122
CO_2	1,028	679	39	-1,026	-495	-931	-1,333	-237	-143	197	-183	-195	-85	-126
CH_4	2	2	2	2	2	2	2	2	2	2	2	2	2	2
N_2O	2	2	2	2	2	2	2	2	2	2	2	2	2	2
4D. Wetlands	79	311	370	42	35	47	53	72	67	48	39	43	41	52
CO_2	79	311	370	42	35	47	53	72	67	48	39	43	41	52
CH_4	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
N_2O	,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
4E. Settlements	2,133	739	-772	-1,207	-1,104	-1,101	-355	-702	231	-1,118	-703	-1,085	-355	-557
CO_2	2,133	739	-772	-1,207	-1,104	-1,101	-355	-702	231	-1,118	-703	-1,085	-355	-557
CH_4	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
N_2O	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
4F. Other land	1,039	859	621	173	147	172	196	203	234	165	155	138	161	162
CO_2	1,028	849	612	166	141	166	190	198	230	161	151	134	157	159
CH_4	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
N_2O	11	10	9	7	6	6	6	5	5	4	4	4	3	3
4G. HWP (CO_2)	-436	1,548	1,205	620	506	-408	-441	457	108	2,098	-126	-253	-1,314	-1,598
4H. Other (CO_2)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4(IV) Indirect N_2O	41	39	36	33	33	32	32	31	31	31	31	31	31	31
Total	-63,455	-77,780	-88,809	-91,548	-86,085	-82,713	-72,102	-67,932	-70,091	-70,736	-73,431	-67,477	-65,114	-60,940

2.1.4.5 Waste

Emissions from the waste sector in FY2015 were 21.2 million tonnes (in CO_2 eq.). They decreased by 26.5% since FY1990, decreased by 20.4% compared to FY2005 and increased by 0.2% compared to the previous year.

Breakdown of the FY2015 emissions from this sector shows that the largest source is CO_2 emissions from waste incineration, associated with waste derived from fossil fuels such as waste plastic and waste oil, accounting for 57%. It is followed by CH_4 emissions from solid waste disposal (14%) and CH_4 emissions from wastewater treatment and discharge (8%).

The main driving factor for the decrease in emissions since FY1990 is 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 improvement of volume reduction ratio by intermediate treatment under Waste Management and Public Cleansing Act (Act No.137 of 1970), Basic Law for Establishing the Recycling-based Society (Act No.110 of June 2, 2000), and other recycling laws.

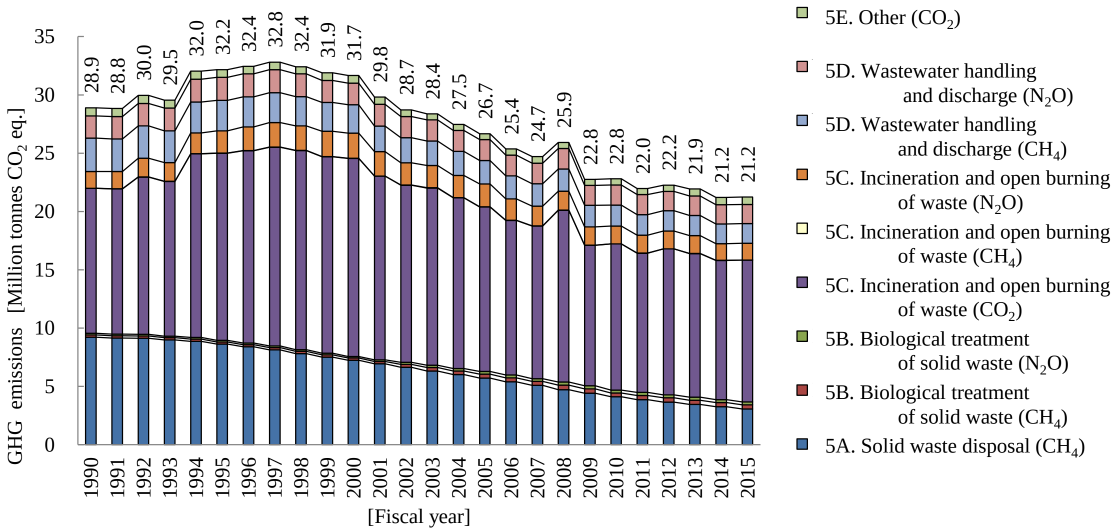


Figure 2-18 Trends in GHG emissions from the waste sector

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

[Thousand tonnes CO_2 eq.]

Category	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
5A. Solid waste disposal (CH_4)	9,221	8,619	7,236	5,703	5,383	5,080	4,717	4,413	4,107	3,861	3,655	3,459	3,252	3,063
5B. Biological treatment of solid waste	334	328	333	582	600	579	651	646	565	621	616	610	609	610
CH_4	195	191	194	340	350	337	380	377	329	362	359	356	355	356
N_2O	139	137	139	243	250	241	271	269	236	259	257	254	254	254
5C. Incineration and open burning of waste	13,876	17,963	19,157	16,074	15,100	14,799	16,376	13,623	14,072	13,480	14,057	13,868	13,379	13,596
CO_2	12,424	16,041	16,986	14,094	13,241	13,091	14,734	12,040	12,544	11,944	12,517	12,314	11,936	12,151
CH_4	16	18	16	17	16	14	14	12	12	11	12	12	11	11
N_2O	1,435	1,905	2,155	1,963	1,843	1,694	1,629	1,571	1,517	1,524	1,528	1,542	1,433	1,434
5D. Wastewater treatment and discharge	4,764	4,589	4,287	3,800	3,757	3,683	3,649	3,562	3,525	3,491	3,392	3,388	3,338	3,338
CH_4	2,860	2,628	2,432	2,006	1,967	1,919	1,895	1,839	1,806	1,772	1,738	1,714	1,690	1,690
N_2O	1,905	1,961	1,855	1,795	1,791	1,765	1,754	1,722	1,719	1,718	1,654	1,675	1,648	1,648
5E. Other (CO_2)	703	668	656	507	522	561	530	514	527	524	528	605	617	625
Total	28,897	32,167	31,668	26,667	25,362	24,702	25,924	22,757	22,796	21,977	22,248	21,931	21,196	21,232

2.1.5 Factor Analysis of Trend of Energy-related CO_2[35] 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 conducted a factor analysis of the trend of energy-related CO_2 regarding the contribution of each factor to changes in emissions and utilize it for planning and implementation of mitigation policies and measures.

Specifically, CO_2 emissions could be basically divided into three factors, "Factor of carbon intensity", "Factor of energy intensity" and "Factor of activity". Emissions are shown as the product of several factors in each sector and changes in emissions caused by changes of each factor are calculated in a quantitative manner. 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 measures, so it is not consistent with emissions by sector in GHG Inventory and BR submitted to the UNFCCC. CO_2 emissions with electricity and heat allocated to each end-use sector are shown in Table 2-16.

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

This section shows the summary of results of factor analysis of energy-related CO_2 for the period from FY2005 to FY2015.

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

	FY1990 emissions [Share]	FY2005 emissions [Share]	FY2013 emissions [Share]	FY2014 emissions [Share]	FY2015			
					Emissons [Share]	(Comapred to FY2005)	(Comapred to FY2013)	(Comapred to FY2014)
Total	1,067 [100%]	1,219 [100%]	1,235 [100%]	1,189 [100%]	1,149 [100%]	-5.7%	-7.0%	-3.4%
Industries (factories, etc.)	502 [47.0%]	457 [37.5%]	432 [35.0%]	424 [35.7%]	411 [35.8%]	-10.0%	-4.8%	-3.1%
Transport (cars, etc.)	206 [19.3%]	240 [19.7%]	225 [18.2%]	217 [18.3%]	213 [18.6%]	-11.0%	-5.0%	-1.7%
Commercial and other (commerce, service, office, etc.)	137 [12.8%]	239 [19.6%]	278 [22.5%]	274 [23.0%]	265 [23.1%]	-11.1%	-4.6%	-3.1%
Residential	131 [12.2%]	180 [14.8%]	201 [16.3%]	189 [15.9%]	179 [15.6%]	-0.2%	-10.9%	-5.1%
Energy transformation (power plnats, etc.)	91.1 [8.5%]	104 [8.5%]	98.9 [8.0%]	85 [7.1%]	79.5 [6.9%]	-23.3%	-19.5%	-6.4%

(Unit Mt-CO_2)

2.1.5.1 Total Energy-related CO_2 Emissions

Energy-related CO_2 emissions in FY2015 were 1,149 million t-CO_2, which decreased by 5.7% compared to FY2005 and by 3.4% compared to the previous year.

The largest decrease factor from FY2005 is "Factor of Energy intensity" due to energy saving activities, followed by "Factor of Population" by the variability of the population. On the other hand, the largest increase factor is "Factor of Carbon intensity" due to the increase of CO_2 emission factor by changing energy mix, followed by "Per unit of GDP factor" by economic development. Particularly after FY2011, the temporary suspension of all nuclear power plants in Japan due to Fukushima Daiichi nuclear power plant accident caused by the Great East Japan Earthquake on March 11th, 2011, leads to the increase in fired power generation and the increase of "Factor of Carbon intensity". However, energy intensity per unit of GDP improves due to the conversion of industrial structure and energy and power saving activities.

The formula for factor analysis of energy-related CO_2 emissions is shown in Figure 2-19. Please refer to "(Reference) Factor analysis of energy-related CO_2 emissions (Japanese only)"[36] for the formula for factor analysis from Figure 2-22 to Figure 2-28.

$$CO_2 \text{ emissions} = \underbrace{\frac{CO_2 \text{ emissions}}{\text{Energy consumption}}}_{\textbf{Factor of Carbon intensity}} \times \underbrace{\frac{\text{Energy consumption}}{GDP}}_{\textbf{Factor of Energy intensity}} \times \underbrace{\frac{GDP}{\text{population}}}_{\textbf{Factor of GDP per capita}} \times \underbrace{\text{population}}_{\textbf{Factor of population}}$$

Figure 2-19 Formula for Factor analysis of energy-related CO_2 emissions

[36] http://www.env.go.jp/earth/ondanka/ghg-mrv/emissions/results/index.html

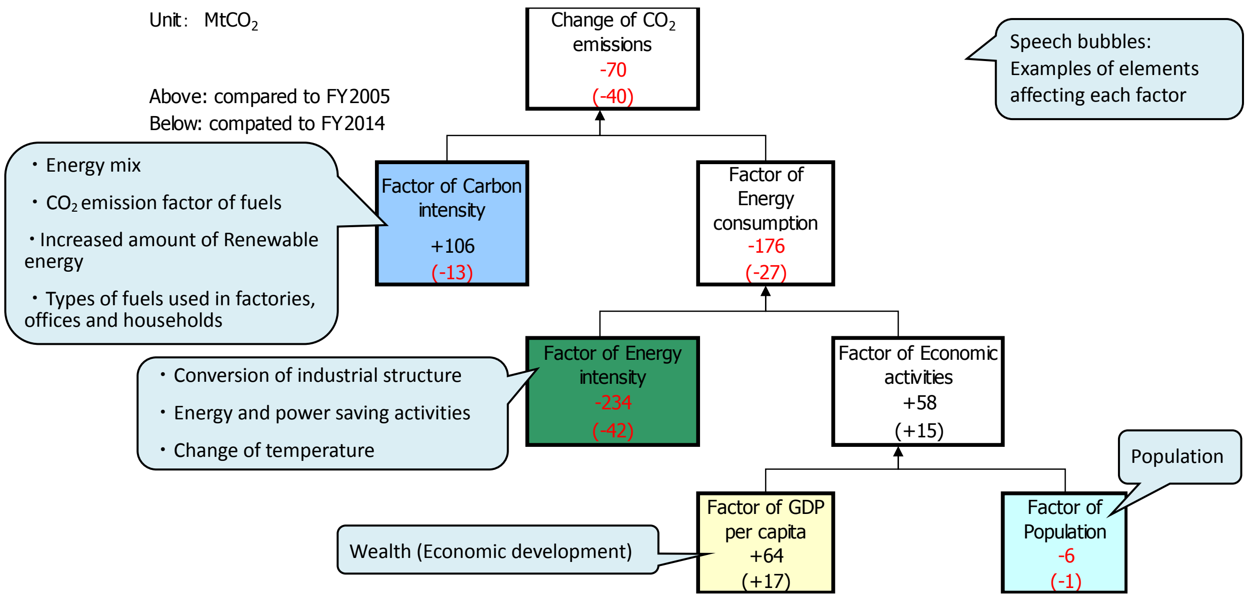


Figure 2-20 Factor of change of energy-related CO_2 emissions in FY2015

Trends in an increase or decrease factors from the previous year are shown in Figure 2-21. The largest decrease factor in energy-related CO_2 emissions from FY2014 to FY2015 was "Factor of Energy intensity" due to the reduction of energy consumption such as saving electricity, followed by "Factor of Carbon intensity" due to changes in CO_2 emission factor. On the other hand, the largest increase factor is "Factor of GDP per capita" due to the vitalization of production activities.

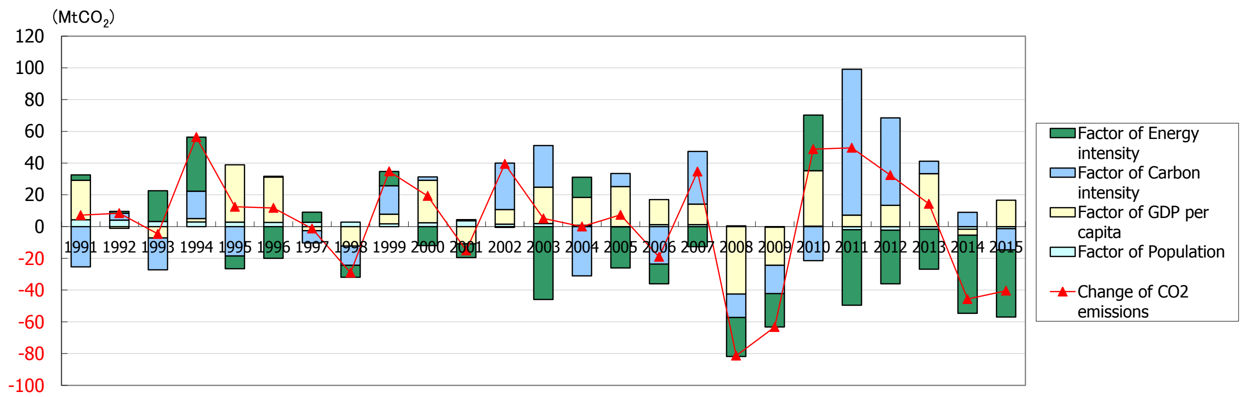


Figure 2-21 Trends of Factor of change of energy-related CO_2 emissions

2.1.5.2 Energy Transformation Sector (Power Generation)

CO_2 emissions (without electricity and heat allocated) in energy transformation sector in FY2015 were 480million tonnes. They increased by 14.7% compared to FY2005 and decreased by 4.9% compared to the previous year. Since emissions from power generation accounted for 90% of the emissions, the result of factor analysis for public electricity sector is shown below.

The largest increase factor from FY2005 is "Factor of Energy mix" due to the increase of the share of fossil fuel power generation in total power generation caused by the decrease of the operating rate of nuclear plants. The largest decrease factor is "Factor of Power generation amount" due to the decrease of the power generation amount, followed by "Factor of Power generation efficiency by power generation type" due to the improvement of power generation efficiency and "Factor of Fuel mix" due to the change in types fuel consumed for power generation.

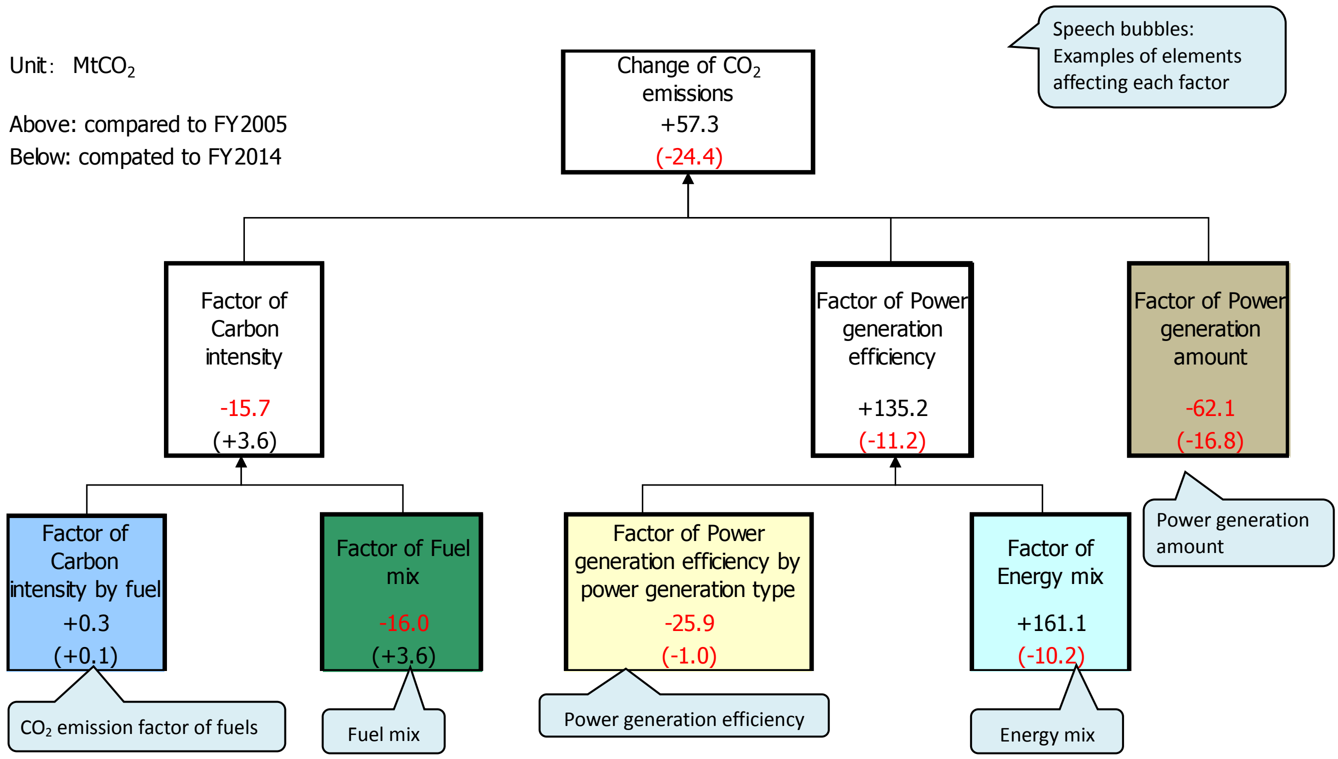


Figure 2-22 Factor of change of CO_2 emissions from Energy transformation sector (Power generation) in FY2015

2.1.5.3 Industrial Sector

(1) Manufacturing Industry

CO_2 emissions in the manufacturing industries sector in FY2015 were 394 million tonnes. They decreased by 10.5% compared to FY2005 and by 3.3% compared to the previous year.

The largest decrease factor from FY2005 is “Factor of Economic activity” due to the decrease of production activities, followed by “Factor of Energy intensity” due to the expansion of energy and power saving activities in factories and “Factor of Industrial structure” due to the structural change of manufacturing. The largest increase factor is “Factor of Carbon intensity (Purchased Electricity)” due to the change of energy mix.

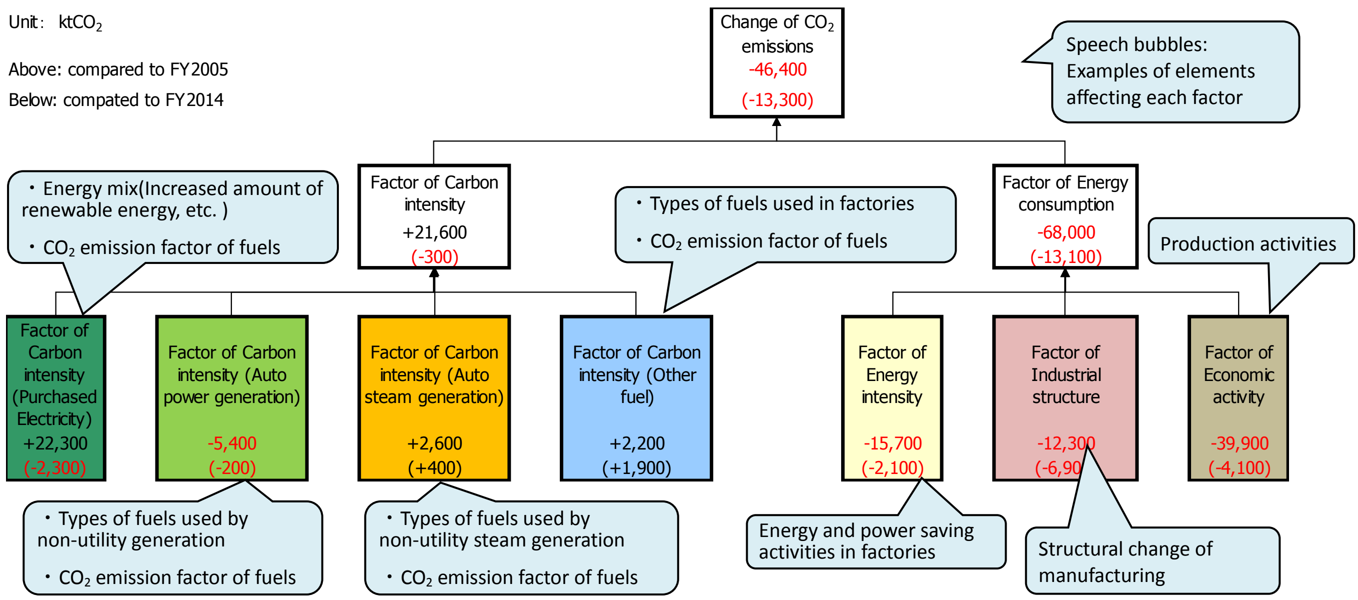


Figure 2-23 Factor of change of CO_2 emissions from Manufacturing sector in FY2015

(2) Non-manufacturing Industry

CO_2 emissions in the non-manufacturing industries sector in FY2015 were 17 million tonnes. They increased by 4.0% compared to FY2005 and 2.1% compared to the previous year.

The largest increase factor from FY2005 is "Factor of Energy intensity" due to the expansion of energy and power saving activities in factories, followed by "Factor of Carbon intensity (Electricity)" due to the change of energy mix. On the other hand, the decrease factor is "Factor of Economic activity" due to the decrease of production activities.

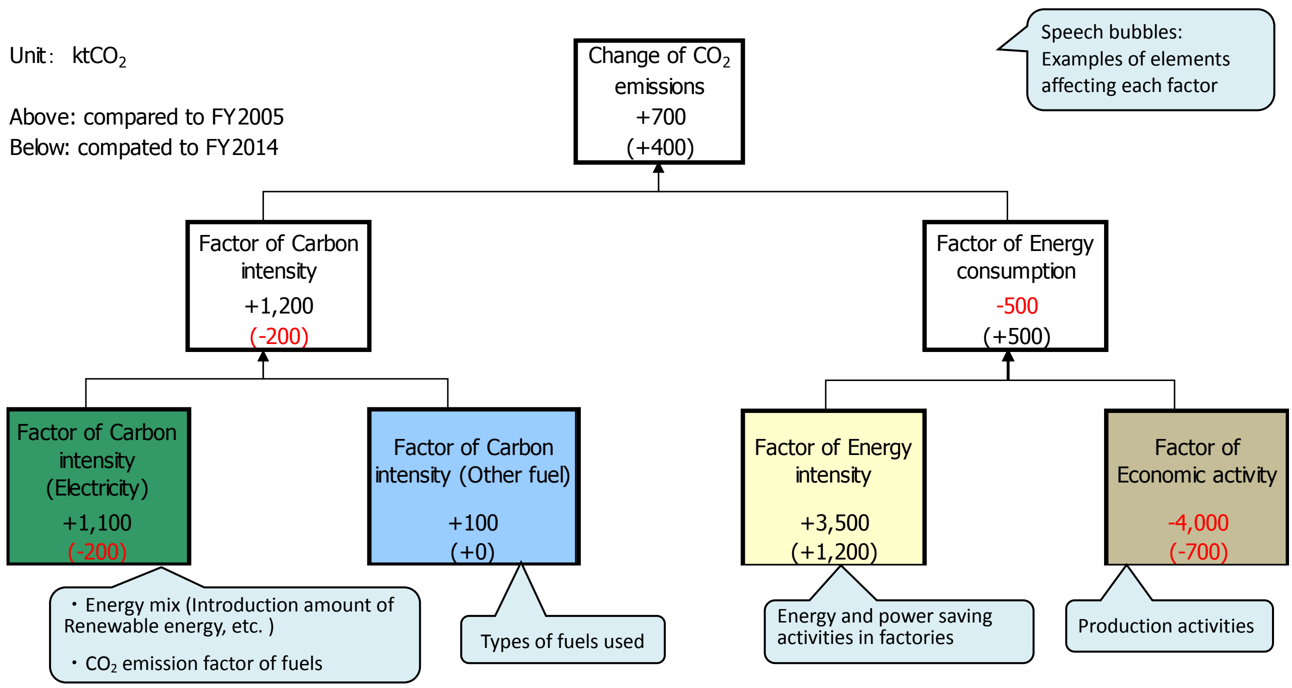


Figure 2-24 Factor of change of CO_2 emissions from Non-manufacturing sector in FY2015

2.1.5.4 Transportation Sector

(1) Passenger

CO_2 emissions in the transportation sector (passenger) in FY2015 were 128 million tonnes. They decreased by 10.5% compared to FY2005 and by 1.4% compared to the previous year.

Compared with FY2005, the largest decrease factor is "Factor of Energy intensity" due to the improvement of fuel efficiency, followed by "Factor of Modal shifts" due to the decrease of the proportion of cars in traffic volume. On the other hand, the largest increase factor is "Factor of Carbon intensity (Other fuel)", followed by "Factor of Carbon intensity (Electricity)".

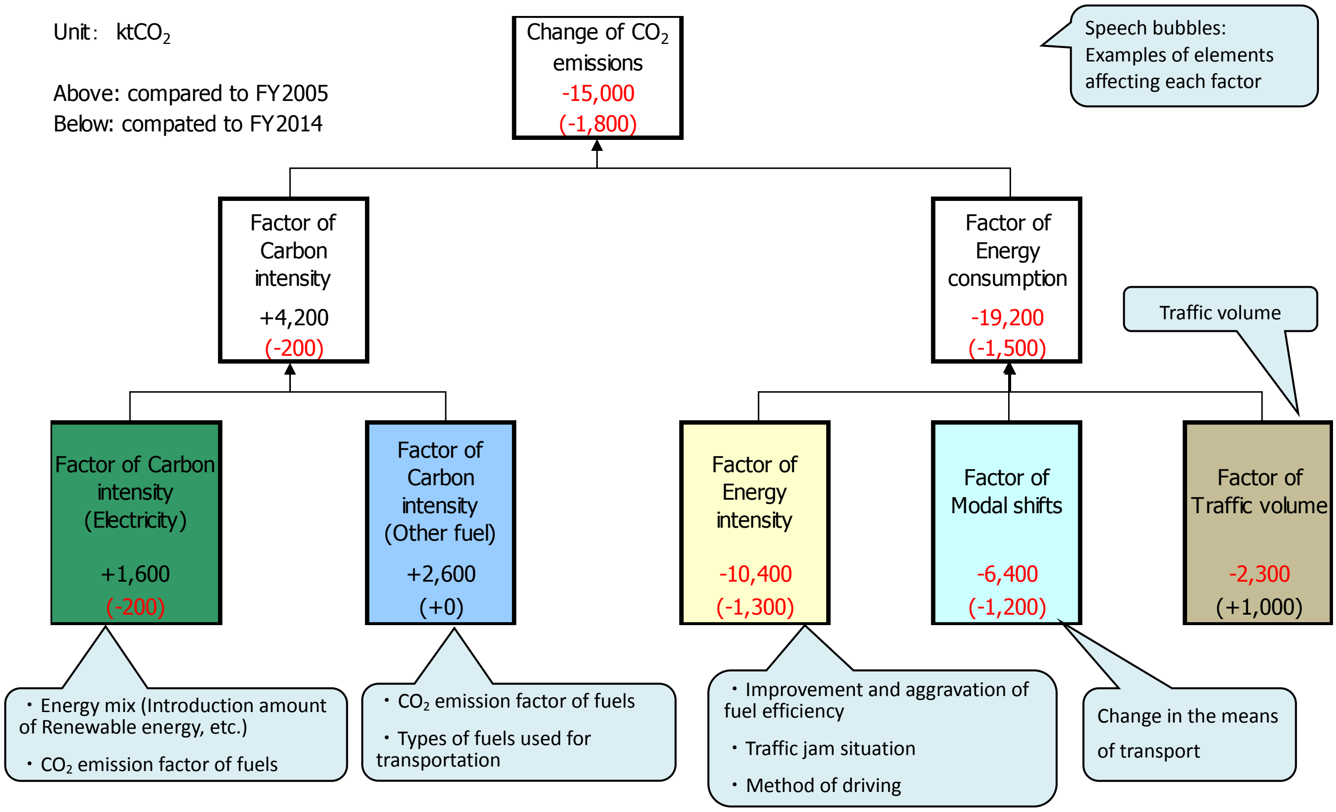


Figure 2-25 Factor of change of CO_2 emissions from Passenger sector (Transportation) in FY2015

(2) Freight

CO_2 emissions in the transportation sector (freight) in FY2015 were 85 million tonnes. They decreased by 11.8% compared to FY2005 and 2.3% compared to the previous year.

Compared with FY2005, the largest decrease factor is “Factor of Traffic volume” due to the decrease of the traffic volume. On the other hand, the largest increase factor is “Factor of Modal shifts” due to the increase of the proportion of cargo trucks in traffic volume.

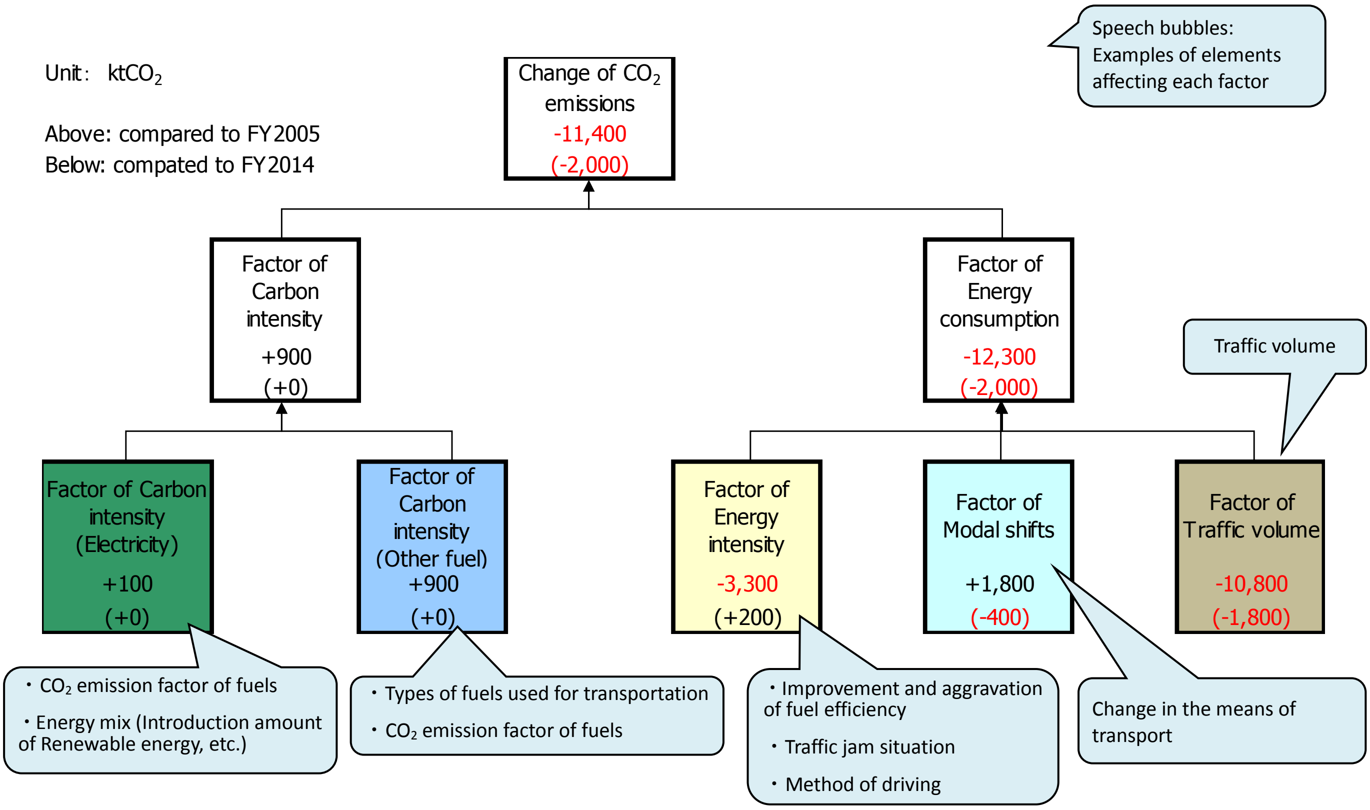


Figure 2-26 Factor of change of CO_2 emissions from Freight sector (Transportation) in FY2015

2.1.5.5 Residential Sector

CO_2 emissions in the residential sector in FY2015 were 179 million tonnes. They decreased by 0.2% compared to FY2005 and 5.1% compared to the previous year.

The largest decrease factor is “Factor of Number per household” due to the decrease in the size of household, followed by “Factor of Energy intensity (excluding Factor of Temperature)” due to the expansion of energy and power saving activities. On the other hand, the largest increase factor from FY2005 is “Factor of Carbon intensity (Electricity)” due to the change of energy mix, followed by “Factor of Number of households” due to the increase in the number of households.

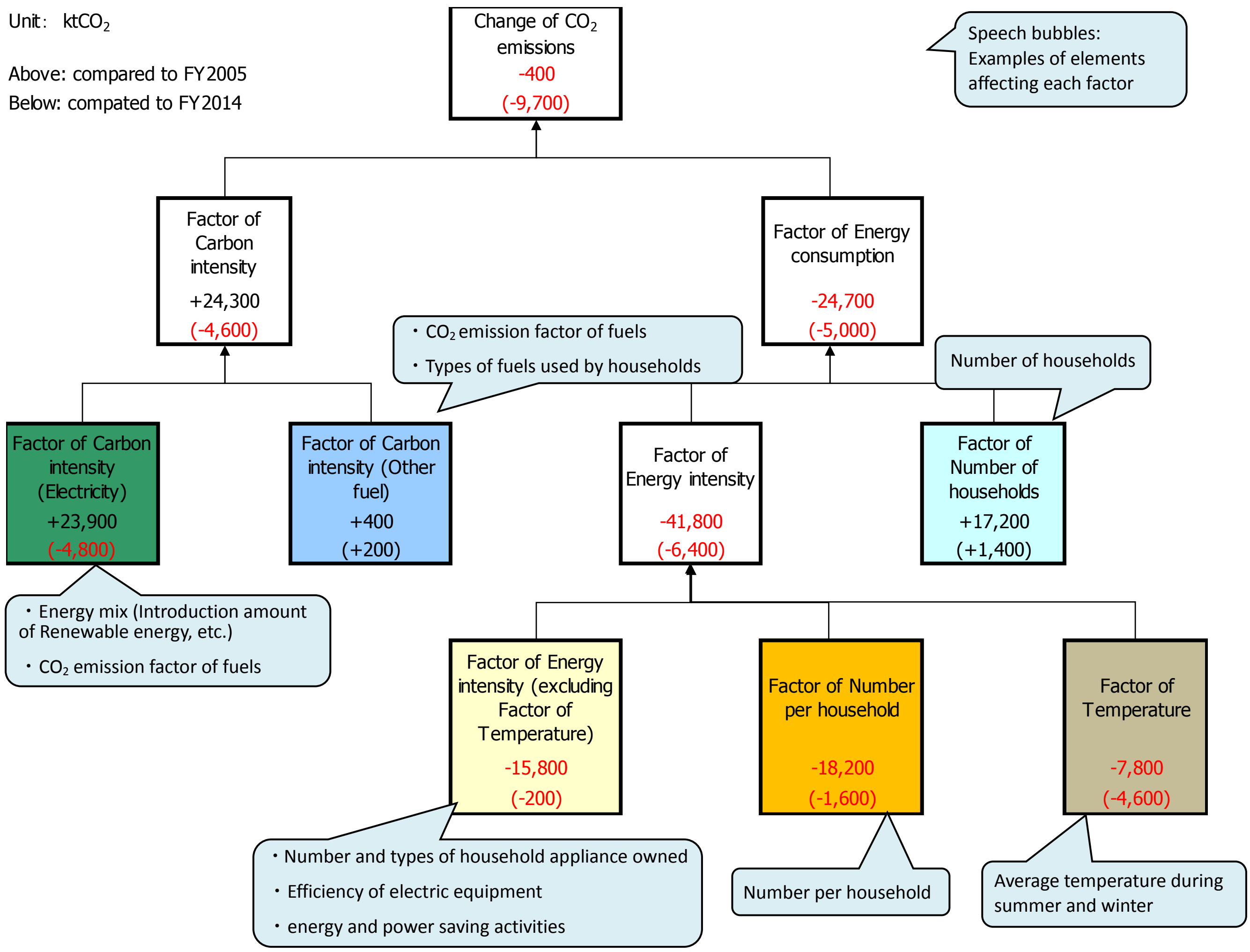


Figure 2-27 Factor of change of CO_2 emissions from Residential sector in FY2015

2.1.5.6 Commercial and Other Sector

CO_2 emissions in the commercial and other sector in FY2015 were 265 million tonnes. They increased by 11.1% compared to FY2005 and decreased by 3.1% compared to the previous year.

Compared with FY2005, the largest increase factor is "Factor of Carbon intensity (Electricity)" due to the change of energy mix, followed by "Factor of Floor space" due to the increase of the floor space.

On the other hand, the decrease factors are "Factor of Energy intensity (excluding Factor of Temperature)" due to the decrease of energy consumption per floor space resulting from the energy-savings in equipment and devices, and the expansion of energy and power saving activities, followed by "Factor of Temperature".

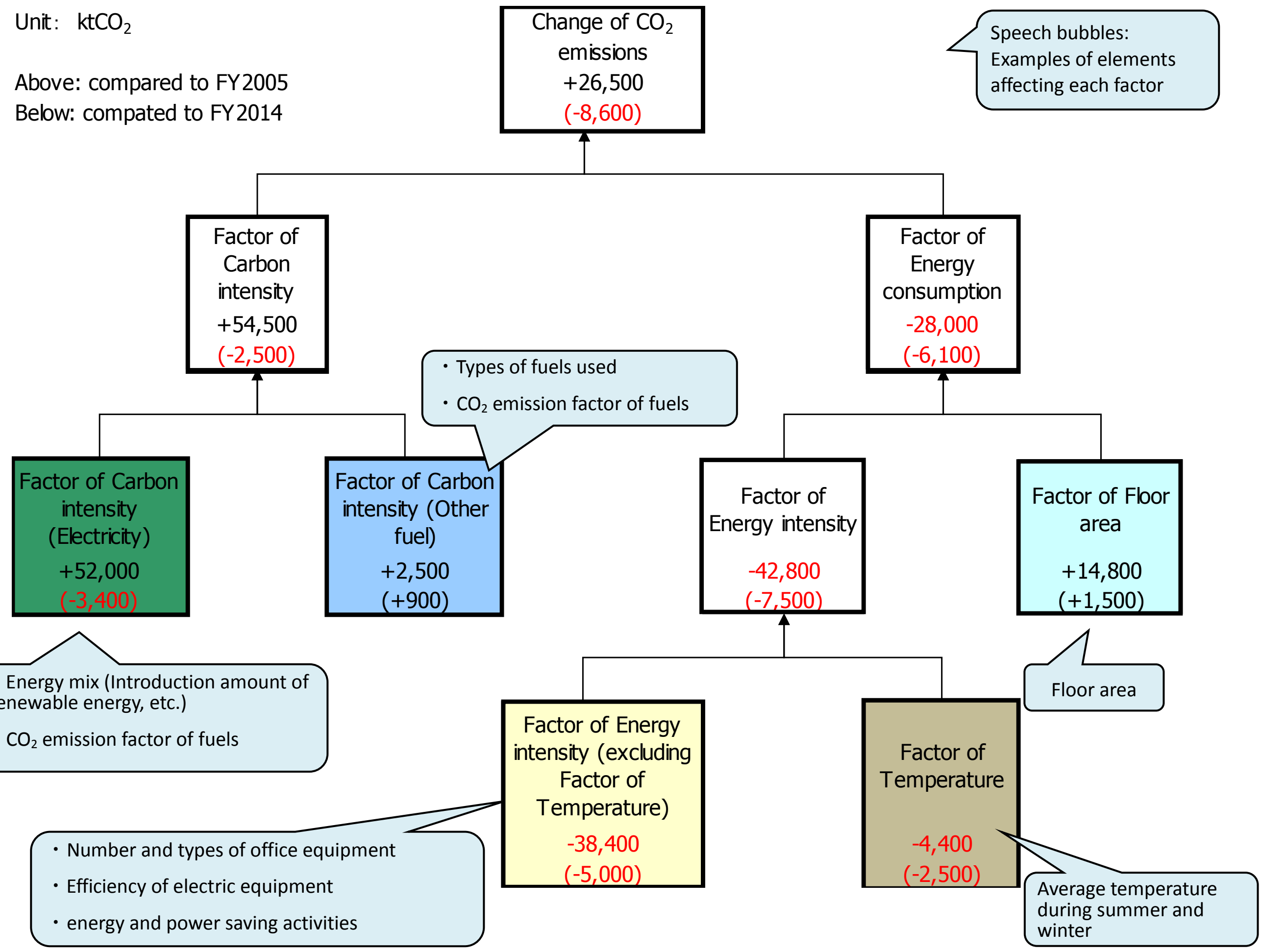


Figure 2-28 Factor of change of CO_2 emissions from Commercial and other sector in FY2015

2.1.5.7 Summary

Summary of factor analysis of energy-related CO_2 emissions by sector from FY2005 to FY2015 is shown in Table 2-17.

Table 2-17 Summary of factor analysis of energy-related CO_2 emissions by sector from FY2005 to FY2015

(Unit: $MtCO_2$)

Sector		Factor of Activity: Indices of Activity	Factor of Activity: Change	Factor of intensity	Factor of intensity: Carbon intensity (excl. electricity)	Factor of intensity: Carbon intensity (electricity)	Factor of intensity: Energy intensity	Factor of temperature	Total change
Residential		Number of households	+17	-10	+0.4	+24	-34	-8	-0.4
Commercial & Other		Floor area	+15	+16	+3	+52	-38	-4	+27
Industry		Indices of Industrial Production	-44	-2	-1	+23	-25	-	-46
Transport	Passenger	Traffic volume	-2	-13	+3	+2	-17	-	-15
	Freight	Traffic volume	-11	-1	+1	+0.1	-2	-	-11
Energy Transformation		Production of secondary energy	-15	-9	-9	-			-24
Total Energy-related CO_2 emissions		–	-40	-16	-3	+101	-115	-12	-70

Increase of number of households

Increase of Floor area

Decrease of production

Increase of carbon intensity due to the increase of fossil power generation

Progress of energy saving

Improvement of fuel efficiency

Improvement of transport efficiency

Note: The description in balloons are major factors that seems to influence the change of emissions. The total and the sum of factors may not match due to rounding.

2.1.6 Trends in Indirect GHGs and SOx emissions"

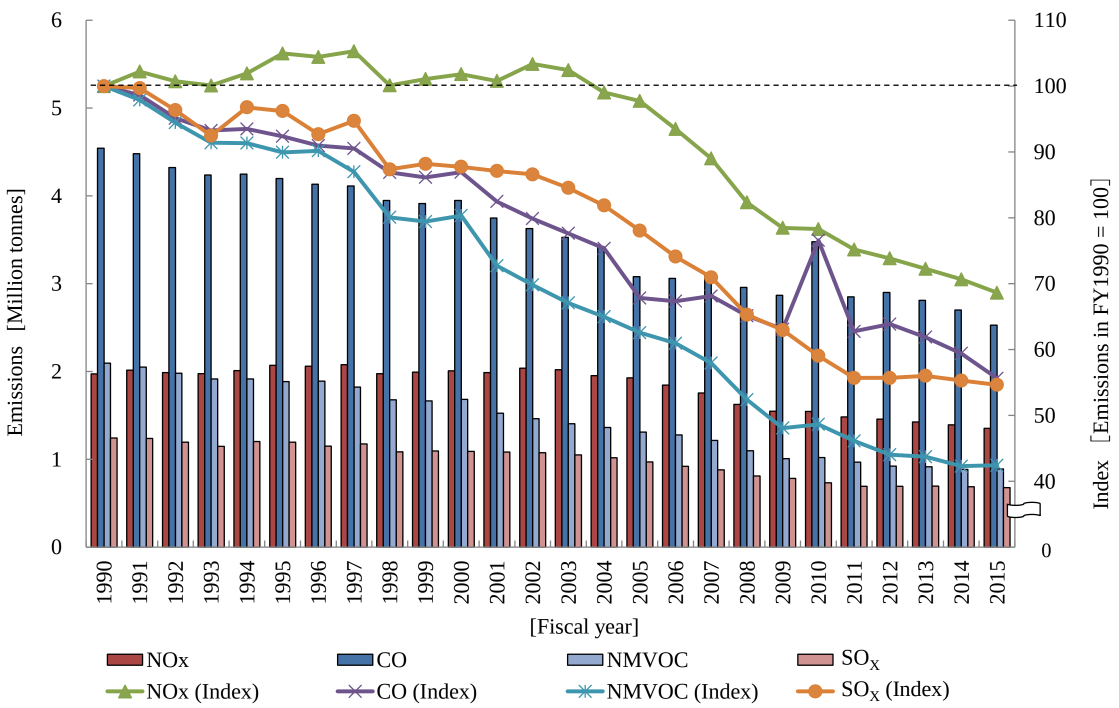
Under the revised UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention (24/CP.19), it is required to report emissions not only of the 7 types of GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, and NF_3), but also emissions of indirect GHGs (NO_X, CO and NMVOC) as well as SO_X. Their emission trends are indicated below.

Nitrogen oxide (NO_X) emissions in FY2015 were 1,354 thousand tonnes. They decreased by 31.4% since FY1990, 29.8% compared to FY2005 and 2.9% compared to the previous year.

Carbon monoxide (CO) emissions in FY2015 were 2,527 thousand tonnes. They decreased by 44.4% since FY1990, increased by 31.1% compared to FY2005 and decreased by 6.4% compared to the previous year.

Non-methane volatile organic compounds (NMVOC) emissions in FY2015 were 889 thousand tonnes. They decreased by 57.6% since FY1990, by 53.9% compared to FY2005 and increased by 0.3% compared to the previous year.

Sulfur oxide (SO_X)[37] emissions in FY2015 were 678 thousand tonnes. They decreased by 45.4% since FY1990, 64.8% compared to FY2005 and 1.2% compared to the previous year.



(* The line chart shows the trend as an index of FY1990 emissions set at 100.)

Figure 2-29 Trends in emissions of indirect GHGs and SOx

[37] Most SO_X consists of SO_2. For major sources, SO_2 emissions are estimated.

2.1.7 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 FY2015 were 46.6 million tonnes (in CO_2 eq.). The breakdown of emissions and removals to each activity in the second commitment period of the Kyoto Protocol is shown in Table 2-18.

Table 2-18 Accounting summary for activities under articles 3.3 and 3.4 of the Kyoto Protocol (CRF Accounting table)

Greenhouse gas source and sink activities	Net Emissions/removals [kt CO_2 eq.]			
	1990（Base Year）	2013	2014	2015
A. Article 3.3 activities				
A.1. Afforestation/reforestation		-1,427	-1,421	-1,417
Excluded emissions from natural disturbances		NA	NA	NA
Excluded subsequent removals from land subject to natural disturbances		NA	NA	NA
A.2. Deforestation		1,459	2,104	1,803
B. Article 3.4 activities				
B.1. Forest management				
Net emissions/removals		-51,478	-52,073	-49,363
Excluded emissions from natural disturbances		NA	NA	NA
Excluded subsequent removals from land subject to natural disturbances		NA	NA	NA
Any debits from newly established forest (CEF-ne)		NA	NA	NA
Forest management reference level (FMRL)		0	0	0
Technical corrections to FMRL		667	913	1,128
Forest management cap				
B.2. Cropland management	10,258	3,543	4,273	3,876
B.3. Grazing land management	842	-284	-108	-241
B.4. Revegetation	-79	-1,223	-1,241	-1,262
B.5. Wetland drainage and rewetting (not elected)	NA	NA	NA	NA

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

Table 2-19 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
	kt CO_2 eq														
CO_2 emissions without net CO_2 from LULUCF	1,157,164.51	1,157,164.51	1,165,634.62	1,175,768.64	1,168,886.54	1,230,224.70	1,243,848.87	1,256,698.02	1,254,568.19	1,219,612.02	1,254,575.01	1,275,777.13	1,259,003.58	1,296,054.66	1,301,102.95
CO_2 emissions with net CO_2 from LULUCF	1,093,427.39	1,093,427.39	1,093,934.31	1,100,931.59	1,091,059.38	1,153,205.58	1,165,799.19	1,173,458.19	1,169,470.38	1,133,149.19	1,167,567.09	1,186,712.02	1,169,928.91	1,205,567.91	1,200,780.58
CH_4 emissions without CH_4 from LULUCF	44,223.07	44,223.07	42,988.35	43,812.14	39,723.47	43,113.90	41,637.89	40,409.83	39,684.96	37,827.74	37,688.16	37,666.02	36,606.10	35,936.38	34,463.26
CH_4 emissions with CH_4 from LULUCF	44,296.05	44,296.05	43,058.16	43,878.76	39,812.82	43,195.13	41,707.78	40,502.72	39,784.31	37,898.63	37,752.17	37,732.72	36,677.85	36,017.29	34,524.19
N_2O emissions without N_2O from LULUCF	31,517.58	31,517.58	31,218.76	31,358.85	31,251.04	32,558.78	32,860.59	33,981.85	34,780.09	33,186.15	27,033.25	29,561.41	25,990.57	25,443.31	25,243.32
N_2O emissions with N_2O from LULUCF	31,726.66	31,726.66	31,425.53	31,563.78	31,456.44	32,762.32	33,060.74	34,181.06	34,977.21	33,379.35	27,224.36	29,750.62	26,178.43	25,630.16	25,426.50
HFCs	15,932.31	15,932.31	17,349.61	17,767.22	18,129.16	21,051.90	25,213.19	24,598.11	24,436.79	23,742.10	24,368.28	22,852.00	19,462.52	16,236.39	16,228.36
PFCs	6,539.30	6,539.30	7,506.92	7,617.29	10,942.80	13,443.46	17,609.92	18,258.18	19,984.28	16,568.48	13,118.06	11,873.11	9,878.47	9,199.44	8,854.21
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
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
Total (without LULUCF)	1,268,259.45	1,268,259.45	1,278,936.92	1,291,992.57	1,284,678.46	1,355,488.78	1,377,819.08	1,391,160.73	1,388,135.91	1,344,348.72	1,366,274.64	1,385,046.80	1,357,302.07	1,388,977.15	1,391,714.51
Total (with LULUCF)	1,204,804.39	1,204,804.39	1,207,513.18	1,217,427.08	1,207,146.05	1,278,754.44	1,300,039.44	1,308,213.00	1,303,334.57	1,258,149.99	1,279,521.84	1,296,237.60	1,268,487.00	1,298,758.16	1,291,636.24
Total (without LULUCF, with indirect)	1,273,560.52	1,273,560.52	1,284,040.26	1,296,863.39	1,289,308.19	1,360,095.99	1,382,327.17	1,395,687.31	1,392,501.65	1,348,350.66	1,370,262.10	1,389,104.97	1,360,938.95	1,392,383.18	1,394,989.95
Total (with LULUCF, with indirect)	1,210,105.45	1,210,105.45	1,212,616.52	1,222,297.90	1,211,775.77	1,283,361.65	1,304,547.53	1,312,739.58	1,307,700.32	1,262,151.93	1,283,509.31	1,300,295.77	1,272,123.88	1,302,164.18	1,294,911.68

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	kt CO_2 eq												*kt CO_2 eq*		
1. Energy	1,091,274.60	1,091,274.60	1,098,416.44	1,107,269.78	1,101,404.02	1,158,694.53	1,172,075.50	1,183,818.55	1,183,724.44	1,154,462.47	1,189,439.18	1,209,882.07	1,195,461.41	1,235,011.36	1,240,572.94
2. Industrial processes and product use	110,451.48	110,451.48	114,807.47	116,656.22	118,864.20	126,295.56	136,418.29	138,541.56	135,570.55	122,813.58	110,147.87	108,173.62	97,152.77	90,166.14	88,783.61
3. Agriculture	37,635.95	37,635.95	36,876.92	38,101.73	34,861.18	38,461.06	37,158.50	36,362.82	36,031.34	34,658.30	34,795.78	35,322.91	34,865.88	35,080.02	33,992.30
4. Land Use, Land-Use Change and Forestryb	-63,455.06	-63,455.06	-71,423.74	-74,565.49	-77,532.42	-76,734.34	-77,779.64	-82,947.73	-84,801.34	-86,198.73	-86,752.80	-88,809.20	-88,815.07	-90,218.99	-100,078.27
5. Waste	28,897.43	28,897.43	28,836.08	29,964.84	29,549.07	32,037.62	32,166.79	32,437.80	32,809.57	32,414.38	31,891.82	31,668.20	29,822.01	28,719.62	28,365.66
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (including LULUCF)	1,204,804.39	1,204,804.39	1,207,513.18	1,217,427.08	1,207,146.05	1,278,754.44	1,300,039.44	1,308,213.00	1,303,334.57	1,258,149.99	1,279,521.84	1,296,237.60	1,268,487.00	1,298,758.16	1,291,636.24

GREENHOUSE GAS EMISSIONS	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
													(%)
CO_2 emissions without net CO_2 from LULUCF	1,300,190.16	1,307,693.19	1,287,099.00	1,321,713.44	1,237,290.85	1,164,685.29	1,215,010.75	1,263,816.17	1,298,157.57	1,313,686.01	1,266,601.40	1,225,239.49	5.88
CO_2 emissions with net CO_2 from LULUCF	1,203,240.71	1,215,898.89	1,200,778.04	1,238,767.35	1,164,933.51	1,096,517.50	1,144,690.19	1,192,851.10	1,224,503.01	1,245,982.81	1,201,239.91	1,164,070.04	6.46
CH_4 emissions without CH_4 from LULUCF	35,484.03	35,279.25	34,762.49	35,013.48	34,719.41	33,802.46	34,855.00	33,840.16	32,982.01	32,675.28	32,068.18	31,294.94	-29.23
CH_4 emissions with CH_4 from LULUCF	35,554.43	35,346.11	34,821.18	35,071.52	34,800.45	33,867.70	34,914.69	33,900.84	33,038.00	32,733.15	32,144.52	31,354.31	-29.22
N_2O emissions without N_2O from LULUCF	25,234.54	24,829.11	24,796.05	24,191.01	23,264.00	22,689.78	22,318.20	21,785.97	21,351.01	21,400.06	20,945.10	20,829.59	-33.91
N_2O emissions with N_2O from LULUCF	25,416.68	25,008.76	24,972.95	24,365.75	23,438.30	22,860.78	22,487.68	21,954.56	21,518.32	21,568.18	21,115.76	20,999.79	-33.81
HFCs	12,420.92	12,781.83	14,627.06	16,707.19	19,284.93	20,937.33	23,305.23	26,071.50	29,348.60	32,094.56	35,765.79	39,202.80	146.06
PFCs	9,216.64	8,623.35	8,998.78	7,916.85	5,743.40	4,046.87	4,249.54	3,755.45	3,436.33	3,280.06	3,361.43	3,308.10	-49.41
Unspecified mix of HFCs and PFCs													
SF_6	5,258.70	5,053.01	5,228.90	4,733.45	4,177.17	2,446.63	2,423.87	2,247.64	2,234.54	2,101.81	2,065.07	2,121.86	-83.49
NF_3	486.04	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	1,651.10
Total (without LULUCF)	1,388,291.03	1,395,731.50	1,376,913.59	1,411,862.21	1,325,960.79	1,249,962.52	1,303,702.34	1,353,317.27	1,389,021.91	1,406,855.02	1,361,929.83	1,322,567.82	4.28
Total (with LULUCF)	1,291,594.13	1,304,183.69	1,290,828.23	1,329,148.92	1,253,858.80	1,182,030.95	1,233,610.94	1,282,581.46	1,315,590.67	1,339,377.80	1,296,815.34	1,261,627.94	4.72
Total (without LULUCF, with indirect)	1,391,488.49	1,398,823.62	1,379,939.06	1,414,752.38	1,328,576.03	1,252,372.78	1,306,045.28	1,355,578.63	1,391,203.02	1,409,037.65	1,364,040.64	1,324,717.74	4.02
Total (with LULUCF, with indirect)	1,294,791.59	1,307,275.82	1,293,853.70	1,332,039.08	1,256,474.04	1,184,441.21	1,235,953.89	1,284,842.83	1,317,771.78	1,341,560.43	1,298,926.15	1,263,777.87	4.44

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
													(%)
1. Energy	1,240,100.48	1,247,116.32	1,226,966.97	1,262,359.12	1,180,333.49	1,115,589.16	1,164,861.85	1,213,892.63	1,247,418.91	1,261,239.40	1,215,004.58	1,174,648.42	7.64
2. Industrial processes and product use	85,579.39	86,721.16	89,543.05	88,651.79	84,176.80	76,848.26	80,158.47	82,086.96	84,602.35	88,922.17	91,496.79	93,020.28	-15.78
3. Agriculture	35,152.12	35,227.10	35,041.65	36,149.19	35,526.14	34,767.85	35,885.72	35,360.47	34,752.48	34,762.88	34,232.58	33,666.91	-10.55
4. Land Use, Land-Use Change and Forestryb	-96,696.90	-91,547.81	-86,085.36	-82,713.30	-72,101.99	-67,931.57	-70,091.39	-70,735.80	-73,431.24	-67,477.22	-65,114.49	-60,939.88	-3.96
5. Waste	27,459.04	26,666.91	25,361.93	24,702.11	25,924.36	22,757.25	22,796.30	21,977.21	22,248.18	21,930.57	21,195.88	21,232.21	-26.53
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (including LULUCF)	1,291,594.13	1,304,183.69	1,290,828.23	1,329,148.92	1,253,858.80	1,182,030.95	1,233,610.94	1,282,581.46	1,315,590.67	1,339,377.80	1,296,815.34	1,261,627.94	4.72

Table 2-20 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
	kt														
1. Energy	1,078,302.44	1,078,302.44	1,085,722.35	1,094,935.33	1,089,556.04	1,146,985.60	1,160,006.80	1,171,925.54	1,171,792.76	1,142,929.79	1,177,812.16	1,198,335.02	1,184,204.88	1,224,528.14	1,230,404.51
A. Fuel combustion (sectoral approach)	1,078,110.87	1,078,110.87	1,085,507.48	1,094,727.02	1,089,344.38	1,146,754.54	1,159,485.35	1,171,354.86	1,171,212.40	1,142,431.17	1,177,272.84	1,197,823.46	1,183,656.72	1,224,003.58	1,229,898.75
1. Energy industries	352,782.85	352,782.85	355,881.04	362,715.03	346,422.62	387,366.79	377,028.59	379,153.02	377,005.39	364,997.08	384,032.34	393,060.45	383,004.42	414,184.08	430,909.93
2. Manufacturing industries and construction	380,140.18	380,140.18	375,130.51	368,513.32	367,039.13	376,906.39	382,895.22	386,977.67	387,219.36	363,916.19	370,533.73	379,699.89	374,058.56	385,211.52	384,245.55
3. Transport	200,214.98	200,214.98	212,672.57	218,928.64	222,568.29	231,618.00	240,453.11	246,923.50	248,301.34	246,427.52	250,254.29	249,013.71	253,036.44	248,697.82	244,439.68
4. Other sectors	144,972.86	144,972.86	141,823.37	144,570.04	153,314.35	150,863.36	159,108.43	158,300.67	158,686.32	167,090.39	172,452.48	176,049.41	173,557.30	175,910.16	170,303.59
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	191.57	191.57	214.87	208.31	211.66	231.05	521.46	570.68	580.36	498.62	539.32	511.56	548.17	524.57	505.76
1. Solid fuels	5.32	5.32	4.80	4.28	3.60	2.96	2.41	2.11	2.00	1.82	1.75	1.60	1.35	0.75	0.67
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
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
2. Industrial processes	65,125.99	65,125.99	66,220.90	66,149.52	64,863.51	66,439.76	66,774.09	67,297.68	64,691.80	58,609.94	58,899.07	59,357.43	58,041.00	55,348.27	54,560.85
A. Mineral industry	49,218.66	49,218.66	50,536.32	50,953.31	50,239.91	51,250.19	51,130.78	51,473.76	48,824.78	43,847.70	43,563.77	43,899.42	42,956.00	40,469.08	40,133.74
B. Chemical industry	7,039.03	7,039.03	7,007.49	6,823.98	6,386.88	6,805.43	7,012.82	7,067.01	7,060.47	6,419.51	6,937.15	6,809.76	6,346.24	6,247.20	6,048.64
C. Metal industry	7,272.76	7,272.76	7,091.43	6,796.03	6,652.23	6,656.19	6,849.59	6,870.52	6,834.13	6,545.54	6,463.18	6,739.53	6,762.50	6,597.90	6,366.50
D. Non-energy products from fuels and solvent use	1,531.28	1,531.28	1,518.88	1,510.94	1,524.93	1,661.15	1,709.35	1,806.71	1,886.33	1,710.69	1,845.65	1,822.21	1,898.04	1,954.22	1,926.65
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
H. Other	64.27	64.27	66.77	65.27	59.56	66.80	71.54	79.67	86.09	86.49	89.33	86.50	78.22	79.87	85.33
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
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
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
I. Other carbon-containing fertilizers	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
4. Land Use, Land-Use Change and Forestry	-63,737.12	-63,737.12	-71,700.31	-74,837.04	-77,827.16	-77,019.12	-78,049.68	-83,239.83	-85,097.81	-86,462.83	-87,007.92	-89,065.11	-89,074.68	-90,486.75	-100,322.37
A. Forest land	-79,074.44	-79,074.44	-86,229.15	-86,577.51	-86,923.35	-87,267.75	-87,612.49	-91,284.18	-91,124.24	-90,963.33	-90,803.06	-90,642.49	-90,482.95	-90,322.35	-99,042.85
B. Cropland	11,506.03	11,506.03	10,470.07	7,037.34	5,413.90	6,244.31	5,437.05	3,795.18	3,176.79	3,174.33	2,091.38	123.01	49.12	173.04	-610.41
C. Grassland	1,027.72	1,027.72	802.88	74.16	-213.90	92.74	678.70	329.71	47.22	19.30	-403.92	38.97	-258.72	-527.24	-1,219.45
D. Wetlands	78.53	78.53	70.09	220.34	122.35	101.27	311.29	552.73	104.89	420.53	396.18	370.20	336.11	82.48	54.56
E. Settlements	2,132.58	2,132.58	2,673.94	3,023.52	1,674.99	896.64	738.84	146.64	-70.02	-185.39	-483.68	-772.49	-958.94	-1,516.14	-1,600.81
F. Other land	1,028.32	1,028.32	1,145.73	918.66	1,123.40	1,013.07	848.67	777.33	1,032.86	768.45	833.02	612.40	650.43	618.84	508.16
G. Harvested wood products	-435.86	-435.86	-633.89	466.44	975.46	1,900.60	1,548.27	2,442.76	1,734.69	303.28	1,362.17	1,205.29	1,590.27	1,004.61	1,588.43
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	13,127.19	13,127.19	13,143.50	14,190.78	13,943.46	16,456.79	16,708.85	17,125.19	17,712.12	17,695.35	17,493.48	17,642.14	16,390.02	15,770.11	15,707.40
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
B. Biological treatment of solid waste															
C. Incineration and open burning of waste	12,424.36	12,424.36	12,457.05	13,491.88	13,262.72	15,754.88	16,041.03	16,484.72	17,056.89	17,086.23	16,840.90	16,986.23	15,759.49	15,193.07	15,190.87
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
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
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
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
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
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 emissions from biomass	34,860.18	34,860.18	35,601.72	35,276.68	34,581.77	35,074.70	36,442.26	36,864.07	37,932.86	36,642.46	37,795.17	39,626.44	38,229.16	40,150.13	42,091.65
CO2 captured	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Indirect N2O															
Indirect CO2 (3)	5,301.07	5,301.07	5,103.34	4,870.81	4,629.72	4,607.22	4,508.09	4,526.58	4,365.74	4,001.94	3,987.46	4,058.17	3,636.87	3,406.03	3,275.44
Total CO2 equivalent emissions without land use, land-use change and forestry	1,157,164.51	1,157,164.51	1,165,634.62	1,175,768.64	1,168,886.54	1,230,224.70	1,243,848.87	1,256,698.02	1,254,568.19	1,219,612.02	1,254,575.01	1,275,777.13	1,259,003.58	1,296,054.66	1,301,102.95
Total CO2 equivalent emissions with land use, land-use change and forestry	1,093,427.39	1,093,427.39	1,093,934.31	1,100,931.59	1,091,059.38	1,153,205.58	1,165,799.19	1,173,458.19	1,169,470.38	1,133,149.19	1,167,567.09	1,186,712.02	1,169,928.91	1,205,567.91	1,200,780.58
Total CO2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	1,162,465.58	1,162,465.58	1,170,737.96	1,180,639.45	1,173,516.26	1,234,831.91	1,248,356.96	1,261,224.60	1,258,933.93	1,223,613.95	1,258,562.47	1,279,835.29	1,262,640.46	1,299,460.69	1,304,378.39
Total CO2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	1,098,728.46	1,098,728.46	1,099,037.65	1,105,802.41	1,095,689.10	1,157,812.80	1,170,307.28	1,177,984.77	1,173,836.12	1,137,151.13	1,171,554.55	1,190,770.18	1,173,565.78	1,208,973.94	1,204,056.02

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
	kt												(%)
1. Energy	1,230,090.48	1,237,037.75	1,217,059.12	1,252,468.73	1,170,793.53	1,106,506.82	1,155,220.69	1,204,706.26	1,238,303.93	1,252,155.12	1,206,055.04	1,165,748.11	8.11
A. Fuel combustion (sectoral approach)	1,229,612.82	1,236,529.98	1,216,506.00	1,251,853.09	1,170,228.36	1,106,005.97	1,154,746.14	1,204,228.78	1,237,813.66	1,251,716.99	1,205,606.02	1,165,285.65	8.09
1. Energy industries	427,940.21	447,938.55	436,480.13	498,751.19	473,839.27	436,771.30	461,182.05	518,617.37	561,892.20	564,207.09	529,229.07	504,112.51	42.90
2. Manufacturing industries and construction	386,313.13	374,648.95	378,847.82	364,920.25	331,853.92	303,283.88	338,811.95	335,113.11	334,157.80	342,281.49	339,109.16	333,942.06	-12.15
3. Transport	238,588.32	232,726.97	229,663.36	226,722.19	218,193.17	214,763.95	215,467.45	212,651.37	217,436.48	215,803.45	208,505.39	204,951.99	2.37
4. Other sectors	176,771.16	181,215.50	171,514.70	161,459.46	146,342.00	151,186.84	139,284.69	137,846.94	124,327.18	129,424.96	128,762.41	122,279.09	-15.65
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
B. Fugitive emissions from fuels	477.66	507.77	553.11	615.64	565.17	500.85	474.55	477.48	490.27	438.13	449.03	462.47	141.41
1. Solid fuels	0.64	0.61	0.59	0.56	0.54	0.53	0.52	0.51	0.50	0.49	0.49	0.48	-90.94
2. Oil and natural gas and other emissions from energy production	477.02	507.16	552.52	615.09	564.63	500.32	474.03	476.97	489.77	437.64	448.53	461.99	148.05
C. CO2 transport and storage	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NE,NO	NE,NO	NO,NE	
2. Industrial processes	54,543.23	55,643.98	55,893.47	55,092.65	50,793.22	45,234.71	46,316.10	46,226.84	46,288.21	48,034.11	47,434.26	46,156.23	-29.13
A. Mineral industry	39,808.97	41,219.73	41,192.26	40,200.22	37,432.49	32,775.52	32,747.86	33,091.44	33,660.76	35,053.79	34,795.26	33,782.35	-31.36
B. Chemical industry	6,130.79	5,790.85	5,870.65	5,962.25	5,103.40	4,868.59	5,423.41	5,099.57	4,648.28	4,784.29	4,685.08	4,591.47	-34.77
C. Metal industry	6,483.04	6,496.47	6,567.97	6,694.93	6,236.57	5,468.35	6,100.70	5,964.62	6,060.79	6,169.61	6,092.97	5,933.95	-18.41
D. Non-energy products from fuels and solvent use	2,034.13	2,046.88	2,175.07	2,149.08	1,949.22	2,050.96	1,968.29	1,995.41	1,841.98	1,944.09	1,780.51	1,765.41	15.29
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	
H. Other	86.29	90.05	87.52	86.16	71.55	71.29	75.85	75.81	76.41	82.33	80.44	83.04	29.21
3. Agriculture	402.22	410.56	383.48	500.08	439.98	390.10	402.94	414.65	520.16	577.77	559.19	559.19	-8.16
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	236.30	231.29	230.36	325.00	305.74	270.15	242.88	246.78	369.97	379.58	370.20	370.20	-32.72
H. Urea application	165.92	179.27	153.12	175.08	134.24	119.95	160.06	167.88	150.19	198.19	188.99	188.99	222.27
I. Other carbon-containing fertilizers	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	
4. Land Use, Land-Use Change and Forestry	-96,949.45	-91,794.30	-86,320.95	-82,946.08	-72,357.34	-68,167.80	-70,320.57	-70,965.07	-73,654.55	-67,703.20	-65,361.49	-61,169.45	-4.03
A. Forest land	-98,528.07	-92,664.68	-86,812.74	-85,549.55	-80,755.61	-75,864.70	-76,372.33	-78,108.40	-77,671.12	-69,963.65	-68,251.86	-63,084.94	-20.22
B. Cropland	2,677.31	2,274.95	1,408.99	4,830.25	10,284.51	7,909.38	5,558.77	5,757.29	4,839.60	3,616.40	4,446.05	3,985.75	-65.36
C. Grassland	-941.35	-1,025.53	-494.79	-930.61	-1,333.47	-237.33	-142.62	197.09	-182.99	-194.86	-85.15	-126.16	-112.28
D. Wetlands	49.03	41.64	34.65	46.95	53.14	72.23	67.07	47.84	38.57	42.80	41.02	52.24	-33.48
E. Settlements	-1,611.19	-1,206.60	-1,103.66	-1,100.93	-355.16	-702.29	230.84	-1,117.85	-703.08	-1,085.46	-355.23	-557.00	-126.12
F. Other land	515.92	166.02	141.04	166.29	190.14	198.09	229.86	160.78	150.65	134.28	157.22	158.54	-84.58
G. Harvested wood products	888.89	619.88	505.57	-408.47	-440.89	456.84	107.84	2,098.19	-126.17	-252.71	-1,313.55	-1,597.87	266.60
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
5. Waste	15,154.23	14,600.90	13,762.93	13,651.98	15,264.11	12,553.67	13,071.02	12,468.42	13,045.27	12,919.00	12,552.90	12,775.96	-2.68
A. Solid waste disposal	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NE,NO	NO,NE	
B. Biological treatment of solid waste													
C. Incineration and open burning of waste	14,647.53	14,094.09	13,240.57	13,090.78	14,733.70	12,039.98	12,544.11	11,944.29	12,517.16	12,314.31	11,935.87	12,151.03	-2.20
D. Waste water treatment and discharge													
E. Other	506.70	506.81	522.36	561.20	530.41	513.69	526.91	524.13	528.10	604.69	617.03	624.93	-11.08
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
Memo items:													
International bunkers	38,595.40	40,883.54	38,383.50	36,650.20	34,259.78	30,233.94	30,732.99	31,095.50	31,727.30	32,915.15	31,845.54	33,434.72	9.09
Aviation	21,190.20	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	19,125.80	45.01
Navigation	17,405.20	19,547.22	18,418.88	18,291.61	16,741.79	14,861.21	14,437.66	12,845.81	12,587.20	13,416.36	12,820.98	14,308.92	-18.04
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
CO2 emissions from biomass	42,247.08	45,966.63	46,513.75	47,218.37	45,556.05	42,528.57	57,791.90	57,349.80	58,247.46	59,390.44	61,918.65	62,372.61	78.92
CO2 captured	0.04	0.12	0.36	0.37	NO	NO	NO	NO	NO	NO	NO	NO	
Long-term storage of C in waste disposal sites	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
Indirect N2O													
Indirect CO2 (3)	3,197.46	3,092.12	3,025.47	2,890.16	2,615.24	2,410.25	2,342.95	2,261.36	2,181.11	2,182.62	2,110.81	2,149.93	-59.44
Total CO2 equivalent emissions without land use, land-use change and forestry	1,300,190.16	1,307,693.19	1,287,099.00	1,321,713.44	1,237,290.85	1,164,685.29	1,215,010.75	1,263,816.17	1,298,157.57	1,313,686.01	1,266,601.40	1,225,239.49	5.88
Total CO2 equivalent emissions with land use, land-use change and forestry	1,203,240.71	1,215,898.89	1,200,778.04	1,238,767.35	1,164,933.51	1,096,517.50	1,144,690.19	1,192,851.10	1,224,503.01	1,245,982.81	1,201,239.91	1,164,070.04	6.46
Total CO2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	1,303,387.62	1,310,785.32	1,290,124.47	1,324,603.60	1,239,906.09	1,167,095.55	1,217,353.70	1,266,077.53	1,300,338.68	1,315,868.63	1,268,712.21	1,227,389.42	5.59
Total CO2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	1,206,438.17	1,218,991.01	1,203,803.51	1,241,657.51	1,167,548.75	1,098,927.75	1,147,033.13	1,195,112.46	1,226,684.13	1,248,165.43	1,203,350.72	1,166,219.97	6.14

Table2-21 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
	kt														
1. Energy	255.69	255.69	234.90	215.87	191.11	174.16	164.28	150.35	142.89	133.20	131.52	126.87	114.81	94.02	92.29
A. Fuel combustion (sectoral approach)	56.76	56.76	56.13	55.68	56.50	56.68	58.40	57.81	55.04	52.88	53.38	53.44	50.80	51.70	51.59
1. Energy industries	17.26	17.26	16.93	15.77	15.59	16.04	16.11	15.72	13.49	12.61	12.13	10.22	8.01	7.90	7.43
2. Manufacturing industries and construction	17.65	17.65	17.20	16.96	17.02	17.24	17.49	18.33	17.46	15.59	15.38	17.08	16.69	17.98	19.44
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
4. Other sectors	10.20	10.20	10.06	10.86	11.94	11.32	12.44	11.13	11.35	12.13	13.33	13.66	13.85	13.96	13.45
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	198.93	198.93	178.77	160.19	134.62	117.48	105.88	92.54	87.85	80.31	78.14	73.43	64.01	42.32	40.70
1. Solid fuels	190.42	190.42	169.71	151.12	125.25	107.95	95.76	82.40	77.32	69.99	67.72	62.52	53.19	30.73	28.85
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
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
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
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
D. Non-energy products from fuels and solvent use	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	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
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	1,019.17	1,019.17	996.36	1,050.31	919.38	1,078.72	1,040.69	1,016.27	1,006.73	957.06	966.24	982.51	973.55	979.39	934.84
A. Enteric fermentation	369.12	369.12	376.53	379.23	375.39	369.68	366.24	362.90	361.79	359.96	357.62	353.57	354.73	351.51	346.93
B. Manure management	134.13	134.13	134.61	133.66	130.50	126.85	125.82	124.07	122.32	120.11	117.81	115.16	114.93	114.62	112.86
C. Rice cultivation	510.84	510.84	480.53	532.56	409.08	577.57	544.18	524.98	518.42	472.97	486.87	509.95	500.08	509.55	471.54
D. Agricultural soils	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
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
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
4. Land use, land-use change and forestry	2.92	2.92	2.79	2.66	3.57	3.25	2.80	3.72	3.97	2.84	2.56	2.67	2.87	3.24	2.44
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
B. Cropland	2.43	2.43	2.40	2.37	2.34	2.32	2.29	2.27	2.26	2.24	2.22	2.21	2.19	2.17	2.16
C. Grassland	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
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
E. Settlements	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
G. Harvested wood products															
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	491.65	491.65	485.95	484.11	476.36	469.45	458.21	447.55	435.58	420.75	407.68	395.09	373.81	361.93	349.38
A. Solid waste disposal	368.83	368.83	366.07	365.07	359.24	354.49	344.75	335.60	325.10	312.43	300.52	289.42	277.34	265.23	252.89
B. Biological treatment of solid waste	7.79	7.79	7.65	7.67	7.69	7.63	7.65	7.67	7.72	7.68	7.71	7.76	7.82	9.90	11.64
C. Incineration and open burning of waste	0.64	0.64	0.62	0.64	0.64	0.69	0.71	0.73	0.70	0.69	0.67	0.63	0.60	0.93	0.80
D. Waste water treatment and discharge	114.39	114.39	111.61	110.73	108.79	106.64	105.10	103.56	102.06	99.95	98.78	97.27	88.06	85.88	84.05
E. Other	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
Total CH_4 emissions without CH_4 from LULUCF	1,768.92	1,768.92	1,719.53	1,752.49	1,588.94	1,724.56	1,665.52	1,616.39	1,587.40	1,513.11	1,507.53	1,506.64	1,464.24	1,437.46	1,378.53
Total CH_4 emissions with CH_4 from LULUCF	1,771.84	1,771.84	1,722.33	1,755.15	1,592.51	1,727.81	1,668.31	1,620.11	1,591.37	1,515.95	1,510.09	1,509.31	1,467.11	1,440.69	1,380.97
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
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
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
Multilateral operations	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	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
	kt												(%)
1. Energy	95.32	98.26	100.27	101.28	99.22	94.71	118.23	103.49	103.17	100.95	100.75	99.17	-61.21
A. Fuel combustion (sectoral approach)	56.26	59.20	60.98	62.28	61.34	58.05	82.84	68.80	69.15	68.29	68.52	67.63	19.16
1. Energy industries	8.50	8.84	8.73	10.98	12.62	12.54	13.93	14.82	15.90	12.97	12.25	11.44	-33.70
2. Manufacturing industries and construction	20.48	20.89	22.76	23.06	22.02	21.83	24.02	19.18	19.80	20.41	21.58	21.55	22.09
3. Transport	10.55	9.90	9.30	8.77	8.00	7.47	7.13	6.81	6.55	6.24	5.93	5.72	-50.93
4. Other sectors	16.72	19.58	20.19	19.47	18.69	16.22	37.77	28.00	26.89	28.67	28.76	28.93	183.56
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
B. Fugitive emissions from fuels	39.06	39.06	39.30	39.00	37.87	36.66	35.40	34.69	34.02	32.65	32.23	31.54	-84.15
1. Solid fuels	26.87	26.18	25.75	24.37	23.59	23.09	22.57	22.09	21.81	21.32	21.52	20.83	-89.06
2. Oil and natural gas and other emissions from energy production	12.20	12.88	13.54	14.63	14.28	13.57	12.83	12.60	12.22	11.33	10.71	10.71	25.79
C. CO_2 transport and storage													
2. Industrial processes	2.15	2.15	2.18	2.04	1.99	2.05	2.16	2.15	1.85	1.86	1.72	1.94	-19.92
A. Mineral industry													
B. Chemical industry	1.34	1.35	1.37	1.21	1.27	1.43	1.45	1.43	1.13	1.13	1.01	1.27	-15.21
C. Metal industry	0.81	0.80	0.82	0.82	0.72	0.62	0.71	0.72	0.72	0.73	0.71	0.67	-27.59
D. Non-energy products from fuels and solvent use	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	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	
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
3. Agriculture	986.32	988.15	979.44	1,003.22	1,007.35	989.69	1,023.65	1,007.68	983.72	982.57	967.94	945.91	-7.19
A. Enteric fermentation	339.01	337.63	338.43	339.04	334.11	329.58	318.66	317.11	309.42	301.11	293.71	293.39	-20.52
B. Manure management	110.19	109.31	107.03	105.36	103.85	102.57	100.43	100.46	98.45	95.96	93.92	93.39	-30.37
C. Rice cultivation	533.74	537.78	530.66	555.58	566.27	554.51	601.62	587.20	573.01	582.62	577.50	556.31	8.90
D. Agricultural soils	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	
F. Field burning of agricultural residues	3.38	3.43	3.32	3.23	3.11	3.02	2.94	2.91	2.83	2.88	2.80	2.81	-44.76
G. Liming													
H. Urea application													
I. Other carbon-containing fertilizers													
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
4. Land use, land-use change and forestry	2.82	2.67	2.35	2.32	3.24	2.61	2.39	2.43	2.24	2.31	3.05	2.37	-18.64
A. Forest land	0.57	0.43	0.12	0.10	1.02	0.41	0.20	0.25	0.08	0.16	0.91	0.24	-39.04
B. Cropland	2.15	2.15	2.14	2.13	2.13	2.11	2.10	2.09	2.08	2.07	2.05	2.04	-15.99
C. Grassland	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	1.10
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	NE,NA, NO	NO,NE, NA	
E. Settlements	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	
G. Harvested wood products													
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
5. Waste	335.57	322.60	308.60	294.01	280.23	265.65	250.16	240.28	230.54	221.64	212.32	204.78	-58.35
A. Solid waste disposal	240.35	228.12	215.32	203.19	188.69	176.51	164.29	154.46	146.20	138.37	130.06	122.51	-66.79
B. Biological treatment of solid waste	12.00	13.58	13.98	13.50	15.18	15.07	13.18	14.48	14.36	14.22	14.21	14.23	82.83
C. Incineration and open burning of waste	0.73	0.68	0.63	0.58	0.56	0.50	0.46	0.46	0.48	0.48	0.43	0.43	-33.48
D. Waste water treatment and discharge	82.49	80.22	78.67	76.74	75.79	73.58	72.23	70.88	69.50	68.56	67.62	67.61	-40.89
E. Other	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	
Total CH_4 emissions without CH_4 from LULUCF	1,419.36	1,411.17	1,390.50	1,400.54	1,388.78	1,352.10	1,394.20	1,353.61	1,319.28	1,307.01	1,282.73	1,251.80	-29.23
Total CH_4 emissions with CH_4 from LULUCF	1,422.18	1,413.84	1,392.85	1,402.86	1,392.02	1,354.71	1,396.59	1,356.03	1,321.52	1,309.33	1,285.78	1,254.17	-29.22
Memo items:													
International bunkers	1.80	2.01	1.89	1.86	1.71	1.52	1.48	1.35	1.33	1.34	1.26	1.42	-18.94
Aviation	0.15	0.15	0.14	0.13	0.12	0.11	0.12	0.13	0.14	0.13	0.13	0.13	41.22
Navigation	1.65	1.86	1.75	1.73	1.59	1.41	1.37	1.22	1.19	1.20	1.13	1.28	-22.33
Multilateral operations	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													

Table2-22 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
	kt														
1. Energy	22.08	22.08	22.89	23.28	23.73	24.68	26.72	27.30	28.05	27.53	27.98	28.11	28.14	27.29	26.38
A. Fuel combustion (sectoral approach)	22.08	22.08	22.89	23.28	23.72	24.68	26.72	27.30	28.05	27.53	27.98	28.10	28.14	27.29	26.38
1. Energy industries	4.02	4.02	4.14	4.13	4.26	4.53	5.83	6.00	6.24	6.31	6.64	6.90	7.53	7.38	7.45
2. Manufacturing industries and construction	4.68	4.68	4.91	5.04	5.36	5.80	6.10	6.32	6.67	6.35	6.49	6.68	6.65	6.77	6.71
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
4. Other sectors	0.84	0.84	0.82	0.84	0.94	0.95	1.02	0.96	0.98	1.04	1.10	1.11	1.10	1.11	1.06
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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
1. Solid fuels	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. Oil and natural gas and other emissions from energy production	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
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
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	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
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	38.75	38.75	38.32	38.09	38.10	37.42	36.18	35.59	35.21	34.75	34.46	34.62	34.09	34.19	34.20
A. Enteric fermentation															
B. Manure management	14.26	14.26	14.36	14.31	14.08	13.78	13.55	13.39	13.31	13.09	12.91	12.98	13.09	13.29	13.47
C. Rice cultivation															
D. Agricultural soils	24.36	24.36	23.84	23.65	23.90	23.52	22.52	22.09	21.79	21.56	21.45	21.55	20.90	20.80	20.63
E. Prescribed burning of savannas	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
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
4. Land use, land-use change and forestry	0.70	0.70	0.69	0.69	0.69	0.68	0.67	0.67	0.66	0.65	0.64	0.63	0.63	0.63	0.61
A. Forest land	0.41	0.41	0.41	0.41	0.42	0.41	0.41	0.42	0.42	0.41	0.41	0.41	0.41	0.41	0.41
B. Cropland	0.11	0.11	0.10	0.10	0.10	0.10	0.09	0.08	0.08	0.08	0.07	0.07	0.07	0.06	0.06
C. Grassland	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
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
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
F. Other land	0.04	0.04	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
G. Harvested wood products															
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	11.67	11.67	11.89	12.32	12.40	12.90	13.43	13.84	14.12	14.09	14.11	13.92	13.71	13.09	13.17
A. Solid waste disposal															
B. Biological treatment of solid waste	0.47	0.47	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.47	0.47	0.59	0.70
C. Incineration and open burning of waste	4.82	4.82	4.95	5.40	5.40	5.93	6.39	6.80	7.04	7.06	7.29	7.23	7.00	6.41	6.40
D. Waste water treatment and discharge	6.39	6.39	6.48	6.46	6.54	6.51	6.58	6.58	6.62	6.58	6.36	6.23	6.25	6.09	6.07
E. Other	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
Total direct N_2O emissions without N_2O from LULUCF	105.76	105.76	104.76	105.23	104.87	109.26	110.27	114.03	116.71	111.36	90.72	99.20	87.22	85.38	84.71
Total direct N_2O emissions with N_2O from LULUCF	106.47	106.47	105.45	105.92	105.56	109.94	110.94	114.70	117.37	112.01	91.36	99.83	87.85	86.01	85.32
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
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
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
Multilateral operations	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
Indirect CO_2															

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
	kt												(%)
1. Energy	25.59	25.58	24.84	24.69	23.69	22.53	22.43	22.14	21.93	22.02	21.58	21.55	-2.42
A. Fuel combustion (sectoral approach)	25.59	25.58	24.84	24.69	23.69	22.53	22.43	22.14	21.93	22.02	21.58	21.55	-2.42
1. Energy industries	7.45	8.19	8.14	8.35	8.19	7.91	7.97	8.59	8.64	8.79	8.57	8.61	114.24
2. Manufacturing industries and construction	6.78	6.74	6.70	6.85	6.60	6.21	6.29	6.09	6.16	6.28	6.26	6.32	35.14
3. Transport	10.23	9.45	8.85	8.39	7.88	7.34	6.88	6.54	6.28	6.04	5.85	5.76	-54.12
4. Other sectors	1.13	1.19	1.15	1.10	1.01	1.08	1.30	0.93	0.85	0.89	0.90	0.86	2.87
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
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	-23.60
1. Solid fuels	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NE,NO	NO,NE	
2. Oil and natural gas and other emissions from energy production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-23.60
C. CO_2 transport and storage													
2. Industrial processes	12.08	10.38	11.20	8.60	8.88	9.32	7.62	6.48	5.83	5.87	5.72	5.41	-83.74
A. Mineral industry													
B. Chemical industry	10.86	9.15	9.88	7.48	7.89	8.45	6.70	5.57	4.80	4.66	3.62	3.17	-90.19
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
D. Non-energy products from fuels and solvent use	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	
E. Electronic industry													
F. Product uses as ODS substitutes													
G. Other product manufacture and use	1.22	1.23	1.33	1.13	1.00	0.87	0.92	0.91	1.03	1.20	2.10	2.24	129.55
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
3. Agriculture	33.87	33.94	34.13	35.47	33.23	32.33	33.19	32.73	32.35	32.28	31.80	31.75	-18.08
A. Enteric fermentation													
B. Manure management	13.52	13.74	14.11	14.37	14.63	14.66	14.31	14.14	13.86	13.63	13.42	13.37	-6.23
C. Rice cultivation													
D. Agricultural soils	20.26	20.11	19.94	21.01	18.52	17.59	18.81	18.51	18.41	18.58	18.30	18.30	-24.87
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
F. Field burning of agricultural residues	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07	-44.76
G. Liming													
H. Urea application													
I. Other carbon containing fertlizers													
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
4. Land use, land-use change and forestry	0.61	0.60	0.59	0.59	0.58	0.57	0.57	0.57	0.56	0.56	0.57	0.57	-18.60
A. Forest land	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.42	0.42	2.50
B. Cropland	0.05	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	-73.25
C. Grassland	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-6.69
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	NE,NA, NO,IE	NO,NE, IE,NA	
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	NA,NO, IE	NO,IE, NA	
F. Other land	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	-71.63
G. Harvested wood products													
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
5. Waste	13.14	13.43	13.03	12.42	12.26	11.95	11.65	11.75	11.54	11.65	11.19	11.20	-4.09
A. Solid waste disposal													
B. Biological treatment of solid waste	0.72	0.81	0.84	0.81	0.91	0.90	0.79	0.87	0.86	0.85	0.85	0.85	82.83
C. Incineration and open burning of waste	6.37	6.59	6.19	5.68	5.47	5.27	5.09	5.12	5.13	5.17	4.81	4.81	-0.06
D. Waste water treatment and discharge	6.05	6.02	6.01	5.92	5.89	5.78	5.77	5.77	5.55	5.62	5.53	5.53	-13.48
E. Other	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	
Total direct N_2O emissions without N_2O from LULUCF	84.68	83.32	83.21	81.18	78.07	76.14	74.89	73.11	71.65	71.81	70.29	69.90	-33.91
Total direct N_2O emissions with N_2O from LULUCF	85.29	83.92	83.80	81.76	78.65	76.71	75.46	73.67	72.21	72.38	70.86	70.47	-33.81
Memo items:													
International bunkers	1.07	1.13	1.07	1.02	0.95	0.84	0.85	0.86	0.88	0.88	0.85	0.89	5.72
Aviation	0.60	0.60	0.57	0.52	0.50	0.44	0.46	0.52	0.54	0.54	0.52	0.53	41.22
Navigation	0.47	0.53	0.50	0.50	0.45	0.40	0.39	0.35	0.34	0.34	0.32	0.37	-22.33
Multilateral operations	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	
Indirect CO_2													

Table2-23 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
	kt														
	22,471.61	22,471.61	24,856.54	25,384.52	29,071.96	34,495.36	42,823.11	42,856.28	44,421.08	40,310.58	37,486.34	34,725.11	29,340.99	25,435.83	25,082.57
Emissions of HFCs - (kt CO_2 equivalent)	15,932.31	15,932.31	17,349.61	17,767.22	18,129.16	21,051.90	25,213.19	24,598.11	24,436.79	23,742.10	24,368.28	22,852.00	19,462.52	16,236.39	16,228.36
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
HFC-32	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	0.00	0.01	0.02	0.05	0.08	0.14
HFC-41	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-43-10mee	NO,NE,IE	NO,NE,IE	NO,NE,IE	IE,NE,NO	NO,NE,IE	IE,NE,NO	IE,NE,NO	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE
HFC-125	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	0.00	0.01	0.02	0.05	0.08	0.14
HFC-134	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134a	0.00	0.00	IE,NO	0.08	0.63	1.30	2.01	2.79	3.49	3.87	4.05	4.31	4.38	4.61	4.76
HFC-143	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-143a	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00
HFC-152	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-152a	0.00	0.00	NO	0.00	0.01	0.01	0.01	0.01	0.00	NO	NO	0.02	0.08	0.16	0.40
HFC-161	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-227ea	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02
HFC-236cb	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236ea	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236fa	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-245ca	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-245fa	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO
HFC-365mfc	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	IE,NO	0.00
Unspecified mix of HFCs - (kt CO_2 equivalent)	2.24	2.24	IE,NO	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
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	17,609.92	18,258.18	19,984.28	16,568.48	13,118.06	11,873.11	9,878.47	9,199.44	8,854.21
CF_4	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	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
C_3F_8	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_4F_{10}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
$c\text{-}C_4F_8$	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_5F_{12}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_6F_{14}	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	0.00	0.00
C10F18	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
c-C3F6	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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
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
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**
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
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

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
	kt												(%)
	21,637.56	21,405.18	23,625.84	24,624.04	25,028.33	24,984.20	27,554.77	29,826.94	32,784.93	35,374.62	39,127.22	42,510.91	89.18
Emissions of HFCs - (kt CO_2 equivalent)	12,420.92	12,781.83	14,627.06	16,707.19	19,284.93	20,937.33	23,305.23	26,071.50	29,348.60	32,094.56	35,765.79	39,202.80	146.06
HFC-23	0.09	0.04	0.06	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-99.77
HFC-32	0.21	0.30	0.39	0.49	0.61	0.72	0.85	1.02	1.21	1.41	1.68	2.01	100.00
HFC-41	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
HFC-43-10mee	NO,NE,IE	IE,NE,NO	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	IE,NE,NO	NO,NE,IE	NO,NE,IE	NO,NE,IE	
HFC-125	0.22	0.31	0.40	0.50	0.62	0.74	0.86	1.04	1.23	1.40	1.58	1.75	100.00
HFC-134	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
HFC-134a	4.32	3.59	2.91	2.85	2.85	2.83	2.78	2.64	2.63	2.64	2.60	2.51	268,445.31
HFC-143	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
HFC-143a	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.04	0.04	100.00
HFC-152	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
HFC-152a	0.84	1.22	1.41	1.44	1.68	1.58	1.30	1.26	0.99	0.68	0.52	0.42	1,121,792.86
HFC-161	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
HFC-227ea	0.04	0.05	0.04	0.04	0.05	0.04	0.03	0.03	0.03	0.03	0.02	0.03	100.00
HFC-236cb	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
HFC-236ea	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
HFC-236fa	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
HFC-245ca	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
HFC-245fa	0.19	0.48	0.67	0.85	0.93	1.01	1.11	1.24	1.36	1.47	1.58	1.67	100.00
HFC-365mfc	0.08	0.17	0.25	0.31	0.35	0.41	0.46	0.51	0.59	0.66	0.70	0.73	100.00
Unspecified mix of HFCs - (kt CO_2 equivalent)	3,542.91	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	1,134,906.07
Emissions of PFCs - (kt CO_2 equivalent)	9,216.64	8,623.35	8,998.78	7,916.85	5,743.40	4,046.87	4,249.54	3,755.45	3,436.33	3,280.06	3,361.43	3,308.10	-49.41
CF_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NO	
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	NO	
C_3F_8	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
C_4F_{10}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
$c\text{-}C_4F_8$	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
C_5F_{12}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
C_6F_{14}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA,NO	0.00	0.00	0.00	100.00
C10F18	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
c-C3F6	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
Unspecified mix of PFCs - (kt CO_2 equivalent)	9,194.74	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	-47.91
Unspecified mix of HFCs and PFCs - (kt CO_2 equivalent)													
Emissions of SF_6 - (kt CO_2 equivalent)	5,258.70	5,053.01	5,228.90	4,733.45	4,177.17	2,446.63	2,423.87	2,247.64	2,234.54	2,101.81	2,065.07	2,121.86	-83.49
SF_6	**0.23**	**0.22**	**0.23**	**0.21**	**0.18**	**0.11**	**0.11**	**0.10**	**0.10**	**0.09**	**0.09**	**0.09**	**-83.49**
Emissions of NF_3 - (kt CO_2 equivalent)	486.04	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	1,651.10
NF_3	0.03	0.09	0.08	0.09	0.09	0.08	0.09	0.10	0.09	0.09	0.07	0.03	1,651.10

2.1.8 Key Category Analysis

key category is one that is prioritized within the national inventory system 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.

Key category analyses in FY2015 and the base year of the UNFCCC (1990) which were carried out in accordance with the 2006 IPCC Guidelines (Approach 1 level assessment[38] and trend assessment[39], Approach 2 level assessment and level assessment and trend assessment) are shown in Table 2-24 and Table 2-25 .46 sources and sinks were identified as Japan's key categories in FY2015 and 41 sources and sinks were identified as key categories in FY1990.

[38] The calculated values of proportion are added from the category that accounts for the largest proportion, until the sum reaches 95% for Approach 1, 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.

[39] 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, 90% for Approach 2. Approach1 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 2-24 Japan's key categories in FY2015

	A IPCC Category		B GHGs	Ap1-L	Ap1-T	Ap2-L	Ap2-T
#1	1.A.1. Energy Industries	Solid Fuels	CO2	#1	#1	#1	#2
#2	1.A.2. Manufacturing Industries and Construction	Solid Fuels	CO2	#2	#12	#3	#30
#3	1.A.3. Transport	b. Road Transportation	CO2	#3		#4	
#4	1.A.1. Energy Industries	Gaseous Fuels	CO2	#4	#3	#12	#14
#5	1.A.1. Energy Industries	Liquid Fuels	CO2	#5	#2	#8	#7
#6	1.A.4. Other Sectors	Liquid Fuels	CO2	#6	#5	#11	#15
#7	1.A.2. Manufacturing Industries and Construction	Liquid Fuels	CO2	#7	#4	#13	#8
#8	4.A Forest Land	1. Forest Land remaining Forest Land	CO2	#8	#8	#2	#6
#9	1.A.2. Manufacturing Industries and Construction	Gaseous Fuels	CO2	#9	#7	#34	#25
#10	1.A.4. Other Sectors	Gaseous Fuels	CO2	#10	#10		
#11	2.F Product uses as substitutes for ODS	1. Refrigeration and Air conditioning	HFCs	#11	#6	#7	#4
#12	2.A Mineral Product	1. Cement Production	CO2	#12	#11	#22	#19
#13	3.C Rice Cultivation		CH4	#13		#27	
#14	5.C Incineration and Open Burning of Waste		CO2	#14		#9	
#15	1.A.3. Transport	d. Domestic Navigation	CO2	#15	#20		
#16	1.A.3. Transport	a. Domestic Aviation	CO2	#16			
#17	1.A.2. Manufacturing Industries and Construction	Other Fossil Fuels	CO2	#17	#17	#14	#16
#18	3.A Enteric Fermentation		CH4	#18		#10	#20
#19	1.A.1. Energy Industries	Other Fossil Fuels	CO2	#19		#24	
#20	3.B Manure Management		N2O			#6	#29
#21	4.B Cropland	1. Cropland remaining Cropland	CO2		#15	#17	#5
#22	3.D Agricultural Soils	1. Direct Emissions	N2O			#25	#23
#23	1.A.4. Other Sectors	Solid Fuels	CO2		#22		
#24	5.A Solid Waste Disposal		CH4		#16	#29	#9
#25	2.B Chemical Industry	Other products except Anmonia	CO2			#15	#18
#26	1.A.1. Energy Industries		N2O			#26	#22
#27	2.F Product uses as substitutes for ODS	2. Foam Blowing Agents	HFCs		#23	#18	#12
#28	1.A.2. Manufacturing Industries and Construction		N2O			#31	
#29	3.D Agricultural Soils	2. Indirect Emissions	N2O			#5	#13
#30	2.D Non-energy Products from Fuels and Solvent		CO2			#30	
#31	5.D Wastewater Treatment and Discharge		CH4				#28
#32	2.E Electronics Industry		PFCs			#16	
#33	4.E Settlements	1. Settlements remaining Settlements	CO2			#32	
#34	5.D Wastewater Treatment and Discharge		N2O			#28	
#35	4.G Harvested Wood Products		CO2			#33	#24
#36	2.F Product uses as substitutes for ODS	5. Solvents	PFCs		#21		#27
#37	1.A.3. Transport	b. Road Transportation	N2O			#23	#10
#38	2.G Other Product Manufacture and Use		SF6		#13	#20	#1
#39	5.C Incineration and Open Burning of Waste		N2O			#21	
#40	4.E Settlements	2. Land converted to Settlements	CO2		#24		#21
#41	1.B Fugitive Emission from Fuel	1.Fugitive emissions from Solid Fuels	CH4		#18		#3
#42	2.B Chemical Industry	4. Caprolactam, Glyoxal and Glyoxylic Acid Production	N2O			#35	#11
#43	2.E Electronics Industry		SF6			#19	
#44	2.B Chemical Industry	3. Adipic Acid Production	N2O		#14		#17
#45	2.B Chemical Industry	9. Fluorochemical Production (Fugitive Emissions)	HFCs		#9		#26
#46	2.B Chemical Industry	9. Fluorochemical Production (Fugitive Emissions)	SF6		#19		

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 of individual level and trend assessments.

Table 2-25 Japan's key categories in FY1990

	A IPCC Category		B GHGs	Ap1-L	Ap2-L
#1	1.A.2. Manufacturing Industries and Construction	Solid Fuels	CO2	#1	#2
#2	1.A.3. Transport	b. Road Transportation	CO2	#2	#4
#3	1.A.1. Energy Industries	Liquid Fuels	CO2	#3	#6
#4	1.A.2. Manufacturing Industries and Construction	Liquid Fuels	CO2	#4	#7
#5	1.A.4. Other Sectors	Liquid Fuels	CO2	#5	#12
#6	1.A.1. Energy Industries	Solid Fuels	CO2	#6	#11
#7	1.A.1. Energy Industries	Gaseous Fuels	CO2	#7	#26
#8	4.A Forest Land	1. Forest Land remaining Forest Land	CO2	#8	#1
#9	2.A Mineral Product	1. Cement Production	CO2	#9	#19
#10	1.A.4. Other Sectors	Gaseous Fuels	CO2	#10	
#11	2.B Chemical Industry	9. Fluorochemical Production (Fugitive Emissions)	HFCs	#11	
#12	1.A.3. Transport	d. Domestic Navigation	CO2	#12	
#13	1.A.2. Manufacturing Industries and Construction	Gaseous Fuels	CO2	#13	
#14	3.C Rice Cultivation		CH4	#14	#27
#15	5.C Incineration and Open Burning of Waste		CO2	#15	#17
#16	4.B Cropland	1. Cropland remaining Cropland	CO2	#16	#8
#17	3.A Enteric Fermentation		CH4	#17	#14
#18	5.A Solid Waste Disposal		CH4	#18	#15
#19	2.G Other Product Manufacture and Use		SF6	#19	#3
#20	2.C Metal Production	1 Iron and Steel Production	CO2	#20	
#21	2.B Chemical Industry	3. Adipic Acid Production	N2O	#21	#29
#22	1.A.3. Transport	a. Domestic Aviation	CO2	#22	
#23	1.A.1. Energy Industries	Other Fossil Fuels	CO2	#23	#24
#24	2.A Mineral Product	2. Lime Production	CO2	#24	
#25	1.A.4. Other Sectors	Solid Fuels	CO2	#25	
#26	3.D Agricultural Soils	1. Direct Emissions	N2O	#26	#20
#27	1.B Fugitive Emission from Fuel	1.Fugitive emissions from Solid Fuels	CH4		#9
#28	3.B Manure Management		N2O		#10
#29	1.A.2. Manufacturing Industries and Construction	Other Fossil Fuels	CO2		#30
#30	2.B Chemical Industry	Other products except Anmonia	CO2		#16
#31	4.E Settlements	2. Land converted to Settlements	CO2		#28
#32	1.A.3. Transport	b. Road Transportation	N2O		#13
#33	3.B Manure Management		CH4		#33
#34	5.D Wastewater Treatment and Discharge		CH4		#31
#35	3.D Agricultural Soils	2. Indirect Emissions	N2O		#5
#36	5.D Wastewater Treatment and Discharge		N2O		#25
#37	2.B Chemical Industry	4. Caprolactam, Glyoxal and Glyoxylic Acid Production	N2O		#18
#38	2.D Non-energy Products from Fuels and Solvent		CO2		#32
#39	2.E Electronics Industry		PFCs		#22
#40	5.C Incineration and Open Burning of Waste		N2O		#23
#41	2.E Electronics Industry		SF6		#21

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 of individual level and trend assessments.

2.2 Brief Description of National Inventory Arrangements

2.2.1 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[40], which determines the domestic measures for the UNFCCC and Kyoto Protocol. The Ministry of the Environment (MOE), with the cooperation of relevant ministries, agencies and organizations, prepares Japan's national inventory and compiles supplementary information required under Decision 2/CMP.8 etc., which is annually submitted in accordance with the UNFCCC and the Kyoto Protocol.

The MOE takes overall responsibilities for the national inventory and therefore makes every effort on improving the quality of inventory. The MOE organizes the "Committee for the Greenhouse Gas Emission Estimation Methods (Committee)" in order to integrate the latest scientific knowledge into the inventory, 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 Common Reporting Format (CRF) 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 of the National Institute for Environmental Studies. The relevant ministries, agencies and organizations provide the GIO the appropriate data (e.g., activity data, emission factors, GHG emissions and removals) through compiling various statistics and also provide relevant information on supplementary information required under Decision 2/CMP.8 etc. 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 by the Ministry of Foreign Affairs.

Figure 2-30 shows the overall institutional arrangement for Japan's inventory preparation. More detailed information on the role and responsibility of relevant ministries, agencies and organizations in the inventory preparation process is described below.

[40] Enacted in October, 1998. The latest amendment was made on May 27th, 2016.

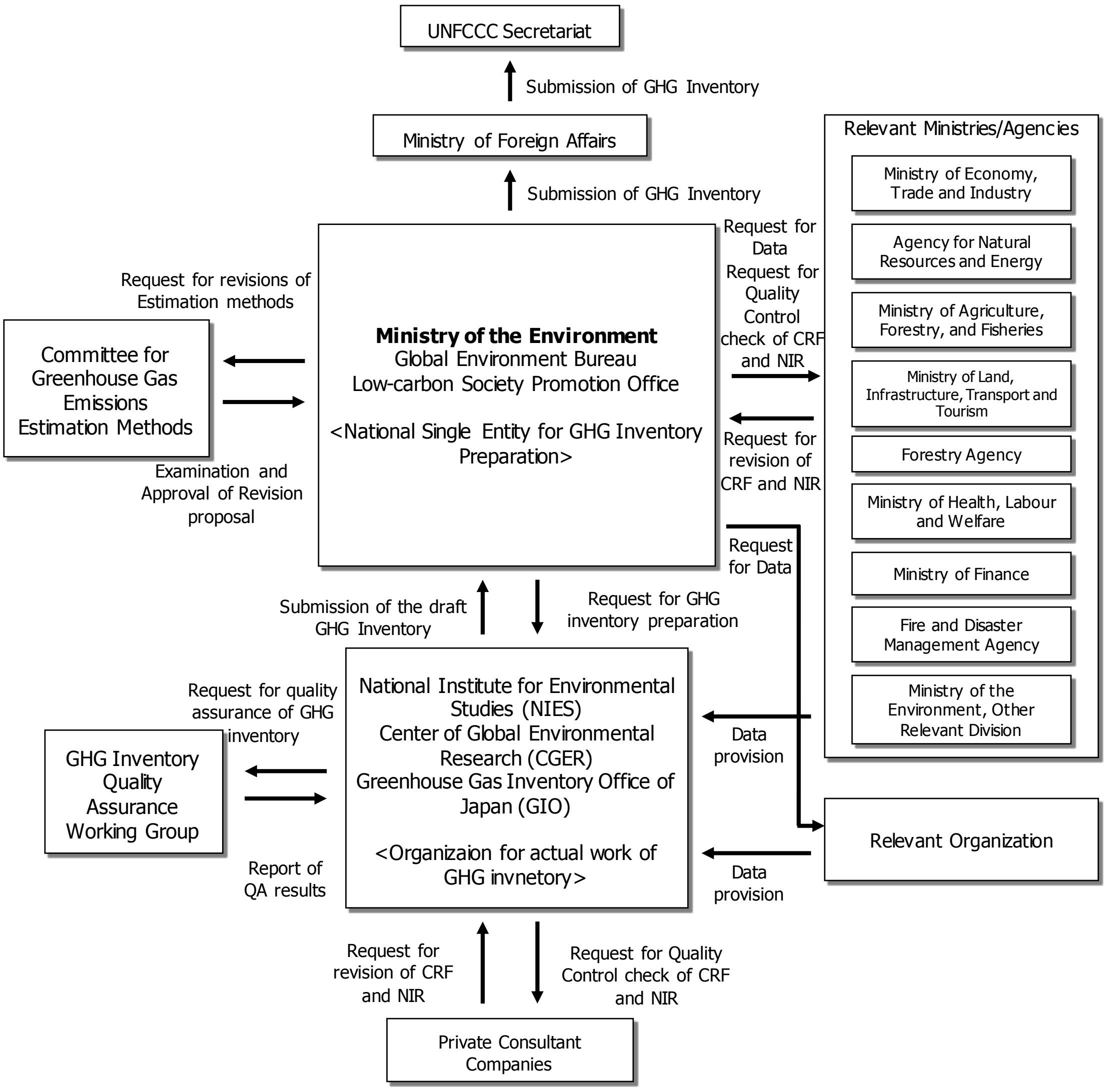


Figure 2-30 Japan's Institutional Arrangements for the National Inventory Preparation

2.2.2 Roles and Responsibilities of Each Entity Involved in the Inventory Preparation Process

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

(1) Ministry of the Environment (Low-carbon Society Promotion Office, Global Environment Bureau)

- 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 QA/QC activities for the inventory.
- It prepares, confirms, and approves the QA/QC plan.
- It prepares, confirms, and approves the inventory improvement plan.

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

(3) Relevant Ministries/Agencies

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

- Confirmation of data provided for the preparation of the inventory.
- Confirmation of the inventory (CRF, NIR, JNGI files, and other information) (Category-specific QC) prepared by the GIO.
- (When necessary), responding to questions from expert review teams 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 visits by expert review teams.

(4) Relevant Organizations

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

- Confirmation of data provided for the preparation of the inventory.
- (When necessary), responding to questions from expert review teams 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 (Committee) is a committee created and run by the Ministry of the Environment. Its role is to consider the methods for calculating inventory emissions and removals, and consider the selection of parameters such as activity data and emission factors. Under the Committee, the inventory working group (WG) that examines cross-cutting issues, and 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, and Breakout group on LULUCF) are set up. In addition, the Taskforce on NMVOC is set up as an additional sub-group under the Inventory WG, and the Taskforce examines methodologies of NMVOC emission estimation. The inventory WG, breakout groups and taskforce comprise experts in various fields, and consider suggestions for inventory improvements.

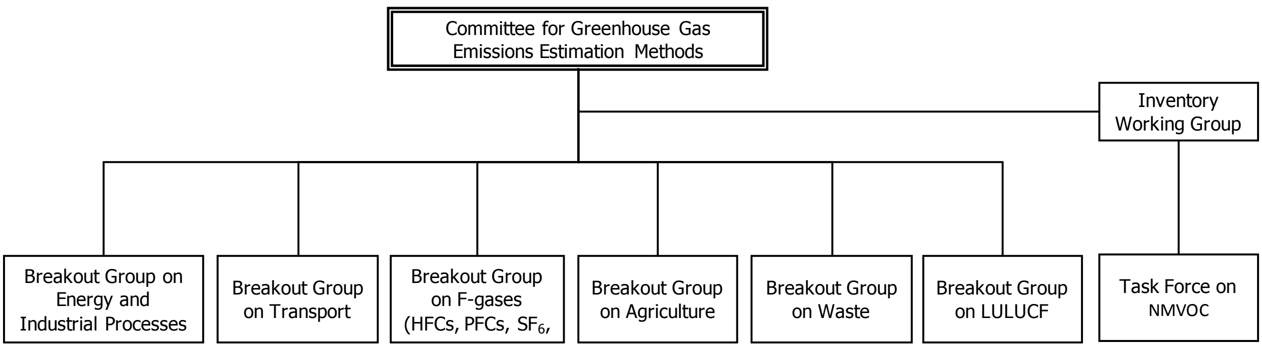


Figure 2-31 Structure of the Committee for the Greenhouse Gas Emissions Estimation Methods

(6) Private Consulting Companies

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

- Quality control (QC) of inventory (CRF, NIR, JNGI files) compiled by the Ministry of the Environment and the GIO.
- (When necessary), providing support for responding to questions from expert review teams and for preparing comments on draft reviews.
- (When necessary), providing support for responding to visits by expert review teams.

(7) GHG Inventory Quality Assurance Working Group (Expert Peer Review) (QAWG)

The GHG Inventory Quality Assurance Working Group (the QAWG) is an organization that is 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.

2.2.3 Brief Description of the Inventory Preparation Process

2.2.3.1 Annual Inventory Preparation Cycle

Table 2-26 shows the annual cycle of the inventory preparation. The inventory preparation cycle is set in conjunction with Japan's fiscal year calendar (starting April 1st and ending March 31 the next year) In Japan, in advance of the estimation of national inventory submitted to the UNFCCC (submission deadline: 15th April), preliminary figures are estimated and published as a document for an official announcement. (In preliminary figures, only GHG emissions excluding removals are estimated.)

Table 2-26 Annual Inventory Preparation Cycle

*Inventory preparation in fiscal yaer "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	Discussion on the inventory improvement	MOE, GIO		→	→	→	→							
2	Holding the meeting of the Committee	MOE, (GIO, Private consultant)		→	→	→	→	→	→	→	→			
3	Collection of data for the national inventory	MOE, GIO, Relevant Ministries/Agencies, Relevant organization, Private consultant								→	→	→	→	
4	Preparation of a draft of CRF	GIO, Private consultant									→	→	→	
5	Preparation of a draft of NIR	GIO, Private consultant									→	→	→	
6	Implementation of the exterior QC and the coordination with the relevant ministries and agencies	MOE, GIO, Relevant Ministries/Agencies, Private consultant										→	→	→
7	Correction of the drafts of CRF and NIR	MOE, GIO, Private consultant											→	→
8	Submission and official announcement of the national inventory	MOE, Ministry of Foreign Affairs, GIO												★
9	Holding the meeting of the QA-WG	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

2.2.3.2 Process of the Inventory Preparation

(1) Discussion on the Inventory Improvement (Step 1)

The MOE and the GIO identify the items, which need to be addressed by the Committee, based on the results of the previous inventory review of the UNFCCC, the recommendations of the "Inventory Quality Assurance Working Group (QAWG)", the items needing improvement as identified at former Committee's meetings, as well as any other items, requiring revision, as determined during previous inventory preparations. The schedule for the expert evaluation (step 2) is developed by taking the above-mentioned information into account.

(2) Holding the Meeting of the Committee for the Greenhouse Gas Emission Estimation Methods [Evaluation and Examination of Estimation Methods by Experts] (Step 2)

The MOE holds the meeting 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.

(3) Collection of Data for the National Inventory (Step 3)

The data required for preparing the national inventory and the supplementary information required under Decision 2/CMP.8 are collected.

(4) Preparation of a Draft of CRF [Including the Implementation of the Key Category Analysis and the Uncertainty Assessment] (Step 4)

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

(5) Preparation of a Draft of NIR (Step 5)

The draft of NIR is prepared by following the general guidelines made by the MOE and the GIO. The MOE and the GIO identify the points, which need to be revised or require an additional description by taking the discussion at step 1 into account. The GIO and the selected private consulting companies prepare new NIR by updating data, and by adding and revising descriptions in the previous NIR.

(6) Implementation of the External QC and the Coordination with the Relevant Ministries and Agencies (Step 6)

As a QC activity, the selected private consulting companies check the JNGI files and the initial draft of CRF (the 0^{th} 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 re-calculating the total amounts of GHG emissions and removals determined by utilizing the same files. Because of this cross-check, any possible data input and emission estimation mistakes are avoided. They also check the content and descriptions of the initial draft of NIR (the 0^{th} 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 requests them to check 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 which provided these confidential data.

(7) Correction of the Drafts of CRF and NIR (Step 7)

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 6), the MOE, GIO and relevant ministries and/or agencies that submit requests for revision coordinate contents of revision and then 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 to be the final versions.

(8) Submission and Official Announcement of the National Inventory (Step 8)

The MOE submitted the completed inventory to the Ministry of Foreign Affairs, and the Ministry of Foreign Affairs submitted the inventory to the UNFCCC Secretariat. At the same time of the submission, information on the estimated GHG emissions and removals are officially announced and published on the MOE's website[41] with additional relevant information. The inventory is also published on the GIO's website[42].

(9) Holding the Meeting of the Greenhouse Gas Inventory Quality Assurance Working Group (Step 9)

The QAWG, which is composed of experts who are not directly involved in or related to the inventory preparation process, is organized in order to perform peer review and assure the inventory's quality and to find out possible improvements.

The QAWG reviews the appropriateness of the estimation methodologies, activity data, emission factors, and the contents of CRF and NIR. 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.

2.2.4 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 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 2-32 is a diagram of the inventory improvement process.

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41 http://www.env.go.jp/

42 http://www-gio.nies.go.jp/index-j.html

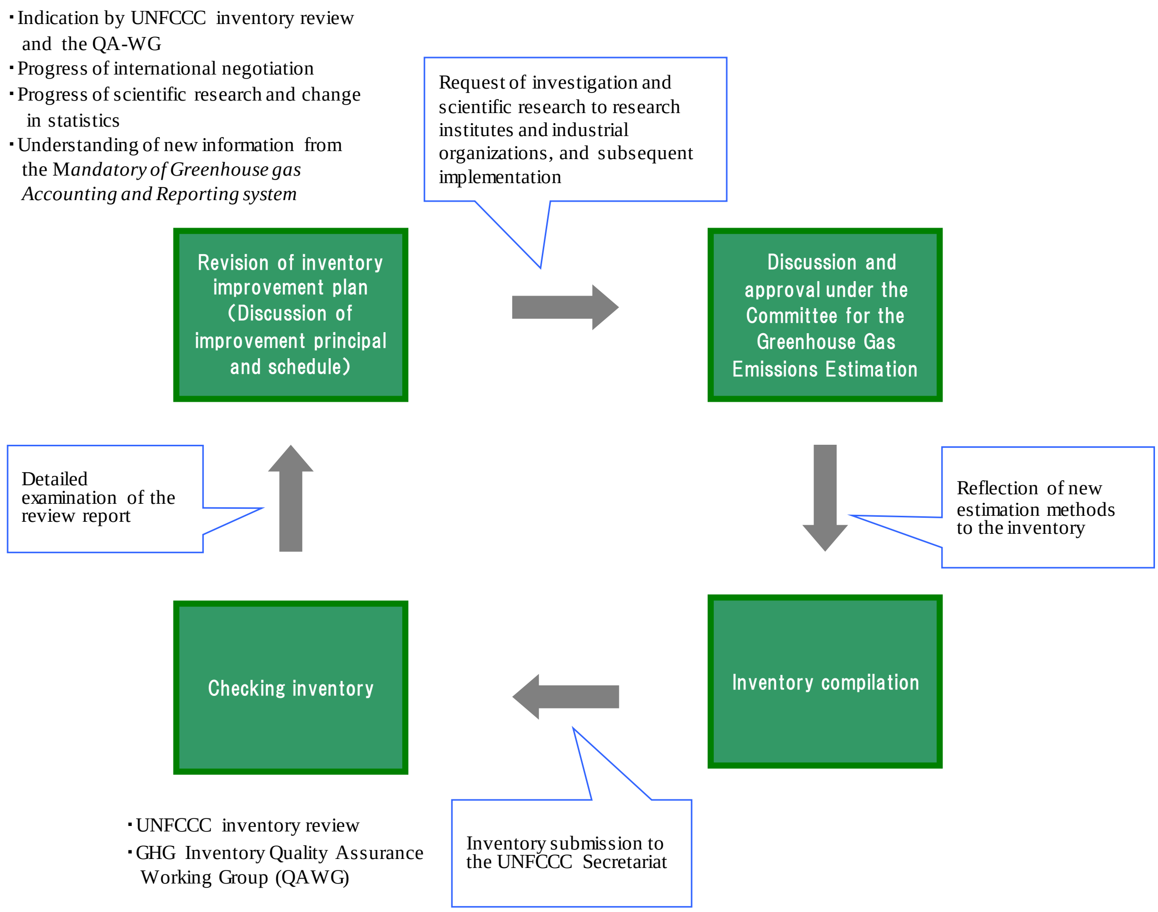


Figure 2-32 Diagram of the inventory improvement process

2.2.5 Information on the QA/QC Process

When compiling the inventory in Japan, inventory quality is controlled by performing quality control (QC) activities (such as checking the correctness of calculations and archive of documents) at each step in accordance with 2006 IPCC Guidelines. In Japan, the quality control activities relating to inventory compilation performed by personnel belonging to agencies involved in inventory compilation—that is, the Ministry of the Environment (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 (QAWG) are considered to be QA (quality assurance). They assess data quality from the perspectives of scientific knowledge and data availability with respect to current calculation methods. Table 2-27 sketches Japan's QA/QC activities.

Table 2-27 Summary of Japan's QA/QC activity

	Implementing entity	Main contents of activity
QC (Quality Control)	Ministry of the Environment (Low-carbon Society Promotion Office, Global Environment Bureau)	・Coordinating QA/QC activities for inventory preparation ・Establishing, revising, and approving QA/QC plan ・Developing, checking, and approving inventory improvement plan
	Greenhouse Gas Inventory Office of Japan, Center for Global Environmental Research, National Institute for Environmental Studies (GIO)	・Conducting general QC check ・Archiving QA/QC activity records and relevant data and documents ・Developing inventory improvement plan ・Revising QA/QC 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, emission factors, and activity data (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 (QA)

2.2.6 Changes in National inventory Arrangements since NC6/BR2

There is no change in National inventory arrangements since Japan's 6th National Communication (NC6) which Japan submitted in December 2013 and second Biennial Report (BR2) which Japan submitted in December 2015.

2.3 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.[43]

Item	Content
(a) The name and contact information of the registry administrator designated by the Party to maintain the national registry.	[Contact information] ・ Mr. Kouhei Tamura, Global Environment Partnership Office Industrial Science and Technology Policy and Environment Bureau, Ministry of Economy, Trade and Industry (TEL: +81-3-3501-1757, E-mail: kyomecha-tourokubo@meti.go.jp) ・ Mr. Kazuhisa Koakutsu, Market Mechanisms Climate Change Policy Division Global Environment Bureau, Ministry of the Environment (TEL: +81-3-5521-8354, 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 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 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 Article4 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

[43] FCCC/CP/2004/10/Add. 2, pp. 15–16.

Item	Content
	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 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 that there was 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 providing the registry administrators with a private connection. ・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

Item	Content
	software installed and virus pattern files are automatically updated on a regular basis.
(g) A list of information publically 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.
(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.

Item	Content
	-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 Policy Making Process

3.1.1 Overall Framework of Promotion of Policies and Measures

In "Basic Environment Law (19 of Nov. 1993, Act No.91)" that defines basic principles regarding environment conservation in Japan and indicates the basic direction of national policy, the proactive promotion regarding 'Global environment conservation' is regulated. The national government formulates "Basic Environment Plan[44]" based on Article 15, paragraph 1 in the Law to promote measures related to the environment conservation comprehensively and strategically. In the Plan, the global warming countermeasure is set as one of the important fields for environment policy.

Additionally, regarding the promotion of global warming countermeasures, "Act on Promotion of Global Warming Countermeasures (1998, Act No. 117)" is formulated as an individual law. The government established the Plan for Global Warming Countermeasures (Cabinet Decision on May 13, 2016) based on Article 8, paragraph 1, of the Act and the Action Policy for Global Warming Countermeasures based on the Paris Agreement (decision by the Global Warming Prevention Headquarters on December 22, 2015) in order for the national government, local governments, businesses and citizens to promote global warming countermeasures in a comprehensive and strategic manner. The Plan for Global Warming Countermeasures is the only general plan regarding global warming in Japan. This plan covers targets for reducing greenhouse gas 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.

3.1.2 Promotion System of Global Warming Countermeasure Plan

The Government has the Global Warming Prevention Headquarters with the Prime Minister as the director and all ministers as members and the executive committee of the Global Warming Prevention Headquarters, the director-level committee of government ministries. These organizations take the initiative in maintaining close communication among relevant government ministries and agencies and work on tasks. They gather opinions of intellectuals and experts in relevant councils at a proper timing and proper manner and maintain coordination with relevant organizations.

In regions, relevant government ministries and agencies use the Regional Energy and Global Warming Mitigation Councils installed in individual regional blocks for them to follow up on and support regional efforts with local governments and Regional Councils for the Mitigation of Global Warming.

3.1.3 Progress Management of Global Warming Countermeasure Plan

The Global Warming Prevention Headquarters inspects target achievement status by types of greenhouse gases and other categories, relevant indexes, and the progress of individual actions and measures every year based on stringent rules and regular evaluations and examinations by relevant councils. Accurate inspections require the identification of the latest conditions. Thus, relevant government ministries and agencies strive to calculate quickly necessary values used for the inspection of the amount of emissions reductions, indexes to evaluate effects of measures, and relevant indexes (hereinafter referred to as "the indexes to evaluate measures").

Specifically, the Global Warming Prevention Headquarters or the executive meeting of the Global Warming Prevention Headquarters clarifies the actual values of all indexes from one year before the inspection (or actual values from two years ago if values from one year before are unavailable). They also present the outlooks of the indexes to evaluate individual measures (outlook for each year if data are available) from the year of the progress inspection to FY 2030. They also clarify the status of measures implemented one year before as the grounds for setting the outlook of the indexes to evaluate measures and the contents of

[44] The Forth Basic Environment Plan decided by the Cabinet on April 27, 2012 is the latest as of October 2017.

measures being implemented for the current year. Furthermore, they present policies and measures on budget proposals, tax reform proposals, and bills that will be implemented in the next fiscal year or later. These data and information are used to evaluate individual policies and measures. If policies and measures showing slow progress are identified, improvement and reinforcement for these policies and measures will be considered. In such cases, new policies and measures are explored without being limited to strengthening policies and measures already included in the Plan for Global Warming Countermeasures.

When necessary, the progress inspection includes a detailed examination of the relationship between indexes to evaluate individual measures and the amount of emissions reductions that are the effects of implementing the applicable measures. Proper evaluation methods should be quickly established for fields without sufficient evaluation methods at this point, such as the indexes to evaluate policies and measures that will lead to the reform of socio-economic systems.

The grounds for the estimated emissions reductions for individual measures and the outcomes of progress inspections are made available to the public on the Internet so that the public can receive proper information about measures and their progress.

In addition to the annual progress inspections, targets and measures set in the Plan for Global Warming Countermeasures are examined at least every three years based on the data such as the amount of greenhouse gas emissions (final values) of two years ago, which is released around April every year; the amount of greenhouse gas emissions (preliminary values) of the last year, which is released around December every year; the results of review for the Biennial Report (BR) and the National Communication (NC) that the Government of Japan submits to the secretariat of the United Nations Framework Convention on Climate Change, taking into account the situation of the amount of greenhouse gas emissions and removals and other circumstances in Japan. The outcomes of the examination are used to reevaluate the Plan for Global Warming Countermeasures when necessary, and the Cabinet Decision is prepared for any revision.

The outlook discussed above is prepared based on the provisions set in the Paris Agreement and COP 21 decisions until 2020. After 2020, the outlook will be prepared based on the provisions of the five-year cycle of target submission and update set in the Agreement and the decisions. Information of efforts will be reported and reviewed internationally in accordance with the transparency system under the Paris Agreement in the future.

3.2 Policies and Measures on Mitigation Actions and Their Effects

3.2.1 Direction of global warming countermeasures that Japan aims for

Japan initiates global warming countermeasures based on scientific knowledge under international cooperation.

3.2.1.1 Actions to achieve the midterm target (reduction target for FY 2030)

Japan ensures domestic emission reductions and removals based on Japan's NDC submitted to the Secretariat of the UNFCCC. Japan thereby makes steady progress toward achieving the midterm target which is at the level of reduction of 26.0% by FY 2030 compared to FY 2013 (25.4% reduction compared to FY 2005).

3.2.1.2 Strategic actions to achieve long-term targets

The Leaders' Declaration of the G7 Summit in Elmau, Germany, in June 2015 stated the following. "We emphasize that deep cuts in global greenhouse gas emissions are required with decarbonization of the global economy over the course of this century. Accordingly, as a common vision for a global goal of greenhouse gas emissions reductions, we support sharing with all parties to the UNFCCC the upper end of the latest IPCC recommendation of 40% to 70% reductions by 2050 compared to 2010 recognizing that this challenge can only be met by a global response. To this end, we also commit to developing long-term low-carbon strategies."

The Paris Agreement also aims to hold the increase in the global average temperature to well below 2°C and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels. In addition, countries need to aim to reach the global peaking of greenhouse gas emissions as soon as possible. It also aims for "rapid reductions in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century." Provisions of the Paris Agreement also provide, "Each Party shall communicate a nationally determined contribution (NDC) every five years," and "All parties should strive to formulate and communicate long-term low greenhouse gas emission development strategies," taking note of the objective of the Agreement. Under such circumstances, Japan takes initiative in international society so that major emitters would strive to reduce emissions in accordance with their capabilities under a fair and effective international framework in which all major emitters participate, and aims to achieve the 80% reduction of greenhouse gas emissions by 2050 as a long-term target while pursuing the global warming countermeasures and the economic growth at the same time, based on the Paris Agreement. Such drastic emission reductions are difficult to realize with only conventional initiatives. Therefore, Japan committedly pursues overcoming the challenge through innovation, such as the development and diffusion of innovative technologies that enable fundamental emissions reductions. At the same time, Japan encourages domestic investment in this field, builds up international competitiveness and gathers knowledge and ideas from citizens to achieve drastic emissions reductions through long-term and strategic efforts, and contributes to the global emissions reductions.

3.2.1.3 Global efforts to reduce greenhouse gas emissions

The development of innovative technologies is the key to pursue the global warming countermeasures and the economic growth at the same time. Effective emissions reductions around the world are necessary to reduce global greenhouse gas emissions. Japan promotes developments and experiments based on the Innovation Plan for Environmental Technology (September 13, 2013, Council for Science and Technology Policy). At the same time, Japan is going to reinforce the research and development of innovative technologies in promising fields not limited to the course of conventional initiatives based on the National Energy and Environment Strategy for Technological Innovation towards 2050 (April 19, 2016, Council for Science, Technology and Innovation). In addition, Japan uses advanced Japanese technologies to make maximum contributions to reducing global greenhouse gas emissions.

3.2.2 Basic concept of the global warming countermeasures

3.2.2.1 Integrated improvement of the environment, economy, and society

Japan promotes global warming countermeasures that would also benefit the comprehensive improvement of environment, economy, and society, utilizing regional resources, technological innovation, and creative ideas, so that the global warming countermeasures would also boost the economy of Japan, create employment, and solve regional problems.

Specific actions include drastic measures in the intensive promotion of energy efficiency, maximum use of renewable energy, acceleration of the development and application of technologies, and reform of lifestyles and workstyles so as to realize economic growth and the high quality lives of citizens and to promote the reduction of greenhouse gas emissions while boosting regional economies.

3.2.2.2 Steady implementation of measures listed in Japan's NDC

The mid-term target in Japan's NDC was established on the basis of the sum of measures, policies, and technologies supported by thorough examination of the various issues of technological limitations and costs so that it would remain in alignment with the energy mix. Therefore, steady implementation of measures listed in Japan's NDC is important to achieving the midterm target. Japan therefore strives for the steady implementation of various policies and measures, such as voluntary approach, regulatory approach, economic approach, and information approach while effectively using their characteristics.

3.2.2.3 Response to the Paris Agreement

Japan communicates and updates its NDC in a five-year cycle, and implements the reporting and reviews related to the progress of implementation and achievement towards the target stipulated in the Paris Agreement. Japan also makes an active contribution to the development of international and detailed rules for the implementation of the Paris Agreement. Japan also responds to the reporting and reviewing of activities by other Parties under the Paris Agreement.

The Paris Agreement requires that all Parties should strive to formulate and communicate long-term low greenhouse gas emission development strategies. The decision at COP 21 also invites Parties to submit the strategies by 2020. Japan contributes to the achievement of the 2°C target, the global goal set in the Paris Agreement. Thus, Japan continues to explore long-term and strategic efforts of the research and development of innovative technologies mentioned in the National Energy and Environment Strategy for Technological Innovation towards 2050, as well as the application of the technologies and reform of social structures and lifestyles to achieve long-term drastic reductions in greenhouse gas emissions. Japan also additionally reinforces the efforts to produce innovations with developing countries based on “Actions for Cool Earth 2.0 (ACE 2.0)”.

3.2.2.4 Contribution to reducing the global greenhouse gas emissions through the reinforcement of research and development, and the diffusion of advanced low-carbon technologies

Development of innovative technologies is the key to purse global warming countermeasures and the economic growth at the same time.

Japan reinforces the research and development of innovative technologies in promising fields based on the National Energy and Environment Strategy for Technological Innovation towards 2050. Japan also promotes the diffusion of advanced low-carbon technologies and activities to mitigate global warming through the Joint Crediting Mechanism and other efforts.

3.2.2.5 Reform of the awareness of all actors, invoking actions, and reinforcement of cooperation

The problem of global warming is deeply related to socioeconomic activities, regional societies, and the lives of citizens. Thus, all actors including the national government, local governments, businesses, and citizens need to get involved with and cooperate in mitigation activities.

Therefore, Japan actively distributes and shares knowledge of exacerbating global warming, specific actions that require greater efforts to achieve the reduction target, and actions that individual citizens must take so that individuals can perceive and understand the necessary information. Japan then trains people who can distribute the necessary information and puts it into practice and implements public campaigns to change awareness at all levels by Japanese citizens to lead them to take action.

In addition, Japan encourages individual actors to actively become involved with policies and measures and reinforces cooperation among them by frequently distributing and sharing information concerning the progress of global warming countermeasures.

3.2.2.6 Importance of assessment and review processes (PDCA)

To constantly monitor and maintain the effectiveness of this plan after its establishment, Japan inspects the annual progress of individual measures implemented by the national government based on indexes to evaluate measures and revises the plan when necessary.

3.2.3 Information on policies and measures

3.2.3.1 Policies and Measures for Greenhouse Gas Emissions Reductions and Removals

(1) Policies and Measures for Greenhouse Gas Emissions Reductions

a) Energy-related CO_2

Japan works to realize an energy mix through thorough energy conservation, full use of renewable energy while suppressing the burdens on the people, improvement of the efficiency of thermal power generation, use of nuclear power generations whose safety is approved, and diversification of fuels in different categories by shifting to natural gas in the industry sector based on the policies in the Strategy for Energy Reform (April 18, 2016 decision of Ministry of Economy, Trade and Industry).

Japan strengthens public campaigns to facilitate all types and classes of people to work on mitigating global warming together, change their awareness, and encourage them to make wise choices by selecting low-carbon products, services, and initiatives so that the lifestyles of Japanese people will be appropriate as members of a low-carbon society.

The national government, local governments, business operators, and general public participate and cooperate in developing low-carbon cities and regions by building compact cities and reconstructing public transportation networks.

1) Policies and Measures by Sectors (Industrial, Residential & Commercial, Transport, etc.)

A. Initiatives in the Industrial Sector (Manufacturers, etc.)

(a) Promotion and Enhancement of Voluntary Action Plans of Industry

✓ **Steady Implementation of Industry's Action Plans towards a Low-carbon Society and Evaluation and Verification of Progress**

The Japan Business Federation and industries have voluntarily established Greenhouse Gas Emissions Reduction Plans (hereinafter referred to as "the Voluntary Action Plans" including plans up to FY 2012 set by individual industry types) and have been evaluated for making high achievements to reduce emissions. Based on the reduction initiatives conducted under the Voluntary Action Plans and the evaluation and verification of the initiatives in the process of initiatives under the Kyoto Protocol Target Achievement Plan, business operators are expected to continue voluntary initiatives as the central players in ensuring steady emissions reductions in the industries.

Voluntary methods like this have benefits from the perspective of improving the transparency, reliability, and the possibility of achieving targets, such as that they require a certain level of involvement of the government while allowing individual parties to select better measures using creativity and ideas, and they encourage parties to work toward higher targets. Thus, it is extremely important for the industry to keep working to reduce greenhouse gas emissions while taking advantage of these benefits. Therefore, each business operator in industrial community establish and implement the contents and objectives of Greenhouse Gases Emissions Reduction Plans as initiatives after FY2013 and review them when necessary based on regular evaluations and verifications by paying attention to the following viewpoints to respond to social demands while recognizing the benefits of respecting the dependency of the industries. (In the Industry, commercial, transport and energy conversion sectors, the Greenhouse Gas Emissions Reduction Plans refer to plans to reduce greenhouse gas emissions set by industry group as members of the Japan Business Federation and non-member industry group. Plans set by individual industry group are hereinafter called "the Industry's Action Plans towards a Low Carbon Society.")

(i) Industry groups which have not set the Industry's Action Plan towards a Low-carbon Society are expected to establish new plans nevertheless that they are participating in the Voluntary Action Plans under the Kyoto Protocol Target Achievement Plan. Industry groups not participating the Kyoto Protocol Target Achievement Plan should also consider establishing a new plan.

(ii) The Industry's Action Plans towards a Low Carbon Society provides CO_2 reduction targets with the perspective of reducing greenhouse gas emissions based on the full use of best available technologies (BATs) and active efforts to commit to energy conservation. Industry group explains to external stakeholders that targets are the highest level they can possibly achieve. The important point is to gather data that will enable the comparison of energy efficiency and CO_2 emissions between Japan and other countries so that they can evaluate the difficulty of achieving target level and the level of efforts required by industry group. Also, BAT and best practices, when presented in advance, enable to evaluate efforts done by each industry group, in addition to the progress toward achieving target level. Targets should be continuously re-evaluated by flexibly raising numerical targets when more BATs become available through technological advancement, for example.

* Indicators of target mainly include energy consumption intensity, energy consumption, CO_2 emission intensity, CO_2 emissions, and reduction from business as usual (BAU) that are selected on the basis of autonomous decisions by each industry group. Methods of setting targets need continuous exploration.

(iii) The Industry's Action Plans towards a Low Carbon Society is implemented on the basis of the PDCA cycle as practiced before to ensure effectiveness, transparency, and reliability. Plans targeting 2030 require a long-term commitment. Thus, assumptions need to be clarified, and various factors, such as social and industrial structures, as well as technological advancement, must be taken into account while ensuring transparency.

(iv) In addition to the emissions reduction targets (commitments) raised in (ii) above, business operators contribute to a reduction in CO_2 emissions by supplying low-carbon products and services while cooperating with relevant industry groups. Business operators also work on improving the awareness and knowledge of the public on the mitigation of global warming.

(v) Each industry group actively works on global warming countermeasures through the overseas development of low-carbon products and services, transfer of technologies and know-how to developing countries with the motivation to mitigate global warming based on international rules, and reinforcement of international cooperation by the private sector from the perspective of contributing to the worldwide effort to mitigate global warming. They must also present how they contribute to reductions with initiatives based on their business types.

(vi) Individual industry groups actively develop and commercialize innovative technologies from the mid-to-long-term perspective that might extend beyond 2030.

(vii) Individual business operators also conduct international comparisons based on reliable data and actively distribute the information to the outside in order to provide logical information to overseas markets and consumers in regards to transactions based on the Industry's Action Plan towards a Low Carbon Society.

Based on the above perspectives from (i) to (vii), the Government organizes relevant councils and committees to strictly and regularly assess and verify initiatives implemented on the basis of the Industry's Action Plan towards a Low Carbon Society established by individual industry groups and the Industry's Action Plan towards a Low Carbon Society for 2030.

✓ **Initiatives in the Commercial, Residential, Transport Categories in the Industry**

The industry contributes to a reduction in CO_2 emissions in the commercial, residential and the transport sector through weight saving and functional improvement of materials, development and supply of energy efficient low-carbon products, improvement of the efficiency of logistic systems through modal shifts, promotion of the use of next-generation automobiles and public transportation, and participation in public campaigns to mitigate global warming.

(b) Promotion of Introduction of Highly Energy-efficient Equipment and Devices

✓ **Thorough Energy Management at Factories and Buildings**

Japan promotes thorough energy management and the introduction of energy efficient equipment and devices based on the Act on the Rational Use of Energy (1979, Act No. 49).

Specifically, business operators are classified into four classes(S, A, B and C) and evaluated by periodic reports submitted based on the Act on the Rational Use of Energy. Stagnating business operators are intensively investigated, and the names of operators with excellent performances are publicized by business types and praised. Through these measures, Japan intensively promotes energy efficiency using various initiatives under the Act on the Rational Use of Energy.

In addition, Benchmark system that sets energy efficiency targets at the level that 10% to 20% of business operators among the same business types can achieve is extended from the manufacturing industry to the retail and service industries. The goal is to expand to include 70% of the energy consumed by all industries by fiscal year 2018.

✓ **Promotion of Introduction of Highly Energy-efficient Equipment and Devices (cross-industrial)**

The industry sector promotes the introduction of energy efficient equipment and devices for main energy-consuming devices used in a variety of business types, such as air conditioners, lighting devices, industrial furnaces, boilers, and cogeneration systems.

✓ **Promotion of Introduction of Highly Energy-efficient Equipment and Devices (manufacturing sector)**

(Iron and steel industry)

As introduction of cutting-edge technologies, the iron and steel industry promotes the spread of high-efficient power demand facilities, waste heat recovery systems, and power generation systems and expand the use of waste plastics to alternate coal to be charged into coke oven.

The industry also develops highly-efficient and low-carbon innovative production process technologies and promotes energy conservation and reduction of CO_2 emissions with practical use of such technologies by around 2030.

(Chemical industry)

The chemical industry, in accordance with the characteristics of each process, promotes to reduce CO_2 emissions by spreading best practice technologies (BPT) listed by the International Energy Agency (IEA) as commercially utilized advanced technologies, recovering emitted energies, and rationalization of process. The industry also contributes to reducing CO_2 emissions by promoting the development and introduction of new innovative energy-saving technologies.

(Ceramic, stone and clay manufacturing industry)

The industry introduces highly energy-efficient equipment and promotes to use waste as alternate of thermal energy to improve the energy efficiency in cement production process. The industries also aim to improve the energy efficiency of cement and glass production processes while maintaining the equivalent quality as existing products by practical use and introduction of advanced processing.

(Pulp, paper, and paper products industry)

The installation of pulpers that allow more efficient pulping of recovered paper than existing ones in deinked pulp manufacturing process will be supported in order to reduce the consumption.

Also, at the renewal timing of recovery boilers used to generate steam by incinerating concentrated black liquor (pulp waste liquor), the installation of the ones with more elevated features in temperature, pressure and energy efficiency will be supported.

- ✓ **Promotion of Introduction of Highly Energy-efficient Equipment and Devices (construction and fields that use special motor vehicles)**

The industry certifies fuel-efficient construction machinery so that the operators could choose easily excellent fuel-performance machinery. Carbon dioxide emissions are also reduced in construction work and fields that use special motor vehicles to support the introduction of certified machinery.

- ✓ **Promotion of Introduction of Highly Energy-efficient Equipment and Devices (Greenhouse horticulture, agricultural machinery, and fishery sector)**

Development and the diffusion of efficient and low-cost energy consumption technologies (e.g. heat pumps, heating systems using woody biomass) are promoted as a measure to reduce greenhouse gas emissions in greenhouse horticulture. Energy efficiency improvements are also promoted through the reduction of CO_2 emissions from agricultural machinery and energy conservation measures in fishing vessels with LED fishing lights and energy efficient outboard engines.

(c) Implementation of thorough Energy Management

- ✓ **Implementation of thorough Energy Management using FEMS**

The industry sector is already conducting a certain level of energy management due to the mandatory energy management required by the Act on the Rational Use of Energy. More energy efficiency and CO_2 emissions reductions are realized through additional energy efficiency actions based on objective data by making energy consumption visible by promoting the introduction of Factory Energy Management System (FEMS) with Internet of Things (IoT).

- ✓ **Promotion of Emissions Reduction Measures among Small and Medium-sized Business Operators**

To reinforce energy efficiency and emission reductions measures among small and medium-sized business operators, public relations to raise awareness of energy saving, boosting the potential capacity of energy efficiency and CO_2 reductions through energy efficiency diagnoses, and CO_2 emission reduction potential diagnoses, the implementation of detailed lectures to energy managers of companies, the horizontal spreading of best practices to promote energy efficiency. In addition, focusing on the improvement of energy consumption per unit, support is provided for small and medium-sized business operators to introduce emission reductive equipment.

Regional organizations, financial institutions, chambers of commerce, and local governments construct platforms together to provide detailed regional supports for small and medium-sized business operators to take energy efficiency actions. With the platforms, they provide a wide range of supports for finding small and medium-sized business operators trying to take energy efficiency actions and providing follow-ups to assist operational improvement and capital investment. Japanese Government constructs platforms so that offices to support energy efficiency actions will be available throughout Japan by fiscal year 2017.

(d) Promotion of Energy Efficiency Actions through Alliance between Industry Groups

Additional energy efficiency becomes possible when factory owners and building owners cooperate with each other in energy trading. Therefore energy efficiency actions conducted through the cooperation of multiple business operators are supported.

In addition, the evaluation system based on the Act on the Rational Use of Energy are constructed to encourage factory owners and building owners to cooperate in accommodating and using the waste heat which can’t be used and is released by factories.

B. Initiatives in the Commercial and Other Sector

(a) Promotion and Enhancement of Voluntary Action Plans of Industry (Reprinted p112)

✓ **Steady Implementation of Industry’s Action Plans towards a Low-carbon Society and Evaluation and Verification of Progress (Reprinted p112)**

(b) Improvement of the Energy Efficiency of Buildings

✓ **Promotion of Mandatory Compliance with Energy Conservation Standards Targeting New Construction**

The Act on the Improvement of Energy Consumption Performance of Buildings (2015, Act No. 53, hereinafter referred to as "the Building Energy Efficiency Act") stipulates mandatory compliance with energy efficiency standards for large construction projects. Japan aims to smoothly start the mandatory compliance as provided in the Act. In addition, the compliance with energy efficiency standards will gradually become requirements for new construction projects by 2020 while taking into account of the necessity of the regulations, their scopes, and balances of regulations. The environment will be prepared for the smooth start of the requirements. Specifically, support is provided for the diffusion of energy conservation measures and the development of new technologies, services, and construction methods that will improve the energy efficiency of buildings, construction materials, and machinery. Support is also provided to encourage voluntary investment in energy conservation by the private sector.

✓ **Improvement of Energy Efficiency of Existing Buildings (Renovation)**

Mandatory compliance with energy efficiency standards will gradually become applicable to newly constructed buildings. On the other hand, mandatory compliance with energy conservation standards is difficult for existing buildings. Thus, the important thing is to accelerate renovation to improve energy efficiency. Specifically, through enhancement and diffusion of energy conservative performance and environmental efficiency for verifying and labeling systems are used to promote the renovation of existing buildings for better energy efficiency and lower carbon footprints so that energy efficiency will be an additional asset value of buildings and reflected in the rents and so on.

✓ **Promotion of Net-Zero-Energy Building (ZEB)**

ZEB guidelines are prepared for major commercial building types such as hospitals and schools to realize and diffuse ZEBs. The goal of the diffusion of ZEBs is to demonstrate ZEBs among newly-constructed public buildings by 2020 and to realize ZEBs as the average of new constructions by 2030.

✓ **Promotion of Diffusion of Certified Low-carbon Building**

Certified low-carbon construction projects (construction projects that consume more than 10% less than the energy efficiency standards) under the Low Carbon City Act (2012, Act No. 84) will be increased. Associated standards are revised based on the progress of implemented measures.

✓ **Promotion of Enhancement and Diffusion of Verifying and Labeling System for Energy**

Conservation and Environmental Performance

Energy efficiency labeling system based on the Building Energy Efficiency Act, dwelling performance labeling system and CASBEE and other systems that evaluate comprehensive environmental performance will be improved and promoted.

(c) Promotion of Introduction of Highly Energy-efficient Equipment and Devices

✓ **Thorough Energy Management at Factories and Buildings (Reprinted p114)**

✓ **Diffusion of Advanced Highly Energy-efficient Equipment and Devices**

Development of energy conservation technologies will be accelerated to further improve the efficiency of individual devices and systems. The diffusion of high efficiency, energy conservative devices is also promoted.

The goal is to increase the use of high-efficiency lighting devices, such as LED lamps, to 100% in the flow by 2020 and 100% in the stock by 2030. To achieve these goals, the diffusion of high-efficiency lighting devices will be promoted by expanding the top-runner standards of lighting devices and by applying the top runner program to incandescent lamps in FY 2016.

The introduction of energy efficient industrial water heaters, such as heat-pump water heaters and latent heat recovery type water heaters, will be supported. The energy efficiency will also be improved for refrigeration air conditioners by improving coolant management technologies. Necessary information will be distributed through Leading Low-carbon Technology (L2-Tech) and other systems.

✓ **Improvement of Energy Efficiency of Equipment and Devices through Top Runner Programs**

The top runner program was established in FY 1998 under the Act on the Rational Use of Energy. Target equipment and devices have gradually increased since then. The number of energy consuming devices targeted in this system was 28 items in FY 2015. Additional devices for this system will continue to be explored. At the same time, standards of targeted devices which reached to the targeted years will be revised to improve their energy efficiency.

(d) Implementation of thorough Energy Management

✓ **Thorough Energy Management through the Use of BEMS and Consultation on Energy Conservation**

Building Energy Management System (BEMS) is designed to display energy consumption status and support optimum operations of equipment and devices, such as lighting devices and air conditioners to support energy efficiency and CO_2 emissions reductions in an entire building. BEMS will be introduced to about half of the buildings by 2030. In addition, energy consumption data obtained through BEMS will be used to enable more efficient and effective energy management in buildings.

In addition, the implementation of diagnoses on potential capacity of GHG emissions reduction and the introduction of devices utilized the results of the diagnoses will be promoted. Actions conducted beyond the boundaries of individual stakeholders, such as building owners, tenants, and energy suppliers, will be promoted. Furthermore, with the promotion of “Eco-tuning” which conducts the appropriate operational improvement of the equipment, devices, and systems, greenhouse gas emissions will be reduced with ensuring the comfort and productivity of buildings.

The introduction of energy efficiency equipment and devices, and downsizing, or the optimization of equipment and devices, will be promoted using businesses (ESCO) that provide comprehensive energy efficiency services and warrant energy efficiency effects based on the results of visualizing energy consumption and energy efficiency diagnoses.

The efficient use of lighting will also be promoted by setting proper lighting intensity based on indoor conditions.

✓ **Promotion of Emissions Reduction Policies among Small and Medium-sized Business Operators (Reprinted p115)**

(e) Expansion of Holistic and Efficient Use of Energy

✓ **Expansion of Holistic and Efficient Use of Energy**

Large energy conservation and CO_2 emissions reductions effects are expected when multiple facilities and buildings share energies, such as electricity and heat, and use unused energies. Such practices are also desirable from the viewpoint of disaster management and the promotion of regional development. Thus, opportunities for urban development will be seized to promote holistic and efficient use of energy at district levels to realize area-wide energy conservation and CO_2 emissions reductions while simultaneously using renewable energy.

A variety of stakeholders, such as the national government, local governments, energy suppliers, and regional developers, must work together to provide support for the use of urban development systems, conduct simulations to find areas where holistic and efficient use of energy will be effective, compute the expected energy conservation and CO_2 emissions reductions effects, and install and use of facilities and systems that contribute to the efficient use of energy.

(f) Other Policies and Measures

✓ **Development of Low-carbon Cities through the Improvement of Thermal Environment by Preventing Heat Island Effects**

Japan promotes comprehensive carbon reduction in cities through the improvement of the thermal environment by implementing measures associated with heat island effects, such as the reduction of anthropogenic heat, improvement of urban surfaces, improvement of urban structure, improvement of lifestyles, and implementation of proper measures to reduce the effects on human health using knowledge obtained through the observation, investigation, and study of heat island effects mainly in urban areas. Specific initiatives include the promotion of the improvement of energy efficiency by energy consuming devices, promotion of the diffusion of low-carbon buildings, promotion of the development and diffusion of next-generation automobile technologies, promotion of traffic flow measures, and the promotion of the use of unutilized energy to reduce the emissions of anthropogenic heat from human activities, such as from air conditioning systems and automobiles in order to reduce overall CO_2 emissions in cities. The ground coverages are also improved in entire areas by securing green spaces through the park maintenance greening of public spaces and government facilities, greening of building lots using green region systems, and the conservation of privately owned green spaces and farmlands to counteract the reduced evapotranspiration caused by expanding artificial ground coverages and to prevent heating of the ground surface. Urban conditions are also improved by promoting the development of water and green networks and development of nature-oriented river works from the perspective of securing the flow of wind from green spaces and water surfaces. In addition, citizens are encouraged to improve their lifestyles with the public campaign to mitigate global warming named “COOL CHOICE” including Cool Biz and Warm Biz while using proper temperature setups for cooling and heating. Local governments and business operators are also encouraged to implement proper measures depending on characteristics of their regions, districts, and business practices.

✓ **Introduction of Renewable Energy and Energy-saving in Water Supply and Sewage System**

Energy conservation facilities such as energy-saving and high-efficiency devices and inverter control of pumps will be introduced to water supply systems. Renewable power generation systems such as small-scale hydropower generators and solar power generators will also be introduced.

Energy saving is promoted in sewage systems by the improvement of facility operations and introduction of high-efficiency devices in aeration systems of reaction tanks and sludge dehydrators. Promotion of substitution of fossil fuel to solid fuels made from sewage sludge. Power generation using biogas from sewage sludge, and effective use of heat exchanged from sewage and treated sewage water are also conducted.

✓ **Initiatives in Waste Management**

The 3Rs initiatives that contribute to a reduction in greenhouse gas emissions are promoted. In addition, more energy is recovered from waste disposal facilities, such as generating power using waste. Energy conservation measures are implemented at waste disposal facilities and recycling facilities. Greenhouse gases emitted from refuse collecting truck are also reduced.

✓ **Schematic Promotion of Joint Measures Implemented by Multiple Government Ministries and Agencies**

Cooperation among relevant government agencies is established based on plans to effectively and efficiently implement initiatives in all fields in order to ensure that reduction targets for FY 2030 in the Commercial and other sector will be achieved. They are going to cooperate in thorough energy conservation, use of renewable energy, and low-carbonizing of buildings.

(g) Development of Public Campaigns (Discussed later p142)

✓ **Promotion of Public Campaigns (Discussed later p142)**

(h) Initiatives by Public Organizations (Discussed later p140)

C. Initiatives in the Residential Sector

(a) Development of Public Campaigns (Discussed later p142)

✓ **Promotion of Public Campaigns (Discussed later p142)**

(b) Improvement of Energy Efficiency of Housing

✓ **Promotion of Compliance with Energy Conservation Standards Targeting New Housing**

The obligation to conform to the energy consumption performance standards will gradually start targeting newly constructed housing by 2020 while sufficiently taking into account the necessity of the regulations, their scopes, and balances. The environment will be established for smooth implementation of the regulations while paying sufficient attention to the improvement of construction technologies of small to medium-sized contractors and carpenters and the position of traditional wooden housing. Specifically, support is provided to accelerate energy conservation measures and the development of new technologies, services, and construction methods that will contribute to energy conservation in housing, construction materials, and devices.

✓ **Promotion of Renovation of Thermal Insulation for Existing Housing**

The obligation to conform the energy consumption standards will gradually promote with newly constructed housing. Meanwhile, the promotion of energy conservation renovation becomes important for existing housing. Specifically, subsidies are provided for installing high-performance insulation materials and windows to improve the thermal insulation of existing housing. Housing renovated to improve energy efficiency can also receive tax cut. In addition, energy efficiency performance and environmental performance evaluation and labeling system will be improved and promulgated so that energy efficiency will become reflected in the asset value of housing. Improvement of energy efficiency and CO_2 emissions reductions in housing will be promoted through these measures. The number of energy conservation reforms of existing housing will be doubled by 2020 with these measures.

In addition, more information will be provided for residents in regards to the benefits of installing energy efficient devices, facilities, and construction materials depending on the conditions of energy consumption.

✓ **Support of Energy Conservation and Low-CO_2 Models Housing**

Support is provided for housing that act as energy conservation and low-CO_2 models such as Zero Energy Houses (ZEH), Life Cycle Carbon Minus housing (LCCM), and certified low-carbon housing to promote the construction of housing with higher performances. The goal of this measure is to turn more than half of newly-constructed custom-built detached houses constructed by housing manufacturers into ZEHs by 2020.

✓ **Promotion of the Diffusion of Certified Low-carbon Housing**

Tax breaks are provided for newly constructing or purchasing certified low-carbon housing. Technical support is also provided for small and medium-sized contractors. The goal is to diffuse their effects to other housing and increase the number of certified low-carbon housing including existing housing.

✓ **Promotion of Enhancement, and Diffusion of Evaluation and Labeling System for Energy Efficiency and Environmental Performances**

Energy efficiency labeling system and housing performance labeling system based on the Building Energy Efficiency Act, and CASBEE and other systems that evaluate comprehensive environmental performance, including the perspectives of Non-Energy Benefit (NEB) will be improved and promoted for more uses.

(c) Promotion of Introduction of Highly Energy-efficient Equipment and Devices

✓ **Diffusion of Highly Energy-efficient Equipment and Devices**

The development of energy conservation technologies will be further accelerated for more improvement of the efficiency of individual devices and systems. The use of high efficiency, energy conservative devices is also promoted.

The goal is to increase the use of high-efficiency lighting devices, such as LED lamps to 100% in the flow by 2020 and 100% in the stock by 2030. To achieve these goals, the diffusion of high-efficiency lighting devices will be promoted by expanding the top-runner standards of lighting devices such as applying top runner program to the incandescent lamps in fiscal year 2016. The introduction of energy efficient water heating systems, such as heat-pump type water heaters and latent heat recovery type water heaters, are also promoted.

Household fuel cells (Ene-Farm) are a decentralized energy system that produces hydrogen from city gas and LP gas and generates electricity through the chemical reaction between the hydrogen and the oxygen in the air. It also effectively uses the heat released from the electricity generation process to achieve up to more than 90% of total energy efficiency. The public-private joint initiative to support the market by lowering the price of the system in order to introduce 1.40 million units in 2020 and

5.30 million units in 2030.

They also distribute necessary information through Leading Low-carbon Technology (L2-Tech) and other systems.

✓ **Improvement of Energy Efficiency of Equipment and Devices through Top Runner Programs (Reprinted p117)**

(d) Implementation of thorough Energy Management

✓ **Implementation of thorough Energy Management Using HEMS and Smart Meters**

The Home Energy Management System (HEMS) is designed to display energy consumption to encourage users to engage in the optimal use of air conditioners, lighting and other energy-consuming equipment/appliances to promote energy conservation and CO_2 emissions reductions by an entire house. Japan aims for the installation of the HEMS in almost all households by 2030. Japan also accelerates the installation of smart meters that measure household energy consumption in detail and make energy consumption visible when connected to the HEMS. More efficient energy management is promoted in households by effectively using the energy consumption data of the HEMS.

(e) Other Policies and Measures

✓ **Schematic Promotion of Joint Measures Implemented by Multiple Government Ministries and Agencies**

Cooperation among relevant government agencies is established based on plans to effectively and efficiently implement initiatives in all fields in order to ensure that the reduction targets for FY 2030 in the residential sector will be achieved through thorough energy conservation, use of renewable energy, and low-carbonizing of housing.

D. Initiatives in the Transport Sector

(a) Promotion and Enhancement of Voluntary Action Plans of Industry (Reprinted p112)

✓ **Steady Implementation of Industry's Action Plans towards a Low-carbon Society and Evaluation and Verification of Progress (Reprinted p112)**

(b) Measures concerning Vehicles

✓ **Diffusion of Next-generation Vehicles and Improvement of Fuel Efficiency**

Japan promotes the diffusion of energy efficient next-generation vehicles (e.g. hybrid vehicles (HV), electric vehicles (EV), plug-in hybrid vehicles (PHV), fuel cell vehicles (FCV), clean diesel vehicles (CDV), and compressed natural gas vehicles (CNGV)). Support through subsidies and tax cut is provided for vehicles that are new to the market and have challenges such as high cost. It aims to increase the share of these vehicles in the new car sales from 50% to 70% by 2030 by promoting measures to create initial demand, support research and development to improve performance and build efficient infrastructure. Special considerations are made for trucks and buses for which the market size is smaller than passenger vehicles, and the diffusion of development and mass-use is slower.

The problem of the short cruising range of electric vehicles and plug-in hybrid vehicles is the key to improve user satisfaction and increase the use of these vehicles. Therefore, research and development will be conducted aiming to double the energy density, the performance indicator directly linked to the cruising range, by the early 2020s. Charging facilities will also be constructed to compensate for battery performance.

Support is provided systematically to put in place the hydrogen stations, the necessary facility for the diffusion of fuel-cell vehicles. Research and development of technologies are conducted to lower the cost of hydrogen stations. In addition, the necessity of revising relevant regulations is examined while taking into account the improvement of the safety and reliability of relevant technologies.

The top runner program is used to encourage automobile manufacturers to strategically accelerate technological innovations to improve fuel efficiency. The fuel efficiency will be further improved while revising preferential tax treatment whenever necessary. Technological developments are conducted for the commercial application of cellulose nano-fibers and other advanced materials that can improve fuel efficiency by reducing the weight of automobile materials.

✓ **Promotion of Development of Biofuel Supply System**

The biofuel supply system will continuously be constructed with a presumption that they ensure enough greenhouse gas emissions reduction effects, stable supply, and economic feasibility by providing support for using biofuel and constructing supply infrastructures.

(c) Measures to Traffic Flow Improvements

Efforts to ensure the smart use of roads are implemented when constructing roads with the recognition of the possibility of causing so-called induced and diverted traffic congestion. Such efforts include the enhancement of ring roads and other arterial road networks, which also ultimately help reduce CO_2 emissions and pinpoint measures to reduce traffic bottlenecks based on scientific data such as the big-data gathered with ETC2.0. The road environment is also improved to encourage the use of bicycles.

Road traffic improvements include the promotion of Intelligent Transport Systems (ITS), including the promotion of centrally controlled signals, the improvement of traffic lights, the development of traffic safety facilities using LED traffic lights, the promotion of automated driving, and the improvement of traffic flows to reduce CO_2 emissions.

Necessary systems will be developed to allow automated driving on highways in 2020.

(d) Development of Public Campaigns (Discussed later p142)

✓ **Promotion of Public Campaigns (Discussed later p142)**

(e) Greening of Vehicle Transport Operators by Promoting the Environmentally-friendly Usage of Vehicles

Vehicle transport operators are encouraged to use the Eco-drive Management System (EMS) to promote eco-driving of commercial vehicles, such as trucks, buses, and taxis. Four relevant government ministries and agencies take the initiative in promoting the use of EMS through Eco-drive Promotion Liaison Council.

They also promote the use of the Green Management Certification System that certifies vehicle transport operators committed to excellent environmental practices such as the improvement of fuel efficiency.

(f) Promotion of Public Transport Utilization and Bicycles

Transportation services and convenience will continuously be improved through the development of public transportation, such as new railways, light-rail transit (LRT), bus rapid transit (BRT), enhancement of connections (modal connect) among modes of transportation through joint development by the government and the private sector, use of existing public transportations, acceleration of digitalization using integrated circuit (IC) cards for transportation, improvement of transits, and the use of park and ride services. Seamless public transportation networks are also constructed at the same time.

The environment for using bicycles is also developed by building a network of bicycle lanes, constructing bicycle parking lots, and increasing the use of community bicycles while coordinating the necessary safety measures.

Business operators also engage in relevant voluntary initiatives through commuter transport management and publicity to raise the awareness of citizens to guide people to shift from traveling in private cars to public transportation, such as trains and buses, or the use of bicycles. The Government workers also actively use public transportation and bicycles for official work.

The excessive dependency on private cars is also reduced to build environmentally sustainable transport (EST).

(g) Measures of Utilization of Railway, Vessel, and Aviation

✓ **Energy Efficiency Improvement in Railways**

The introduction of energy efficient railway cars, such as lightweight cars and cars with VVVF devices, has recently started in the railway sector and will be further accelerated. The energy efficiency of railways will be further improved through the promotion of the eco rail line project that supports the introduction of advanced energy conservative devices.

✓ **Energy Efficiency Improvement in Vessels**

The vessel sector has promoted the use of vessels that reduce energy consumption by experimenting with innovative energy conservation technologies. It will continue to further diffuse energy-saving vessels.

✓ **Low Carbonization in Aviation**

The aircraft sector has introduced energy efficient aircraft materials and advanced air traffic control systems, and promoted carbon reduction in airport facilities. The industry will continue to promote these policies, increase the use of alternative jet fuels, and improve the efficiency of airfreight transportation.

(h) Promotion of Low-Carbonized Logistics Systems

✓ **Promotion to Improve Truck Transport Efficiency and Cooperative Transport and Delivery**

Efforts to promote activities against global warming and to push forward the greening of the entire logistics system by improved transportation efficiency and load efficiency shall be achieved through promotion of shared transportation and delivery of clients who order deliveries and logistics service providers who carry the goods of such clients.

Thus, the clients and distributors continue to cooperate with each other in energy management under the Act on the Rational Use of Energy. In addition, the Green Logistics Partnership Conference recognizes and awards the activities with outstanding outcomes, such as (1) the reduction of environmental load from logistics, such as modal shift achieved through the joint efforts of shippers and logistics providers, as well as improvement of truck transportation efficiencies; and (2) the establishment of sustainable logistics systems, including the improvement of logistics productivity. The awards motivate business operators to voluntarily engage in environmentally friendly operations and to expand green logistics. An integrated method or guideline is elaborated for the calculation of CO_2 emissions from distribution so that both the clients and distributors can use it to streamline cooperation among them. A system to objectively evaluate effects of individual efforts is also established.

In addition, the number of home deliveries has been steadily increasing in recent years due to the rapid expansion of e-commerce (EC). Yet, about 20% of deliveries are ending up being redelivered. The increasing number of redeliveries is expected to result in increased CO_2 emissions as well as shortage of truck drivers. Therefore, measures are being implemented to reduce the number of redeliveries by diversifying ways to receive packages, such as picking them up at train stations and convenience stores through the development of delivery boxes and other tools.

The transportation efficiency is also improved through the ease the regulations to increase the length of full trailers for transportation on arterial roads, improvement of accessibility by building direct connections between highways and private facilities, simplification of permission for driving special vehicles using ETC2.0, and support for operational management.

In addition, based on Act on Advancement of Integration and Streamlining of Distribution Business (2005, Act No. 85), measures are implemented to streamline transportation systems through the construction of truck stations adjacent to logistics facilities where cargos are stored, sorted, and processed for distribution, as well as the implementation of measures to rationalize transport through the introduction of truck reservation systems. The delivery networks are thereby integrated and rationalized. At the same time, the carbon emission reduction in logistics is accelerated by providing support for business operators engaging in truck transportation without standby time, and the promotion of shared transportation and delivery.

✓ **General Measures for the Greening of Marine Transport and Promotion of Modal Shift to Rail Freight Transport**

Stakeholders are encouraged to shift from truck transportation to coastal shipping and/or railway transportation that will emit lower amounts of CO_2 for the greening of the entire logistics system.

Domestic terminals that accommodate combined and integrated transportation will be constructed to increase the competitiveness of coastal shipping that is to take over some of the load from vehicle transportation. Transportation costs are thereby reduced while improving the quality of service. The use of energy efficient coastal vessels is also increased and expanded. The modal shift to coastal shipping is also accelerated through the introduction of truck with separable trailers and the “Eco-Ship Mark”, as well as the improvement of the efficiency of transport using refrigerated containers.

The competitiveness of rail freight transport also needs to be improved. Thus, the modal shift to rail freight transport is accelerated through the following measures: the increased volume of rail freight transport, the use of innovative time schedules; the improvement of transport equipment, such as refrigerated containers with advanced features to keep contents fresh because they are effective when switching from trucks; the reduction of the cost of user-end transport; and the promotion of the use of “Eco-Rail Mark”.

In addition, modal shift will be promoted through its support based on Act on Advancement of Integration and Streamlining of Distribution Business.

The efficiency of truck transport will be further promoted. This initiative includes the shift from private trucks to commercial trucks and the use of larger trucks, and trailers. Other initiatives include the promotion of load efficiency through carrying loads on return trips.

✓ **Improvement of Energy Conservation at Facilities of Distribution Bases**

Distribution warehouses are functioning as the core facility of distribution. The carbon footprints of distribution bases are reduced by supporting efforts to integrate the energy conservation of distribution facilities, such as the use of solar energy generation systems and energy conservative lighting devices with the improvement in the efficiency of distribution operations.

✓ **Initiatives at Harbors**

Harbors are crowded with freight ships and passenger ships and function as the base of industrial activities where marine and land distribution systems intersect each other. Since ports and harbors emit large amounts of greenhouse gases, the emissions can be effectively reduced. The emissions reduction efforts are conducted from the perspective of maintaining necessary functions in case of emergencies, such as large-scale natural disasters, and remaining resilient during the tight supply of electricity.

Specific initiatives include the construction of international marine container terminals, international distribution terminals, and domestic distribution bases that can accommodate combined and integrated transport systems. These facilities enable marine transport to the nearest ports and shorten the driving distance of truck transport.

Other efforts include supporting the introduction of energy efficient equipment, promotion of modal shifts and improved transportation efficiency using marine transport for reverse logistics systems, examination of the development of onshore power supply systems for vessels in ports, facilitation of renewable energy introduction and its use, development of green areas in harbors and seaweed beds to absorb CO_2, and examination of technological development to reduce CO_2 emissions in harbors.

(i) Other Policies and Measures

✓ **Schematic Promotion of Joint Measures Implemented by Multiple Government Ministries and Agencies**

Cooperation among relevant government ministries and agencies is established on the basis of plans to effectively and efficiently implement initiatives in all fields in order to ensure the reduction targets for 2030 in the transportation sector, including carbon reduction in individual modes of transportation and the promotion of modal shifts.

The initiatives also include special regulatory measures implemented through the Special Zone System for Structural Reform.

E. Initiatives in the Energy Conversion Sector

(a) Promotion and Enhancement of Voluntary Action Plans of Industry (Reprinted p112)

✓ **Steady Implementation of the Industry's Action Plans towards a Low-carbon Society and Evaluation and Verification of Progress (Reprinted p112)**

(b) Maximum Introduction of Renewable Energy

[Renewable Energy Generation]

Renewable energy does not emit greenhouse gases when generating electricity. Thus, promoting further introduction of renewable energy is vital for conducting measures in the energy conversion sector. In addition, renewable energy is promising, diversified, and important because low-carbon domestic energy sources in Japan contribute to energy security. Therefore, the renewable energy will be expanded their introduction to the maximum extent in accordance with their characteristics while reducing the burden on the people by properly responding to issues such as stable supply, cost, and environmental aspects.

✓ **Appropriate Operation and Revision of the Feed-in Tariff Scheme**

The feed-in tariff scheme implemented under the Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electricity Utilities (2011, Act No. 108) is accelerating the renewable energy. The proper operation of the system will be continued. The system is also revised when necessary in order to expand to the maximum of renewable energy in a good balance while reducing the burdens on people, as well as based on a mid-to-long-term perspective of maintaining autonomous energy sources.

✓ **Development of the Business Environment for the Expansion of Introduction and Long-term and Stable Power Generation**

The business environment is established to gain the understanding of people toward renewable energy and to realize the long-term and stable use of renewable energy. The development includes the establishment of systems and rules for system operations, the efficiency improvement and cost reduction of power generation facilities, and rationalization of relevant regulations as necessary.

The following initiatives are going to be implemented taking into consideration the characteristic of fuel type.

-Solar energy generation

The solar energy generation enables mid-to-small scale power generation near consumers. It is expected to reduce the loads on systems and function as emergency power supplies. Still, it faces challenges such as high cost of power generation and problems in stable supply as it is associated with unstable output.

When the cost of solar energy is lowered from a mid-to-long term perspective, it can fill the gap for peak demand of the afternoon using decentralized energy system and contribute to the realization of a consumer participatory energy management. Technological developments and other efforts are conducted to achieve these visions by improving the efficiency and lowering the cost of power generation facilities and advancing the system operations.

-Wind energy generation

The economic feasibility may become achievable if large-scale wind energy generation systems can be developed. The technological development is thus conducted to improve the efficiency and to lower the cost of wind energy generation facilities. The speed of environmental impact assessments is increased so that wind energy generation facilities can be more quickly and smoothly installed and used while maintaining a good balance with the environment and local communities. The Government and local governments work together to select areas for installing wind energy facilities so as to reduce the uncertainties of the project while ensuring environmental conservation.

In addition, sufficient system regulation capacity is not necessarily available in appropriate land for wind energy generation such as Hokkaido and northern Tohoku. Technological developments are conducted to develop systems, such as inter-district power system, and to sophisticate system operations.

From the mid-to-long-term perspective, the expansion of offshore floating offshore wind energy generation systems is essential because Japan has limited availability of land-based installation of wind energy systems. Therefore, the installation of bottom-mounted wind energy is accelerated in harbors areas. In addition, trial research will be conducted to realize the world's first full-scale business operation of floating offshore wind energy.

-Geothermal power generation

Japan has the third largest geothermal heat resources in the world. Geothermal power is an energy source that can become the baseload power supply for realizing low-cost and stable power generation. On the other hand, geothermal power development requires time and cost. Measures will be implemented to more quickly and smoothly introduce geothermal power facilities by reducing investment risks, promoting understanding of people in the local level, streamlining the procedure of environmental impact assessment, and rationalize regulations and institutions as necessary. Sustainable development that coexists with regional features is thereby conducted while protecting the natural environment and local communities.

-Hydropower generation

Hydropower is an energy source that offers excellent stability as a power supply, except when drought occurs. Hydropower generation facilities will be installed in dams where no hydropower generation is conducted. Existing hydropower generation facilities in dams will also be replaced with new ones. Meanwhile, medium to small-scale hydropower generation is often installed in undeveloped locations. These facilities are going to be utilized as the energy source to become the foundation of regionally distributed energy supply-demand structure while facing challenges in the business environment, such as the use of high-cost structures.

-Biomass energy generation

Biomass energy is an energy source that can deliver stable power supply and support the regional economy. However, it uses various materials such as wood and waste in various forms and such variation causes challenges such as high cost. Thus, conflicts with existing business need to be arranged, and the stable supply of raw materials needs to be secured. Based on these measures including measures in the forestry industry such as pursuing an advantage of expansion of industry size and the use of mixed combustion in existing thermal power generation plants, the long-term and steady expansion of the introduction of biomass energy generation can be achieved.

Individually, measures such as support to ensure a stable and efficient supply of unused materials and the recovery of energy from waste heat such as the methane fermentation of waste biomass and/or combustion heat will be implemented.

[Renewable Heat Energy]

Renewable heat energy sources that are specific to particular regions, such as solar heat, biomass heat, geo-heat, hot springs heat, river heat, sewage heat and ice melt heat. It is important to increase the use of renewable heat energy; biomass heat from sewage, sludge, waste, unused materials; biofuels that can replace some oil products used as fuel in the transport sector; and waste heat generated in the process of waste disposal depending on economic efficiencies and regional characteristics. Support will be provided for the introduction of renewable heat energy supply systems. The use of renewable heat energy is also going to be expanded by testing and creating models for the effective use of various thermal energies in different regions.

- ✓ **Initiatives in Water Supply and Sewage System (Reprinted p118)**
- ✓ **Initiatives in Waste Management (Reprinted p119)**

[Full Use of Electricity and Heat from Regional Renewable Energy Source and Unused Heat]

- ✓ **Expansion of Holistic and Efficient Use of Energy (Reprinted p118)**

(c) Reduction of CO_2 emission intensity in the Power Sectors

[Persuasion of High Efficiency of Thermal Power Generation]

✓ **Initiatives of the Power Sectors to Low-carbonization**

The voluntary framework of the power sectors in which major business operators participate and the Industry's Action Plan toward a Low-carbon Society was announced in July 2015. (The Action Plan toward a Low-carbon Society aims to achieve about 0.37 kg-CO_2/kWh as the emission factor that matches the national energy mix and the CO_2 reduction target.) The Electric Power Council for a Low Carbon Society was launched in February 2016. The Council established individual reduction plans and announced mechanisms and rules of the entire industry to implement PDCA.

Policies are going to be established to accelerate activities to achieve targets of the voluntary framework based on the Act on the Rational Use of Energy and the Act on Promotion of Use of Non-fossil Energy Sources and Effective Use of Fossil Energy Materials by Energy Suppliers (2009, Act No. 72, hereinafter referred to as "the Advancement Act"). The effectiveness of the efforts of the entire power sectors is ensured under the energy deregulation.

Specifically, the policies include the following categories. Effective activities will be continued based on the Summary of Director-level Meeting on the Bid on Thermal Power Supply of Tokyo Electric Power Company (April 25, 2013, Ministry of Economy, Trade and Industry and Ministry of the Environment).

<Voluntary framework>

- Continuous improvement of effectiveness and transparency is promoted. Participating business operators are also expected to sincerely achieve listed targets.
- The national council (Natural Resources and Energy WG, Global Environment Subcommittee, Committee on Industrial Science and Technology Policy and Environment, Industrial Structure Council) also follows up on activities conducted under the voluntary framework of the power industry.

<Policy responses>

- Power suppliers are required to satisfy the standard of expected power generation efficiency in the energy mix set for individual power generation facilities when they install and use new power generation facilities (42.0% or more for coal, 50.5% or more for LNG, and 39.0% or more for oil).
  Individual power suppliers are also required to satisfy the actual power generation efficiency expected in the energy mix when they use currently installed power generation facilities. (The presumed standard to achieve in index A of thermal power generation efficiency is 1.00 or more (target of power generation efficiency: 41% for coal, 48% for LNG, and 39% for oil) (all at the power generation end, HHV). The standard expected to achieve in index B of the thermal power generation efficiency is 44.3% or more (at the power generation end, HHV).)
- Electricity retailers are required to ensure that the ratio of energy generated from non-fossil energy sources is 44% or more of all the electricity they sell based on the Advancement Act.
- Guidelines for electricity retail operations regard the labeling of post-adjustment emission factor as a desirable practice.
- The Ministerial Ordinance under the Act on Promotion of Global Warming Countermeasures requests all electricity retailers to report actual emission factors for the greenhouse gas emissions accounting, reporting and disclosure system. Reported emission factors are released to the public. (Actual emission factors over the past two fiscal years and other data are added to the reporting requirement to enrich the contents of the reports).

The effectiveness and transparency of efforts in the entire power sector will be secured through these activities and measures. The progress of these activities and measures is evaluated every year to see whether they remain effective in reaching the emission factor target of 0.37 kg-CO_2/kWh in FY 2030 that matches the reduction target and energy mix set for FY 2030.

Emissions from the power sector such as the amount of emissions and emissions factor are evaluated. Revision of policies and other measures are considered if the evaluation finds that the goal of 0.37 kg of CO_2/kW cannot be achieved.

✓ **Promotion to Introduce the Latest Thermal Power Generation Facilities**

An important point of introducing power generation facilities is to constantly encourage the advancement of power generation technologies through competition, to maintain and improve the technological superiority of Japan in the power generation business, to improve Japan's competitiveness on the international stage, and to contribute to environmental protection. Based on this idea, Japan promotes the use of BAT while taking into account the trend of the development of power generation technologies in the future.

✓ **Carbon Dioxide Capture and Storage (CCS)**

Japan works on CCS based on decisions including the Summary of Director-level Meeting on the Bid on Thermal Power Supply of Tokyo Electric Power Company and the Strategic Energy Plan in looking ahead to after 2030.

✓ **Responses to Small-scale Thermal Power Generation**

The number of plans is increasing to construct small-scale thermal power plants that are smaller, especially ones that are only slightly smaller than the minimum size covered in the regulation of the Environmental Impact Assessment Act (1997, Act No. 81). The Act on the Rational Use of Energy will become applicable to power suppliers that are planning to construct such plants to require them to satisfy high standards of power generation efficiency that contribute to the energy mix.

[Utilizing Nuclear Power Generations whose Safety is Approved]

✓ **Initiatives of the Power Sectors to Low-carbonization (Reprinted p128)**

✓ **Utilizing of Nuclear Power Generations whose Safety is Approved**

Nuclear power is a low-carbon baseload power source that does not emit greenhouse gases during operation. The safety of nuclear power plants is overseen by the Nuclear Regulation Authority, whose decisions are based on scientific and technical judgments. Upon approval by the Nuclear Regulation Authority that the regulatory standards are met, the government will respect its judgment and will proceed with the restart of the nuclear plant. In this case, the Government will make efforts to obtain understanding and cooperation of relevant parties including the municipality of each nuclear facility site.

[Maximum Introduction of Renewable Energy]

✓ **Initiatives of the Power Sectors to Low-carbonization (Reprinted p128)**

✓ **Maximum Introduction of Renewable Energy (Reprinted p125)**

(d) Promotion of Energy Conservation Policies in the Oil Product Manufacturing Sector

✓ **Initiatives in the Oil Refinery Industry**

Japan promotes oil refiners to reduce one million kiloliters of energy in crude oil equivalent from business as usual (BAU) in the oil product manufacturing field, based on the Industry's Action Plan toward a Low Carbon Society through the following initiatives: (i) effective use of heat, (ii) introduction of advanced control and high efficient devices, (iii) improvement of the motors system operation, and (iv) major improvement and advancement of processes.

b) Non Energy-related CO_2

✓ **Increasing the Use of Blended Cements**

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

In public works administrated by the government, the use of blended cement will be promoted in accordance with the Act on 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").

✓ **Diffusion of Biomass Plastics**

CO_2 emissions from the combustion of waste plastics are reduced by increasing the use of plastics made from biomass as the replacement for plastics made from oil (intended to reduce CO_2 from the oil-originated carbon in waste plastics).

✓ **Reduction of the Amount of Waste Incineration**

Through the promotion of 3Rs initiatives for achieving the targets set out in the Basic Plan for Establishing a Recycling-Based Society (Cabinet Decision on May 31, 2013, hereinafter referred to as "Basic Recycling Plan"), formulated in accordance with the "Basic Act on Establishing a Sound Material-Cycle Society (Law No. 110, 2000; hereinafter referred to as "the Basic Recycling Law") as well as the waste reduction targets set out in the "Waste Management and Public Cleansing Law" in line with the target set in Basic Recycling Law. (1970, Law No. 137, hereinafter referred to as "the Waste Management Law"). The incineration of waste plastics made from oil is thereby reduced. Specific measures to reduce the amount of waste, promote reuse, and reduce CO_2 emissions from the incinerated waste plastics include the thorough waste sorting and collection as well as imposition of charges for waste collection by municipal governments, and actions complying with individual recycling laws.

✓ **Promotion of Public Campaigns (Discussed later p142)**

c) Methane (CH_4)

✓ **Measures to Reduce Greenhouse Gas Emissions in Relation to Agricultural Soil**

Methane emissions associated with rice cultivation can be reduced by changing the way organic matter is managed in line with local conditions, including replacing the conventional approach of plowing in rice straw with the application of compost.

✓ **Reduction of the Amount of Wastes in Final Disposal**

Initiatives are conducted for achieving the targets set out in the Basic Recycling Plan formulated in accordance with the Basic Recycling Law and the waste reduction targets stipulated in the Waste

Management Law in line with the targets in the Basic Recycling Law. Specifically, the Government will reduce methane emissions associated with landfilling of waste by promoting the reduction of the amount of directly landfilled wastes such as raw garbage through reviews of disposal methods and thorough waste sorting and collection, and reinforcement of disposal systems by municipal governments.

✓ **Adoption of Semi-aerobic Landfill Structure in Final Waste Disposal Sites**

The use of semi-aerobic landfill structure for the installation of final waste disposal sites can reduce biological degradation of organic waste, such as raw garbage, and lower the amount of methane emissions from waste landfills compared to anaerobic landfill structure.

d) Nitrous Oxide (N_2O)

✓ **Measures to Reduce Greenhouse Gas Emissions in Relation to Agricultural Soil**

The Government will aim at the emissions reduction of nitrous oxide associated with the application of fertilizers with lower fertilizer application rates, split-application regimes and slow-release fertilizers.

✓ **Advancement of Combustion in Sewage Sludge Incineration Facilities**

The amount of nitrous oxide emissions from incineration of sewage sludge is reduced through introducing high temperature combustion and the replacement with the incinerators that emit less nitrous oxide or facilities that produce solid fuel by carbonizing sewage sludge.

✓ **Reduction of the Amount of Municipal Wastes Incinerated**

The amount of waste incinerated in municipal waste incinerators is reduced by promoting the 3R initiatives to achieve the targets set in the Basic Recycling Plan formulated in accordance with the Basic Recycling Law and waste reduction target stipulated in the Waste Management Law. The combustion technology at municipal waste incineration facilities is advanced by shifting to continuous incinerators and increasing the ratio of continuous operation of waste disposal in municipal waste incineration facilities under wide-area waste disposal systems. The combustion in municipal waste incineration facilities is thereby advanced, and the amount of nitrous oxide emissions from waste incineration is reduced.

e) Fluorinated Gases: HFCs, PFCs, SF_6, and NF_3

✓ **Practical Efforts on Phasing Down of Fluorocarbons**

Gas manufacturers and relevant business operators (business operators producing and importing fluorocarbons) are encouraged to use fluorocarbons with lower GWP and switch to gases other than fluorocarbons including reducing their production and recycle them in order to increase the low recovery rate and decrease the environmental load from fluorocarbons.

Therefore, gas manufacturers are expected to set plans and reduce the amount of fluorocarbons they produce based on the projection of the use of fluorocarbons the Government established on the basis of the Fluorocarbons Emissions Reduction Law.

✓ **Promotion of Eliminating Fluorocarbons and Lowering GWP of Products**

The following measures are implemented to gradually and steadily switch to non-fluorocarbons and reduce the GWP of refrigeration and air conditioners and other products containing fluorocarbons while taking into account technological progress in Japan and in the world and market trends.

(i) Business operators producing and importing fluorocarbons are required to meet standards within the target year based on proper product categories provided in the Fluorocarbons Emissions Reduction Law in order to promote switching to non-fluorocarbons and lower global warming potential (GWP) with sufficient consideration for the actual conditions of individual products.

(ii) Labeling of products containing fluorocarbons is improved to make labels easier to understand for users and consumers in order to increase recognition of the global warming effect of fluorocarbons and encourage consumers to select non-fluorocarbons and low-GWP products.

(iii) Measures beside the improvement of systems include technological development and measures to install and use the technologies to encourage product manufacturers and users, measures to promote the use of energy efficient devices containing natural refrigerants, training people who install and maintain devices compatible with new alternative refrigerants, securing the quality of contractors, and measures to raise the public awareness.

✓ **Preventing Leakage of Fluorocarbons from Use of Refrigeration and Air conditioning Equipment for Business Use**

The leakage of fluorocarbons during the use of refrigeration and air conditioning equipment for business use is prevented in cooperation with prefectural governments through compliance with the decision criteria of management that stipulates the device inspection rules, use of systems to report and release calculated amount of leaked fluorocarbons, and compliance with proper filling procedures based on the Fluorocarbons Emissions Reduction Law.

Beside device users, contractors who maintain devices play important roles in preventing the leakage of fluorocarbons during the use of refrigeration and air conditioning equipment. The contractors are encouraged to improve technological levels for device maintenance and management to detect the leakage of refrigerants in the early phases, and secure and train workers who are knowledgeable in the management of refrigeration and air conditioning equipment.

✓ **Recovery and Proper Disposal of Fluorocarbons from Refrigeration and Air Conditioning Equipment**

Fluorocarbons are recovered from refrigeration air conditioners and properly disposed of based on the Fluorocarbons Emissions Reduction Law, the Act on Recycling, etc. of End-of-Life Vehicles (2002 Act No. 87), and the Act on Recycling of Specified Kinds of Home Appliances (1998, Act No.97).

Refrigeration and air conditioning equipment for business use (except for automobile air conditioners) account for about 70% of HFCs emissions from refrigeration and air conditioning equipment. The rate of recovery from these devices will continuously be increased through the cooperation with prefectural governments based on the Fluorocarbons Emissions Reduction Law.

✓ **Promotion of Voluntary Initiatives in Industries**

Measures that industries implement as their voluntary action plans to prevent the leakage of fluorocarbons are evaluated and verified. At the same time, business operators are assisted in emissions reduction efforts by providing subsidies for installing and using devices that reduce emissions.

✓ **Use and Examination of Economic Approaches**

Technological development of fluorocarbon-free and low-GWP products is supported, and support is provided for the introduction of such technologies. Tax cut is also provided for these activities.

The other economic approaches will be continued to examine as they both have benefits and challenges.

(2) Greenhouse Gas Sink Policies and Measures

a) Measures for Managing Forest Carbon Sink

Measures, such as proper forest management and conservation designed to achieve the objectives regarding fulfillment of the multiple roles of forests as well as the supply and use of forest products, are outlined in the “Basic Plan for Forest and Forestry” approved by the Japanese Cabinet in accordance with the Forest and Forestry Basic Act (1964, Act No. 161). These measures include activities under Article 3.3 of the Kyoto Protocol, namely afforestation, reforestation and deforestation since 1990 and forest management, such as proper forest management and conservation through thinning and designation of protection forests under Article 3.4. Through implementation of these measures, the targeted amount of carbon sinks in forests (about 38 million t-CO_2 or more in FY 2020 and about 27.8 million t-CO_2 in FY 2030) will be achieved. Therefore, while collaborating with various entities including local governments, forest owners, forestry and lumber industries and business operators, and citizens, the following measures including cross-sectoral ones will be comprehensively implemented. Besides, these measures addressing promotion of activities under Article 3.3 and 3.4 of the Kyoto Protocol contribute to promoting conservation of forest and sustainable forest management, conservation of biodiversity, and sustainable use of forest resources.

✓ **Healthy Forest Management**

A. Implementation of necessary thinning, and promotion of diversified forest practices aiming at multi-storied forests and/or longer rotations

B. Promotion of additional thinning through more efforts from the municipalities based on the Act on Special Measures concerning Advancement of Implementation of Forest Thinning (2008, Act No. 32)

C. Proper combination of different types of roads used for forestry operation including forest roads and construction of road networks with due consideration for nature conservation

D. Promotion of the development of mixed conifer-broadleaf forests through thinning and introducing broad-leaved trees, depending on natural conditions.

E. Promotion of reforestation after final cutting through lowering reforestation cost, development and securement of seeds and seedlings that grow well, and prevention of damage caused by wild animals

F. Ensuring reforestation through proper operation of logging and afforestation notification system

G. Restocking of treeless lands within headwater forests in the back regions, and restoration of degraded forests nearby human habitats

✓ **Promotion of the Proper Management and Conservation of Protection Forests**

A. Proper conservation and management through regulations of Protection Forest System,, planned designation of Protection forest, and operation of Protected Forest System, and promotion of conservation and restoration of natural vegetation in cooperation with NPOs

B. Planned promotion of forest conservation projects in areas vulnerable to mountain disasters and devastated forests in the back regions

C. Prevention of pest and animal damage in forests, and promotion of the measures to prevent forest fire

D. Expansion of natural parks and natural environment conservation zones, and reinforcement of conservation management in these areas

✓ **Development of Efficient and Stable Forest Management**

A. Identification of forest owners, clarification of boundaries, and integration of forestry operations

B. Gathering of the information on forest owners in municipalities

C. Preparation of forest management plans and implementation of low cost and efficient practices based on the plans

D. Improvement of productivity in log production with efficient operation systems based on proper combination of construction of road networks and use of advanced forestry machinery

E. Promotion of efforts to train and secure people who are to play the leading role in forests and forestry sector

F. Promotion of entrusting forest operation and management to motivated forestry workers, promotion of forest management by public bodies

✓ **Promotion of People's Participation in Forest Management**

A. Promotion of the public relations activities for People's Participation in Forest Management through nationwide greening events, such as the National Tree-Planting Festival

B. Promotion of afforestation programs by a variety of organizations including participation of private companies in growing forests, through the National Campaign for Beautiful Forest Development and other events

C. Improvement of skills of forest volunteers and securing working conditions

D. Promotion of forest environmental education

E. Promotion of forest conservation and management, and the use of forest resources in cooperation with local residents, forest owners and other stakeholders

F. Promotion of Ecosystem Maintenance and Recovery Project to conserve forest ecosystem and Green Workers Project in national parks and reserves

G. Fostering of the awareness of citizens to recognize rich environment as an important supporter for their lives

✓ **Promotion of the Use of Lumber and Woody Biomass**

Lumber is a renewable resource and can store carbon. Encouraging the use of lumber results in reducing use of fossil fuels and CO_2 emissions. It also contributes to sustainable forest management. The following measures are thus implemented for the use of lumber.

A. Promotion of the use of locally sourced lumber in housing

B. Promotion of the use of lumber in public buildings and non-residential buildings based on the Act for Promotion of Use of Wood in Public Buildings (2010, Act No. 36)

C. Research, development, and commercialization of new technologies for the use of forest products and new wooden materials

D. Development of systems to ensure stable supply of domestically produced lumber to respond to demand, such as construction of efficient processing and distribution facilities

E. Establishment of efficient and low-cost collection and transportation systems of woody biomass and promotion of the use of wooden materials as energy and products

F. Promotion of the "Kizukai (due care for wood use)", an initiative to disseminate the importance of wood use to consumers and expand the use of wood

b) Measures to Increase Carbon Sinks in Agricultural Soils

It is proven that the carbon storage in cropland and grassland soils in Japan can be increased by continuous usage of organic matter such as compost and green manure. Thus, carbon stock in the soil of cropland and grasslands is increased by promoting soil development by applying organic matter, such as compost and green manure. The activities contribute to the LULUCF activities under article 3, paragraph 4 of the Kyoto Protocol (cropland management and grassland management)

c) Promotion of Urban Greening

Urban greening is the closest carbon sink improvement measure in the daily lives of the public, including revegetation as LULUCF activities under article 3, paragraph 4 of the Kyoto Protocol. Promotion of urban greening is highly effective in raising public awareness of global warming mitigation rather than the actual effects of increasing carbon sinks.

Therefore, the actions will be continuously promoted such as urban park maintenance, greening in roads, rivers, and sand control facilities, bays, sewage treatment facilities, public housing, and government buildings, along with the increase of new green spaces on the rooftops of buildings. These initiatives are conducted based on general plans to maintain and increase green spaces established by the national government and local governments, such as the Outline of Green Policies and the Basic Plan of Greening established by municipalities.

Meaning and effects of urban greening are widely publicized for all types of the public as a part of these initiatives. Support will also be provided to create new green spaces in cities using various methods and by various organizations through urban greening projects conducted with various participants including the public, business operators, and NPOs, as well as the use of three-dimensional urban park systems.

Improvement in report and verification system of removals by the urban greening will also be strategically carried out.

3.2.3.2 Cross-sectional Strategies

(1) Cross-section measures to achieve targets

(a) Promotion of J-Credit Scheme

✓ **Promotion of J-Credit Scheme**

Active promotions are needed to reduce emissions through the introduction of energy conservation facilities and the use of renewable energy by various parties in Japan, as well as to increase carbon sinks through appropriate forest management. Therefore, the J-Credit Scheme is going to be steadily implemented to certify credits that can be used to achieve the Industry’s Action Plan toward a Low Carbon Society and carbon offsets.

(b) Development of Public Campaigns (Discussed later p142)

✓ **Promotion of Public Campaigns (Discussed later p142)**

(c) Formulation of Low-carbon Urban/Regional Structures and Socioeconomic Systems

✓ **Formulation of Low-carbon Urban/Regional Structures and Transportation Systems**

Urban/regional structures and transportation systems will continue to influence CO2 emissions in the mid- and long-term periods through increases/decreases in traffic and commercial floor areas. Therefore, low-carbon urban/regional development needs to be promoted through compact city planning, rebuilding public transportation networks, and efficiency improvement of urban energy system in order to transform from existing diffusional system.

Support is thus provided to encourage the establishment of urban functions based on appropriate location plans and low-carbon city development based on the Low Carbon City Act. Measures and enterprises are also promoted based on integrated urban/regional transportation strategies and shared use of energy at the district level. Green areas that remove greenhouse gases are also preserved and expanded. Local government action plans are implemented while coordinating with urban planning and agricultural development area planning and compatibility with low carbon urban development plans. Other promotional measures are also considered to increase the use of public transportations linked to land use measures, as well as the optimization of retail floor areas and the promotion of area-wide use of natural resources. The decarbonization of housing, buildings and infrastructures are also promoted.

Advanced low-carbon urban/regional developments are also accelerated for projects to build environmental future cities and environmental model cities. The experience and know-how gained through these projects are applied for other cases throughout Japan.

✓ **Development of Innovative Energy Management Systems by Effectively Using Distributed Energy Resources on the Electricity Consumer Side**

"Demand response" is expected to provide energy resources to make balance in energy supply and demand in the energy system through electricity consumers save electricity consumption. In order that electric power utilities can purchase the amount of electricity that consumers saved upon request from them, which is called “Negawatt”, the “Negawatt trading market” has surely been inaugurated in April 2017.

In addition to this, the national demonstration project has developed regulation system using IoT technologies, as if they form one power plant, which collectively manages and controls electricity utilizations in distributed energy resources on the consumer side, such as solar photovoltaic systems, storage batteries and demand responses. The project will create a new type of energy business (energy resource aggregation business), so as to accelerate introduction of renewable energy and promote additional energy conservation.

✓ **Expansion of Holistic and Efficient Use of Energy (Reprinted p118)**

✓ **Development of Low-carbon Cities through the Improvement of Thermal Environment by Preventing Heat Island Effects (Reprinted p118)**

(2) Other relevant Cross-section measures

(a) Realization of Hydrogen Society

Hydrogen is associated with many excellent features, such as being convenient and energy efficient, no emission of greenhouse gases during the consumption phase, useful during emergencies, and produced from various energies including renewable energy Hydrogen energy will be the trump card for energy security and measures to address global warming.

Many entities have conducted research, development, and experiments in the elemental technologies to expand the use of hydrogen. Still, there are many challenges in regards to technology, cost, system, and infrastructure to realize a so-called “hydrogen society” in which people use hydrogen in their daily lives and industrial activities. To collectively overcome these challenges, Japan promotes various technological developments and cost reduction efforts while strategically creating systems and infrastructures to start social applications of technologies starting with the feasible ones.

Necessary technological developments will specifically be conducted in regards to Ene-Farm and fuel cell vehicles (FCVs) to lower their costs and improve performance. In addition, hydrogen stations, the necessary infrastructure for the diffusion of FCVs, will be installed while expecting the use of hydrogen derived from renewable energy in the future. Technological developments are also conducted to lower costs related to hydrogen stations. Relevant regulations will be streamlined if necessary in preparation for the improvement of safety and the reliability of relevant technologies.

Technological developments and experiments are also conducted in regards to the other uses of hydrogen and fuel cells, such as fuel cells for business use and industrial power generation.

Technological developments will be conducted to realize low cost and stable hydrogen production and transportation so that the demand for hydrogen will be further expanded in the future. Development and experiments will also cover hydrogen production, transport, and storage technologies with the lowest possible CO_2 emissions, such as the production of hydrogen from renewable energy and conversion of unused energy into hydrogen.

(b) Initiatives based on the Guidelines for Controlling Greenhouse Gas Emissions

In regards to emissions reduction the guidelines for controlling greenhouse gas emissions based on the Act on Promotion of Global Warming Countermeasures, menus of measures will be expanded for selecting energies with lower carbon footprints based on technological trends such as BAT. Guidelines will be established and released as soon as possible for areas without guidelines. Business operators are encouraged to voluntarily and actively practice environmentally friendly business activities by providing assistances and distributing information to drive them to implement the measures stipulated in the applicable guidelines.

(c) GHG Emissions Accounting, Reporting and Disclosure Program

Greenhouse gas emitters compute the amount of greenhouse gases they emit. The foundation of voluntary initiatives for global warming countermeasures is thereby established, and the amounts of emissions are made visible to the public. In addition, emitters that exceed a given threshold of emission to report their emission quantities to the Government on an annual basis which are collected and disclosed it to the public in order to increase the incentive and motivation for the public and business operators to engage in voluntary efforts. The implementation of these initiatives will be continued. At the same time, business operators are expected to actively reduce greenhouse gas emissions by properly reevaluating their initiatives based on IPCC Guidelines, as well as through accurate report, prompt collection and disclosure of emission information.

(d) Promotion of Environmental Considerations in Business Initiatives

Japan properly includes the perspective of committing to environmental friendliness in economic activities and promotes investments and technological developments in business activities to reduce greenhouse gas emissions.

Specifically, Japan develops a foundation where business operators engaging in environmentally friendly practices can enjoy benefits through the series of the following actions. (i) The value of the environment is recognized in products, services, and the financial market, and business operators adopt attitudes to pursue environmental friendliness. (ii) Suppliers engage in environmentally friendly business activities while distributing information to improve the understanding of customers. (iii) Customers who receive accurate information come to recognize the value of environmentally friendly business operators products, and services and select them as a consequence.

Therefore, Japan encourages business operators to implement environmentally-conscious business activities on a voluntary and active basis by formulating and publishing the Guidelines. By releasing stakeholder environmental reports in accordance with the Act Concerning the Promotion of Business Activities with Environmental Consideration by Specified Corporation, etc. by Facilitating Access to

Environmental Information, and Other Measures (Law No. 77, 2004), Japan encourages the use of environmental information by stakeholders and by the general public and provide the conditions for business activities with environmental consideration to be highly valued by society and by markets. To realize such conditions, Japan develops the foundation for identifying and managing the amount of greenhouse gas emissions throughout the entire supply chain, supports development and implementation of corporate's target consistent with Paris 2-degree target (Science-Based Target, SBT), promulgates and encourages the use of the idea of the carbon footprint, develops the foundation to release information using ICT, and improves the comparability and reliability of environmental information.

Japan also diffuses the use of environmental management systems equipped with the PDCA cycle, including ISO 14001 and Eco Action 21 designed for small and medium-sized businesses, to improve the effectiveness of environmental business practices. At the same time, Japan promotes even more environmentally friendly business practices by promoting employee education in companies.

(e) Joint Crediting Mechanism (JCM)

Implementing of emission reductions or removals through diffusion of advanced low carbon technologies can contribute to mutual low carbon development of both recipient countries and Japan.

Thus, Japan establishes and implements the 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. Apart from contributions achieved through private-sector based projects, accumulated emission reductions or removals by FY 2030 through governmental JCM programs to be under taken within the government’s annual budget are estimated to be ranging from 50 to 100 million t-CO_2. The JCM is not included as a basis of the bottom-up calculation of Japan’s emission reduction target, but the amount of emission reductions and removals acquired by Japan under the JCM will be appropriately counted as Japan’s reduction.

Japan will, for the purpose of further implementation of actual emission reductions or removal projects, support further formulation of projects through measures including appropriate operation of the JCM. These include development of measurement, reporting and verification methodologies; formation of projects and feasibility studies through utilization of city-to-city cooperation and the JCM Special Financing Scheme (JSF) in collaboration with Japan Bank for International Cooperation (JBIC) and Nippon Export and Investment Insurance (NEXI); appropriate operation of internal institutional arrangements in order to promote utilization of the JCM; and collaboration with relevant organizations such as New Energy and Industrial Technology Development Organization (NEDO), Japan International Cooperation Agency (JICA) and Asian Development Bank (ADB).

(f) Measures for Greening Tax Scheme and Effective Utilization of Tax for Climate Change Mitigation

Greening environmentally-related taxes proposed in the plan is an important policy for global warming countermeasures, including promoting a low-carbon society. The Government of Japan is to proceed global warming countermeasures through carrying out comprehensive and systemic research and analysis on environmental effectiveness of environmentally-related taxes, with investigating policies and measures in other countries

Utilizing revenues from Tax for Climate Change Mitigation, which was introduced in October 2012, the Government of Japan is to steadily implement measures to curb energy-oriented CO_2 including promotion of energy saving, diffusion of renewable energy, and utilization of cleaner and more efficient fossil fuels.

(g) Greening Finance

The proper supply of private finance for the necessary greenhouse gas emission reduction measures is essential to drastically cut greenhouse gas emissions and create a low-carbon society. In addition, an increasing number of institutional investors around the world are adopting the environmental friendliness of companies as one of their decision-making criteria. Therefore, Japan uses financial measures, or greening finance, to promote initiatives to develop the green economy by providing proper incentives for being environmentally friendly.

Specifically, Japan provides financial supports to mobilize private funds into low-carbon projects. More specifically, it provides equity finance into low-carbon projects where private financial resources are not sufficient, encourages leasing of low-carbon equipment to reduce the burden of up-front costs, and spurs issuance of and investment in Green Bonds in Japan.

Japan also promotes environmentally friendly actions to reduce greenhouse gas emissions, such as the loans based on environmental responsibility ratings that incentivize the environmentally friendly actions of investment candidate companies by evaluating corporate activities based on their financial aspects and environmental aspects to reflect the findings in investment activities; ESG investment that takes into account environmental contributions, social contributions, and governance of companies; and releases of the policies on ESG activities of institutional investors.

(h) Domestic Emissions Trading Scheme

Japan considers an emission trading scheme carefully, taking into consideration the burden on domestic industry and associated impacts on employment; ongoing developments of emission trading schemes overseas; evaluation of existing major climate change policy measures such as voluntary actions implemented by the industry sector.

3.2.3.3 Fundamental measures

(1) Development of National System for Estimating Greenhouse Gas Emissions and Removals based on the United Nations Framework Convention on Climate Change (UNFCCC)

Government ministries and agencies, mainly the Ministry of the Environment, have been closely working for: development of national system to aggregate, estimate, and disclosure statistics concerning emissions and removals; quality assurance and quality control of data; and responding to reviews implemented by expert review teams dispatched on the basis of the Kyoto Protocol in order to estimate greenhouse gas emissions and removals based on the UNFCCC and the Kyoto Protocol and submit data to the Secretariat of the UNFCCC. Japan continues to improve and elaborate estimation methods and process of emission factors and activity data to estimate emissions and removals taking into account global trends in reinforcing MRV.

More accurate identification of emissions by sector and refined methods to evaluate the implementation of measures by individual entities are needed. Thus, Japan promotes investigations and research concerning the development of statistics to measure activity data, the estimation of energy consumption intensity and CO_2 emission intensity, and methods to monitor greenhouse gas emissions. Japan also additionally refines methods to estimate greenhouse gas emissions and removals. Specifically, Japan develops the necessary statistics for estimating detailed CO_2 emissions in the residential sector.

Japan also responds to the submission of biennial reports required based on decisions at COP17 as well as the international assessment and reviews.

Meanwhile, Japan is estimating emissions and removals when measuring, monitoring, and reporting removals (or emissions) by sinks under the 2006 IPCC Guidelines and the 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol. Necessary data for MRV concerning the activity data and changes in land uses will be gathered to improve data precision. Research and study projects on greenhouse gas emission and removals mechanisms in forests are also conducted.

(2) Technology Development for Global Warming Countermeasures and Application of These Technologies in Society

Developing and verifying technologies for global warming countermeasures are initiatives to realize the future reduction of a large amount of greenhouse gas emissions by promoting the expansion of greenhouse gas emission reductions and the decrease of reduction costs and thereby widely diffusing them in society. Therefore, Japan promotes the technological development and verification in order to realize the lower cost, higher efficiency and longer life of renewable energy and energy conservation from the early phases and assists in the social application of these technologies based on the Environmental Energy Technology Innovation Plan (September 13, 2013, Council for Science and Technology Policy) for solar power generation, wind power generation, geothermal power generation, hydropower generation, biomass energy, ocean energy, the use of other renewable heat energy, and energy conservation technologies.

(3) Strengthening Promotion, Observation, and Monitoring System of Climate Change

The accumulation of the latest scientific information from research projects inside and outside of Japan is necessary to promote global warming countermeasures in the future from long-term and global perspectives. The research, observation, and monitoring of climate change are extremely important initiatives that build the foundation of such knowledge. Japan conducts global warming research based on past research initiatives and through international cooperation to clarify the mechanisms of climate change, identify current conditions of global warming, forecast global warming, promote the necessary technological developments, implement measures to reduce greenhouse gas emissions and adapt to global warming, and assess the effects of global warming on the environment, society, and economy.

3.2.3.4 Initiatives by Public Organizations

✓ **Initiative of the National Government**

The national government takes the initiative in purchasing and using of building construction and management, financial services and other administration and projects, based on the national government action plan established under the Act on Promotion of Global Warming Countermeasures and ministerial action plans established based on the national government action plan.

Specifically, the national government implements the following:

- Improvement of operations based on results of energy conservation diagnosis and the development of cost-effective and rational infrastructures;
- Visualization of energy consumption and thorough energy management (e.g. introduction of BEMS);
- Taking initiatives in introduction of LED lamps when replacing currently installed lighting devices;
- Taking initiatives in introduction and use of energy efficient devices;
- Establishment of work systems to reduce CO_2 emissions such as the reduction of overtime work;
- Carbon reduction of using energies;
- Taking initiatives in introduction of next-generation vehicles;
- Aiming to realize ZEBs in Buildings;
- Using recycled products such as recycled paper and lumbers;
- Active utilization of bicycles in daily communication work.

The national government action plan is designed to firmly implement measures specified in the Plan.

The Plan targets a reduction of 40% in the total amount of greenhouse gases directly and indirectly emitted from the administration and projects of the national government by FY 2030 from the level of FY 2013. An interim target is to cut the emissions from the entire government by 10% by FY 2020.

The Central Environment Council evaluates and verifies the progress of the national government action plan. The executive meeting of the Global Warming Prevention Headquarters then inspects the progress every year and releases the outcome of the inspection to the public. To ensure transparency and the diffusion of the effects of the initiatives, the inspection outcomes are released along with evaluations of indexes specified in the national government action plan, such as the total emission of greenhouse gases and the progress of individual categories in comparison to target values and past data, in addition to cross-section comparative evaluation of planned actions and the progress of individual actions.

The national government also signs contracts for reducing greenhouse gas emissions from their undertakings mainly in six sectors, including electricity, automobiles, ships, ESCO, construction, and industrial waste based on the Act on Promotion of Contracts of the State and Other Entities, Which Show Consideration for Reduction of Emissions of Greenhouse Gases, etc. (2007, Act No. 56, hereinafter referred to as "the Environmental Friendliness Contract Act") and basic policies specified in the Act. The national government thereby ensures the achievement of targets specified in the national government action plan and realizes additional reductions.

In regards to the national government buildings, the national government continues to promote the visualization of energy consumption and the proper energy operation and management, including environmental load reduction and the construction of government buildings in a way to protect the nearby environment (green government buildings) along with the use of life cycle energy management (LCEM) for air conditioning devices. In order to spur demands for products that contribute to greenhouse gas emissions reduction and other eco-friendly goods and services, the national government takes the initiative in procuring such goods and services based on the “Act on Green Purchasing”. Furthermore, the national government promotes wood use in public buildings based on the Act for Promotion of Use of Wood in Public Buildings.

✓ **Actions Led by Local Governments and Promotions by the National Government**

Local governments establish and implement the Local Government Action Plan, Administration and Projects, in regards to their own administration and projects based on the Plan for Global Warming Countermeasures. They are expected to take the initiative to become the role models of business operators and residents in their regions.

Local government agencies are to establish and use so-called PDCA systems with responsible participation of the bureaus assigned to individual undertakings targeting all administration and projects in principle. They thereby engage in effective and lasting reduction of greenhouse gases.

Upon the establishment of the PDCA system, the local governments pay special attention to the following points while referring to manuals for establishing local government action plans that the national government has prepared.

Additionally, the national government promotes wood use in public buildings, many of which are not currently built with wood based on the Act for Promotion of Use of Wood in Public Buildings.

✓ **Promotion of the Initiatives of Public Organizations besides the National Government and Local Governments**

The national government and local governments provide information concerning effective global warming mitigation measures to public organizations, such as independent administrative institutions. The public organizations thereby promote to establish action plans to reduce greenhouse gas emissions from their administration and projects in accordance with the national government action plan and local government action plans. They promote the initiative in taking action based on their action plans. The national government regularly grasps the state of their initiatives whenever possible.

Public organizations, such as independent administrative institutions, special corporations, and national university corporations, use environmental friendliness contracts to reduce greenhouse gas emissions.

3.2.3.5 Development of Public Campaigns

✓ **Promotion of Public Campaigns**

The Government provides clear and useful information to the public associating with their generation and lifestyles about the critical conditions of global warming and its effects on the society using reliable domestic and international information based on the latest scientific knowledge presented in the IPCC Assessment Reports, Climate Change Adaptation Plans, and other documents to reform consciousness and instill crisis awareness against the global warming on the public.

Specifically, information is continuously distributed through various media or word-of-mouth about future effects that serious, extended, and irreversible effects will occur to us and to the ecosystem in the future if global warming mitigation initiatives are not strengthened. Such information is expected to improve the understanding toward the problem of climate change and drive people to voluntarily act to mitigate global warming.

Also, relevant government ministries and agencies work as a team and cooperate with the industry, labor circle, local governments, NPOs, and other entities to stimulate the understanding of the public toward the mitigation of global warming, foster a momentum of understanding and cooperation towards the global warming countermeasures and boost consumer behaviors. Through these initiatives, government ministries and agencies promote a public campaign named COOL CHOICE that is intended to encourage the public to choose all possible smart choices to contribute to global warming prevention, such as replacement of products, services and lifestyle which are energy conservative and low-carbon. The public is encouraged to actively and voluntarily change their behavior. These will result in the development of markets for energy efficient and low-carbon products and change their lifestyle towards the ones appropriate for suitable low-carbon social systems and innovations in lifestyles.

Specifically, relevant government ministries and agencies work together and implement the public campaign named “COOL CHOICE” with the support of private organizations associated with energy consumption in various categories such as consumer electronics, housing and building, automobiles, energy services, and transportation and traffic services. Mass media, such as the television, newspaper, and the Internet, are actively used to distribute proper information through various means to strongly affect the awareness of the public. The public is thus steered toward voluntary efforts to mitigate global warming and make active choices.

The Government recruit and train communicators who are close to the public to transmit information about global warming in scenes close to the public to motivate them.

✓ **Promotion of Environmental Education**

Providing knowledge alone is not enough to drive people to take action to solve the problem of global warming. Specialized viewpoints of environmental education become important for learners to gain a scientific understanding of the mechanism of global warming and make them think and come up with specific solutions, including what they and their regions can do.

Environmental education is already being provided in schools and other educational facilities so that the public can deepen their understanding of environmental conservation through all types of opportunities depending on their growth stages from the childhood. In addition to that, Regional Environmental Partnership Offices and other organizations are utilized to more effectively provide environmental education in schools, as well as workplaces, households, and all scenes of regions to support the training of instructors who teach the problem of global warming and develop educational programs.

Table 3-1 Summary of Policies and Measures

Name of mitigation action	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 of entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq) 2020	2030
Industrial Sector/Commercial and other Sector										
Steady implementation of Industry's action plans towards a low-carbon society and evaluation and verification of progress	Energy	CO2	Steady implementation of Industry's action plans towards a low-carbon society and evaluation and verification of progress	Voluntary Agreement	Implemented	Individual industries set reduction targets and work to reduce the emission of greenhouse gases through the emission reduction measures by the improvement of energy efficiency, development and spread of low-carbon products, and the transfer of technologies for international contributions.	Since 1997 (Depends on a group)	METI	-	-
Industry Sector										
Promotion of introduction of highly energy-efficient equipment and devices (cross industrial)	Energy	CO2	Introduction of highly energy-efficient air conditioners	Budget/Subsidy Financing	Implemented	Promote the introduction and use of energy-efficient facilities and devices across industries. Try to spread the use of these devices by achieving targets for top-runner standards and providing support for their Introduction and use.	2008	METI	480	890
			Introduction of industrial heat pump（Heating and drying)	Budget/Subsidy Financing	Implemented		2008	METI	150	1,350
			Introduction of industrial lighting devices	Budget/Subsidy Financing	Implemented		2008	METI	3,490	4,300
			Introduction of low-carbon industrial furnaces	Budget/Subsidy Financing	Implemented		2008	METI	22,810	30,930
			Introduction of industrial motors	Budget/Subsidy Financing	Implemented		2008	METI	3,760	6,610
			Introduction of highly energy-efficient boilers	Budget/Subsidy Financing	Implemented		2008	METI	2,306	4,679
			Introduction of cogeneration systems	Budget/Subsidy Financing	Implemented		2008	METI	2,940	10,200
Promotion of introduction of highly energy-efficient equipment and devices (Iron and steel industry)	Energy	CO2	Energy efficiency improvements of power demand facilities	Budget/Subsidy Financing Awareness rising	Implemented	Update and replace electricity-consuming facilities in ironworks with more energy-efficient facilities (e.g. replacement of oxygen plants with ones with higher efficiency, changing millmotor to AC systems, reduction of the power of air blowers and fan pumps, introduction of energy efficient lighting devices, and updating motors and transformers to models with higher efficiency).	2008	METI	800	650
			Expanding the chemical recycling of waste plastics at ironworks	Budget/Subsidy Financing Awareness rising	Implemented	Reduce the use of coal by effectively using the waste plastics collected on the basis of the Act on the Promotion of Sorted Collection and Recycling of Containers and Packaging (Act #112, 1995) by decomposing them in coke ovens.	2008	METI	2,120	2,120
			Introduction of next generation coke production technology	Budget/Subsidy Financing Awareness rising	Implemented	Reduce energy consumption from coke production by installing a pretreatment process for coal in coke production processes.	2008	METI	170	1,300
			Improvement of power generation efficiency	Budget/Subsidy Financing Awareness rising	Implemented	Update power generating systems for private power generators and joint thermal power plants to more efficient facilities.	2008	METI	840	1,100
			Enhancement of energy-efficient equipment	Budget/Subsidy Financing Awareness rising	Implemented	Increase systems to use waste heat, such as the top pressure recovery turbine (TRT) and Coke Dry Quenching(CDQ）and strengthen energy-conservation facilities.	2008	METI	990	1,220
			Introduction of innovative steel processing (ferrocoke)	Budget/Subsidy Financing Awareness rising	Implemented	Introduce innovative iron-making processes with using innovative coke alternative (ferrocoke) .	2013	METI	-	820
			Introduction of environmentally friendly steel processing	Budget/Subsidy Financing Awareness rising	Implemented	Introduce innovative iron-making processes with technologies to reduce CO2 emissions from blast furnace and CO2 capture.	2008	METI	-	110

Name of mitigation action	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 of entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)	
									2020	2030
Industrial Sector/Commercial and other Sector										
Promotion of introduction of highly energy-efficient equipment and devices (Chemical industry)	Energy,Waste Management / Waste	CO_2	Introduction of energy-efficient processing technology for petrochemical industry	Budget/Subsidy Financing	Implemented		2009	METI	192	192
			Introduction of energy-efficient processing technology for other chemical products	Budget/Subsidy Financing	Implemented	Promote the use of Best Practice Technologies (BPT) that the International Energy Agency (IEA) organizes as the advanced technology used in commercial scale in the field of petrochemical and caustic soda. Reduce energy use and improve energy efficiency through exhaust energy recovery and rationalization of processes. Promote the development and introduction of new and innovative energy conservation technologies. Establish energy-efficient material production technology with high production efficiency using botanical functions to reduce CO_2 emissions from material production processes. Develop technologies to directly use recycled plastic flakes to reduce the thermal processes for producing pellet materials.	2013	METI	851	1,612
			Introduction of energy-efficient distillation processing technology by membrane	Budget/Subsidy Financing	Implemented		2009	METI	5.7	335
			Introduction of CO_2 using technology for material	Budget/Subsidy Financing	Implemented		2013	METI	-	800
			Introduction of chemical manufacturing technology by inedible plant-derived raw material	Budget/Subsidy Financing	Implemented		2013	METI	-	136
			Introduction of waste water treatment technology with electric power generation by microbial catalyst	Budget/Subsidy Financing	Implemented		2013	METI	-	55
			Introduction of enclosed plant factory	Budget/Subsidy Financing	Implemented		2011	METI	-	215
			Utilization of recycled plastic flakes	Budget/Subsidy Financing	Implemented		2014	METI	11	59
Promotion of introduction of highly energy-efficient equipment and devices (Ceramic, stone and clay manufacturing industry)	Energy	CO_2	Existing energy-efficient technology	Budget/Subsidy Financing	Implemented	Improve the energy efficiency of the cement production processes by promoting the introduction and use of facilities to effectively use thermal energy and electricity.	2008	METI	26	57
			Waste utilization technology as alternate of heat energy	Budget/Subsidy Financing	Implemented	Promote the use of waste as an alternative to thermal energy to improve the energy efficiency of the cement production process.	2008	METI	-	35
			Relevant technology of low-temperature calcination in cement production process	Budget/Subsidy Financing	Implemented	Improve the energy efficiency of cement production processes through the practical application of the cutting-edge technologies while maintaining the same level of quality as conventional products.	2010	METI	16	408
			Glass fusing processing technology	Budget/Subsidy Financing	Implemented	Improve the energy efficiency of glass production processes through the practical application of the cutting-edge technologies while maintaining the same level of quality as conventional products.	2008	METI	26	134
Promotion of introduction of highly energy-efficient equipment and devices (Pulp, paper, and paper products industry)	Energy	CO_2	Introduction of highly energy-efficient used paper pulping manufacturing technology	Budget/Subsidy Financing	Implemented	The installation of pulpers that allow more efficient pulping of recovered paper than existing ones in deinked pulp manufacturing process will be supported in order to reduce the consumption.	2008	METI	100	100
			Introduction of black liquor recovery boilers that operate with higher temperatures and higher pressures	Budget/Subsidy Financing	Implemented	At the renewal timing of recovery boilers used to generate steam by incinerating concentrated black liquor (pulp waste liquor), the installation of the ones with more elevated features in temperature ,pressure and energy efficiency will be supported.	2008	METI	110	160
Promotion of introduction of highly energy-efficient equipment and devices(Construction and construction and fields that use special motor vehicles)	Energy	CO_2	Promotion of introduction of highly energy-efficient equipment and devices(Construction sector)	Budget/Subsidy Financing Other	Implemented	Certify fuel-efficient construction machinery to make it easier for contractors to select energy efficient construction machinery for construction projects. Also support the Introduction and use of such machinery.	2010	METI	130	440

Name of mitigation action	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 of entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq) 2020	2030
Industrial Sector/Commercial and other Sector										
Promotion of introduction of highly energy-efficient equipment and devices(Greenhouse horticulture, agricultural machinery, and fishery sector)	Energy	CO2	Introduction of energy-efficient equipment and devices in greenhouse horticulture	Budget/Subsidy Awareness Raising	Implemented	Install and use energy efficient heating facilities for greenhouse horticulture to reduce the consumption of fuel oil and CO2 emissions from the combustion of fuel oil (mainly A heavy oil) in heating facilities.	2007	MAFF	590	1,240
			Introduction of energy-efficient agricultural machinery	Budget/Subsidy Awareness Raising	Implemented	Reduce the consumption of fuel oil in agricultural machinery.	2007	MAFF	0.5	1.3
			Switch to energy-efficient fishing vessels	Budget/Subsidy Awareness Raising Technology Development	Implemented	Switch to energy efficient fishing vessels.	2007	MAFF	67	162
Implementation of thorough energy management using FEMS	Energy	CO2	Implementation of thorough energy management using FEMS	Budget/Subsidy Awareness Raising	Implemented	Start using factory energy management system (FEMS) and reduce energy consumption through energy management based on the FEMS.	2013	METI	1,230	2,300
Promotion of energy conservation initiatives through alliance between industry groups	Energy	CO2	Promotion of energy conservation initiatives through alliance between different industry groups	Budget/Subsidy Awareness Raising	Implemented	Promote energy conservation activities through the cooperation among multiple businesses.	2013	METI	210	370
Commercial and Other Sector										
Improvement of the energy efficiency of buildings	Energy	CO2	Promotion of mandatory compliance with energy conservation standards targeting new construction	Law/Standard Budget/Subsidy Other	Implemented	Increase the ratio of building stocks that satisfy the energy conservation standards to reduce CO2 emissions from the energy consumed in the buildings. Require buildings to comply with energy conservation standards based on the Act on the Improvement of Energy Consumption Performance of Buildings (issued on July 8, 2015). Also accelerate the construction of energy efficient buildings by mandating the notification of energy efficiency of buildings.	2003 (When the reporting period of energy-saving performance started, based on the Energy Saving Law)	MLIT	-	10,350
			Improvement of energy efficiency of existing buildings (renovation)	Law/Standard Budget/Subsidy Other	Implemented	Increase the ratio of building stocks that satisfy the energy conservation standards to reduce CO2 emissions from the energy consumed in buildings. Provide tax incentives and financial support promoting investment in energy conservation to accelerate the energy conservation renovation in already constructed buildings.	2003 (When the reporting period of energy-saving performance started, based on the Energy Saving Law)	MLIT	-	1,220
Diffusion of highly energy-efficient equipment and devices (Commercial and Other Sector)	Energy	CO2	Introduction of highly energy-efficient water heating systems	Budget/Subsidy Financing	Implemented	Reduce energy consumption by increasing the use of energy efficient water heaters.	2008	METI	640	1,550
			Introduction of highly energy-efficient lighting devices	Budget/Subsidy Financing	Implemented	Reduce energy consumption by increasing the use of energy efficient lighting devices such as LED lamps.	2008	METI	8,030	9,910
			Introduction of coolant management technologies	Law/Standard	Implemented	Increase energy efficiency by implementing refrigerant leak prevention measures through the spread of proper management technologies.	2014	METI	416	24

Name of mitigation action	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 of entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)	
									2020	2030
Commercial and Other Sector										
Improvement of energy efficiency of equipment and devices through Top Runner Programs (Commercial and Other Sector)	Energy	CO2	Improvement of energy efficiency of equipment and devices through top runner programs (Commercial and Other Sector)	Law/Standard Budget/Subsidy	Implemented	Reduce energy consumption of devices used in industries by increasing the energy efficiency of top-running devices.	1998	METI	5,640	17,060
Thorough energy management through the use of BEMS and consultation on energy conservation	Energy	CO2	Thorough energy management through the use of BEMS and consultation on energy conservation	Taxation Budget/Subsidy Other	Implemented	Reduce energy consumption through the introduction of BEMS and detailed identification of energy consumption in industrial facilities (such as buildings) using energy conservation diagnosis, as well as the control of devices based on the diagnosis.	1998 (Energy Use Rationalization Business support Program) 2012 (Subsidy to promote innovative energy conservation technology implementation in housing and buildings)	METI	4,450	10,050
Expansion of holistic and efficient use of energy	Energy	CO2	Expansion of holistic and efficient use of energy	Budget/Subsidy Awareness Raising	Implemented	Support the construction of systems for spatial use of energy.	2008	METI	73	164
Development of low-carbon cities through the improvement of thermal environment by Preventing Heat Island Effects	Other	CO2	Development of low-carbon cities through the improvement of thermal environment by preventing heat island effects	Other	Implemented	Promote low-carbon cities through the improvement of the thermal environment by mitigating the urban heat island such as through roof-top greening.	2008	MLIT	4.4 〜 20.2	4.1 〜 19.1
Introduction of renewable energy and energy-saving in water supply and sewage system	Energy	CO2	Promotion of energy saving and energy creation measures in sewage system	Budget/Subsidy	Implemented	Reduce CO2 emissions by promoting energy saving in sewage treatment plants. Also reduce CO2 emissions by generating power using biogas from sewage sludge and submitting fossil fuel to solid fuel made from sewage sludge.	2016	MLIT	900	1,340
			Promotion of energy saving and renewable energy measures in water service business	Budget/Subsidy	Implemented	Reduce CO2 emissions from the use of electricity as water service companies all around Japan and water suppliers implement energy conservation activities and start using renewable energies.	2016	MHLW	284	336

Name of mitigation action	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 of entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)	
									2020	2030
Commercial and Other Sector										
Initiatives in waste management	Waste Management /Waste, Energy	CO2	Promotion of sorting, collection and recycling of waste plastic containers and packaging	Law/standard/Budget/ Subsidy/Awareness raising/	Implemented	Promote sorted collection and recycling (recycling of materials and chemical recycling) of plastic containers and packaging materials based on the Act on the Promotion of Sorted Collection and Recycling of Containers and Packaging.	2000	MOE	25	62
			Introduction of waste power generation at municipal solid waste incineration facilities	Budget/Subsidy Other	Implemented	Reduce CO2 emissions from energy uses associated with electricity consumption by installing the proper sizes of high-efficient power generation facilities when constructing new waste incineration facilities or updating or renovating currently operating facilities.	2016(National Plan for Adaptation to the Impacts of Climate Change)	MOE	860 ～ 1,360	1,350 ～ 2,140
			Introduction of waste power generation at industrial waste incineration facilities	Budget/Subsidy	Implemented	Reduce CO2 emissions from energy uses associated with electricity consumption by installing proper sizes of high-efficient power generation facilities when constructing new waste incineration facilities or updating or renovating currently operating facilities.	2003	MOE	25	28
			Promotion of producing fuels from waste and energy-efficiency measures in waste disposal business	Budget/Subsidy	Implemented	Produce fuels from waste, such as waste plastics and paper scraps, and use the fuel as the alternative to fossil fuel in manufacturing industries to reduce CO2 emissions from energy associated with the combustion of fuel. Promote energy conservation measures, such as the Introduction of fuel efficient waste collection and transportation vehicles and treatment facilities and energy conservation activities to reduce CO2 emissions from energy associated with fuel uses.	2016	MOE	77	230
Actions led by local governments and promotions by the national government	Cross-Cutting	CO2,CH4,N2O,HFCs,PFCs,SF6,NF3	Actions led by local governments and promotions by the national government	Law/Standard	Implemented	Reduce greenhouse gas emissions by establishing local municipality action plans (office work version) based on the Global Warming Mitigation Plan and promote the implementation of activities based on the action plans.	2001	MOE	-	-
Initiatives of the national government	Cross-Cutting	CO2,CH4,N2O,HFCs,PFCs,SF6,NF3	Initiatives of the national government	Law/Standard	Implemented	Implement and inspect the National Government Action Plan. Implement and inspect implementation plans at relevant government agencies.	2001	MOE	115	461

Name of mitigation action	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 of entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)	
									2020	2030
Residential Sector										
Improvement of energy efficiency of equipment and devices through top runner programs(Residential Sector)	Energy	CO2	Improvement of energy efficiency of equipment and devices through top runner programs(Residential Sector)	Law/Standard Budget/Subsidy	Implemented	Reduce energy consumption from devices at household sector by improving the energy efficiency of top-running devices.	1998	METI	3,000	4,830
Improvement of energy efficiency of housing	Energy	CO2	Promotion of compliance with energy conservation standards targeting new housing	Law/Standard Taxation Budget/Subsidy Financing Technology Development Awareness Raising Other	Implemented	Reduce CO2 emissions from energy consumed in households by increasing the ratio of household devices that satisfy energy conservation standards. Promote the supply of energy efficient houses by mandating the notification of energy efficiency of houses based on the Act on the Improvement of Energy Consumption Performance of Buildings (issued on July 8, 2015).	2003 (When the reporting period of energy-saving performance started, based on the Energy Saving Law)	MLIT	-	8,720
			Promotion of renovation of thermal insulation for existing housing	Law/Standard Taxation Budget/Subsidy Financing Technology Development Awareness Raising Other	Implemented	Reduce CO2 emissions from energy consumed in households by increasing the ratio of houses that satisfy energy conservation standards. Support the promotion of energy conservation renovation of already constructed houses through tax incentives, subsidies, and loans.	2003 (When the reporting period of energy-saving performance started, based on the Energy Saving Law)	MLIT	-	1,190
Diffusion of highly energy-efficient equipment and devices (Residential Sector)	Energy	CO2	Introduction of highly energy-efficient water heating systems	Budget/Subsidy Awareness Raising	Implemented	Reduce energy consumption through the Introduction of high-efficient water heaters.	2013	METI	2,260	6,170
			Introduction of highly energy-efficient lighting devices	Budget/Subsidy Awareness Raising	Implemented	Reduce energy consumption through the Introduction of high-efficient lighting devices such as LED lamps.	2013	METI	7,110	9,070
			Energy efficiency improvement of septic tanks	Budget/Subsidy Awareness Raising	Implemented	Reduce CO2 emissions from electricity uses by reducing the electricity consumption of blowers through the Introduction of septic tanks with 10% lower electricity consumption compared to the current low-carbon septic tanks when installing a new purification tank or when updating a current one.	2013	MOE	19	39
Implementation of thorough energy management using HEMS and smart meters in the residential sector	Energy	CO2	Implementation of thorough energy management using HEMS and smart meters in the residential sector	Budget	Implemented	Identify detailed household energy consumption using HEMS or smart meters and reduce electricity consumption through the control of devices based on identified data.	2010	METI	2,020	7,100

Name of mitigation action	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 of entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq) 2020	2030
Transport Sector										
Diffusion of next-generation vehicles and improvement of fuel efficiency	Transport	CO2	Diffusion of next-generation vehicles and improvement of fuel efficiency	Law/Standard Taxation Budget/Subsidy Technology Development	Implemented	Reduce CO2 emissions by reducing energy consumption through the diffusion of next-generation automobiles and improved fuel efficiency.	1979 (When the Fuel Efficiency Standards were determined based on the Energy Saving Law)	METI	7,025	23,790
Measures to traffic flow improvements	Transport	CO2	Promotion of the measures to traffic flow improvements	Budget/Subsidy Awareness Raising	Implemented	Build the network of arterial roads, including ring roads, to increase driving speed and implement measures to promote the smart use of roads by promoting the use of ETC2.0.	2012 (Priority Plan for Social Infrastructure Development)	MLIT	-	1,000
			Promotion of the use of Intelligent Transport Systems (the promotion of centrally controlled signals)	Budget/Subsidy Awareness Raising	Implemented	Realize not congested traffic flows with centralized control of traffic lights to improve fuel efficiency and reduce CO2 emissions from automobiles.	2012 (Priority Plan for Social Infrastructure Develoment)	NPA	1,400	1,500
			Development of traffic safety facilities (Improvement of traffic lights)	Budget/Subsidy Awareness Raising	Implemented	Realize not congested traffic flows by improving of traffic lights to improve fuel efficiency and reduce CO2 emissions from automobiles.	2012 (Priority Plan for Social Infrastructure Development)	NPA	520	560
			Development of traffic safety facilities (Promotion of the use of LED traffic lights)	Budget/Subsidy Awareness Raising	Implemented	Switch from light bulbs to LED lights in traffic lights to reduce energy consumption and CO2 emissions.	2012 (Priority Plan for Social Infrastructure Development)	NPA	155	160
			Promotion of automated driving	Budget/Subsidy Awareness Raising	Implemented	Improve energy efficiency in the transport sector using automatic driving technologies such as ACC/CACC technologies.	2012 (Priority Plan for Social Infrastructure Development)	METI	270	1,400
Greening of vehicle transport operators by promoting the environmentally friendly usage of Vehicles	Transport	CO2	Greening of vehicle transport operators by promoting the environmentally friendly usage of Vehicles	Budget/Subsidy Awareness Raising	Implemented	Reduce CO2 emissions by promoting the use of environmentally friendly automobiles.	2012 (Priority Plan for Social Infrastructure Development)	MLIT	300	660
Promotion of public transport utilization and bicycles	Transport	CO2	Promotion of public transport utilization	Taxation Budget/Subsidy Awareness Raising	Implemented	Reduce CO2 emissions from the use of private cars by providing subsidies and tax incentives for the construction of new rail roads, promotion for the use of current train services (e.g. improved convenience of railroad stations), promotion for the use of buses (e.g. the introduction of BRT and bus location system), promotion of the spread of eco-commute, as well as by reconstructing regional public transportation networks and improving the convenience for users.	1992	MLIT	980	1,780

Name of mitigation action	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 of entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)	
									2020	2030
Transport Sector										
Energy efficiency improvement in Railways	Transport	CO2	Improvement of energy efficiency of railways	Taxation Budget/Subsidy Financing Technology Development	Implemented	Promote the use of energy-efficient vehicles, such as vehicles with VVVF systems, vehicles with storage batteries, and hybrid vehicles. Also promote the introduction and use of energy conservation systems in railroad facilities.	2005	MLIT	768	1,776
Energy efficiency improvement in Vessels	Transport	CO2	Promotion of the use of vessels that reduce energy consumption	Taxation Budget/Subsidy Financing Technology Development	Implemented	Reduce CO2 emissions associated with fuel combustion in vessels by promoting the use of energy efficient vessels.	2005	MLIT	640	1,570
Low carbonization in Aviation	Transport	CO2	Promotion of low carbonization in Aviation	Taxation Budget/Subsidy Financing Technology Development	Implemented	Promote of low carbonization in social infrastructures of the airline industry by promoting the introduction and use of new devices with better energy efficiency, advancement of airline traffic systems, energy conservation and CO2 reduction measures at airports, and increasing the use of alternative jet fuels.	2005	MLIT	395	1,012
Promotion to improve truck transport efficiency and cooperative transport and delivery	Transport	CO2	Improvement of the efficiency of truck transportation	Taxation Budget/Subsidy Financing Awareness Raising	Implemented	Reduce CO2 emissions by improving the efficiency of truck transportation.	2001	MLIT	2,020	2,060
			Promotion of cooperative transport and delivery	Budget/Subsidy Awareness Raising	Implemented	Reduce CO2 emissions and labor shortages by promoting cooperative transport and delivery through the cooperation among owners and distributors involved with the truck transport that accounts for the majority of land transport to improve transport efficiency and load efficiency.	2001	MLIT	-	21
General measures for the greening of marine transportation and promotion of modal shifts to rail freight transport	Transport	CO2	General measures for the greening of marine transportation	Taxation Budget/Subsidy Awareness Raising	Implemented	Modal shift to costal shipping will be promoted through support for business based on Act on Advancement of Integration and Streamlining of Distribution Business, as well as by introduction of facilities which supports shipping and promotion of "Eco-Ship Mark".	2001	MLIT	788	1,724
			Promotion of modal shifts to railfreight transport	Taxation Budget/Subsidy Awareness Raising	Implemented	Modal shift to costal shipping will be promoted through support for business based on Act on Advancement of Integration and Streamlining of Distribution Business, as well as by introduction of facilities which supports rail freight and promotion of "Eco-Rail Mark".	2001	MLIT	589	1,334

Name of mitigation action	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 of entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq) 2020	2030
Transport Sector										
Initiatives at Harbors	Transport	CO2	Reduction in the total distance of land transport through the optimum ports selection	Budget/Subsidy	Implemented	The construction and improvement of ports where vessels can touch at would enable coastal transport to the nearest ports, which can reduce the driving distance of truck transport.	2016	MLIT	960	960
			Promotion of introduction of energy-efficient cargo handling machinery	Budget/Subsidy	Implemented	Promote the introduction and use of energy efficient cargo handling machinery.	2016	MLIT,MOE	7.3	7.3
			Promotion of modal shifts and the improvement of transportation efficiency in the reverse logistics	Other	Implemented	Promote modal shift and the improvement of transport efficiency related to the reverse logistics.	2016	MLIT,MOE	15.2	15.2
Schematic promotion of joint measures implemented by multiple Government Ministries and Agencies (Transport Sector)	Transport	CO2	Use of Special Zone System for Structural Reform regarding global warming mitigation measures	Law/Standard	Implemented	Reduce CO2 emissions by decreasing the number of vehicles transporting steel products to public wharfs under special measures on regulations (port and harbor distribution streamlining project using special large transportation vehicles). Also reduce CO2 emissions using special measures on regulations for special project using pipelines for the transport of industrial wastes requiring special management.	2016	CAO	53	53
Energy Conversion Sector										
Maximum introduction of renewable energy	Energy	CO2	Expanded use of electricity generated by renewable energy	Law Budget/Subsidy Taxation Technology Development	Implemented	Reduce CO2 emissions from the combustion of fossil fuels by increasing the use of renewable energies as the source of energy for power generation and heat uses to replace fossil fuels.	n/a	METI	-	156,160 ～ 165,990
			Expanded use of heat generated by renewable energy	Law Budget/Subsidy Taxation Technology Development	Implemented		n/a	METI	-	36,180
Reduction of CO2 emission intensity in the Power Sectors	Energy	CO2	Persuasion of High Efficiency in Thermal Power Generation	Law/Standard Budget/Subsidy Technology Development	Implemented	The voluntary framework of the electricity industry (aiming to achieve the emission coefficient of about 0.37 kg-CO2/kWh, which is consistent with the energy mix and CO2 reduction targets of the national government) was announced in July 2015 with the participation of main electricity companies. The Electric Power Council for a Low Carbon Society was then established in February 2016. The Council established reduction targets of individual companies and announced systems and rules for the entire industry to implement PDCA. The effectiveness of the activities of the entire electricity industry is going to be ensured under the deregulation of electricity systems by establishing policies under the Act on the Rational Use of Energy and the Act on the Advancement of Energy Supply Structures to promote activities to achieve targets set in the voluntary framework.	n/a	METI	7,000	11,000
			Improvement of the efficiency of thermal power generation, use of nuclear power generations whose safety is approved and full use of renewable energy	Law/Standard Budget/Subsidy Technology Development	Implemented		n/a	METI	-	188,000
Promotion of introduction of highly energy-efficient equipment and devices (Oil Product Manufacturing sector)	Energy	CO2	Promotion of introduction of highly energy-efficient equipment and devices (Oil Product Manufacturing sector)	Awareness Raising	Implemented	Japan promotes oil refiners to reduce one million kiloliters of energy in crude oil equivalent from business as usual (BAU) in the oil product manufacturing field, based on the Industry's Action Plan toward a Low Carbon Society through the following initiatives: (i) effective use of heat, (ii) introduction of advanced control and high efficient devices, (iii) improvement of the motors system operation, and (iv) major improvement and advancement of processes.	2013	METI	810	2,080

Name of mitigation action	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 of entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq) 2020	2030
Non-energy related CO_2										
Increasing the use of blended cements	Industry/Industrial Processes	CO2	Increasing the use of blended cements	Law/Standard Awareness Raising	Implemented	Reduce CO2 emitted from decarbonation of limestone in the clinker production process by increasing the use of blended cements. It leads to decrease the production of clinker, the intermediate product of cement.	Year 2001 (Based on Act on Green Purchasing, blended cements is are designated as the eco-friendly goods.)	METI,MLIT,MOE	44	388
Diffusion of biomass plastics	Waste Management / Waste	CO2	Diffusion of biomass plastics	Other	Implemented	Reduce non-energy oriented CO2 emissions from the combustion of plastics that are nonindustrial and industrial waste by increasing the use of biomass plastic, a carbon-neutral product, to replace the plastic made from petroleum used in products.	2016	MOE	720	2,090
Reduction of the amount of waste incineration	Waste Management / Waste	CO2	Reduction of the amount of waste incineration.	Law/Standard Awareness Raising Other	Implemented	Reduce the amount of incineration and non-energy oriented CO2 emissions from the combustion of plastics by reducing the emission of plastics of municipal solid waste and by promoting the recycled uses through the sorted collection and recycling of plastic containers and wrapping products based on the Act on the Promotion of Sorted Collection and Recycling of Containers and Packaging. Also reduce non-energy oriented CO2 emissions from the incineration of industrial plastic waste by decreasing its amount through the promotion of 3R activities.	2016(National Plan for Adaptation to the Impacts of Climate Change)	MOE	320	440
Methane										
Measures to reduce greenhouse gas emissions from agricultural soil	Agriculture	CH4	Reduction of methane emissions associated with rice cultivation	Law/Standard Budget/Subsidy	Implemented	Reduce methane emission from paddy fields by promoting soil preparation based on the conversion from the plowing-in of rice straw of which the methane emission factor is relatively large to the application of compost of which the emission factor is lower.	2007	MAFF	330～920	640～2430
Reduction of the amount of wastes in final disposal	Waste Management / Waste	CH4	Reduction of the amount of wastes in final disposal	Law/Standard Other	Implemented	Reduce the direct landfilling of organic municipal solid waste by banning the direct landfilling of such waste. Reduce methane emissions associated with the biological decomposition of organic municipal solid waste in landfill sites. Continuously reduce the final disposal of industrial wastes through the promotion of 3R activities.	2016(National Plan for Adaptation to the Impacts of Climate Change)	MOE	180	520
Adoption of semi-aerobic landfill structure in final waste disposal sites	Waste Management / Waste	CH4	Adoption of semi-aerobic landfill structure in final waste disposal sites	Law/Standard Other	Implemented	Reduce methane emissions associated with the biological decomposition of organic waste to realize lower emissions from anaerobic landfill structure by selecting semi-aerobic landfill structure for the new construction of landfill sites and managing the ends of wastewater pipes in open systems.	2016(National Plan for Adaptation to the Impacts of Climate Change)	MOE	10	30

Name of mitigation action	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 of entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq) 2020	2030
Nitrous Oxide (N_2O)										
Measures to reduce greenhouse gas emissions from agricultural soil	Agriculture	N2O	Emissions reduction of nitrous oxide associated with the application of inorganic fertilizers	Law/Standard Budget/Subsidy	Implemented	Reduce N2O emissions from the application of inorganic fertilizers by reducing the use of fertilizers, practicing divided fertilization, and using slow-acting fertilizers.	2007	MAFF	70	100
Advancement of combustion in sewage sludge incineration facilities	Waste Management / Waste	N2O	Advancement of combustion in sewage sludge incineration facilities	Taxation Budget/Subsidy Technology Development	Implemented	Reduce N2O emissions from the incineration of sludge generated from wastewater treatment by advancement of incineration systems.	2001 (the level of sophistication of combusting sewage sludge at sewage treatment facilitie was standardized)	MLIT	500	780
Fluorinated Gases (HFCs, PFCs, SF_6, and NF_3)										
Measures to fluorinated gases	Other	HFCs,PFCs,SF6,NF3	Promote eliminating fluorocarbons and lowering GWP in gases and products manufacture	Law/Standard Budget/Subsidy Technology Development Awareness Raising	Implemented	Promote eliminating fluorocarbons and lowering GWP by following up on target achievement status for designated products and supporting the use of energy efficient devices with natural refrigerant.	2015 (Act on Rational Use and Proper Management of Fluorocarbons came into force)	MOE,METI	3,500	11,200
			Preventing leakage of fluorocarbons from use of refrigeration and air conditioning equipment for business use	Law/Standard	Implemented	Reduce leaks of fluorocarbons while using products through the effective use of fluorocarbons leakage report system and public announcement system, the support for prefectures to instruct and supervise relevant activities and to implement awareness-raising activities.	2015 (Act on Rational Use and Proper Management of Fluorocarbons came into force)	MOE,METI	6,500	20,100
			Promotion of recovery of fluorocarbons from refrigeration and air conditioning equipment for business use in disposal	Law/Standard Budget/Subsidy Awareness Raising	Implemented	Achieve a high recover rate by supporting prefectures to give instructions, supervise, and raise awareness for relevant activities.	2001 (Fluorocarbons Recovery and Destruction Law was adopted)	MOE,METI	7,900	15,700
			Promotion of voluntary initiatives in industries	Voluntary Agreement	Implemented	Reduce the emissions of HFCs and other three gases from various fields by following up on the progress of autonomous action plans.	1998	MOE,METI	550	1,220

Name of mitigation action	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 of entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)	
									2020	2030
Carbon Sink										
Forest Sink Strategies	LULUCF	CO_2	Forest Sink Strategies	Law/Standard Budget/Subsidy Technology Development Awareness Raising	Implemented	Maintain the CO_2 removals in forests by promoting the maintenance of healthy forests through proper forest thinning and forest building, properly managing and protecting conservation forests, implementing activities to train people to engage in efficient and stable forestry business, encouraging forest development with the participation of citizens, and promoting measures to conserve forest absorption sources by controlling the use of lumbers and wooden biomass, using various methods based on the Forest and Forestry Basic Plan.	2007	MAFF	pprox. 38,00	pprox. 27,800
Measures for Sinks in Agricultural Soils	LULUCF	CO_2	Measures for Sinks in Agricultural Soils	Law/Standard Budget/Subsidy Technology Development Awareness Raising	Implemented	Promote carbon storage in cropland and grassland soils by promoting soil development using organic matter such as compost and green manure.	2008	MAFF	7,080 ～ 8,280	6,960 ～ 8,900
Promotion of Urban Greening	LULUCF	CO_2	Promotion of Urban Greening	Law/Standard Budget/Subsidy Technology Development Awareness Raising	Implemented	Build parks in cities and increase green areas around roads, harbors, etc.	2006	MLIT	1,190	1,240

Name of mitigation action	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 of entities	Estimate of mitigation impact (not cumulative, in kt CO2 eq)	
									2020	2030
Cross-sectional Strategies										
Promotion of J-Credit Scheme	Cross-Cutting	CO2,CH4,N2O,HFCs,PFCs,SF6,NF3	Promotion of J-Credit Scheme	Budget/Subsidy	Implemented	Certify credits for the reduction of greenhouse gas emissions and the removals of greenhouse gas which are achieved by reduction measures, such as the use of energy efficient facilities and the use of renewable energies, and removal measures implementing proper forest management. Also promote the use of the credit to achieve the Industry's Action Plan toward a Low Carbon Society and carbon offset.	2013	MOE,METI,MAFF	3,210	6,510
Development of public campaigns	Energy	CO2	Promotion of thorough implementation of Cool Biz (Commercial Sector)	Budget/Subsidy Awareness Raising	Implemented	Among the energy conservation measures implemented to achieve the INDC of Japan, CO2 emissions reduction measures in the public and consumer sector are extremely important as the emission is increasing in this sector. The CO2 emissions need to be reduced by about 40% in the household and commercial sector and about 30% in the transport sector. In order to achieve these goals, the public needs to improve their understanding on the critical conditions of global climate change and its negative effects on the society. In addition, energy-efficient attires, shift to energy efficient devices, Home CO2 advisor service, and efficient use of lighting devices are also promoted. The practice of eco-driving and car sharing is also encouraged to reduce environmental load.	2005	MOE	73	145
			Promotion of thorough implementation of Cool Biz (Residential Sector)	Budget/Subsidy Awareness Raising	Implemented		2005	MOE	77	150
			Promotion of thorough implementation of Warm Biz(Commercial Sector)	Budget/Subsidy Awareness Raising	Implemented		2005	MOE	77	116
			Promotion of thorough implementation of Warm Biz(Residential Sector)	Budget/Subsidy Awareness Raising	Implemented		2005	MOE	158	291
			Promotion of equipment replacement (electric dehumidifier(compression type) and full automatic washing with drying machine)	Budget/Subsidy Awareness Raising	Implemented		2005	MOE	110	112
			Home CO2 advisor service	Budget/Subsidy Awareness Raising	Implemented		2005	MOE	11	137
			Efficient use of lighting devices	Budget/Subsidy Awareness Raising	Implemented		2005	MOE	1,150	1,680
			Eco driving (private cars、private freight car)	Budget/Subsidy Awareness Raising	Implemented		2005	MOE	1,930	2,440
			Car sharing	Budget/Subsidy Awareness Raising	Implemented		2005	MOE	430	550
Promotion of measures based on Local Government Action Plan for Regional Measures	Energy,Transport,Industry/Industrial Processes,Agriculture,LULUCF,Waste Management/Waste,Other	CO2,CH4,N2O,HFCs,PFCs,SF6,NF3	Promotion of measures based on Local Government Action Plan for Regional Measures	Law/Standard Budget/Subsidy Awareness Raising	Implemented	Promote the establishment of regional municipality action plans (regional measures edition) to accelerate measures to mitigate climate change at regional levels and reduce the emission of greenhouse gases.	2008	MOE	-	-

Table 3-2 Target indicator and target level of each industry in Industry's Action Plans towards a Low-carbon Society

Type of industry	2020			2030		
	Target indicator	Base year/BAU	Target level of 2020	Target indicator	Base year/BAU	Target level of 2030
Industry Sector						
Industry under Ministry of Finance						
Brewers Association of Japan	CO_2 emissions	BAU	-54kt-CO_2(Comparison to BAU)	CO_2 emissions	BAU	-102kt-CO_2(Comparison to BAU)
Japan Tobacco Inc.	GHG emissions	2009	- 20%	-	-	-
Indeustry under Ministry of Health, Labour and Welfare						
The Federation of Pharmaceutical Manufacturers' Associations of Japan	CO_2 emissions	2005	-23%	CO_2 emission intensity (amount of sales/CO_2 emissions)	2005	3 times
				CO_2 emissions		-40%
Industry under Ministry of Fisheries, Forestry and Agriculture						
Japan Soft Drink Association	CO_2 emission intensity	1990	-10%	CO_2 emission intensity	2012	-18%
Japan Starch & Sweeteners Industry Association	CO_2 emission intensity	2005	-3%	CO_2 emission intensity	2005	-5%
Japan Dairy Industry Association	energy consumption intensity	2012	-1%(Annual rate)	energy consumption intensity	2012	-1%(Annual rate)
Japan Baking Industry Association	CO_2 emission intensity	2009	-1%(Annual rate)	-	-	-
Japan Canners Association	energy consumption intensity	2009	-1%(Annual average)	-	-	-
All Nippon Kashi Association	CO_2 emissions	2013	-7%	CO_2 emissions	2013	-17%
Japan Beet Sugar Association	energy consumption intensity	2010	-15%	energy consumption intensity	2010	-15%
Japan Oilseed Processors Association	CO_2 emission intensity	1990	-16%	CO_2 emission intensity	1990	-16%
	CO_2 emissions	1990	-8%	CO_2 emissions	1990	-8%
Japan Frozen Food Association	energy consumption intensity	2013	-6.8%	energy consumption intensity	2013	-15.7%
Japan Sugar Refiners' Association	CO_2 emissions	1990	-33%	CO_2 emissions	1990	-33%
Flour Millers Association	CO_2 emission intensity	1990	-16.5%	-	-	-
Japan Ham & Sausage Processors Cooperative Association	energy consumption intensity	2011	-5%	energy consumption intensity	2011	-1%(Annual average)
All Japan Coffee Association	CO_2 emission intensity	2005	-15%	CO_2 emission intensity	2005	-25%
Japan Convenience Foods Industry Association	CO_2 emission intensity	1990	-30%	CO_2 emission intensity	1990	-21%
Japan Soy-sauce Association	CO_2 emissions	1990	-18%	CO_2 emissions	1990	-23%
Nihon Hamburg & Hamburger Association	energy consumption intensity	2011	-5%	energy consumption intensity	2011	-1%(Annual average)
Japan Rice Millers Association	energy consumption intensity	2005	-10%	energy consumption intensity	2005	-12%
Japan Association of Mayonnaise & Dressings	CO_2 emissions	2012	-8.7%	CO_2 emissions	2012	-21.1%
	CO_2 emission intensity		-4.8%	CO_2 emission intensity		-17.9%

Type of industry	2020			2030		
	Target indicator	Base year/BAU	Target level of 2020	Target indicator	Base year/BAU	Target level of 2030
Industry Sector						
Industry under Ministry of Economy, Trade and Industry						
The Japan Iron and Steel Federation	CO2 emissions	BAU	-5000kt-CO2(Comparison to BAU)	CO2 emissions	BAU	-9000kt-CO2(Comparison to BAU)
Japan Chemical Industry Association	CO2 emissions	BAU	-1500kt-CO2(Comparison to BAU)	CO2 emissions	BAU	-2000kt-CO2(Comparison to BAU)
Japan Paper Association	CO2 emissions	BAU	-1390kt-CO2(Comparison to BAU)	CO2 emissions	BAU	-2860kt-CO2(Comparison to BAU)
Japan Cement Association	energy consumption intensity	2010	-1.10%	energy consumption intensity	2010	-1.40%
Liaison Group of Japanese Electrical and Electronics Industries for Global Warming Prevention	energy consumption intensity	2012	-7.73%	energy consumption intensity	2012	-16.55%
Japan Auto Parts Industries Association	CO2 emission intensity	2007	-13%	CO2 emission intensity	2007	-20%
Japan Automobile Manufacturers Association / Japan Auto-Body Industries Association	CO2 emissions	1990	-28%	CO2 emissions	1990	-33%
Japan Mining Industry Association	CO2 emission intensity	1990	-15%	CO2 emission intensity	1990	-18%
Lime Manufacture Association	CO2 emissions	BAU	-150kt-CO2(Comparison to BAU)	CO2 emissions	BAU	-120kt-CO2(Comparison to BAU)
The Japan Rubber Manufactures Association	CO2 emission intensity	2005	-15%	CO2 emission intensity	2005	-21%
Japan Aluminium Association	energy consumption intensity	BAU	-0.8GJ/t(Comparison to BAU)	energy consumption intensity	BAU	-1.0GJ/t(Comparison to BAU)
Japan Federation of Printing Industries	CO2 emissions	2010	-85kt-CO2	CO2 emissions	2010	-180kt-CO2
Japan Textile Finishers' Association	CO2 emissions	1990	-39%	CO2 emissions	1990	-40%
Flat Glass Manufacturers Association of Japan	CO2 emissions	1990	-35%	CO2 emissions	1990	-49%
Japan Glass Bottle Association	CO2 emissions	1990	724kt-CO2	CO2 emissions	1990	700kt-CO2
	energy consumption		343GL	energy consumption		341GL
The Japanese Electric Wire & Cable Makers' Association	(Copper・Aluminum) energy consumption	1990	-34%	(Copper・Aluminum) energy consumption	1990	-36%
	(Optical fiber) energy consumption	1990	-80%	(Optical fiber) energy consumption	1990	-80%
The Japan Bearing Industry Association	CO2 emission intensity	1997	-23%	CO2 emission intensity	1997	-28%
The Japan Society of Industrial Machinery Manufacturers	energy consumption intensity	2008〜2012(average of 5 years)	-1%(Annual average)	CO2 emissions	2013	-6.50%
Japan Copper and Brass Association	energy consumption intensity	BAU	-1 %(Comparison to BAU)	energy consumption intensity	BAU	-1 %(Comparison to BAU)
Japan Construction Equipment Manufacturers Association	energy consumption intensity	2008〜2012(average of 5 years)	-8%	energy consumption intensity	2013	-17%
Limestone Association of Japan	CO2 emissions	BAU	-4,300t-CO2(Comparison to BAU)	CO2 emissions	BAU	-5,800t-CO2(Comparison to BAU)
Japan Machine Tool Builders' Association	energy consumption intensity	2008〜2012(average of 5 years)	-7.70%	energy consumption intensity	2008〜2012(average of 5 years)	-12.20%

Type of industry	2020			2030		
	Target indicator	Base year/BAU	Target level of 2020	Target indicator	Base year/BAU	Target level of 2030
Industry Sector						
Industry under Ministry of Economy, Trade and Industry						
Japan Petroleum Development Association	CO_2 emission intensity	1990	-25%	CO_2 emissions	2005	-60kt-CO_2
	CO_2 emissions	2005	-60kt-CO_2			
Japan Sanitary Equipment Industry Association	CO_2 emissions	1990	-35%	CO_2 emissions	2005	-49%
Japan Prefabricated Construction Suppliers & Manufacturers Association	CO_2 emission intensity	2010	-10%	CO_2 emission intensity	2010	-10%
Japan Industrial Vehicles Association	CO_2 emissions	2005	51kt-CO_2	CO_2 emissions	2005	49kt-CO_2
Industry under Ministry of Land, Infrastructure, Transport and Tourism						
Japan Federation of Construction Contractors	CO_2 emission intensity	1990	-20%	CO_2 emission intensity	1990	-25%
Japan Federation of Housing Organizations	CO_2 emissions of construction phase （whole of life cycle）	1990	2700kt-CO_2 （158,100kt-CO_2）	Environmental performance of new housing	—	Realization of ZEH with new housing average
The Shipbuilders' Association of Japan/The Cooperative Association of Japan Shipbuilders	CO_2 emission intensity	2012	-5%	CO_2 emissions	2013	-6.5%
Japan Ship Machinery and Equipment Association	energy consumption intensity	1990	-27%	energy consumption intensity	1990	-30%
Japan Marine Industry Association	CO_2 emissions	2010	-1%(Annual rate)	CO_2 emissions	2010	-0.5%(Annual rate)
Japan Association of Rolling Stock Industries	CO_2 emissions	1990	-33%	CO_2 emissions	1990	-35%
Commercial and Other Sector						
Industry under Financial Services Agency						
Japanese Bankers Association	energy consumption intensity	2009	-10.5%	energy consumption intensity	2009	-19%
The National Association of Shinkin Banks	energy consumption	2009	-10.5%	energy consumption	2009	-19%
Japan Securities Dealers Association	energy consumption intensity	2009	-10%	energy consumption intensity	2009	-20%
The Life Insurance Association of Japan	energy consumption	2009	-1%(Annual average)	energy consumption	2020	-1%(Annual average)
The General Insurance Association of Japan	energy consumption intensity	2009	-10.5%	energy consumption intensity	2009	-14.8%
Community Bank Shinyo Kumiai	energy consumption	2006	-10%	energy consumption	2009	-18%

Type of industry	2020			2030		
	Target indicator	Base year/BAU	Target level of 2020	Target indicator	Base year/BAU	Target level of 2030
Commercial and Other Sector						
Industry under Ministry of Internal Affairs and Communications						
Telecommunications Carriers Association	energy consumption intensity	2010	-1%	energy consumption intensity	2010	-1%
The Japan Commercial Broadcasters Association	CO2 emission intensity	2012	-8%	-	-	-
Japan Broadcasting Corporation	-	-	-	-	-	-
Telecom Services Association	-	-	-	-	-	-
Japan Cable and Telecommunications Association	-	-	-	-	-	-
Japan Satellite Broadcasting Association	energy consumption intensity	2010	-10%	energy consumption intensity	2010	-15%
Japan Internet Providers Association	-	-	-	-	-	-
Industry under Ministry of Education, Culture, Sports, Science and Technology						
The Federation of All Japan Private Schools' Associations	CO2 emissions	2015	-1%(Annual rate)	-	-	-
Industry under Ministry of Health, Labour and Welfare						
Japan Medical Association / Council of 4 Hospitals	-	-	-	CO2 emission intensity	2006	-25.0%
Japanese Consumers Co-operative Union	CO2 emissions	2005	-15%	-	-	-
Industry under Ministry of Fisheries, Forestry and Agriculture						
Japan Foodservice Association	energy consumption intensity	2013	-6.8%	energy consumption intensity	2013	-15.7%
Japan Processed Foods Wholesalers Association	energy consumption intensity	2011	-5%	-	-	-
Industry under Ministry of Economy, Trade and Industry						
Japan Chain Stores Association	energy consumption intensity	1996	-24%	energy consumption intensity	1996	-24%
Japan Franchise Association	energy consumption intensity	2010	-10%	energy consumption intensity	2010	-10%
Japan Council of Shopping Centers	energy consumption intensity	2005	-13%	energy consumption intensity	2005	-23%
Japan Department Stores Association	energy consumption intensity	1990	-20%	energy consumption intensity	1990	-38%
Japan Association of Chain Drug Stores	energy consumption intensity	Average from 2005 to 2013	-8%	energy consumption intensity	Average from 2005 to 2013	-11%
Ote Kaden Ryutsu Kyoukai (home appliances retail)	energy consumption intensity	2006	-44%	energy consumption intensity	2006	-49.1%
Japan Information Technology Services Industry Association	（Office） energy consumption	2006	-2%	（Office） energy consumption	2006	-5.1%
	（Data center） energy consumption	2006	-5.5%	（Data center） energy consumption	2006	-7.1%
Japan DIY Industry Association	energy consumption intensity	2004	-15%	energy consumption intensity	2004	-25%
Japan Foreign Trade Council, Inc.	energy consumption intensity	2009	-15.3%	energy consumption intensity	2009	-19.0%
Japan LP Gas Association	energy consumption	2010	-5%	energy consumption	2010	-9%
Japan Leasing Association	energy consumption intensity	2009	-10%	energy consumption intensity	2009	-20%

Type of industry	2020			2030		
	Target indicator	Base year/BAU	Target level of 2020	Target indicator	Base year/BAU	Target level of 2030
Commercial and Other Sector						
Industry under Ministry of Land, Infrastructure, Transport and Tourism						
Japan Automobile Service Promotion Association	-	-	-	-	-	-
The Japan Warehousing Association Inc.	energy consumption intensity	1990	-16%	energy consumption intensity	1990	-20%
Japan Association of Refrigerated Warehouses	energy consumption intensity	1990	-15%	energy consumption intensity	1990	-20%
Japan Hotel Association	energy consumption intensity	2010	-10%	energy consumption intensity	2010	-15%
Japan Ryokan & Hotel Association	-	-	-	-	-	-
The Real Estate Companies Association of Japan	energy consumption intensity	2005	-25%	energy consumption intensity	2005	-30%
Japan Building Owners and Managers Association	energy consumption intensity	2009	-15%	energy consumption intensity	2009	-20%
Industry under Ministry of the Environment						
National Federation of Industrial Waste Management Associations	GHG emissions	2010	±0%	-	-	-
The Japan Newspaper Publishers & Editors Association	energy consumption	2005	-13%	-	-	-
Zenkoku Pet Kyoukai (pet retail)	CO_2 emission intensity	2012	±0%	CO_2 emission intensity	2012	±0%
Industry under National Police Agency						
All Japan Pachinko Association	CO_2 emissions	2007	-18%	CO_2 emissions	2007	-22%
All Nippon Amusement Machine Operators' Union	CO_2 emissions	2012	-8.9%	CO_2 emissions	2012	-16.6%

Type of industry	2020			2030		
	Target indicator	Base year/BAU	Target level of 2020	Target indicator	Base year/BAU	Target level of 2030
Transport Sector						
Industry under Ministry of Land, Infrastructure, Transport and Tourism						
The Japanese Shipowners' Association	CO2 emission intensity	1990	-20%	CO2 emission intensity	1990	-30%
Japan Trucking Association	CO2 emission intensity	2005	-22%	CO2 emission intensity	2005	-31%
The Scheduled Airlines Association of Japan	CO2 emission intensity	2005	-21%	CO2 emission intensity	2012	-16%
Nihon Bus Association	CO2 emission intensity	2010	-6%	-	-	-
Japan Federation of Hire-Taxi Associations	CO2 emissions	2010	-20%	CO2 emissions	2010	-25%
Japan Passengerboat Association	CO2 emission intensity	1990	-6%	CO2 emission intensity	2012	-3.6%
Japan Federation of Coastal Shipping Associations	CO2 emissions	1990	-31%	CO2 emissions	1990	-34%
The Association of Japanese Private Railways	energy consumption intensity	2010	-5.7%	energy consumption intensity	2010	-5.7% or more
East Japan Railway Company	energy consumption	2010	-8%	energy consumption	2010	-25%
	CO2 emission intensity of Private power generation	1990	-30%			
West Japan Railway Company	energy consumption	2010	-3%	energy consumption	2010	-2%
Central Japan Railway Company	energy consumption intensity	1995	-25%	energy consumption intensity	1995	-25%
Japan Freight Railway Company	energy consumption intensity	2013	-8%	energy consumption intensity	2013	-15%
The Japan Harbor Transportation Association	CO2 emission intensity	2005	-12%	-	-	-
Kyushu Railway Company	energy consumption intensity	2011	-2.5%	energy consumption intensity	2011	-2.5%
	Introduction ratio of energy saving vehicles	-	83%	Introduction ratio of energy saving vehicles	-	83%
Hokkaido Railway Company	energy consumption intensity	1995	-14%	-	-	-
	Possession ratio of energy saving vehicles	1995	85%	-	-	-
All Japan Freight Forwarders Association	CO2 emissions	2009	-11%	CO2 emissions	2009	-20.2%
Shikoku Railway Company	energy consumption	2010	-8%	energy consumption	2010	-8%

Type of industry	2020			2030		
	Target indicator	Base year/BAU	Target level of 2020	Target indicator	Base year/BAU	Target level of 2030
Energy Conversion Sector						
Industry under Ministry of Economy, Trade and Industry						
The Electric Power Council for a Low Carbon Society	CO_2 emissions	BAU	-7000kt-CO_2(Comparison to BAU)	CO_2 emission intensity	-	about 0.37kg-CO_2/kWh
				CO_2 emissions	BAU	-1100kt-CO_2(Comparison to BAU)
Petroleum Association of Japan	energy reduction	BAU	-530GL(Comparison to BAU)	energy reduction	BAU	-1000GL(Comparison to BAU)
The Japan Gas Association	CO_2 emission intensity	1990	9.9g-CO_2/m3	CO_2 emission intensity	1990	10.4g-CO_2/m3
	energy consumption intensity	1990	0.26MJ/m3	energy consumption intensity	1990	0.27MJ/m3

3.2.4 Policies and Measures Based on Kyoto Protocol

3.2.4.1 Formulating International Regulation on CO_2 Emissions from Aviation and Maritime Transport Industries

It is difficult in international transportation industries (including international aviation and maritime transport industries) to decide how to allocate CO_2 emissions allowances to each country since they operate transnationally, thus the industries are excluded from the subjected industries of the Kyoto Protocol and it is currently discussed how to reduce the emissions from the industries by the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO).

In the international aviation industry, some emissions reduction policies have already practiced such as improving fuel efficiency by 2 per cent per annum and keeping the net carbon emissions from 2020 at the same level, which was set by ICAO. Meanwhile Japan has also actively been committing into the discussions. ICAO adopted the resolution on the Global Market Based Measure in the 39th Assembly last October and showed its strong commitment to emission reductions in the international aviation sector. Also, it was adopted at the 210th ICAO council held in February 2017 concerning the establishment of an annex toward the start of application of CO_2 emission standards from 2020.

In the international shipping industry, Japan played a leading role at the IMO in the review process on the phased strengthening of the EEDI (Energy Efficiency Design Index) regulation which started in 2013. In addition, the International Convention for the Prevention of Pollution from Ships was amended by IMO in 2016 to introduce the Data Collection System for Fuel Consumption (which aims to visualize fuel consumption of ships in actual operation and to encourage energy efficient operation) and the amendment was based on the proposal from Japan. The Ministry of Land, Infrastructure, Transport and Tourism has strategically suggested promoting innovative development of technologies associated with a production of low-emission ships and the practical use of natural gas-fueled ships parallel with the negotiation over the introduction of the fuel efficiency regulation. The provisional amendments which will be implemented from 2019 will possibly lead to the enhancement of competence of Japan over the international maritime transport industry as well as the significant reduction of CO_2 emissions from the industry.

3.2.4.2 Actions to Minimize Adverse Impacts in Accordance with Article 3, Paragraph 14

(1) Assessment of economic and social consequences of response measures

Japan takes actions, taking into account the importance to make an effort to minimize adverse impacts in accordance with Article 3, paragraph 14. 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 balance between supply and demand as well as numerous other factors (e.g., trend in crude oil futures market or economic fluctuation), and it is uncertain whether there exists a causal link or, if so, to what extent it results from adverse impacts of climate change policy and measures.

In addition, it is necessary to change the perception of response measures in order to address climate change issues effectively, and sustainable development could be one of the key options. For instance, the introduction of renewable energy leads to improve energy access, prepare for a disaster and create employment through development of a new industry, as well as contributes to reducing GHG emissions. As discussed in Rio+20 and COP, the transition to green economy and the attainment of low-carbon growth are the key elements in order to address climate change and to achieve the sustainable development which strikes a balance between environment and economy. Efforts toward the establishment of low-carbon society should be accelerated throughout the world. Japan proposed “East Asia Low Carbon Growth Partnership” with the aim of promoting low-carbon growth through regional cooperation among the participating countries of the East Asia Summit and presented “A proposal from East Asia Low Carbon Growth Partnership Dialogue - Transformation to Low Carbon Growth –“which contains some good practices towards the low carbon economic growth at a COP21 official side event. In order to facilitate the achievement of an agreement at COP21, Japan announced its new policies of contribution called “Actions for Cool Earth 2.0 (ACE 2.0)” which consists of two pillars: (1) providing support to developing countries worth of 1.3 trillion yen in 2020 and (2) promoting innovation. Japan continues to proactively contribute to the international community in these fields.

(2) Actions to minimize adverse impacts in accordance with Article 3, paragraph 14

Japan has given a priority to the efforts below, taking into consideration that these efforts are important to minimize 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 noted that it is impossible to evaluate these efforts since the method of evaluation has not been established internationally.

■ Technical assistance in the energy and environmental sectors

Japan has provided technical assistance in the field of energy and environment throughout the world and has contributed to the sustainable economic growth of developing countries taking into consideration their needs. For example, Japan has provided cooperation for development and operation of institutions related to energy-saving and renewable energy through capacity building such as inviting trainees from, and sending experts to developing countries including in Middle East region. Moreover, from the view point of deployment of renewable energy in small island nations particularly vulnerable to climate change, Japan, in collaboration with International Renewable Energy Agency (IRENA), invited governmental officials from Asia-Pacific and other small island nations to international workshop in Fiji (December 2016) and training program in Tokyo (February 2016) for capacity building and support for developing projects.

■ Development of carbon capture and storage (CCS) technologies

Recognizing that CCS is an important technology for global warming countermeasures, Japan has been implementing large-scale demonstration projects toward practical use of CCS by around 2020, research and development activities on cost reductions and safety improvements, evaluations of environmental impacts in the CO_2 capture process, and geological surveys to identify potential CO_2 offshore storage sites in Japan. Also, Japan actively exchanged information on CCS technologies with other countries such as the United States of America and European countries.

3.3 Policies and Measures no longer in place

All policies and measures reported in the 6th National Communication (NC6) submitted in December 2013 are being implemented. There are no policies and measures that are no longer in place.

Chapter 4

Projections

4.1 Projections

4.1.1 Projected scenarios

The future level of 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 FY2020 and FY2030 are estimated as follows.

Based on the outlook on macro frame shown in 4.4.1, the projections for FY2020 and FY2030 are estimated under a 'with measures' scenario taking into account future emission reduction by each policy and measure described in 3.1.2.

The energy supply structure satisfying the energy demand (Primary energy supply) without measures was not estimated in Japan. 'With measures' scenario is taking into account the policy measures already implemented in FY2013 and policy measures to be implemented by FY2030.

4.1.2 Overall projections of GHG emissions

The estimated total GHG emissions in FY2020 under a 'with measures' scenario are approximately 1,399 million t-CO_2 equivalent, which are an increase by 0.2% from the base year FY2005 (1,397million ton). However, they aim at a target of 3.8% or more emission reduction in FY2020 compared to the FY2005 level by implementing additional mitigation measures and using removals from LULUCF sector[45].

The estimated total GHG emissions in FY2030 under a 'with measures' scenario is approximately 1,079 million t-CO_2 equivalent. It is a decrease by 23.4% and 22.7% from FY2013 and FY2005, respectively. Taking into the account the projections of removals (removals from forests (approximately 27.8 million t-CO_2), agricultural soils (approximately 7.9 million t-CO_2) and revegetation (approximately 1.2 million t-CO_2)) in FY2030, they decrease by 26.0% and 25.4% from FY2013 and FY2005, respectively, as shown in Japan's NDC.

[45] The projections of removals in FY2020 are expected to be removals from forests (approximately 38 million t-CO_2), agricultural soils (approximately 7.7 million t-CO_2) and revegetation (approximately 1.2 million t-CO_2).

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 (2005)	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2030**
Sector									
Energy	1,009,693.34	887,029.05	927,209.22	956,559.13	1,011,324.63	947,165.71	967,837.99	1,053,578.32	784,200.00
Transport	235,977.66	204,245.55	244,866.29	253,322.94	235,791.69	217,696.14	206,810.43	194,840.61	165,500.00
Industry/industrial processes	84,728.60	110,451.48	136,418.29	108,173.62	86,721.16	80,158.47	93,020.28	93,001.43	74,800.00
Agriculture	40,015.02	37,635.95	37,158.50	35,322.91	35,227.10	35,885.72	33,666.91	38,723.08	37,500.00
Forestry/LULUCF	-89,643.58	-63,455.06	-77,779.64	-88,809.20	-91,547.81	-70,091.39	-60,939.88	-36,404.03	-25,900.00
Waste management/waste	26,095.94	28,897.43	32,166.79	31,668.20	26,666.91	22,796.30	21,232.21	19,321.96	17,300.00
Gas									
CO_2 emissions including net CO_2 from LULUCF	1,214,416.17	1,157,164.51	1,243,848.87	1,275,777.13	1,307,693.19	1,215,010.75	1,225,239.49	1,261,710.51	971,600.00
CO_2 emissions excluding net CO_2 from LULUCF	1,304,375.96	1,093,427.39	1,165,799.19	1,186,712.02	1,215,898.89	1,144,690.19	1,164,070.04	1,298,375.21	997,800.00
CH_4 emissions including CH_4 from LULUCF	39,029.18	44,223.07	41,637.89	37,666.02	35,279.25	34,855.00	31,294.94	33,988.76	31,700.00
CH_4 emissions excluding CH_4 from LULUCF	38,962.32	44,296.05	41,707.78	37,732.72	35,346.11	34,914.69	31,354.31	33,932.91	31,600.00
N_2O emissions including N_2O from LULUCF	25,760.31	31,517.58	32,860.59	29,561.41	24,829.11	22,318.20	20,829.59	21,762.11	21,300.00
N_2O emissions excluding N_2O from LULUCF	25,510.95	31,726.66	33,060.74	29,750.62	25,008.76	22,487.68	20,999.79	21,557.28	21,100.00
HFCs	12,724.24	15,932.31	25,213.19	22,852.00	12,781.83	23,305.23	39,202.80	38,300.00	21,600.00
PFCs	8,623.35	6,539.30	17,609.92	11,873.11	8,623.35	4,249.54	3,308.10	4,000.00	4,200.00
SF_6	5,063.86	12,850.07	16,447.52	7,031.36	5,053.01	2,423.87	2,121.86	2,400.00	2,700.00
NF_3	1,249.87	32.61	201.09	285.77	1,471.75	1,539.74	571.03	1,000.00	500.00
Total with LULUCF	1,306,866.97	1,268,259.45	1,377,819.08	1,385,046.80	1,395,731.50	1,303,702.34	1,322,567.82	1,363,061.37	1,054,000.00
Total without LULUCF	1,396,510.56	1,204,804.39	1,300,039.44	1,296,237.60	1,304,183.69	1,233,610.94	1,261,627.94	1,399,465.40	1,079,000.00

*Projected emissions of Transport sector for FY2020 and FY2030 include CO_2 emissions from electricity consumption from railways which is typically included in the energy sector.

*For FY 2020, the Total does not match the sum of the gases because of rounding.

*For FY 2030, the Total does not match the sum of the sectors because of rounding. *'Base year (2005)' shows value in reduction targets agreement.

*For projections in FY 2020 and 2030 in Forestry/LULUCF, projections relating to managing forest carbon sink, carbon sinks in agricultural soils, and urban greening are derived from activity-based assumption in line with KP-LULUCF.

4.1.3 Projections by gas

4.1.3.1 Energy-related CO_2

Energy-related CO_2 covers approximately 90% of Japan's GHG emissions. Based on statistics, it can be broken down into the following 5 sectors: Industry; Commercial and other; Residential; Transport; and Energy conversion. The effects of policies and measures can be observed in each sector as well. Table 4-2 shows emission projection for each sector.

The estimated emissions in FY2020 increase by 0.4% (approximately 1,224 million t-CO_2) compared to the emissions in FY2005. A significant reduction is expected in the Transport sector, meanwhile estimated emissions increase in Industry, Commercial and other sectors due to vitalization of economic activities. However, actual emissions in FY2015 shows a reduction by 5.7% (approximately 1,149 million t-CO_2) compared to the emissions in FY2005. It is especially contributed by the reduction in Industry, Transport and Energy conversion sectors.

In FY2030, a significant reduction is estimated in Commercial and other, Residential, Energy conversion and Transport sectors. And it is estimated decrease by 25.0% (approximately 924 million t-CO_2) compared to the emissions in FY2013.

Table 4-2 Estimated emissions of energy-related CO_2 by sector

	Actual emissions			Estimated emissions			
	FY2005	FY2013	FY2015	FY2020		FY2030	
	(Mt-CO_2)	(Mt-CO_2)	(Mt-CO_2)	(Mt-CO_2)	(Changes from FY2005)	(Mt-CO_2)	(Changes from FY2013)
Industry	457	432	411	490	+7.3%	401	-6.6%
Commercial and Other	239	278	265	267	+11.6%	168	-39.7%
Residential	180	201	179	178	-0.9%	122	-39.4%
Transport	240	225	213	193	-19.7%	163	-27.4%
Energy conversion	104	99	80	96	-7.1%	73	-27.5%
Total	**1,219**	**1,235**	**1,149**	**1,224**	**+0.4%**	**927**	**-25.0%**

*Actual emissions in the base year (FY2005 and FY2013) were revised due to GHG inventory recalculations after reduction targets agreement. Estimated emissions (FY2020 and FY2030), changes from base year (from FY2005 and FY2013) show value in reduction targets agreement.

4.1.3.3 Non-energy-related CO_2

The estimated emissions of non-energy-related CO_2 in FY2020 decrease by 13.0% compared to FY2005 (approximately 74.3 million t-CO_2).

The estimated emissions in FY2030 decrease by 6.7% compared to FY2013 (by 17.0% from FY2005) (approximately 70.8 million t-CO_2).

Main emission sources in FY2015 are cement production (the Industrial Processes and Product Use sector (IPPU)) and waste incineration (the Waste sector) and so on. Reduction rate in the IPPU sector is the largest in FY2020, followed by the Waste sector (Excluding 'the Other sector'). On the contrary, the largest reduction rate in FY2030 is in the Waste sector, followed by the IPPU sector.

Table 4-3 Estimated emissions of Non -energy-related CO_2 by sector

	Actual emissions			Estimated emissions			
	FY2005	FY2013	FY2015	FY2020		FY2030	
	(Mt-CO_2)	(Mt-CO_2)	(Mt-CO_2)	(Mt-CO_2)	(Changes from FY2005)	(Mt-CO_2)	(Changes from FY2013)
Fugitive emissions from fuels	0.5	0.4	0.5	0.7	+31.9%	0.9	+96.4%
Industrial Processes and Product Use	55.6	48.0	46.2	45.6	-15.4%	44.0	-5.5%
Agriculture	0.4	0.6	0.6	0.6	+39.1%	0.6	+13.3%
Waste	31.7	29.3	28.9	27.2	-9.6%	25.0	-11.1%
Other	0.5	0.3	0.2	0.3	-36.2%	0.3	+16.3%
Indirect CO_2	3.1	2.2	2.1	–	–	–	–
Total	**91.8**	**80.8**	**78.4**	**74.3**	**-13.0%**	**70.8**	**-6.7%**

*Actual emissions in the base year (FY2005 and FY2013) were revised due to inventory recalculations after reduction targets agreement. Estimated emissions (FY2020 and FY2030), changes from base year (from FY2005 and FY2013) show value in reduction targets agreement.

*Indirect CO_2 was not estimated in reduction target agreement.

4.1.3.4 Methane

The estimated emissions of for methane in FY2020 decrease by 12.9% compared to FY2005 (approximately 33.9 million t-CO_2 eq.).

The estimated emissions in FY2030 decrease by 12.3% compared to FY2013 (by 18.8% from FY2005) (approximately 31.6 million t-CO_2 eq.).

Main emission sources in FY2015 are rice cultivation, enteric fermentation of livestock (the Agriculture sector), waste landfill (the Waste sector) and so on. The largest reduction rate is in the Waste sector, followed by the Fugitive emission from fuels sector in both FY2020 and FY2030.

Table 4-4 Estimated emissions of methane by sector

	Actual emissions			Estimated emissions			
	FY2005	FY2013	FY2015	FY2020		FY2030	
	(Mt-CO_2)	(Mt-CO_2)	(Mt-CO_2)	(Mt-CO_2)	(Changes from FY2005)	(Mt-CO_2)	(Changes from FY2013)
Fuel combustion	1.4	1.6	1.5	1.5	+9.3%	1.5	-2.1%
Fugitive emissions from fuels	1.0	0.8	0.8	0.8	-21.0%	0.7	-10.9%
Industrial Processes and Product Use	0.1	0.0	0.0	0.0	-15.6%	0.0	-4.5%
Agriculture	24.7	24.6	23.6	27.1	-4.3%	26.0	-7.1%
Waste	8.1	5.7	5.3	4.4	-45.6%	3.4	-40.7%
Total	**35.3**	**32.7**	**31.3**	**33.9**	**-12.9%**	**31.6**	**-12.3%**

*Actual emissions in the base year (FY2005 and FY2013) were revised due to inventory recalculations after reduction targets agreement. Estimated emissions (FY2020 and FY2030), changes from base year (from FY2005 and FY2013) show value in reduction targets agreement.

4.1.3.5 Nitrous oxide

The estimated emissions of nitrous oxide in FY2020 decrease by 15.5%compared to FY2005 (approximately 21.6 million t-CO_2 eq.).

The estimated emissions in FY2030 decrease by 6.1% compared to FY2013 (by 17.4% from FY2005) (approximately 21.1 million t-CO_2 eq.).

Main emission sources in FY2015 are agricultural soils, manure management (the Agriculture sector) and Fuel combustion sector and so on. Reduction rate in the IPPU sector is the largest, followed by the Waste sector in FY2020. The largest reduction rate in FY2030 is in the Waste sector, followed by the Fuel combustion sector.

Table 4-5 Estimated emissions of nitrous oxide by sector

	Actual emissions			Estimated emissions			
	FY2005	FY2013	FY2015	FY2020		FY2030	
	(Mt-CO_2)	(Mt-CO_2)	(Mt-CO_2)	(Mt-CO_2)	(Changes from FY2005)	(Mt-CO_2)	(Changes from FY2013)
Fuel combustion	7.2	6.2	6.1	6.2	-16.2%	5.9	-7.1%
Fugitive emissions from fuels	0.0	0.0	0.0	0.0	-20.2%	0.0	+0.0%
Industrial Processes and Product Use	3.1	1.7	1.6	1.8	-42.9%	1.9	+7.0%
Agriculture	10.1	9.6	9.5	11.0	-2.0%	10.9	-0.9%
Waste	4.4	3.8	3.7	2.6	-31.8%	2.3	-28.9%
Total	**24.8**	**21.4**	**20.8**	**21.6**	**-15.5%**	**21.1**	**-6.1%**

*Actual emissions in the base year (FY2005 and FY2013) were revised due to inventory recalculations after reduction targets agreement. Estimated emissions (FY2020 and FY2030), changes from base year (from FY2005 and FY2013) show value in reduction targets agreement.

Table 4-6 Estimated emissions of non-energy-related CO_2, methane and nitrous oxide

	Actual emissions			Estimated emissions			
	FY2005	FY2013	FY2015	FY2020		FY2030	
	(Mt-CO_2)	(Mt-CO_2)	(Mt-CO_2)	(Mt-CO_2)	(Changes from FY2005)	(Mt-CO_2)	(Changes from FY2013)
Non-energy-related CO2	91.8	80.8	78.4	74.3	-13.0%	70.8	-6.7%
Methane	35.3	32.7	31.3	33.9	-12.9%	31.6	-12.3%
Nitrous oxide	24.8	21.4	20.8	21.6	-15.5%	21.1	-6.1%

*Actual emissions in the base year (FY2005 and FY2013) were revised due to inventory recalculations after reduction targets agreement. Estimated emissions (FY2020 and FY2030), changes from base year (from FY2005 and FY2013) show value in reduction targets agreement.

4.1.3.6 Fluorinated gases

The estimated emissions of fluorinated gases (HFCs, PFCs, SF_6, NF_3) in CY2020 increase by 64.6%from

CY2005 (approximately 45.6 million t-CO_2 eq.). The estimated emissions in CY2030 decrease by 25.1% from CY2013 (increase by 4.5% from CY2005)(approximately 28.9 million t-CO_2 eq.).

Main emission sources in FY2015 are fugitive emission during production, use and disposal of HFCs used as refrigerants in refrigerators and air conditioners. Since refrigerants in refrigerators and air conditioners have shifted from Hydrochloro-fluorocarbons (HCFCs), which are ozone-depleting substances, to HFCs, it is expected that the emissions of fluorinated gases are projected to increase. The estimated emissions of HFCs in FY2020 increase approximately threefold compared to the emissions in FY2005, meanwhile it will fall below compared to the actual emissions in FY2015. The estimated emissions of HFCs in FY2030 decrease by 32.1% compared to FY2013 with the measures such as eliminating fluorocarbons, lowering GWP and leakage prevention.

Table 4-7 Estimated emissions of fluorinated gases and each gas

	Actual emissions			Estimated emissions			
	FY2005	FY2013	FY2015	FY2020		FY2030	
	(Mt-CO_2)	(Mt-CO_2)	(Mt-CO_2)	(Mt-CO_2)	(Changes from FY2005)	(Mt-CO_2)	(Changes from FY2013)
HFCs	12.8	32.1	39.2	38.3	+201.6%	21.6	-32.1%
PFCs	8.6	3.3	3.3	4.0	-53.5%	4.2	+27.2%
SF_6	5.1	2.1	2.1	2.4	-52.9%	2.7	+23.5%
NF_3	1.5	1.6	0.6	1.0	-16.7%	0.5	-64.8%
Total	**27.9**	**39.1**	**45.2**	**45.6**	**+64.6%**	**28.9**	**-25.1%**

*Actual emissions in the base year (FY2005 and FY2013) were revised due to inventory recalculations after reduction targets agreement. Estimated emissions (FY2020 and FY2030), changes from base year (from FY2005 and FY2013) show value in reduction targets agreement.

4.1.4 Projections by sector

4.1.4.1 Energy

The estimated emissions of the Energy sector in FY 2020 are an increase of approximately 0.2% compared to FY 2005 (approximately 1,248.4 million t-CO_2 eq.). In FY 2030, it is a decrease of approximately 24.6% compared to FY2013 and a decrease by 23.8% compared to FY2005 (approximately 949.7 million t-CO_2 eq.).

Almost all emissions in the Energy sector are CO_2 derived from fuel combustion. See “4.1.3.1 Energy-related CO_2“ for the increase and decrease of the future estimated emissions.

4.1.4.2 Industrial Processes and Product Use (IPPU)

The estimated emissions of the Industrial Processes and Product Use (IPPU) sector in FY 2020 (approximately 93.0 million t-CO_2 eq.) are an increase of approximately 9.8% compared to FY 2005. In FY 2030 (approximately 74.8 million t-CO_2 eq.), it is a decrease of approximately 14.0% level as compared to FY2013 and a decrease by 11.7% compared to FY2005.

Main emission sources are mineral industry (CO_2), refrigerants (HFCs), metal production (CO_2, CH_4) and chemical industry (CO_2, CH_4, N_2O). The main driver is an increase of emissions in refrigerants sector since refrigerants have shifted from Hydrochloro-fluorocarbons (HCFCs), which are ozone-depleting substances, to HFCs. The main factor of the emission decrease in FY2030 is an emission reduction in refrigerants sector by leakage prevention of fluorocarbons from use of refrigerators and air conditioners, promotion of recovery of fluorocarbons in disposal and promotion of eliminating fluorocarbons and lowering GWP.

4.1.4.3 Agriculture

The estimated emissions of the Agriculture sector in FY 2020are a decrease of approximately 3.2% compared to FY 2005 (approximately 38.7 million t-CO_2 eq.). In FY2030, it is a decrease of approximately 5.1% as compared to FY2013 and a decrease by 6.3% compared to FY2005 (approximately 37.5 million t-CO_2 eq.).

Main emission sources in FY2015 are rice cultivation (CH_4), enteric fermentation (CH_4), manure management (CH_4, N_2O) and agricultural soils (N_2O). The main driver of the emission decrease in FY2020 and FY2030 is an emission reduction from rice cultivation by the implementation of emission reduction measures.

4.1.4.4 LULUCF

The estimated removals of the LULUCF sector in FY 2020 are approximately 36.4 million t-CO_2. In FY2030, it is approximately 25.9 million t-CO_2[46].

The LULUCF sector covers CO_2 emissions and removals resulting from carbon stock change and non-CO_2 emissions in forest land, cropland, grassland, wetlands, settlements, and other land. Major parts of removals attribute to forest land sinks.

4.1.4.5 Waste

The estimated emissions of the Waste sector in FY 2020 are a decrease of approximately 26.0% compared to FY 2005 (approximately 19.3 million t-CO_2 eq.). In FY2030, it is a decrease of approximately 20.7% compared to FY2013 and decrease of approximately 33.7% compared to FY2005 (approximately 17.3 million t-CO_2 eq.).

Main emission sources are waste incineration and incineration with energy recovery (CO_2, CH_4, N_2O), final disposal (CH_4) and wastewater treatment (CH_4, N_2O). Main drivers of the emission decrease in FY2020 and FY2030 are a decrease of 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.

4.1.5 Indirect CO_2

Since total emissions of GHG have come to include the emissions of indirect CO_2 in GHG inventory submitted to the UNFCCC in 2017, the future projected value is not estimated yet.

Table 4-8 Estimated emissions in FY2020 and FY2030 by sector (without LULUCF)

	Actual emissions			Estimated emissions			
	FY2005	FY2013	FY2015	FY2020		FY2030	
	(Mt-CO_2)	(Mt-CO_2)	(Mt-CO_2)	(Mt-CO_2)	(Changes from FY2005)	(Mt-CO_2)	(Changes from FY2013)
Energy	1,247.1	1,261.2	1,174.6	1,248.4	+0.2%	949.7	-24.6%
Industrial Processes and Product Use	86.7	88.9	93.0	93.0	+9.8%	74.8	-14.0%
Agriculture	35.2	34.8	33.7	38.7	-3.2%	37.5	-5.1%
Waste	26.7	21.9	21.2	19.3	-26.0%	17.3	-20.7%
Indirect CO_2	3.1	2.2	2.1	–	–	–	–
Total	**1,398.8**	**1,409.0**	**1,324.7**	**1,399.5**	**+0.2%**	**1,079.0**	**-23.4%**

*Actual emissions in the base year (FY2005 and FY2013) were revised due to inventory recalculations after reduction targets agreement. Estimated emissions (FY2020 and FY2030), changes from base year (from FY2005 and FY2013) show value in reduction targets agreement. *Indirect CO_2 was not estimated in reduction target agreement.

[46] These estimated removals are not directly used for archiving reduction target in FY2020 and 2030. The emission and removal sources in FY 2020 and 2030 don't completely correspond with those in FY2005 and 2013.

4.2 Assessment of total effect of policies and measures

The reductions achieved by emission reduction measures have been quantified for methane, nitrous oxide and fluorinated 4 gases. Reduced emissions in FY2020 consists of methane reduction amounted to 0.8 Mt-CO_2 eq., followed by nitrous oxide (0.6 Mt-CO_2 eq.), and fluorinated gases (18.5 Mt-CO_2 eq.) for a total of 19.8 Mt-CO_2 eq. In addition, reduced emissions in FY2030 consists of methane reduction amounted to 2.1 Mt-CO2 eq., followed by nitrous oxide (0.9 Mt-CO_2 eq.), and fluorinated gases (48.2 Mt-CO_2 eq.) for a total of 51.2 Mt-CO_2 eq. (Table 4-9)

For CO_2, the estimation of mitigation impact except some measures is shown in CTF Table3. However, since it is difficult to quantify the estimation of mitigation impact for all measures and definition of the estimation in CTF Table3 is not the same for all measures, the total level of reduced emissions cannot be calculated.

Table 4-9 Future level of reduced emissions by mitigation actions

	reduced emissions	
	FY2020	FY2030
	(Mt-CO_2)	(Mt-CO_2)
Methane	0.8	2.1
Nitrous oxide	0.6	0.9
Fluorinated gases	18.5	48.2
Total	**19.8**	**51.2**

4.3 Supplementarity relating to mechanisms under Articles 6, 12 and 17, of the Kyoto Protocol

Since Japan does not have emission reduction obligation of the second commitment period of the Kyoto Protocol, there is no supplementarity information to be reported relating to the use of mechanisms under Articles 6, 12 and 17, of the Kyoto Protocol.

4.4 Methodology

4.4.1 Key parameters and assumptions

The outlook on the macro frame below based on estimated economic growth rate, population and other parameters is considered for projections.

Table 4-10 Key assumptions on the macro frame (key parameters and assumptions) (CTF Table 5)

item	unit	Actual values						estimated values			
		FY1990	FY1995	FY2000	FY2005	FY2010	FY2011	FY2015	FY2020	FY2025	FY2030
real GDP	trillion(2005)yen			477	507	512	514	NE	611	NE	711
population	10^3people	123,611		126,926	127,766	128,058	127,799	NE	124,100	NE	116,618
household	10^3households	40,670		46,782	49,063	51,842	52,055	NE	53,053	NE	51,231
crude steel production	10^6t	112		107	113	111	106	NE	NE	NE	120
cement production	10^6t	87		79	74	56	58	NE	NE	NE	56
ethylene production	10^6t	6		7	8	7	6	NE	NE	NE	6
paper and paperboard production	10^6t	29		30	31	27	27	NE	NE	NE	27
Commercial floor area	10^6m^2				1,759	1,831	1,828	NE	NE	NE	1,971

*Projections compiled from "Economic and Fiscal Projections for Medium to Long Term Analysis", "Medium projection (National Institute of Population and Social Security Research)", "Long-term Energy Supply and Demand Outlook relevant material (July, 2015) (Agency for Natural Resources and Energy)" and other sources.

4.4.2 Estimation method for energy-related CO_2 emissions

4.4.2.1 Fuel combustion (CO_2)

Future projected values of energy consumptions and CO_2 emissions are calculated based on the energy supply and demand model. The entire structure of the energy supply and demand model is shown in Figure 4-1. Table 4-11 shows description for primary sub models included in the energy supply and demand model.

Table 4-11 Primary sub models included in the energy supply and demand model

Sub models	Details
Macroeconomic model	Estimates economic activity indices which influence energy demand directly /indirectly on the basis of calculation consistently balanced macro frames such as income distribution, production market, labor market and general prices
Secondary energy price model	Estimates energy purchase prices which influence energy demand and selection behavior using import prices of energy such as crude oil and LNG and domestic general price index.
Optimum generation planning model	For electric power 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 total system cost (equipment cost and fuel expenses) after conversion into discounted current value within a target period. The optimum method is dynamic programming.
Elements bottom-up model	Estimates energy conservation indicators such as efficiency of home appliances and fuel consumption of vehicles to reflect an effect clearly based on top runner standard which is difficult to be dealt with in regression macroeconomic model.
Energy supply and demand model	Estimates energy demand in each final consumption sector using economic activity indices, price indices, and energy conservation indicators which are calculated from above-mentioned models. Secondly, primary energy supply is estimated through energy conversion such as electric power generation. Finally, CO_2 emissions are calculated based on the 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)

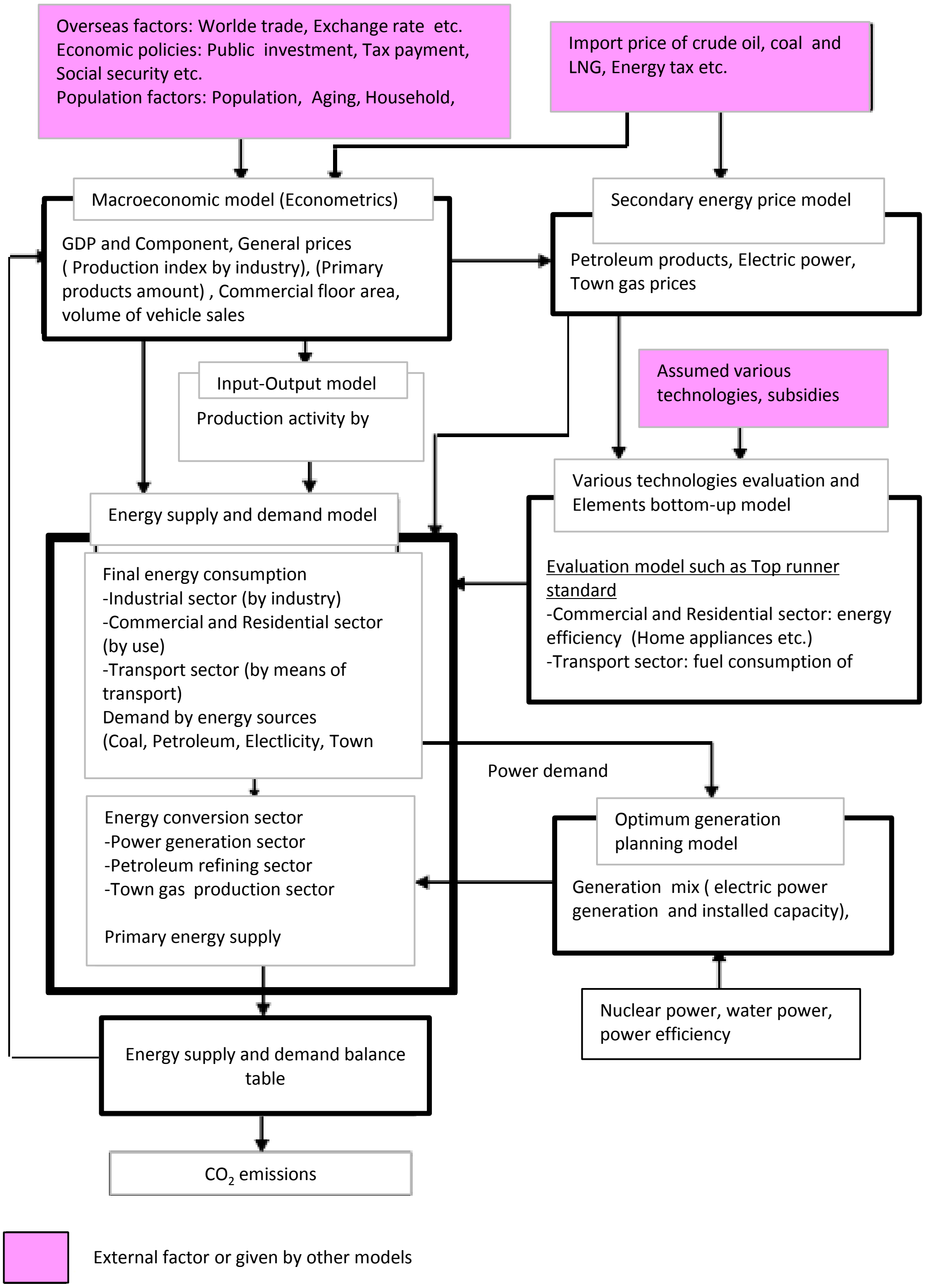


Figure 4-1 Overall structure for energy supply and demand model

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 4-10. Structure of power generation (Energy Mix) is shown in Table 4-12. These data are entered as exogenous values. In the model, in order to maintain consistency with the energy mix, the energy consumptions and the emissions in future are calculated based on sound policies and measures and technologies taking into account technical constraints and cost-related issues.

Table 4-12 Energy mix used for 2030 emission projection

	FY2030
●Final energy consumption	326 10^6kl
(Reduction of energy saving)	50 10^6kl
●Total electric power generation	approximately 1,065 TWh
Renewable energy	approximately 22%～24%
Nuclear	approximately 22%～20%
Coal	approximately 26%
LNG	approximately 27%
Oil	approximately 3%
(Breakdown of Renewable energy)	
Solar	approximately 7.0%
Wind	approximately 1.7%
Geothermal	approximately 1.0%～1.1%
Hydropower	approximately 8.8%～9.2%
Biomass	approximately 3.7%～4.6%

4.4.2.2 Fuel combustion (CH_4, N_2O)

Based on the GHG inventory, projections of CH_4 and N_2O emissions from fuel combustion cover 5 sectors: Industry; Commercial and Other; Residential; Transport; and Energy conversion.

The projected future emissions are based on calculation multiplying projected fuel consumption for each sector by projected emission factor in accordance with estimation method of the GHG inventory.

The projected future activity data is established based on the future estimated indices in the associated sectors, such as the projected future Indices of Industrial Production in the industrial sector, the projected future commercial floor area in the Commercial and Other sector, and the projected future number of households in the Residential sector.

The projected emission factors are the same as those used as current emission factors assuming that the present emission level is supposed to continue in the future.

4.4.2.3 Fugitive emissions from fuels

Based on the GHG inventory, projections of fugitive emissions from fuels cover 2 sub sectors: solid fuel (CO_2, CH_4) and fugitive emissions from oil, natural gas and other energy (CO_2, CH_4, N_2O).

The projected future emissions are based on calculation multiplying projected activity data (for example, Coal, crude oil and natural gas outputs, crude oil refining volume and natural gas sales) by projected emission factor for each emission source in accordance with estimation method of the 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 the amount of production of coal, crude oil and natural gas is established supposing that current activity level is supposed to continue in the future.

The projected emission factors are the same as those used as current emission factors assuming that the present emission level is supposed to continue in the future.

4.4.2.4 CO_2 transport and storage

In Japan, current and future CO_2 emissions and removals from this sector are not calculated.

4.4.3 IPPU sector

4.4.3.1 CO_2, CH_4, and N_2O

Based on estimation in the GHG inventory, projected future emissions from IPPU sector cover 5 sub sectors: mineral industry (CO_2), chemical industry (CO_2, CH_4, N_2O), metal production (CO_2, CH_4) non-energy products from fuels and solvent use (CO_2) and other product manufacture and use (N_2O).

The projected future emissions are based on calculation multiplying projected activity data (for example, clinker production and ethylene production) by projected emission factor for each emission source in accordance with estimation method of the 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. However, activity data varies in accordance with the level of measures when implementation of measures influences activity data.

The projected emission factors are the same as those used as current emission factors assuming that the present emission level is supposed to continue in the future.

4.4.3.2 Fluorinated gases

Based on estimation in the GHG inventory, projected future emissions from fluorinated gases cover 5 sectors: chemical industry (HFCs, PFCs, SF_6, NF_3), metal production (HFCs, PFCs, SF_6), electronic industry (HFCs, PFCs, SF_6, NF_3), use of ozone-depleting substance alternative (HFCs, PFCs) and other product manufacture and use (PFCs, SF_6).

The projected future emissions are based on calculation multiplying projected activity data (for example, the amount of charged refrigerant by type of refrigerant) by projected emission factor for each emission source in accordance with estimation method of the GHG inventory.

4.4.4 Agriculture sector

Based on estimation in the GHG inventory, projected future emissions from agriculture sector cover 7 sub sectors: enteric fermentation(CH_4), manure management(CH_4, N_2O), rice cultivation(CH_4), agricultural soil(N_2O), field burning of agricultural waste(CH_4, N_2O), lime application (CO_2)and urea application (CO_2).

The projected future emissions are based on calculation multiplying projected activity data (for example, number of domestic animals and area of cropland) by projected emission factor for each emission source in accordance with estimation method of the GHG inventory.

The projected future activity data is established based on the future number of livestocks and area of cropland in “The Basic Plan for Food, Agriculture and Rural Areas (Ministry of Agriculture, Forestry and Fisheries, Cabinet decision on March 31, 2015)”. However, activity data varies in accordance with the level of measures when implementation of measures influences activity data.

The projected emission factors are the same as those used as current emission factors assuming that the present emission level is supposed to continue in the future. As for the resource which emission reduction measures is implemented, current emission factors decrease in accordance with the level of reduction measures.

4.4.5 LULUCF sector

Based on estimation in the GHG inventory, projected future emissions and removals from LULUCF sector covers CO_2 emissions and removals resulting from carbon stock change and non-CO_2 emissions on forest land, cropland, grassland, wetlands, settlements, and other land.

The projection of LULUCF sector covers all the GHG inventory categories and is based on accumulation of four assumptions; 1) target of measures for managing forest carbon sink, 2) target of measures to increase carbon sinks in agricultural soils, 3) target of urban greening, and 4) projected amount of emissions and removals from other sources and sinks which are not covered in 1) to 3).

1) The projected net removals of forest land are consistent with the targets amount of carbon sinks in forests through implementing measures for managing forest carbon sinks, including activities of afforestation, reforestation and deforestation under Article 3.3 and forest management under Article 3.4 of the Kyoto Protocol. These removals by forest land are calculated by conversion of the net carbon stock changes of the envisaged state of forests that comes from KP-LULUCF activities such as appropriate forest development and conservation based on the Basic Plan for Forest and Forestry forests into CO_2 equivalent by multiplying a coefficient.

2) The projection of carbon sinks in agriculture soil is represented as net emissions and which are consistent with the projected amount of net emissions from mineral soils of cropland and grassland used for preparing the target amounts of measures to increase carbon sinks in agricultural soils. The scope of this projection is in line with the activities contribute to the LULUCF activities under article 3, paragraph 4 of the Kyoto Protocol (cropland management and grassland management). These estimations are based on mathematical model (revised Roth-C, Rothamsted Carbon Model), future temperature and future cultivated area provided in the Basic Plan for Food, Agriculture and Rural Areas.

3) The net removals of urban greening in settlements are consistent with the targets amount of carbon sinks due to promotion of urban greening, including revegetation as LULUCF activities under article 3, paragraph 4 of the Kyoto Protocol. These are calculated, estimating the area of urban green areas under 30 years (activity data), in accordance with estimation method of the GHG inventory.

4) The emissions and removals not contained in 1) to 3) (about net emissions of 200 kt CO_2 as total) are estimated in each most detailed category and pool level. Estimations relating to cropland and grassland (not covered 2)) 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 estimation method of the GHG inventory. Other small sources of emissions are estimated by simple extrapolation, etc., without the assumption of scenarios, because the contribution of these emissions and removals are not large.

4.4.6 Waste sector

Based on estimation in the GHG inventory, projected future emissions from waste sector cover 4 sectors: solid waste disposal (CH_4), biological treatment of solid waste (CH_4, N_2O), incineration and open burning of waste (CO_2, CH_4, N_2O) and wastewater treatment and discharge (CH_4, N_2O).

The projected future emissions are based on calculation multiplying projected activity data (for example, the amount of municipal waste and industrial waste, and amount of domestic wastewater and Industrial wastewater) by projected emission factor for each emission source in accordance with estimation method of the GHG inventory.

The future projected activity data is established based on future population (Municipal Waste) and industrial activity (Industrial waste). However, activity data varies in accordance with the level of measures when implementation of measures influences activity data.

The projected emission factors are the same as those used as current emission factors assuming that the present emission level is supposed to continue in the future.

4.5 Sensitivity Analysis

As a sensitivity analysis, the estimation of impact on the energy-related CO_2 and cost in accordance with the changes of the generation mix is calculated. The result is shown in Table 4-13. In the case of changes of power supply resource by 1.0%, if coal-fired power generation decreases by 1.0% and nuclear power generation increases by 1.0% for example, CO_2 emissions decrease 8.4Mt CO_2 and the power generation cost decreases by 34 billion yen.

Table 4-13 Impact on the energy-related CO_2 and cost in the case of fluctuation in the generation mix

	Coal ▲1%	LNG ▲1%	Nuclear ▲1%	Renewable Energy ▲1%
Coal +1%		+4.4MtCO_2 ▲64 billion yen	+8.4MtCO2 +34 billion yen	+8.4MtCO2 ▲184 billion yen
LNG +1%	▲4.4MtCO2 +64 billion yen		+4.0MtCO2 +98 billion yen	+4.0MtCO2 ▲120 billion yen
Nuclear +1%	▲8.4MtCO2 ▲34 billion yen	▲4.0MtCO2 ▲98 billion yen		±0MtCO2 ▲ 218 billion yen
Renewable Energy +1%	▲8.4MtCO2 +184 billion yen	▲4.0MtCO2 +120 billion yen	±0MtCO2 +218 billion yen	

*Values are rounded numbers

Reference: Long-term Energy Supply and Demand Outlook relevant material (July 2015) (Agency for Natural Resources and Energy.)

4.6 Differences from the projections reported in the NC6/BR2

4.6.1 Changes in projection methodologies

No changes in projection methodologies have been made after Japan's Second Biennial Report (BR2) was submitted in December, 2015.

In BR2, projection methodologies were changed from those in Japan's 6th National Communication Report (NC6) and Japan's First Biennial Report (BR1) submitted in December, 2013. As for changes in BR2, refer to BR2.

4.6.2 Comparison of projections

Future projected emission results in FY2020 and FY2030 are the same as those in BR2.

In BR2, future projected value changed in accordance with the changes in projection methodologies from NC6 and BR1 submitted in December, 2013. For comparison result of future projected va lue in NC6/BR1 and BR2, refer to BR2.

Chapter 5

Vulnerability Assessment, Climate Change Impacts, and Adaptation Measures

5.1 Observation Results and Projections of Climate Change in Japan

Japan has set up a subcommittee on climate change impact assessment under the Global Environmental Committee of the Central Environment Council in July, 2013 and has been conducting deliberations in order to assess the impact of climate change in Japan. The subcommittee compiled the results of deliberations as “Assessment Report on the Impact of Climate Change in Japan" in March, 2015[47]. Also, the Central Environment Council expressed to the Minister of the Environment its opinion as "Report on impact assessment of climate change in Japan and future issues (Climate Change Impact Assessment Report)” [48].

This section based on this Climate Change Impact Assessment Report.

The results of observation on climate change described below are based mainly on the “Climate Change Monitoring Report2016” (Japan Meteorological Agency, available in Japanese and English).

The projections of climate change described below mainly utilize of the results of the Japan Meteorological Agency’s “Global Warming Projection Vol. 8” (2013) (hereinafter GWPV8), and the “Results of Climate Change Projections in Japan Considering Uncertainty (Announcement)” (in Japanese) (Friday, December 12, 2014: press release by the Ministry of the Environment and the Japan Meteorological Agency) detailed climate projections for the Japan region, implemented by the Ministry of the Environment and the Japan Meteorological Agency (hereinafter “Projection with Uncertainty”) (in Japanese). These projections for the end of the 21st century rely on dynamic downscaling using a non-hydrostatic regional climate model (NHRCM) developed by the Meteorological Research Institute, and each is calculated as shown below.

Table 5-1 Summary of Projections

		GWPV8	Projection with Uncertainty
Period for reproduction of current climate		(1980–1999)	September 1984 – August 2004
Period for projection of future climate		(2016–2035) (2076–2095)	September 2080 – August 2100
Horizontal resolution of regional climate model		5 km	20 km
General features of projections with global climate models used for boundary conditions	Model	MRI-AGCM3.2S	MRI-AGCM3.2H
	Scenario (Numbers in parentheses indicate the number of ensemble members with various conditions)	SRES A1B [49] (1 member)	RCP2.6 (3 members) RCP4.5 (3 members) RCP6.0 (3 members) RCP8.5 (9 members)
	Horizontal resolution	20 km	60 km

Note: In GWPV8, to input global model projection results to the NHRCM, a regional climate model with horizontal resolution of 15 km was used.
Note: Please refer to the following URL for general descriptions of each set of projections.
GWPV8

http://ds.data.jma.go.jp/tcc/tcc/products/gwp/gwp8/index.html (excerpt)
http://www.data.jma.go.jp/cpdinfo/GWP/Vol8/pdf/all.pdf (full, in Japanese)

Projection with Uncertainty

http://www.env.go.jp/press/19034.html (in Japanese)
http://www.jma.go.jp/jma/press/1412/12a/21141212_kikouhendou.html (in Japanese)

In the following discussion, citations from the “Climate Change Monitoring Report 2016” are indicated by *I, GWPV8 by *II, and “Projection with Uncertainty” by *III. Other citations are indicated by their respective sources.

47 http://www.env.go.jp/press/upload/upfile/100480/27462.pdf (Published in Japanese)

48 https://www.env.go.jp/en/focus/docs/files/20150300-100.pdf

49 SRES A1B scenario: One of the scenarios in the Special Report on Emission Scenarios (SRES) by the IPCC, which characterizes future society with continued rapid economic growth, a reduction in regional disparities caused by globalization, and the rapid spread of new technologies, along with a balanced emphasis on all energy sources. It is expected that emissions increase until the middle of the 21st century, and after peaking, follow a gently-declining trend to reach atmospheric CO_2 concentrations of about 700 ppm by approx. the year 2100. Compared using radiative forcing in approx. the year 2100, this corresponds roughly to the RCP6.0 scenario (van Vuuren and Carter 2014).

Climate change projections are calculated by climate models based on scenarios of how atmospheric concentrations of greenhouse gases, aerosols, and other substances change; those projections of the future involve a certain degree of uncertainty due to such factors as the uncertainty of the models, imperfections in the models, and internal variability of climate systems.

Also, in day-to-day weather and seasonal variations, high or low temperature events, torrential rainfall, heavy snowfall, or other events can sometimes be observed that diverge significantly from the long-term trends. Because of this, to ascertain the impacts of global warming, it is important to have the long-term perspective of time in terms of several decades.

5.1.1 Atmospheric Temperature

5.1.1.1 Observation Results

- The annual mean temperature in Japan fluctuates on different time scales ranging from years to decades, and it is virtually certain that it has increased from 1898 to 2016, at a rate of 1.19°C per 100 years (statistically significant at a confidence level of 99%). (*I)
- It is virtually certain that seasonal mean temperatures for winter, spring, summer and autumn have risen at rates of about 1.11°C, 1.38°C, 1.08°C and 1.20°C per 100 years (all statistically significant at a confidence level of 99%). (*I)
- The annual number of days with maximum temperatures of 30°C or higher shows a changing trend in the period 1931 to 2016 (statistically significant at a confidence level of 90%). , the annual number of days with maximum temperatures of 35°C or higher has increased (statistically significant at a confidence level of 99%). (*I)
- It is virtually certain that the annual number of days with minimum temperatures below 0°C has decreased during the statistical period 1931–2016, while the annual number of days with minimum temperatures of 25°C or higher has increased (both statistically significant at a confidence level of 99%). (*I)
- In addition to the impact of climate change, a long-term temperature increase trend is also evident in big cities[50] due to urbanization. The rate of increase per 100 years in annual mean temperature since 1931 was 1.5°C at 15 stations on average where the impacts of urbanization are considered to be relatively small.[51] In comparison, a significant increasing trend is evident in large cities such as Tokyo (3.3°C), Osaka (2.7°C), and Nagoya (2.9°C), and the differences in the long-term trends of urban stations from the average of 15 stations largely represent the influence of urbanization. The long-term trend of daily minimum temperature is particularly noticeable in winter, with Tokyo showing an increase of 6.0°C per 100 years.[52]

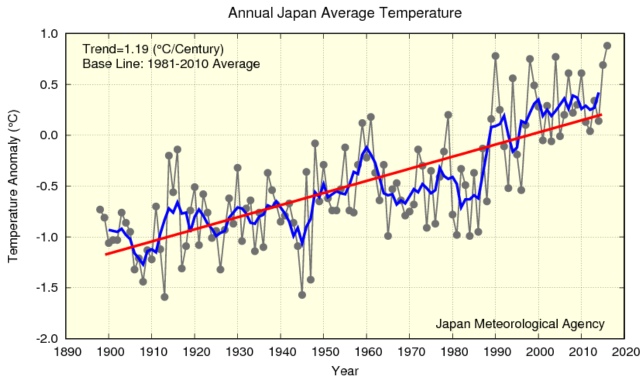


Figure 5-1 Annual Japan Average Temperature (*I)

50 This refers to 10 cities: Sapporo, Sendai, Nagoya, Tokyo, Yokohama, Kyoto, Hiroshima, Osaka, Fukuoka, and Kagoshima.

51 This is the average of fifteen meteorological observatories which are relatively least affected by the change of environment due to urbanization, and their observation data's homogeneity is consistent over a long period.(Abashiri, Nemuro, Suttsu, Yamagata, Ishinomaki, Fushiki, Iida, Choshi, Sakai, Hamada, Hikone, Tadotsu, Miyazaki, Naze, and Ishigakijima). For Iida and Miyazaki, the data are corrected for the effects of relocation during the statistical period. However, these observation sites as well are not entirely unaffected by urbanization.

52 Excerpt from "Heat Island Observation Report 2016" (2017), Japan Meteorological Agency (in Japanese).

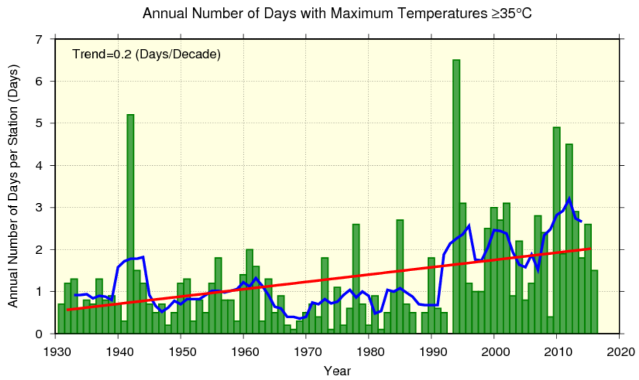


Figure 5-2 Annual Number of Days with Maximum Temperatures ≧35°C (*I)

5.1.1.2 Projections

- The higher the GHG emissions, the more the temperature will increase. (*II, *III)
- Annual mean temperature will increase, with more increase at higher than lower latitudes, and in winter more than in summer. (*II, *III)
- The number of hot days and hot nights will increase, and the number of cold days will decrease. (*II, *III)

<Low emissions of GHGs (GHG concentrations stabilize at low levels) RCP2.6 scenario>

- Annual mean temperature will increase by 1.1°C in Japan, relative to the end of the 20th century (confidence interval[53] 0.5–1.7°C). An increase in temperature will be greater at higher than lower latitudes, and in winter more than in summer. (*III)
- The annual number of days with maximum temperatures of 30°C or higher will increase by a national average54 of 12.4 days relative to the end of the 20th century, in particular, with an increase of an average 26.8 days in Okinawa and Amami. (*III)
- On the other hand, for the annual number of days with maximum temperatures below 0°C, the national average will decrease by 4.4 days relative to the end of the 20th century, and in particular, the average will decrease by 9.8 days and 9.4 days, respectively, on the Sea of Japan side and the Pacific Ocean side of northern Japan, respectively. (*III)

<High emissions of GHGs (GHG concentrations stabilize at high levels) SRES A1B scenario>

- Annual mean temperature will increase by 3.0°C in Japan, relative to the end of the 20th century. (*II)
- The maximum temperature on extremely hot summer days (the 20-year return value of annual maximum temperature) will increase by 2°C to 3°C, depending on the region, relative to the end of the 20th century. Also, the minimum temperature on extremely cold winter days (the 20-year return value of annual minimum temperature) will increase by 2.5°C to 4°C, relative to the end of the 20th century. (*II)
- The annual number of days with daily minimum temperatures below 0°C and annual number of days with daily maximum temperatures below 0°C will decrease relative to the end of the 20th century, particularly in northern Japan. The annual number of days with daily minimum temperatures above 25°C and daily maximum temperatures above 35°C will increase relative to the end of the 20th century, in eastern Japan, western Japan, Okinawa and Amami. (*II)

<Very high emissions of GHGs (GHG concentrations reach very high levels) RCP8.5 scenario>

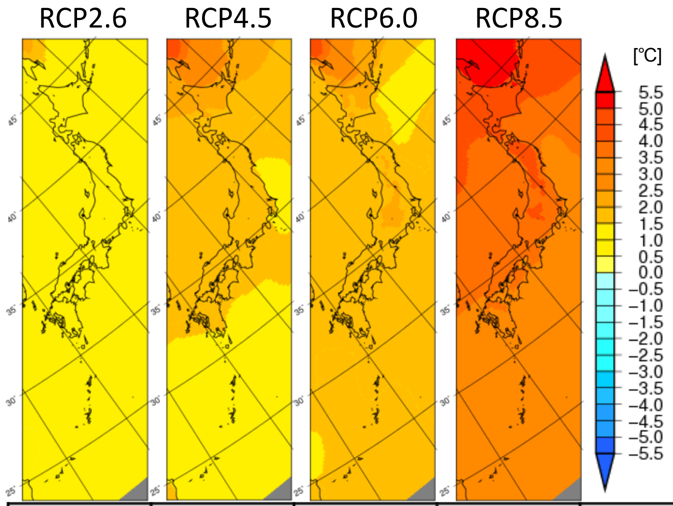
- Annual mean temperature will increase by 4.4°C in Japan relative to the end of the 20th century (confidence range 3.4°C to 5.4°C). (*III)
- The annual number of days with daily maximum temperatures of 30°C or higher will increase an average of 52.8

[53] Confidence interval: The product of standard deviation calculated as a combination of uncertainties multiplied by a constant in the standard distribution table (approx. 1.64), based on the results of multiple projection calculations conducted using modified criteria. In the case of normal distribution, approximately 1.64 times the standard deviation corresponds to a 90% confidence interval.

[54] Averages indicated here are the arithmetic means of multiple projection calculations conducted under various conditions.

days in Japan, relative to the end of the 20th century; in particular, the average increase will be 86.7 days in Okinawa and Amami. (*III)

- The annual number of days with daily maximum temperatures less than 0°C will decrease by an average of 15.5 days in Japan relative to the end of the 20th century; in particular, the average will decrease by 38.1 days and 33.3 days, on the Sea of Japan side and the Pacific Ocean side of northern Japan, respectively. (*III)



1.1°C (0.5～ 1.7°C)	2.0°C (1.3～ 2.7°C)	2.6°C (1.6～ 3.6°C)	4.4°C (3.4～ 5.4°C)	National average

Figure 5-3 Distribution of changes of annual mean temperature (*III)

※Map of distribution of changes shows partial results of calculations (SST1 and YS cases)

5.1.2 Precipitation

5.1.2.1 Observation Results

- For annual precipitation, no long-term trend is evident for the period 1898–2016, but Japan experienced relatively large amounts of rainfall until the mid-1920s from the beginning of the observation, and during the 1950s, and the annual figure has become more variable since the 1970s. (*I)
- The annual number of days with precipitation of ≥ 100 mm has increased from 1901 to 2016 (statistically significant at a confidence level of 99%). It is also extremely likely that the annual number of days with precipitation of ≥ 200 mm has increased over the same period (statistically significant at a confidence level of 95%). On the other hand, the annual number of days with precipitation of ≥ 1.0 mm has decreased (statistically significant at a confidence level of 99%); these results suggest a decrease in the annual number of wet days including light precipitation and in contrast, an increase in extremely wet days. (*I)

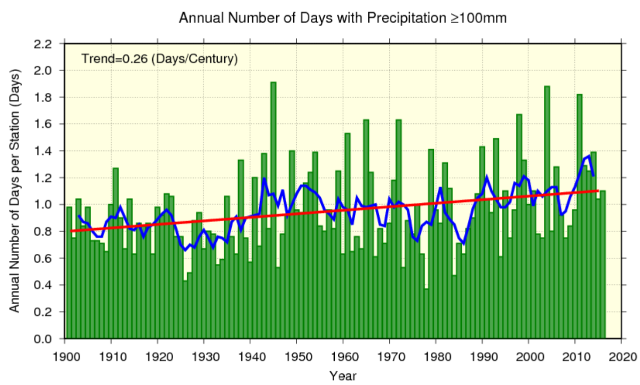


Figure 5-4 Annual Number of Days with Precipitation ≧100mm(*I)

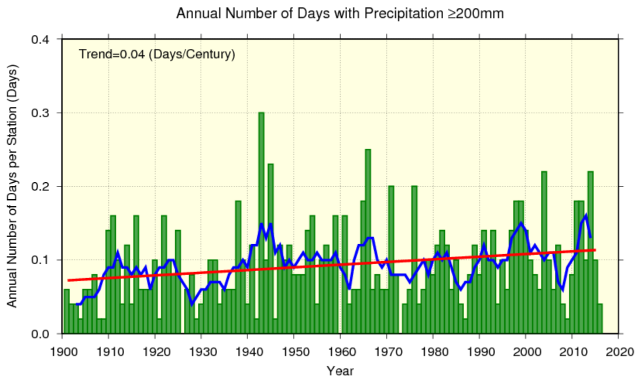


Figure 5-5 Annual Number of Days with Precipitation ≧200mm(*I)

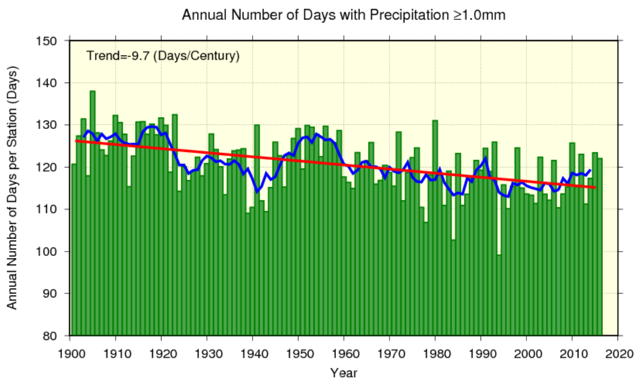


Figure 5-6 Annual Number of Days with Precipitation ≧1.0mm(*I)

5.1.2.2 Projections

- Annual precipitation is characterized by a large range of inter-annual variability; changes in both national and regional averages (Sea of Japan side of northern Japan, Pacific side of northern Japan, Sea of Japan side of eastern Japan, Pacific side of eastern Japan, the Sea of Japan side of western Japan, Pacific side of western Japan, and Okinawa/Amami) exhibit no clear trend that depends on differences in scenarios; in some cases, the projections are for increases in precipitation, and in other cases, for decrease, relative to the end of the 20th century. (*III)
- The frequency of heavy rainfall and short-term intense rainfall will increase across Japan relative to the end of the 20th century (*II, *III)
- The annual number of dry days (days with daily precipitation of less than 1.0 mm) will increase relative to the end of the 20th century. (*II, *III)
- The northward shift of the Baiu front (which brings rainfall widely in Japan) will be delayed, and the end of the Baiu will be delayed.[55]

<Low emissions of GHGs (GHG concentrations stabilize at low levels) RCP2.6 scenario>

- The amount of precipitation from heavy rainfall (amount of precipitation in one day from the top 5% of precipitation events) will increase by an average of 10.3% relative to the end of the 20th century. (*III)
- The annual number of dry days (daily precipitation of less than 1.0 mm) will be almost unchanged, or will increase slightly relative to the end of the 20th century. (*III)

<High emissions of GHGs (GHG concentrations stabilize at high levels) SRES A1B scenario>

- The annual number of dry days (daily precipitation of less than 1.0 mm) will increase by 7.7 days relative to the end of the 20th century. (*II)

[55] Kusunoki et al. (2006), Kitoh and Uchiyama (2006), Hirahara et al. (2012)., and other literature

<Very high emissions of GHGs (GHG concentrations reach very high levels) RCP8.5 scenario>

- The amount of precipitation from heavy precipitation (amount of precipitation in one day from the top 5% of precipitation events) will increase by an average of 25.5% relative to the end of the 20th century. (*III)
- The annual number of dry days (days with daily precipitation of less than 1.0 mm) will increase by an average of 10.7 days relative to the end of the 20th century. (*III)

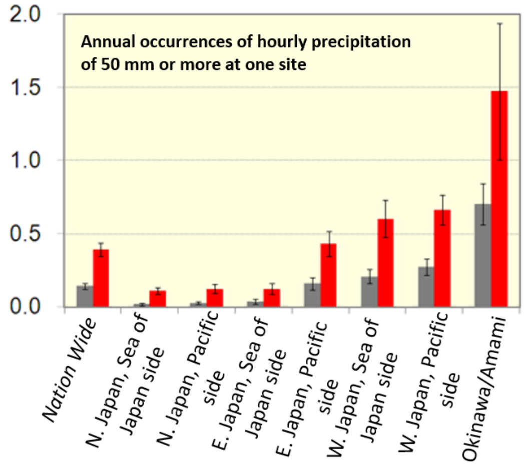


Figure 5-7 Number of occurrences of hourly precipitation of 50 mm or more, by region (*I)
(1980 - 1999 average (grey) relative to 2076 - 2095 average (red))

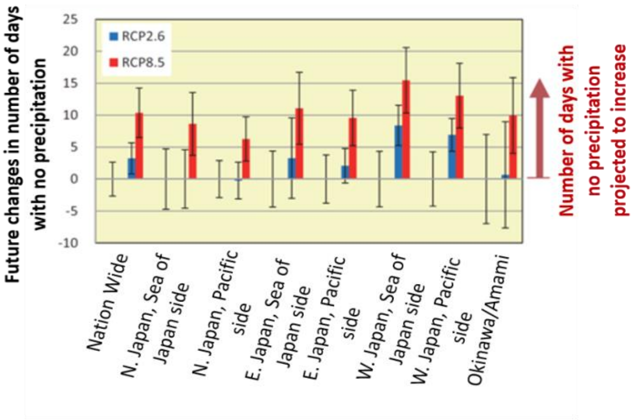


Figure 5-8 Changes in the number of days with no precipitation (*I)
(difference between 1984 -2100 average)

5.1.3 Snow Cover / Snowfall

5.1.3.1 Observation Results

- For the period 1962 to 2016, the annual maximum snow depth on the Sea of Japan side of Eastern Japan has decreased at rates of 12.3% per decade (statistically significant with 99% confidence level). The annual maximum snow depth on the Sea of Japan side of Western Japan shows clearly a decreasing trend and the rate of decrease is 14.6% per decade (statistically significant with 95% confidence level). On the other hand, the annual maximum snow depth on the Sea of Japan side of northern Japan shows no discernible trend. As the annual maximum snow depth is subject to large annual variations and the period covered by observation records is still relatively short, the addition of further observation to the data series is expected to increase the reliability of statistical trend detection. (*I)

5.1.3.2 Projections

- Snow cover and snowfall will decrease mainly on the Sea of Japan side of eastern Japan.[56] In some inland areas in Hokkaido, snow cover and snowfall will both increase. [(*II)]
- The snow cover duration and snowfall season will be shorter (beginning of the season will be later, and ending will be sooner). [(*II)]

5.1.4 Oceans

5.1.4.1 Observation Results

- The annual mean sea surface temperature around Japan has risen by +1.09°C per century, which is greater than the corresponding value for the North Pacific overall (+0.50°C per century). [(*I)]
- Sea levels in Japanese coastal areas exhibited no significant rise from 1906 to 2016, but have shown a rising trend since the 1980s. In Japanese coastal areas, variations with 10- to 20-year periods were seen between 1906 and 2016, with the maximum sea level appearing around 1950. Recent rates of rise around the country have been 1.1 [0.6 to 1.6] mm/year from 1971 to 2010 and 2.8 [1.3 to 4.3] mm/year from 1993 to 2010. These are comparable to the global average figures provided in the IPCC's Fifth Assessment Report 2013 (AR5).[57]

5.1.4.2 Projections

- Sea surface temperature around Japan is projected to increase, and the projected long-term SST trend in the Sea of Japan that is greater than those in the seas south of Japan.[58]
- Even if the necessary global warming countermeasures were taken to limit the extent of temperature rise to a relatively low level, global mean sea level is projected to continue rising during the 21st century.[59] However, regarding sea levels around Japan, for uncertainty of projections, it is also necessary to take into account the conspicuous periodic variations in sea level.[60]

5.1.5 Sea Ice

5.1.5.1 Observation Results

- The maximum sea ice extent[15] in the Sea of Okhotsk shows large interannual variations. However, it is virtually certain that it exhibited a long-term trend of decrease for the period from 1971 to 2016 (statistically significant at the confidence level of 99%). [(*I)]
- During the period 1971–2016 the maximum extent has decreased by 67,000 km^2 per decade (corresponding to 4.3% of the Sea of Okhotsk's total area).

5.1.5.2 Projections[61]

- The sea ice extent in the Sea of Okhotsk from January to April is projected to decrease by around 75% by the end of the 21st century.
- The maximum sea ice extent observed in the Sea of Okhotsk during March is projected to shrink to about 75% by

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56 There is uncertainty associated with bias error between the climate models used and the current climate, so some caution is needed for use. However, examples of projections for the Sea of Japan side of eastern Japan show a reduction of an average 17 cm in annual maximum snow depth and average 26 cm in annual snowfall under the RCP2.6 scenario, and a reduction of an average 78 cm in annual maximum snow depth and average 146 cm in annual snowfall under the RCP8.5 scenario. [(*III)]

57 The values in square brackets show the 90% uncertainty range.

58 Projections calculated by primary regression analysis based on climate projections for 1981–2100 using the high-resolution North Pacific Ocean General Circulation Model (NPOGCM), applying the SRES A1B and B1 scenarios. (Source: Global Warming Projection Vol.7, Japan Meteorological Agency.)

59 Covered in projections under RCP scenarios in the Working Group I contribution to the AR5.

60 Excerpted from "Synthesis Report on Observations, Projections, and Impact Assessments of Climate Change, *"Climate Change and Its Impacts in Japan"* (FY 2012 edition)".

61 From comparison of the 20-year average for 2081–2100 projected by Coupled atmosphere-ocean Regional Climate Model (CRCM), applying the SRES A1B scenario, and the 20-year mean for 1981–2000. (Source: Global Warming Projection Vol.7, Japan Meteorological Agency).

the end of the 21st century.

- With global warming, a later onset of sea ice freeze-up in late autumn and an earlier retreat northward in early spring is projected in the Sea of Okhotsk.

5.1.6 Typhoons

5.1.6.1 Observation Results

- During the period from 1951 to 2016, the numbers of formations show no discernible long-term trend, but have often been lower since the latter half of the 1990s than in previous years. Since 1977 when the collection of complete data on maximum wind speed near the typhoon centers began, no trend is shown in the incidence of typhoons with maximum wind speeds of 33 m/s or higher. [(*I)]

5.1.6.2 Projections

- An increasing trend is projected relative to the present in the number of occurrences of strong typhoons, the maximum intensity of typhoons, and rainfall intensity at the time of maximum typhoon intensity. It should be noted that the number of occurrences of typhoons in the western Pacific is projected to decrease slightly in the long term.[62]
- Some research results indicate that extremely strong typhoons may increase in Japan's southern seas relative to the present, and that these extremely strong typhoons may reach the vicinity of Japan while relatively maintaining their strength.[63]

5.2 Summary of the Findings of Japan's Climate Change Impact Assessments

5.2.1 Climate Change Impact Assessment Report

To formulate the "national adaptation plan," it is necessary to ascertain what kind of impacts could be occurring due to climate change in Japan, and to develop plans based on the findings. That is why the Expert Committee on Climate Change Impact Assessment (hereinafter "Expert Committee") was formed under the Global Environment Committee of the Central Environment Council (an advisory body to the Japanese Cabinet), and in the committee, "the projections of climate change in the future based on existing research" and "the assessments of climate change impacts on nature and human society in Japan" (hereinafter "impacts") are compiled. In this way, the impacts of climate change in Japan have been discussed. As a result, it formulated the "Climate Change Impact Assessment Report in March 2015. 5.2.1.1, 5.2.1.2 and 5.2.1.3 show summary, basic approach and criteria for Climate Change Impact Assessment excerpted from the Report.

5.2.1.1 Summary of Japan's Climate Change Impact Assessments

This section presents summaries of the findings of Japan's climate change impact assessments for each of the seven sectors indicated in the Climate Change Impact Assessment Report (agriculture, forest / forestry and fisheries; water environment / water resources; natural ecosystems; natural disasters / coastal areas; human health; industrial and economic activities; and life of citizenry / urban life).

For the impact assessments, expert judgment based on scientific findings was used to rate the three parameters of "significance," "urgency," and "confidence" from the following perspectives.

The impact assessment results are expressed using the following legend.

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62 Based on, the Working Group 1 contribution to the IPCC's Fifth Assessment Report (2013), and Knutson et al. (2010).

63 Tsuboki et al. (2015) and Murakami et al. (2012)

Legend:

【Significance】 ● Very High ◆ Not “Very High” —N/A (currently cannot be assessed)
Criteria: Soc (Social), Ec (Economic), Env (Environmental)
【Urgency】 ● High ▲ Medium □ Low —N/A (currently cannot be assessed)
【Confidence】 ● High ▲ Medium □ Low —N/A (currently cannot be assessed)

Table 5-2 Summary of the Findings of Japan’s Climate Change Impact

Sectors	Categories	Sub-categories	Significance	Urgency	Confidence
Agriculture, Forest/Forestry, Fisheries	Agriculture	Paddy field rice	●	●	●
		Vegetables	—	▲	▲
		Fruit trees	●	●	●
		Barley/Wheat, Soybean, Feed crops, and other crops	●	▲	▲
		Livestock Farming	●	▲	▲
		Plant pests and weeds	●	●	●
		Water, Land and Agricultural Infrastructure	●	●	▲
	Forest/Forestry	Timber production (e.g., Plantations)	●	●	□
		Non-wood forest products (e.g., Mushrooms)	●	●	□
	Fisheries	Migratory fish stocks (Ecology of fishes)	●	●	▲
		Propagation and Aquaculture	●	●	□
Water Environment, Water Resources	Water environment	Lakes/ Marshes, Dams (Reservoir)	●	▲	▲
		Rivers	◆	□	□
		Coastal areas 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		●	▲	□
	Phenology		◆	●	●
	Shifts in distribution and populations		●	●	●
Natural disasters, Coastal areas	Rivers	Floods	●	●	●
		Inland waters	●	●	▲
	Coastal areas	Sea-level rise	●	▲	●
		Storm surges, High waves	●	●	●
		Coastal erosion	●	▲	▲
	Mountain areas	Debris flows, Landslide, and other disasters	●	●	▲
	Others	Strong winds and other	●	▲	▲
Human Health	Winter warming	Mortality in winter season	◆	□	□
	Heat stress	Risk of mortality	●	●	●
		Heat illness	●	●	●
	Infection	Water- and food-borne diseases	—	—	□
		Vector-borne diseases	●	▲	▲
		Other infectious diseases	—	—	—

Sectors	Categories	Sub-categories	Significance	Urgency	Confidence
	Others		—	▲	▲
Industrial / Economic activities	Manufacture		◆	□	□
	Energy	Energy demand and supply	◆	□	▲
	Commerce		—	—	□
	Finance, Insurance		●	▲	□
	Tourism	Leisure	●	▲	●
	Construction		—	—	—
	Medical		—	—	—
	Others	Other impacts (e.g., Overseas impact)	—	—	□
Life of Citizenry, Urban Life	Urban infrastructure, Critical services	Water supply, Transportation, and other	●	●	□
	Life with sense of culture and history	Phenology, Traditional events / local industry	◆	●	●
	Others	Impacts on life due to heat stress	—	●	□
	Urban infrastructure, Critical services	Water supply, Transportation, and other	●	●	●

5.2.1.2 Basic Approach of Climate Change Impact Assessments

Assessments are done for the sub-categories indicated in Table 5-3, in terms of significance, urgency, and confidence. It is difficult to mechanically and quantitatively establish assessment criteria across the board due to the unique characteristics of each sector. As a result, it was decided to use expert judgment based on scientific findings in each Working Group, while using common metrics in each sector for "significance," "urgency," and "confidence." In addition, the Expert Committee considered the results of the discussions in each sector.

Table 5-3 Classification of Sectors and Categories

Sectors	Categories	Sub-categories
Agriculture, Forest/Forestry, Fisheries	Agriculture	Paddy field rice
		Vegetables
		Fruit trees
		Barley/Wheat, Soybean, Feed crops, and other crops
		Livestock Farming
		Plant pests and weeds
		Water, Land and Agricultural Infrastructure
	Forest/Forestry	Timber production (e.g., Plantations)
		Non-wood forest products (e.g., Mushrooms)
	Fisheries	Migratory fish stocks (Ecology of fishes)
		Propagation and Aquaculture
Water Environment, Water Resources	Water environment	Lakes/ Marshes, Dams (Reservoir)
		Rivers
		Coastal areas 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

Sectors	Categories	Sub-categories
	Coastal ecosystems	Marshlands
		Subtropics
		Temperate / Subarctic
	Marine ecosystems	
	Phenology	
	Shifts in distribution and populations	
Natural disasters, Coastal areas	Rivers	Floods
		Inland waters
	Coastal areas	Sea-level rise
		Storm surges, High waves
		Coastal erosion
	Mountain areas	Debris flows, Landslide, and other disasters
	Others	Strong winds and other
Human Health	Winter warming	Mortality in winter season
	Heat stress	Risk of mortality
		Heat illness
	Infection	Water- and food-borne diseases
		Vector-borne diseases
		Other infectious diseases
	Others	
Industrial / Economic activities	Manufacture	
	Energy	Energy demand and supply
	Commerce	
	Finance, Insurance	
	Tourism	Leisure
	Construction	
	Medical	
	Others	Other impacts (e.g., Overseas impact)
Life of Citizenry, Urban Life	Urban infrastructure, Critical services	Water supply, Transportation, and other
	Life with sense of culture and history	Phenology, Traditional events / local industry
	Others	Impacts on life due to heat stress

5.2.1.3 Criteria for Climate Change Impact Assessment

- Significance: Assess in terms of three criteria: social, economic, and environmental.
- Urgency: Assess in terms of two criteria: Timing of occurrence of impacts, and timing required to initiate adaptation measures and critical decision-making.
- Confidence: To some extent, applying to the approaches to confidence used in the IPCC Fifth Assessment Report, assess in terms of two criteria: Type of research/report (e.g., quantitative projection based on model simulation; projection using an index such as degree of an increase in temperature; qualitative analysis or estimates); and degree of agreement. Where the amount of research or reporting is rather limited (examples are only one or two cases), judgment is used to determine whether the contents are reasonable.

<Approach for Assessment of Significance>

- The assessment of significance of impacts was done from three criteria: social, economic, and environmental. Reference was made to four elements listed in the IPCC Fifth Assessment Report as a basis to identify key risks (see below) as "Criteria used in the IPCC Fifth Assessment Report as a basis to identify key risks" ("timing of impacts" to assess urgency and "potential to reduce risks through adaptation or mitigation" were excluded), and also to the U.K. CCRA[64] approach.
- The assessments are conducted, in principle, based on science, including the contents of research papers and

[64] U.K. CCRA: U.K. Climate Change Risk Assessment

other materials. Also based on the assessment approach shown in Table 5-4, expert judgment is used to determine if an impact is “particularly high” or “not particularly high.”

- Also, the term “N/A (currently cannot be assessed)” is used to indicate cases where assessment is difficult to do under current conditions.
- As for “the potential to reduce risks through adaptation or mitigation,” the potential to reduce risk through mitigation is not considered because it is difficult to make an assessment for each impact compiled, but for the potential to reduce risk through adaptation, comments are provided as required, for reference.

Criteria used in the IPCC Fifth Assessment Report as a basis to identify key risks

- Magnitude (of impacts)
- Probability
- Irreversibility
- Timing (of impacts)
- Persistent vulnerability or exposure contributing to risks
- Limited potential to reduce risks through adaptation or mitigation

Table 5-4 Approach for Assessment of Significance

Criteria for Assessment	Metrics for Assessment (Approach)		Means of Indicating Final Assessment
	Particularly High	**Not Particularly High**	
	Assess significance in terms of social, economic, environmental impacts based on the following criteria: ● Magnitude of impacts (area, duration) ● Likelihood of occurrence of impacts ● Irreversibility of impacts (difficulty of restoring original conditions) ● Persistent vulnerability or exposure contributing to the impacts of concern		Indicate the degree of significance, and where it is particularly large, indicate the criteria.
1. Social	At least one of the following applies: ● Involves the loss of human life, or on the health dimension, the extent of impacts and likelihood of occurrence are particularly high (abbreviated as "extent" below). e.g.: Hazards (disasters) could result in the loss of human life Health impacts for large numbers of people ● Magnitude of impacts on local society and community is particularly high e.g.: Impacts are nationwide Impacts are not nationwide, but are serious locally ● Magnitude of impacts on cultural assets and community services is particularly high e.g.: Irreversible impacts on cultural assets Serious impacts on life of citizenry	An assessment of "particularly high" does not apply.	
2. Economic	The following applies: ● Magnitude of economic losses is particularly high e.g.: Large-scale losses occur to assets and infrastructure Loss of employment opportunities for a large number of citizens Large-scale disruptions of transportation networks over a large area	An assessment of "particularly high" does not apply.	
3. Environment	The following applies: ● Magnitude of losses to environment and ecosystem functions is particularly high e.g.: Large-scale loss of important species, habitats, and landscapes For ecosystems, significant deterioration in quality of places that are important internationally and nationally Significant decline in land/water/atmospheric/ecological functions over a broad area	An assessment of "particularly high" does not apply.	

<Approach for Assessment of Urgency>

- For criteria corresponding to urgency, reference was given to the IPCC Fifth Assessment Report "timing of impacts" and U.K. CCRA "timing of impacts" and "urgency with which adaptation decisions need to be taken." These are different concepts, but here, it was decided to consider both approaches and adopt the one that has the highest urgency. It should be noted that because adaptation includes measures that need to be implemented in the long term and on an ongoing basis, for the "timing of impacts" and "urgency with which adaptation decisions need to be taken" it is necessary to consider the amount of time required to implement measures.
- Also, the term "N/A (currently cannot be assessed)" is used to indicate cases where assessment is difficult to do under current conditions.

Table 5-5 Approach for Assessment of Urgency

Criteria for Assessment	Metrics for Assessment			Means of Indicating Final Assessment
	High Urgency	Medium Urgency	Low Urgency	
1. Timing of impacts	Impacts are already evident.	High likelihood that impacts will occur *by* about 2030.	High likelihood that impacts will occur *after* about 2030. Or level of uncertainty is extremely high.	The level of urgency is to be indicated for each sub-category as one of three levels, with criteria 1 and 2 both considered.
2. Timing needed to initiate adaptation measures and make critical decisions	Decisions need to be made as soon as possible.	Major decisions need to be made before about 2030.	There is not much need to make major decisions before about 2030.	

<Approach for Assessment of Confidence>

- The assessment of confidence is conducted, in principle, based on the IPCC Fifth Assessment Report's "type, amount, quality, and consistency of evidence," and "degree of agreement," and the assessment is expressed with five terms (very high, high, medium, low, and very low).
  Types of evidence: Monitoring/observation to date, models, experiments, paleoclimatic analogues
  Quantity of evidence: Numbers of research and reports
  Quality of evidence: Qualitative content of research and reports (e.g., ask whether assumptions are reasonable)
  Consistency of evidence: Consistency of research and reports (e.g., consistency of scientific mechanisms)
  Agreement of opinion: Agreement of opinion among research/reports

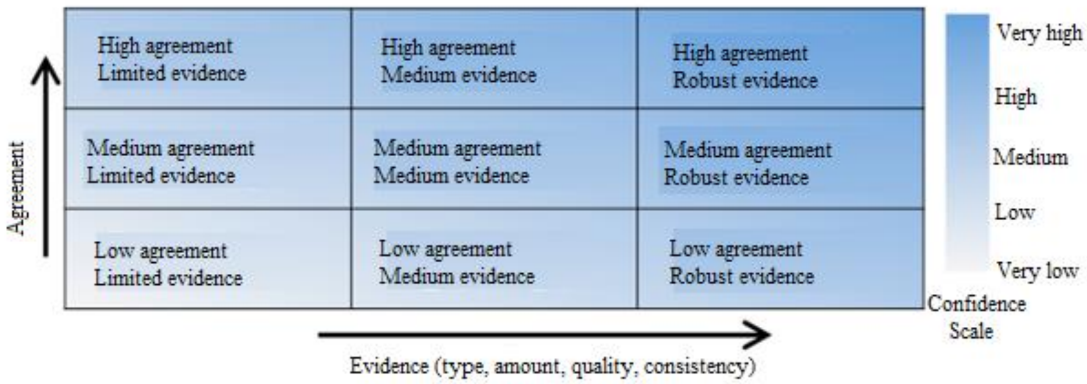

Figure 5-9 Evidence and agreement statements and their relationship to confidence[65]

Confidence increases toward the top right corner. Generally, evidence is most robust when there are multiple, consistent, independent lines of high-quality evidence.

- Here, the same two metrics are utilized as in the IPCC Fifth Assessment Report ("type, amount, quality, and consistency of evidence" and "degree of agreement"). Regarding "type, amount, quality, and consistency of evidence," integrated judgment is to be used, but the amount of research and reports with projections of future impacts in Japan is believed to be less available than in IPCC discussions. Thus, as an approach and metric for judgment, evaluators could consider whether or not research and reports with quantitative analysis are available.
- Regarding the assessment levels, it may not be possible to obtain a sufficient amount of literature, so only three options are used: high, medium, and low.
- When assessing confidence, the assessment shall also take into account the degree of certainty of projections (e.g., the amount of precipitation) from climate models on which projections are based.
- Also, the term "N/A (currently cannot be assessed)" is used to indicate cases where assessment is difficult to do under current conditions.

[65] Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties (IPCC 2010)

Table 5-6 Approach for Assessment of Confidence

Considerations for Assessment	Levels of Assessment (Approach)			Means of Indicating Final Assessment
	High Confidence	**Medium Confidence**	**Low Confidence**	
IPCC Assessment of Confidence ・Type, amount, quality, and consistency of research/reports ・Degree of agreement in research/reports	Corresponds to IPCC confidence rating of "high" and above	Corresponds to IPCC confidence rating of "medium"	Corresponds to IPCC confidence rating of "low" and below	Using the IPCC's level of confidence, indicate the level of confidence for each sub-category using one of three levels.

5.2.2 Nexus between Socioeconomic Fragility and Assessment of Climate Change Impacts

The nexus between climate change and security, in particular the issue of socioeconomic fragility as a consequence of climate change has been discussed in the G8 and G7 Foreign Ministers' Meetings since 2013. A working group was established at the G7 Lübeck Foreign Ministers' Meeting in 2015, the Working Group subtitled its report to the Ministers at the G7 Hiroshima Foreign Ministers' Meeting in 2016. In a statement issued in the G7 Lucca Foreign Ministers' Meeting in Italy in May 2017, the Foreign Ministers encouraged the Working Group to identify proposals for action to increase resilience in fragile states. The Working Group endeavors to elucidate the relation between climate change and security. In particular, the Working Group focuses on specific regions to identify regional fragility issues. The Working Group institutes the significance to seek opportunities to conduct case studies and pilot programs in this regard.

As its contribution to G7 Working Group process, Japan published a report on climate change and fragility, titled 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 -[66]. In the Asia Pacific region, the majority of the world population is estimated to concentrate and expected to grow. The region is also vulnerable to natural disasters. This report therefore focuses on the Asia-Pacific region and draws from a collection of researches and studies conducted in Japan, which includes Program for Risk Information on Climate Change promoted by Ministry of Education, Culture, Sports, Science and Technology between 2012 to 2016, regarding the effects of climate change on disasters and its relation with regional, socioeconomic fragility in the regions. The findings of the report were presented at the COP23 preparatory workshop held in Suva, Fiji on September 26 and 27 to the participants of the Asia-Pacific countries as well as the G7 Working Group meeting held in Rome in Italy on October 27, 2017. (The report is accessible on MOFA website) Japan will employ and disseminate the outcome of this report not only on the climate change negotiations but also in various diplomatic endeavors to cooperate for development, prevent disasters and achieve Sustainable Development Goals.

[66] http://www.mofa.go.jp/press/release/press4e_001714.html

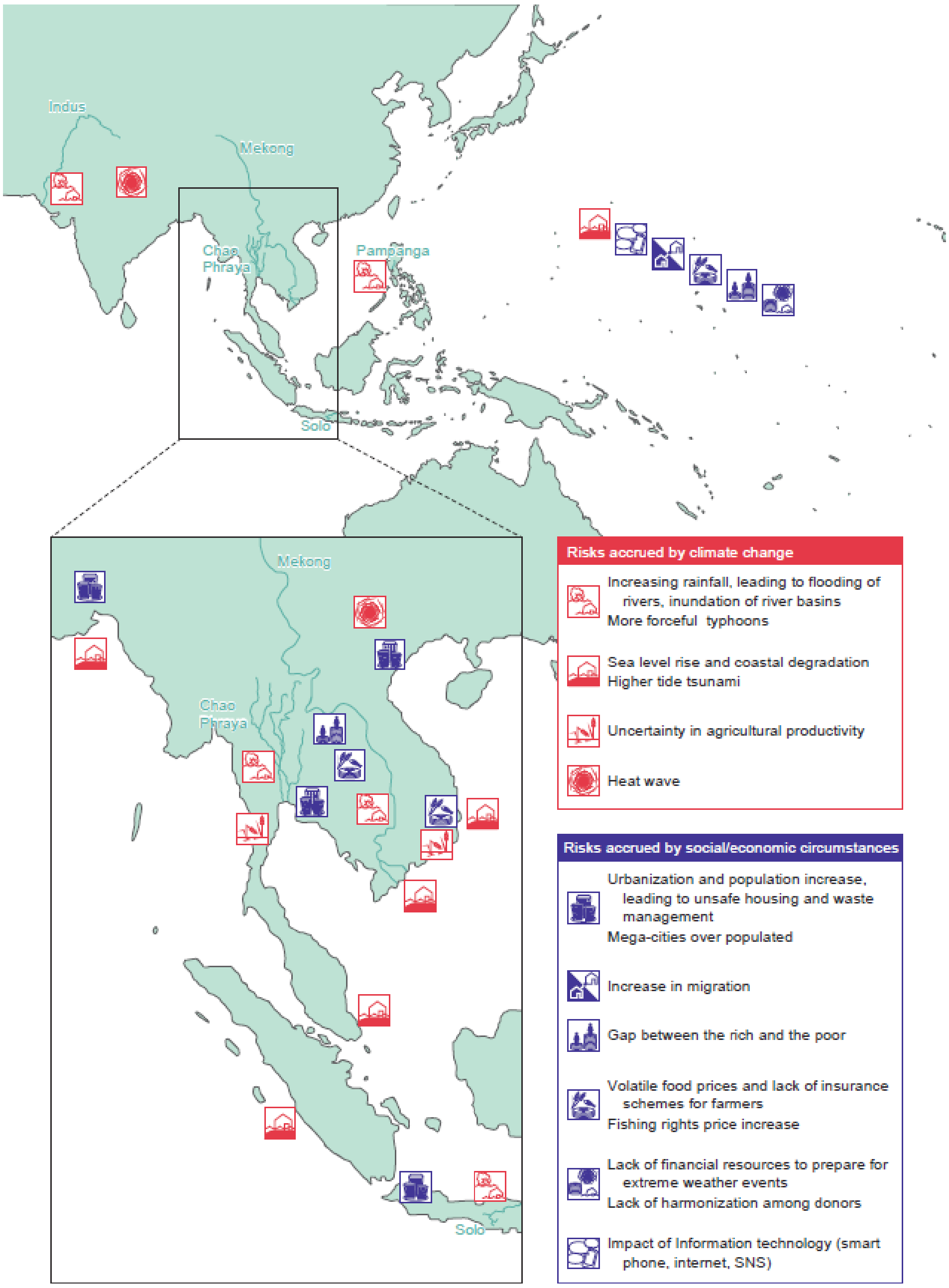

Figure 5-10 Nexus between Climate Change and Socioeconomic Fragility in the Asia-Pacific Region

Figure above displays a mapping on risks accrued by climate change and social/economic circumstances deprived from the studies and interviews introduced in this report. Further studies are required to see correlations among the risks in order to better understand the nexus between climate change and socioeconomic fragility.

5.3 Basic Adaptation Measures

5.3.1 Formulation of Adaptation Plan

The Climate Change Impact Assessment Report formulated in Mar. 2015 showed that the impacts of climate change are appearing in Japan, including an increase in temperature and frequency of heavy rainfall, a decrease in number of days with precipitation, and an increase in sea surface temperature, and that due to high temperature, impacts can already be seen, including a decline in quality of agricultural crops, and shifts in the distribution of flora and fauna. The submission also revealed that in the future, there may be further increases in temperature and the frequency of heavy rainfall events, decreases in the number of days with precipitation, and increases in sea surface temperature, as well as increases in the amount of precipitation falling in heavy rainfall events, increases in the maximum intensity of typhoons, and sea-level rise. The report reveals that a variety of impacts may occur in various sectors, including agriculture, forestry, fisheries, the water environment, water resources, natural ecosystems, natural disasters, and human health.

In order to promote systematic and integrated efforts that are coordinated to address these impacts of climate change, the first Adaptation Plan was approved by the Cabinet, which establishes the basic principles, such as a vision for society, as well as basic approaches, the basic direction for measures in each sector, basic measures, and international measures[67].

This Adaptation Plan aims to create a secure, safe, and sustainable society that, whatever impacts arise from climate change, is able to minimize or avoid any damage—such as loss of life of citizens, and damage to property, livelihoods, the economy, and the natural environment—and is able to recover quickly. This is to be achieved through facilitating adjustment of social systems and natural systems by promoting measures to adapt to the impacts of climate change.

The section of 5.3.2 is based on the Adaptation Plan

5.3.2 Basic Directions for Measures in Each Sector

In this section, basic adaptation measures in seven sectors are described based on Part 2 of Adaptation Plan.

5.3.2.1 Agriculture, Forest/Forestry, Fisheries

Recently, the production and foundation of the livelihood of the agriculture, forestry, and fisheries, including mountain and fishing villages in Japan, have been put at risk by hindered growth and declining quality of agricultural and fishery products due to high temperature, as well as large-scale disasters caused by record high temperature, torrential rainfall and heavy snow. In addition, as the IPCC AR5 report indicates, climate change without adaptation is projected to negatively impact production of the major crops, and the agriculture, forestry and fisheries industries are most likely to be impacted by climate change.

Unless measures for reducing and preventing negative impacts of climate change are appropriately implemented at the sites where agriculture, forestry and fisheries are operated, such negative impacts will pose a threat to securing a stable food supply, the fulfillment of multiple functions of forests such as land conservation, the development of agriculture, forestry and fisheries, and the promotion of farming, mountain, and fishing villages. Thus, it is extremely important to utilize the efforts for climate change adaptation in agriculture, forestry and fisheries.

(1) Basic Adaptation Measures for Agriculture

Overview of Agricultural Production

Efforts have been taken in overall agricultural production as follows: dissemination of adaptation measures and instructions at production sites, such as technologies for avoiding and mitigating impacts such as those of high temperature, as well as the introduction of high-temperature-resistant varieties and the demonstration of new adaptation technologies.

Furthermore, in cooperation with local governments (or related institutions), impacts of global warming are monitored and information related to adaptation measures are offered in the “Global Warming Impact Investigation Report” and on the website of the Ministry of Agriculture, Forestry and Fisheries.

Make special efforts for paddy field rice and fruit trees, and plant pests and weeds whose significance is especially high and whose urgency and confidence are found high in the Climate Change Impact Assessment Report.

Regarding other items, in addition to continuing to promote measures taken so far, based on a future projection of impacts, develop new adaptive varieties and cultivation management technologies or conduct basic research.

[67] http://www.env.go.jp/en/focus/docs/files/20151127-101.pdf

Moreover, in continued cooperation with local governments (or related institutions), monitor global warming impacts, and offer information related to adaptation measures in the "Global Warming Impact Investigation Report" and on the website of the Ministry of Agriculture, Forestry and Fisheries.

Paddy Field Rice

Make active efforts to establish basic technologies of soil and water management for adaptation to high temperature, and to disseminate high-temperature-resistant varieties. Although the area in which high-temperature-resistant varieties are planted has increased gradually, such varieties have not fully prevalent since they do not meet actual consumers' needs (according to the Global Warming Impact Investigation Report 2014, the planted area of high-temperature resistant varieties was 77,500 ha).

Moreover, for pest control, promote pest control along with adjusting the timing, utilizing forecasting information.

In addition to the above efforts, the following measures will be taken hereafter:

Develop varieties based on varieties with high-temperature resistance, which are less likely to be damaged by high temperature.

A decrease in yield has been already evident in extremely high temperature years. Since much higher temperature is expected in the future, commencing from 2015 onward, develop breeding materials capable of maintaining fertility under high-temperature sterility[68] to prevent a decrease in yield.

Efforts are to continue to establish basic technologies of soil and water management. From 2016, support is to be provided to efforts to spread high-temperature-resistant varieties, such as selection and demonstration of high-temperature-resistant varieties and sampling promotion, with all the stakeholders such as producers, rice wholesalers, and actual consumers working together.

Continuously promote adjusted pest control utilizing forecasting information. And by around 2019, develop and disseminate damage mitigation technologies against pests including rice sheath blight disease and rice streak, which are expected to increase due to global warming.

Fruit Trees

In order to mitigate the occurrence of sunburned fruit of satsuma mandarin oranges due to high temperature and strong solar radiation, thinning out of the upper part of the fruit tree crown exposed to direct sunlight has been promoted. For the purpose of mitigating the occurrence of peel puffing of fruit, the application of plant growth regulators such as calcium compounds has been promoted. Moreover, as also a measure against poor coloring, spraying of Figaron (ethychlozate)[69], which is used for the purpose of fruit thinning, has been promoted.

Replanting has been also promoted in order to switch from satsuma mandarin oranges to medium late ripening citrus fruits (such as *Citrus reticulata Shiranui* and blood orange) that prefer warm climate.

Regarding apples, in addition to introducing superior colored varieties including "Akibae" and yellow-colored varieties as measures against poor coloring, introduction of sprinkling water and reflective sheets have been promoted as measures against sunburned fruit and poor coloring.

As common measures against drought for fruits including peaches and cherries, the following measures have been promoted: utilization of water evaporation control with multilayered sheets, deep plowing and feeding organic substrates at the dormant stage in order to maintain soil moisture, and adjusting controls at the proper time for spider mites and other pests that are likely to occur at the time of drought. Also, as a measure against frost damage due to late frost during the flowering period, establishment of a frost damage alert system has been promoted.

As a common measure against poor coloring of fruit due to climate change, support for establishing a production and distribution system for fruits for processing use has been promoted in order to proactively utilize such fruits as raw ingredients for fruit juice.

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[68] Due to high temperature during the flowering period, insemination is hindered and starch does not accumulate in the grain.

[69] Plant growth regulator used for the purpose of accelerating the ripening period, fruit thinning and mitigating peel puffing of citrus fruits.

In addition to the above efforts, the following measures will be taken hereafter:

Regarding satsuma mandarin oranges, accelerate dissemination of cultivation management technologies from 2015 as follows: spraying of gibberellin[70] combined with prohydrojasmon[71] that mitigate the occurrence of peel puffing, and active utilization of light-shielding materials that prevent sunburn of fruit. For the purpose of stabilizing the flower setting, commence development of production stabilizing technologies by improving fertilizer application and water management.

Regarding apples, commence development of cultivation management technologies from 2015, for the purpose of reducing the occurrence of poor coloring and sunburn fruits in high temperature.

In view of projection of the shift of suitable area for production, and in order to establish new orchards utilizing high-elevation zones, from 2016, provide support for cultivation demonstration toward such efforts and replanting for switching varieties, while promoting orchard infrastructure development at high-elevation zones.

In the case of grapes, the following measures will be taken: as measures against poor coloring, continuously promote introducing superior-colored varieties such as “Queen Nina” and yellow-green-colored varieties such as “Shine Muscat.” At the same time, in order to mitigate the coloring trouble due to high temperature at the ripening stage, accelerate dissemination of production stabilizing technologies such as girdling[72] from 2015.

In the case of Japanese pears, the following measures will be taken for the purpose of mitigating damage caused by poor sprout emergence: utilization of a sprout promoter, further introduction and dissemination of technical measures such as changing the application timing of fertilizers, as well as the commencement of developing production stabilizing technologies in warm regions through measures including soil improvement.

On the other hand, in terms of breeding of satsuma mandarin oranges, apples and Japanese pears, develop breeding materials adaptive to high temperature conditions by or around 2019. Thereafter, the said developing new varieties will be cultivated. From 2027, actually introduce such varieties to the place of production for demonstration.

In addition to the above, in the case of the advancement of global warming due to climate change, it is projected that the area where subtropical and tropical fruits can be cultivated in facilities will expand. Thus, from 2016, introduce highly-valuable subtropical and tropical fruits (such as atemoyas, avocados, mangoes and lychees) for demonstration, and promote shifts from the existing fruits in line with local producers’ selection.

If the temperature zone favorable to the cultivation of apples moves northward due to the advancement of global warming, it is considered possible to form the production area in a new region. When forming such a new production site, promote establishment of low-cost and labor-saving orchards.

Considering that being perennial crops, fruit trees require a certain period of time to bear fruits, and that the prices of fruits tend to fluctuate due to supply-and-demand imbalances, it is necessary to implement measures from the long-term viewpoint more so than for other crops. Therefore, it is necessary to establish a network among major production regions and prefectures, in order to share precise information such as global warming impacts and adaptive measures and examine action plans at the sites of production.

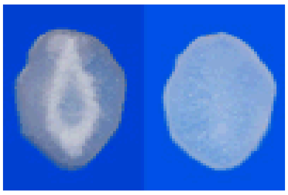

Figure 5-11 Cross-section of paddy field rice
---White immature grain (left), normal grain (right)

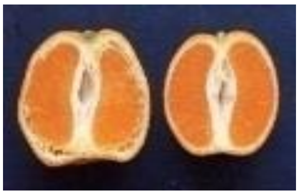

Figure 5-12 Mandarin citrus peel puffing

[70] Plant growth regulator used for the purposes including accelerating the growth of fruit trees, accelerating flowering and fruit enlargement.

[71] Plant growth regulator used for the purposes including accelerating coloring of fruit and mitigating peel puffing of satsuma mandarin oranges.

[72] A technique leading to improvement of coloring as follows: peeling off the outer skin of a trunk, and sending nutrients made in leaves to a fruit cluster, without sending them to parts lower than the peeled part.

Figure 5-13 Poor coloring of Apple


Figure 5-14 Poor coloring of Grape

Land-Extensive Crops

As for wheat and barley, the following measures have been taken against heavy rainfall and moisture damage: while completing basic techniques such as drainage measures, measures including preventing fusarium head blight at an appropriate time and harvesting at an appropriate time, a shift to resistant varieties against diseases including fusarium head blight and against pre-harvest sprouting[73] have been promoted. As a result, certain effects have been observed. Moreover, as measures against frost damage, efforts have been taken to develop and disseminate varieties and breeding materials adaptive to climate change, as well as production stabilizing technologies.

The following measures against heavy rainfall, high temperature and drought have been taken for soybeans: completing drainage measures and promoting the dissemination of a ground-water-level control system. As a result, certain effects have been observed. In addition, as pest control, efforts have been taken to develop and disseminate varieties and breeding materials resistant to pests as well as weed control techniques. Further work has been done on developing a cultivating system less likely to be impacted by climate change, such as the application of organic manure and crop rotation, which mitigates pest and disease occurrence risks.

In the case of red beans, the dissemination of a high-temperature-resistant variety, “Kitaasuka,” has been promoted in Hokkaido (central Hokkaido and southern Hokkaido).

Regarding tea plants, a measure against frost damage has been promoted by implementing a frost protection technique with an energy-saving frost-protective fan system. As a result, certain effects have been observed. Moreover, the following drought measures have been implemented: soil moisture evaporation control by grass mulch and sprinkling water. As for pest control, forecasting technology has been introduced, and replanting of varieties resistant to white peach scale[74] has been promoted.

Regarding sugar beet, pests and diseases control has been taken to develop and disseminate species resistant to diseases, which are frequently caused by high temperature. As a result, certain effects have been observed. Measures for high temperature also have been periodically taken to monitor and investigate the production status at the production site and to accumulate findings for the purpose of selecting the most suitable species. Moreover, drainage measures against heavy rain have been taken.

Measures taken so far will be continuously promoted hereafter.

Horticultural Crops

Regarding vegetables, while promoting the development of breeding materials adaptive to warmer conditions and the dissemination of such varieties as measures against higher temperature, efforts have been made toward the stable supply of open-field vegetables by selecting adequate varieties, adjusting the cultivation periods, and pest control at appropriate times. The following drought measures have been promoted: establishing irrigation facilities, soil moisture evaporation control with multilayered sheets, and an appropriately timed extermination of spider mites and other pests that are likely to occur at the time of drought.

[73] A phenomenon where a sprout comes out of a seed that grew on an ear due to events including rainfall before harvesting.

[74] A major pest insect for tea, which is a parasite living in the branches and trunk of a tea plant. It causes damages including dieback, due to decaying tree vigor. In recent years, its outbreak has been frequent nationwide, but there is no clear cause-and-effect relationship between climate change and the trend.

As for measures against high temperature concerning vegetables grown in greenhouses, efforts have been made to implement low-cost nighttime air-conditioning technologies by utilizing soil temperature-controlling multilayered sheets, light-shielding materials, fog cooling machines, pads and fans[75], circulating fans, and heat pumps[76] mainly at relatively large facilities. The following measures against typhoons and heavy snow have been promoted: implementation of a low-cost weather-resistant greenhouse, reinforcement of a pipe-framed greenhouse, installation of a backup power source. As a result, certain effects have been observed.

As for measures against high temperature concerning ornamental plants, adequate use of sprinkling water has been promoted. In addition, work has been done on disseminating varieties adaptive to hot conditions.

As for measures against high temperature concerning ornamental plants grown in greenhouses, efforts have been made to implement low-cost nighttime air-conditioning technologies by utilizing soil temperature-controlling multilayered sheets, light-shielding materials, fog cooling machines, pads and fans, circulating fans, and heat pumps. In addition, the following measures against typhoons and heavy snow have been promoted: implementation of a low-cost disaster-resistant greenhouse, reinforcement of a pipe house, installation of a backup power source. As a result, certain effects have been observed.

Measures taken so far will be continuously promoted hereafter.

Livestock Farming

As for livestock, while securing an adequate livestock barn environment by disseminating summer heat measures, such as water sprinkling and misting in a livestock barn and application of lime and water sprinkling to the roof, the following efforts have been made: avoidance of close rearing and strict enforcement of clipping, and instruction and completion of adequate feeding management techniques, such as supplying cold water and feedstuff of good quality. Moreover, efforts have been taken to develop and disseminate productivity improvement techniques to prevent a decline in the rate of gain and fertility in the summertime through adequate nutrition management.

Regarding forage crops, establishment of a cultivating system adaptive to climate change, development and dissemination of summer heat measures including manuring management techniques, as well as varieties and breeding materials resistant to heat have been promoted. Also, disease and pest measures have been taken, such as development and dissemination of resistant varieties and breeding materials.

Measures taken so far will be continuously promoted hereafter.

Plant Pests, Weeds, and Animal Infectious Diseases

It is important to understand appropriately the situations of the occurrence and damage of pests presented in Japan. For this reason, a pest forecasting program applicable to the specified pests[77] will be continuously implemented, and while investigating changes of the status of the occurrence and damage, such information will be transmitted for the purpose of timely and proper pest control. Moreover, in response to climate change, commence reviewing the specified pests for the pest forecasting program and the pest control system in order to adapt to climate change.

As for serious pests[78] that are absent, or present but not widely distributed in Japan, while continuously taking phytosanitary measures in order to prevent the introduction of pests from overseas, domestic quarantines for preventing such pests from spreading in Japan, and surveillance as well as control of the pests, implement further risk assessment of pests based on information in the world, and work on reviewing phytosanitary measures based on the results of risk assessment of pests.

Regarding serious pests that are already present in a part of Japan, efforts will be gradually taken for technical

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75 A device made by combining a water-dampened cooling pad and a cooling fan, which obtains cooling effects by evaporatively cooling a greenhouse for agriculture.

76 A technology that collects heat in the air by a small amount of input energy, in order to use it as a large amount of thermal energy.

77 As specified by the Minister of Agriculture, Forestry and Fisheries in Article 22 of the Plant Protection Act (Act No. 151 of 1950), pests and diseases of which distribution in Japan is not localized, and they spread quickly and tend to do material harm to crops.

78 Pests and diseases that possibly do material harm to useful plants if they spread within the country.

development toward the improvement of accuracy of monitoring survey for newly invading pests, and the advancement of control techniques.

As for long-range migratory pest insects[79], commence development of technology for clearing the change of the situations of migration from overseas, (i.e., the period of migration and the number of migrated insects), and technology for projecting the change of distribution area in Japan, (i.e., northward expansion of the overwintering area and the acceleration of occurring and migration).

Regarding diseases such as rice sheath blight and rice stripe, which is expected to occur increasingly in paddy fields, clarify the impacts on paddy rice yields, and develop technologies against such impacts.

Regarding weeds, while assessing the risk of occurrence of spoiled grains of soybeans due to increases in the amount of weeds remaining until the harvesting season, commence work on developing a technology mitigating damage on soybeans.

As for animal infectious diseases, the following efforts will be taken: selection of a vaccine candidate strain against livestock infectious diseases carried by vectors (virus for manufacturing vaccine suitable for epidemic infectious diseases), examination of risk management including effective preventive measures, and investigation on risks of migratory birds, which are considered a major factor for avian influenza invasion of Japan.

Water, Land and Agricultural Infrastructure

While formulating the “Global Warming Measures in Agricultural and Rural Development” and conducting examinations and investigations of measures concerning water, land and agricultural infrastructure, promote the development of technologies that contribute to the projected impacts of global warming and measures based on the technical development plan concerning agricultural and rural development.

In light of impacts such as an increase in temperature expected to occur in the future and a decline in snowmelt runoff volume, agricultural water will be effectively secured and utilized by appropriately combining measures in hard(structural) and soft(non-structural) aspects as follows: reducing the amount of irrigation water by automated water management and pipelining waterways and effective utilization of existing water resources by changing the operation of reservoirs and agricultural dams.

In order to respond to increasing torrential rainfall, efforts will be taken for disaster prevention in rural areas, as well as the maintenance and improvement of disaster reduction functions, by appropriately combining measures in hard(structural) and soft(non-structural) aspects as follows: promoting prevention of farmland flooding, by developing drainage pumping stations and drainage canals, grasping facilities and regions highly vulnerable to inundation, conducting risk assessment such as formulating hazard maps, and promoting the development of a business continuity plan by facility managers. In doing so, measures will be effectively taken by utilizing the existing facilities and by demonstrating local communities’ functions.

Under present circumstances, climate change projections are highly uncertain, and there are no sufficient grounds for conducting specific examinations based on projected impacts. Thus, in light of new scientific findings, accompanied by the advancement of climate change research, medium- to long-term impacts will be projected and assessed.

If the grounds for improving facilities based on projected impacts become definite in the future, due to new scientific findings and climate models as well as improved accuracy of the assessment methods of impacts on water, land and agricultural infrastructure, conduct examinations on desirable infrastructure improvement.

Securing Food and Feed Safety (Agricultural Products Including Cereal Grain and Cereal Products, and Feeds)

Through continuous surveillance of the distribution of mycotoxin[80]-producing fungi in domestic field soil, and

[79] Insect pests that travel from several hundred kilometers to several thousand kilometers using not only their own flying capability, but also a large-scale weather phenomenon, including many serious insect pests in agriculture such as plant hoppers, aphids, and Noctuidae. Insect pests such as rice brown plant hopper (Nilaparvata lugens) and the white backed plant hopper (Sogatella furcifera) are known to migrate mainly to western Japan across from mainland China by a low-level jet stream that develops during the rainy season in Japan.

[80] Substances that have harmful effects on humans and livestock among natural chemical substances made by mold

mycotoxin contamination of domestic agricultural products and feeds, endeavor to ascertain the impacts of climate change. If there is a possibility that increases in mycotoxin contamination of agricultural products and feeds will pose a health problem for humans and livestock, develop technologies to reduce contamination and extend such measures to producers of agricultural products and feeds. Mycotoxin contamination reduction measures will be regularly verified and reviewed in consideration of new findings.

(2) Basic Adaptation Measures for Forest/Forestry

Mountain Disaster and Forest Conservation Works and Forest Road Facilities

In order to fully fulfill the multiple functions of forests, such as watershed conservation and disaster prevention, while promoting planned designation of protection forests, the following measures have been taken for protection forests:

Preventing mountain disasters or minimize the damages from those disasters and improve the safety of hilly and mountainous areas by means of promoting implementation of disaster control facilities and forest management works.

Establishing the Forestry Agency Plan for Extending Service Life of Infrastructure (action plan), and appropriately maintaining and updating disaster control and forest road facilities.

Cooperation with regional evacuation arrangements by offering information about areas vulnerable to mountain disaster, designated as Mountain Disaster Danger Zones (MDDZ), and implementing effective projects toward disaster risk reduction. When implementing such projects, biodiversity conservation is managed, such as by installing fish ways at disaster control facilities, taking local conditions into consideration.

Maintaining and developing protection forests that contain rich forest soil having high infiltration and water-holding capacity, located in important headwaters for the upstream toe of a dam, or headwaters for a village for the purpose of contributing to stable supply of good quality water through maintaining and enhancing of watershed conservation functions of forests.

Enhancing disaster prevention functions of forests such as preventing salt damage by promoting coastal disaster-prevention forests.

In addition to the above efforts, the following measures will be taken hereafter:

Reviewing the criteria investigation standards of MDDZ and figuring out more precisely the zones with higher disaster risk in order to respond to occurrences of mountain disasters due to recent torrential rainfall.

Promoting measures including designating forests located in the MDDZ as protection forests for sediment runoff prevention, in order to improve functions for landslide prevention and sediment runoff prevention. While implementing measures against harvesting and development, providing disaster control facilities and forest management activities, and developing forest roads.

The improvement of forest road facilities will be promoted in consideration of an increase in the frequency of occurrence of torrential rainfall in recent years, aiming at improving disaster prevention functions of the facilities.

On the other hand, increases in the number of rainless days, decreases in snowfall, and early snow melting are expected and the risk of drought is concerning. Therefore, considering requests from local communities, management and conservation of forest suitable for the characteristics of each basin and development of necessary forest roads will be promoted in order to appropriately fulfill watershed conservation functions.

In terms of coastal disaster-prevention forests, taking local conditions into consideration, development of the growth base which takes into account disaster mitigation effects against storm surges and coastal erosion, and enhancement of functions of facilities, including tide embankments will be promoted.

Examining enhancement of the accuracy in ascertaining the MDDZ, improvement of facilities in response to disaster risks, and forest management making use of disaster risk reduction functions of forests based on new scientific findings and the improved accuracy of climate models.

Planted Forests

Information related to climate change impacts on forests and the forestry industry is collected through research and studies.

In order to conduct the adaptability assessment of planted trees against changes in the growing environment such as temperature rise and dryness, experimental planting of seedlings for main reforestation tree species such as cedar and cypress, which are collected from different areas, is promoted widely. Furthermore, continuous monitoring and impact assessment for climate change impacts on the growth of these tree species and the surrounding environment of trees such as understory vegetation, assessment of risks on long-rotation forests, and development of varieties adaptive to climate change such as high temperature and drought are commenced.

Natural Forests

In order to conduct impact assessments, information on climate change impacts, including shifts in the distribution area, has been collected.

Moreover, “Protected Forests” which protect primary forest ecosystems and habitat of rare wildlife species, as well as “Green Corridors” which serve as migratory pathways for wildlife, are designated in national forests. Appropriate conservation and management of national forests will be promoted through continuous monitoring surveys to precisely ascertain their conditions and also through efforts to help form forest ecosystem network together with mountain streams.

Data collection, future projections and vulnerability assessments will be conducted on the climate change impacts on the forest ecosystems of each World Natural Heritage Site, in order to develop necessary measures. Furthermore, efforts will be taken to build a system for the purpose of conducting long-term monitoring of the climate change impacts on the surrounding environment including trees and lower-layer vegetation.

Pests

In order to prevent the spread of forest pests, continuous pest control is conducted in cooperation with prefectures, in accordance with the Forest Pest Control Act.

The distribution of pest-damaged area is deemed likely to expand due to intensified insect activities accompanied by an increase in temperature. While continuous research on climate change impacts and damage control are promoted, monitoring of forest damage is conducted.

Furthermore, for the purpose of mitigating forest pest damage, while developing varieties having high resistance to the pine wilt disease, development of effective and efficient techniques to evaluate the resistance of varieties is promoted.

Non-Wood Forest Products

Efforts have been made to ascertain climate change impacts on shiitake mushroom bed log cultivation such as the status of damage caused by disease-causing bacteria and the infection route; the status of occurrence of damage caused by fungus gnat pest insects; and the influence on yields under high temperature conditions in the summer and examination of a cultivation method that controls an increase in temperature within a bed log laying yard by utilizing cheesecloth that blocks out sunlight.

While data concerning outbreaks of disease-causing bacteria and influence on yields due to the influence of climate change is accumulated, development, verification and dissemination of shiitake mushroom cultivation techniques and varieties adaptive to global warming will be promoted.

(3) Basic Adaptation Measures for Fisheries

Marine Fisheries

Endeavor to ascertain impacts such as impacts on living aquatic resources due to changes in marine environment by continuing marine environment studies at spawning areas and at the major fishing grounds of various living aquatic resources.

Moreover, improve the precision of an oceanic condition projection model in operation by upgrading the method including assimilation of various observational data obtained from research vessels and satellites. Based on such information, aiming at ascertaining and projecting the amount of resources under the changing environment, and improving the precision and efficiency of fishing ground projection, examine measures enabling adaptive fishery production activities in response to environmental changes.

Regarding highly migratory species, such as tuna and bonito, which require resource management by international efforts, for the purpose of estimating their carrying capacity, which is considered to fluctuate due to climate change impacts, aim hereafter to collect various data, such as resource information, genome information, and ocean information and develop a data integration and analysis system.

By specifying climate conditions and marine environment conditions that will become a factor for the outbreak of harmful plankton, and by utilizing satellite information and a variety of coastal observation information, develop a system to promptly provide information to the related institutions concerned with real-time monitoring.

Furthermore, as changes in the marine environment will possibly affect the survival of released juvenile salmon and other species, develop the releasing methods of juvenile salmon and other species in response to changes in the marine environment.

Marine Aquaculture

Continue research and studies concerning the relationship between the occurrence of red tide plankton, which causes significant impacts on the aquaculture industry, and climate change.

Hereafter, while utilizing metagenome analysis technologies to develop methods that enable detecting with high sensitivity the emergence of tropical and subtropical red tide plankton, which is becoming a new threat, ascertain the physiology and biological characteristics of such plankton, and use such information for projections and development of preventive technologies and measures technologies.

Based on a concern for decreasing growth in the aquaculture areas, continuously work on developing breeds including high-water-temperature-tolerant culture breeds. As for seaweed in particular, further work will be done as follows: developing high-water-temperature-tolerant breeding materials by utilizing a new laver breeding technique based on already developed cytogamy techniques, and developing a breeding technique by separating a high-temperature-tolerant strain of large-sized algae such as wakame seaweed.

Hereafter, formulate measure guidelines for fish diseases that are expected to frequently occur at the time of high water temperature, as well as fish diseases that will possibly invade Japan from tropical and subtropical waters, accompanied by an increase in water temperature, and develop various measures technologies.

In consideration of the increasing possibility of occurrence of unknown fish diseases due to an increase in water temperature, aim to promptly respond to the occurrence of unknown fish diseases by systematizing and enhancing a series of technical developments including specifying pathogens, diagnosis, and measures regarding infectious diseases whose pathogens are unknown. Vaccinations for various fish diseases have already been developed. The efforts will be taken to further develop and disseminate vaccinations in response to various fish diseases.

Hereafter, in tandem with such measures for fish disease, by utilizing the latest breeding techniques, create strains that appear to be resistant to various fish diseases that are expected to break out accompanied by global warming, and aim to introduce such strains at the aquaculture sites.

In addition to the aforementioned technical developments, take efforts to identify the characteristics of pathogens, the working mechanisms of vaccinations, the molecular mechanism of disease tolerance and resistance and other.

While proceeding with monitoring and ecological surveys of breeds that appear as a result of an increase in water temperature such as Longheaded eagle ray, which eat bivalves including short-neck clams, and developing management technologies to prevent adverse impacts on ecosystems and aquaculture, proceed with developing efficient capturing methods, contributing to regional development, application technologies and high-value-added technologies.

Although the range of diurnal variability of partial pressure of carbon dioxide that affects the pH of seawater is known to be large in the coastal areas, it is unknown how this mechanism is affecting marine organisms. Thus, while solving such a mechanism and projecting acidification impacts on bivalve aquaculture, develop measures technologies based on such projections.

Inland Water Fisheries and Aquaculture

Assess impacts on the habitat and abundance of important resources in inland waters such as Salmonidae fish and Sweetfish that are brought by environmental change of rivers, as well as lakes and marshes, accompanied by climate change.

Based on a concern about decreasing growth in the inland water aquaculture areas, continuously work on developing breeds including high-water-temperature-tolerant culture breeds. Particularly, a seawater immersion treatment at the larval fish period is known to be effective in selecting individual landlocked salmons tolerant to high water temperature. Thus, a high-water-temperature-tolerant strain will be created by applying this technology to other Salmonidae fish.

In order to upgrade feeding and releasing technologies for pond smelt, whose catch is projected to decrease due to high water temperature, while aiming at stabilization, mass-production, and simplification of seedling production, hereafter efforts will be taken in the following areas: developing an efficient production technique of plankton bait, discovering the most suitable rearing density and bait density at the time of seedling production, and developing extensive and mass-productive seedling production techniques.

Collect Information concerning the outbreak of diseases caused by high water temperature. As for diseases of inland water fish, whose damage is expected to increase due to an increase in water temperature, conduct research on the characteristics and onset factors of pathogens, and develop measure technologies based on such research.

Improvement and Development of Fishing Grounds

While precisely ascertaining changes in the distribution areas and the habitats of marine organisms due to an increase in seawater temperature, work on improving fishing grounds, which will become spawning and nursery grounds of marine creatures, in response to such changes. When improving and developing seaweed beds, in addition to seeding and transplanting high-water-temperature-tolerant species according to the situation of the site, after making improvements, promote more effective measures by adopting an adaptive management method as follows: monitoring the condition of thickly growing algae and the movement of phytophagous animals, and implementing the measures for organisms causing feeding damage, such as removing phytophagous fish, according to the situation.

As the foundation for improving and developing fishing grounds adaptive to climate change, analyze accumulated observational data and fish catch data in order to work on technical development concerning the method assessing climate change impacts on coastal resources in each region.

By ascertaining the distributive characteristics, feeding habits, seasonal changes of organisms causing rocky-shore denudation and by utilizing the global warming projection model, project changes in the distribution areas and impacts. By selecting seaweed relatively resistant to such feeding damage, develop a reproduction technique. Moreover, develop a method for improving and developing combined seaweed beds for the purpose of regrowing seaweed beds in empty spaces within seaweed beds arising from feeding damage in a short period of time.

Fishing Ports and Villages

In order to respond to increases in high waves due to extreme weather events, while monitoring tide levels and waves for the purpose of precisely ascertaining signs of climate change impacts, promote the following measures in a continuous and planned manner: raising the levees of fishing port facilities such as breakwaters and shallow draft quay, and developing tenaciously structured shore protection facilities.

In consideration of socio-economic activities of the hinterlands and the mid- and long-term movement in land use, strategically and adaptively take measures in material and non-material aspects, which are combined in the most suitable manner (best mixed) going forward.

Moreover, develop design conditions for infrastructure facilities in response to rising water levels and increases in high waves, and a low-cost technique for improving the existing facilities.

(4) Basic Adaptation Measures for Other Issues related to Agriculture, Forest/Forestry, and Fisheries

Global Warming Projection Studies and Technical Development

In terms of a global warming projection study, impact assessment of the agriculture, forestry and fisheries industries has been conducted and, by presenting future impact assessments, contributed to the preparation of the IPCC and various other reports. In terms of technical development, techniques for adaptation to issues that are currently occurring due to impacts such as declining quality of paddy field rice and fruit trees has mainly been developed.

While enhancing efforts on items requiring highly accurate projection studies on climate change impacts on the agriculture, forestry and fisheries industries, aim hereafter to provide substantial information concerning such items, in order to provide communities with an opportunity to tackle climate change.

As for technical developments, develop varieties and breeding materials in light of the mid- and long-term viewpoints based on forecast studies as well as production stabilizing technologies, and develop techniques in order to utilize opportunities brought about by climate change.

Continue to develop cultivation techniques adaptive to climate change and crops resistant to drought, develop techniques contributing to international contributions, and provide assistance for such technical developments.

Expanding Measures to Regions Based on Projected Impacts

By providing information concerning various adaptation measures indicated in a more detailed impact assessment and this Adaptation Plan, which is analyzed and organized in an easy-to-understand manner for each of the regions that are similar in terms of climate conditions, production items and other, assist the place of production to practice and promote the measures at its own discretion and prepare for future impacts.

Climate change affects not only the supply of the products, but also the surrounding environment such as farmland, forests, and related facilities as the infrastructure in the agriculture, forestry, and fisheries industries. Thus, promote dissemination and enlightenment activities concerning the necessity of the adaptation measures among all levels of citizens, including users of agricultural, forestry, and fishery products, as well as consumers.

Heat Illness among Farmers, Forestry Workers and Fishermen

As the effort of the government for heat illness, the government designated July as a “Heat Illness Prevention Awareness Month” and set up the Inter-Minister Meeting for Heat Illness comprised of the relevant government ministries and agencies for the purpose of examining and exchanging information on efficient and effective methods for ensuring that heat illness preventative measures are intensively implemented especially during the prevention month.

Prior to the prevention month, while requesting prefectures and the related organizations to notify farmers, forestry workers and fishermen of precautions, such as frequent water intake, and wearing clothing made of perspiration-absorbing and quick-drying materials, prepare posters and flyers to raise awareness through the “Heat Illness Prevention Project,” a private-public initiative

In coordination with the relevant government ministries and agencies, and in cooperation with prefectures and the related organizations, hereafter promote the dissemination and guidance concerning heat illness prevention measures for farmers, forestry workers and fishermen including use of new technologies and instruments, such as highly breathable work clothes and a heat illness meter, which notifies the wearer when the risk of heat illness is high.

In some cases, workers engaged in the agriculture, forestry and fisheries industries work under harsh working conditions, such as under a scorching sun and on steep slopes. Thus, measures to reduce workload on such workers will be taken by proactively introducing robot technology and the ICT, as well as high-performance machinery.

Wildlife Damage

Until now, the following measures in each area have been taken:

In the case of field crops, some supports such as installing intrusion-preventive fences has been taken for the purpose of preventing damage by wildlife, and trapping. In the case of forests and forestry, some activities such as installing guard fences has been taken to protect planted trees and natural vegetation, trapping and shooting while developing efficient control techniques. In the case of fisheries, implement the following various measures: removing great cormorants, shooting northern sea lions with rifles for preventing and mitigating damage on fisheries, and promoting the introduction of improved fishing gears, employing enhanced protective nets made of a new material.

While continuously working on installing intrusion-preventive fences, promoting population control, and improving techniques for controlling population and damage, hereafter continue to ascertain information on the condition of the habitats of wildlife and monitor damage on the agriculture, forestry and fisheries industries.

Moreover, based on Wildlife Protection and Management Act, promote scientific and planned protection and control of wildlife by enhancing population control of wildlife such as the sika deer by prefectures and training persons implementing population control of wildlife.

World Food Supply and Demand Forecasts

Under such conditions, in order to precisely respond to risks anticipating food supply and demand in Japan in the future, in consideration of the IPCC's latest assessment results anticipating the situation in 2100 concerning climate change impacts on the world food supply and demand, build a system forecasting world food supply and demand in the long term, which applies the most suitable forecast models, including economic growth and population increases.

For the purpose of developing strategies toward securing a stable food supply in the mid-term, in consideration of climate change impacts and in light of social/economic trends including economic growth and the trends of policies of each country, continuously conduct mid-term forecasts concerning world food supply and demand, in coordination with the Policy Research Institute, the Ministry of Agriculture, Forestry and Fisheries.

While collecting and analyzing in an integrated manner information concerning food supply and demand overseas and impacts on stable food supply in Japan regarding the trends of world food supply and demand, analyze the causes of impacts on stable food supply in Japan. Such information will be continuously and widely provided.

Furthermore, in order to supplement and enhance information concerning the trends of food supply overseas, aim to obtain and accumulate earth observation data (including image analysis) such as soil moisture via satellite in collaboration with the Japan Aerospace Exploration Agency, and examine whether it is appropriate to analyze and utilize such data.

5.3.2.2 Water Environment, Water Resources

(1) Basic Adaptation Measures for Water Environment (General efforts for the water environment)

Based on the fact that various climate change-induced changes are expected, including changes in water quality, continue promoting studies and research relating to water quality monitoring and projections, and promote water quality conservation measures. Specifically, as general efforts for the water environment, promote studies relating not only to direct changes in water bodies associated with climate change such as an increase in water temperature, but also relating to characteristics of runoff (including nutrients from watersheds), and continue to promote water quality conservation measures such as the use of advanced wastewater treatment and improvement of combined sewer systems. In addition, conduct the following efforts.

(Efforts for lakes/marshes, dams (reservoirs))

In lakes and marshes expected to have changes in phytoplankton and worsening of water quality associated with an increase in water temperature and changes in rainfall, promote measures to reduce the inflow loads, including measures for wastewater from factories and business premises and measures for domestic wastewater, and strengthen monitoring systems to properly ascertain changes in phytoplankton.

Consider bottom-layer environmental changes associated with changes in water temperature in lakes and marshes, and conduct projections relating to the risk of occurrence of bottom-layer oxygen deficiency, as well as red tides and blue tides.

In deep water layers of stratified lakes and marshes, where incomplete circulation is projected to occur in winter due to changes in water temperature, consider appropriate measures to improve dissolved oxygen (DO) at bottom layers.

Based on prior analysis, consider appropriate adaptation measures for lakes and marshes nationwide, endeavor to obtain the latest scientific findings and improve the accuracy of projections, and based on the results, consider additional measures as required.

Regarding reservoirs (i.e., dam reservoirs), continue implementing water quality conservation measures including the use of selective water intake equipment and aeration-circulation equipment, and consider actions including the review of operational rules of water quality conservation equipment responding to climate change-induced changes in water quality.

(Efforts for rivers)

Regarding climate change-induced impacts on rivers and related environments, some research is under way to make projections of changes in the water quality and water temperatures of specific rivers, but at present the quantity of examples is not yet sufficient, and the certainty of predictions is assessed to be low. Therefore, it is currently difficult to ascertain and make projections of the changes occurring in river environments overall. Therefore, continue to conduct actions including monitoring of river quality, and endeavor to collect more scientific findings.

(Efforts for coastal areas and enclosed sea areas)

Promote studies and research relating to impacts of climate change including impacts on water quality and biodiversity, as well as adaptation measures, and endeavor to collect scientific findings.

Consider changes in bottom-layer environment associated with changes in water temperature in port areas and inner bay areas, and consider projections relating to the risk of occurrence of bottom-layer oxygen deficiency, as well as red tides and blue tides.

(2) Basic Adaptation Measures for Water Resources (Basic Approach to Adaptation Measures)

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; also, prepare for droughts through drought risk information sharing with collaboration among actors, including the national government, local governments, water users, companies, and residents.

In close cooperation with stakeholders, TimeLine (time schedule of emergency actions) should be developed in order to specify the state of a drought event which will grow serious issue over time from its early stage, the impacts caused by such an event, expected damage and the countermeasures to reduce damage caused by such an event.

(Assessment of disaster risks)

In order for stakeholders including residents and companies to undertake preparations for droughts, assess the safety of water supplies of existing facilities, and also, assess the situation facing the stakeholders as a drought progresses from the initial stage to become increasingly severe, and based on that information, assess drought risks such as impacts and damage in areas including socioeconomic activities, social and medical services, public facilities and services, and individual livelihoods; present the findings in comprehensible ways, and share the information with stakeholders, including the national government, local governments, users, companies, and residents.

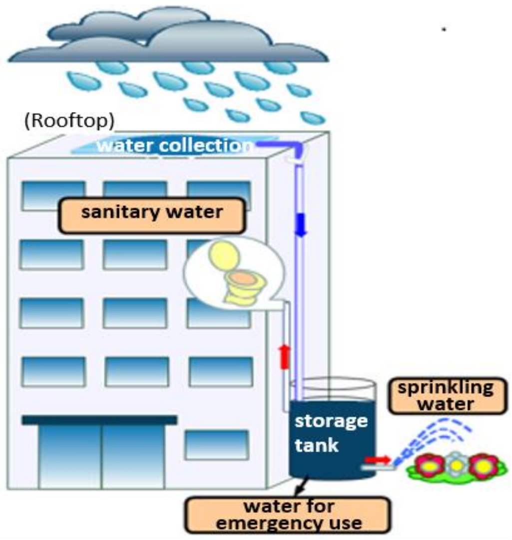
a) Measures to prevent damage from droughts that occur relatively frequently

(Optimal use of existing facilities)

In areas where development of water resources infrastructure are needed, promote initiatives for water resource development continuously and also consider other potential options to increase the capacity of existing facilities, heightening of dams, and excavating reservoirs or dredging sediment buildup in reservoirs. Also, maintain the capacity of existing facilities by conducting systematic maintenance, management and upgrades, including the implementation of steady actions such as measures against aging facilities. In addition, while taking into account factors such as each dam’s water reserves and precipitation conditions, consider the potential for efficient dam operations, including multi-dam operation in the river basin.

(Use of rainwater, reclaimed wastewater)

Promote the consideration of revisions to technical standards relating to plans and designs in order to encourage the installation of facilities to utilize rainwater, based on tools such as enforcement of legislation relating to the promotion of rainwater use. Also, responding to local needs and other factors, promote the installation of faucets at wastewater treatment plants, and encourage the use of treated wastewater for applications including road maintenance and tree watering, and even in times of emergency; also, promote the re-use of water by considering standardization, including international standardization of Japanese water reclamation technologies.



Rainwater collected in storage tank is used for sanitary water, sprinkling water, etc.

Figure 5-15 Utilization of rainwater

(Information provision, awareness raising)

Promote information dissemination and appeals for water-saving efforts during normal times and also at an early stage when drought concerns arise, through collaboration with the related institutions and media organizations. In order to promote efficient water use, conduct educational and awareness raising activities to deepen interest and understanding of citizens about the importance of water.

b) Measures to mitigate damage from droughts that exceed the capacity of facilities

(Organizational systems for drought management in collaboration with stakeholders)

Prior to a drought, among the stakeholders, consider water sharing and special water delivery systems; also, in close cooperation with stakeholders, TimeLine should be developed in order to specify the state of a drought event which will grow serious issue over time from its early stage, the impacts caused by such an event, expected damage and the countermeasures to reduce damage caused by such an event. Also, endeavor to improve drought prediction technologies, including the utilization of information on medium- and long-term precipitation prediction, and consider the potential for actions such as implementation ahead of schedules of water withdrawal restrictions, depending on the circumstances, and based on factors such as drought impact and damage scenarios as indicated in the above-mentioned TimeLine.

(Measures to minimize damage from crisis-level droughts)

In order to prepare for a crisis-level drought, conduct assessments of drought risks and the safety levels of water supplies of existing facilities, and consider actions including unified responses by governments, drought responses by companies, and establishment of priority levels for water recipients, including those to receive special water deliveries based on the assumption of effects and damages to socio-economic activities, healthcare and welfare services, and life of the people.

(Monitoring and information gathering relating to river environments during times of drought)

Due to reductions in river flows during times of drought, as there are concerns about impacts on river environments—affecting water quality and ecosystems, including aquatic flora and fauna that inhabit and grow in rivers—implement monitoring of the river environment during the drought, and endeavor to gather findings about the situation.

(Utilization of groundwater and assessing the situation during times of drought)

Groundwater is not only used during regular times, but can also serve as an emergency alternative water source during droughts. However, excessive groundwater withdrawals can lead to problems such as ground subsidence and groundwater salinization, and generally these types of issues are highly localized in nature.

Therefore, local governments or other regional stakeholders need to take the lead in groundwater management, including consideration of rules for sustainable groundwater conservation and use, reflecting local conditions. In addition, the national government is to conduct technology development to help understand groundwater conditions in order to facilitate consideration of groundwater use as an emergency alternative water source; also, create an enabling environment such as through the formulation of common rules for shared use of a variety of data collected by entities including the national and local governments. In addition, using this data, the national government endeavors to understand the groundwater balance and behavior, and relationships between factors such as groundwater withdrawals, ground subsidence, and salinization.

c) Measures in agriculture, forest and forestry sectors

In the agricultural sector, agricultural water will be effectively secured and utilized by appropriately combining measures in material and non-material aspects as follows: reducing the amount of irrigation water by automated water management and pipelining waterways, etc., and effective utilization of existing water resources by changing the operation of reservoirs and agricultural dams.

In addition, efforts will be made to maintain and develop protection forests that contain rich forest soil having high infiltration and water-holding capacity, located in important headwaters for the upstream toe of a dam, or headwaters for a village; also, based on factors including the risk of occurrence of drought, management conservation of forest suitable for the characteristics of each basin and development of necessary forest roads will be promoted in order to appropriately fulfill watershed conservation functions.

d) Promoting studies and research

Promote studies and research relating to drought risks, including climate change-induced impacts on water resources and on society.

Because sub-surface structures where groundwater is present are diverse and regionally unique, promote research regarding poorly understood aspects, including the condition of groundwater reserves, water balance and groundwater behavior, and the relationships between surface water and groundwater; and promote studies and research regarding the impacts of climate change on groundwater.

Study the current status of water bank systems and water pricing systems being used in overseas countries as emergency water saving strategies, and promote studies and research regarding their applicability.

5.3.2.3 Natural Ecosystems

Considering that land, freshwater, coastal, and marine ecosystems are closely interconnected, and that climate change-induced changes in ecosystems are caused on the whole, 5.3.2.3 on Natural Ecosystems sets out the following basic approach and common efforts.

(Basic Approach)

For natural ecosystems, individual efforts are to be implemented based on the following basic approach.

- Measures by humanity will not be able to broadly limit climate change-induced changes in ecosystems, as the changes in ecosystems are caused on the whole.
- The basic approach to adaptation measures in the area of natural ecosystems is to use monitoring to ascertain changes in ecosystems and species, to pay attention not only to stresses arising from climate change factors but also to factors other than climate change, and by reducing these stresses and creating networks of ecosystems, to endeavor to conserve and restore healthy ecosystems that have a high degree of adaptability to climate change.
- Within a limited scope, proactive intervention to maintain ecosystems, species and ecosystem services may be possible, but careful consideration is necessary regarding factors such as impacts on ecosystems and the burden of ecosystem management.

(Common Efforts)

Based on the basic approach, the following efforts are presented as “common efforts” as outlined in Sections (1), (2), (3), (4) and (6) of 5.3.2.3on Natural Ecosystems, and are to be implemented.

- Strengthen and expand monitoring in order to more accurately ascertain climate change-induced changes such as changes in ecosystems and distributions of species.
- Promote studies and research, and secure and develop human resources, in order to ascertain the impacts of climate change on biodiversity and ecosystem services.
- Continue to undertake efforts to reduce stresses other than those from climate change (e.g., development, environmental pollution, overuse, invasion of alien species). Also, when implementing adaptation measures, endeavor to avoid and minimize the negative impacts on biodiversity.
- Not only secure routes for flora and fauna to migrate and spread, but also promote the creation of networks of ecosystems that can be expected to serve multiple functions. Also, promote the restoration of damaged ecosystems, as required.
- Regarding measures relating to ecosystem conservation, consider reviewing factors such as the objectives, targets, and methodologies of conservation, with consideration given to the impacts of climate change, and build systems for considering and implementing adaptive adaptation measures in accordance with the results of monitoring.
- Only in cases of significant negative impacts of a loss of biodiversity and decline in ecosystem services, within a limited scope, consider proactive intervention such as management to maintain existing ecosystems and species, ex-situ conservation, and management to promote adaptability to climate change. That consideration must give careful thought to impacts on ecosystems and the burden of management.
- Promote studies and research relating to specific policies, methodologies, and technologies relating to implementation of adaptation measures.
- Through studies and research, collect information such as findings, examples, and methodologies to assess functions relating to adaptation measures that utilize ecosystems.
- Implement information sharing and awareness-raising about the relationships between climate change, biological diversity, and ecosystem services, and secure and develop human resources.

(1) Basic Adaptation Measures for Terrestrial Ecosystems

Based on the basic approaches introduced at the beginning of this chapter, the common efforts, as well as the following individual efforts will be implemented.

In particular, while implementing priority monitoring to assess impacts in places such as alpine zones that have a high likelihood of impacts occurring continuous monitoring of wild flora and fauna will be conducted in places such as World Natural Heritage Sites, national parks, and protected forests of national forests in order to ascertain the impacts of climate change. Also, in order to conserve and restore healthy ecosystems with high adaptability to climate change, endeavor will be made to bolster measures to protect biodiversity that have been implemented to date, such as reviewing and properly managing protected areas in places including national and quasi-national parks; managing wildlife populations such as the sika deer, which has a growing population and is having significant impacts on ecosystems; taking measures to prevent damage from wildlife; conducting control and entry prevention measures for alien species; and protection and recovery of endangered species considering the projected impacts of climate change. Additionally, ecosystems networks will be formed connecting places such as national and quasi-national parks, nationally designated wildlife protection areas, and protected forests of national forests, and the creation of forest ecosystem networks integrated with mountain streams will be promoted.

(2) Basic Adaptation Measures for Freshwater Ecosystems

Based on the basic approaches introduced at the beginning of this chapter, implement the common efforts, as well as the following individual efforts.

In order to more accurately ascertain changes such as changes in ecosystems and shifts in species distribution, endeavor to ascertain the impacts of climate change, by enhancing monitoring and promoting studies and research, specifically for important inland water bodies, as required.

In order to conserve and restore healthy ecosystems with high adaptability to climate change, endeavor to bolster measures to protect biodiversity that have been implemented to date, by considering the projected impacts of climate change; examples include reviewing and properly managing protected areas in places including national and quasi-national parks; managing wildlife populations such as the sika deer, which has a growing population and is having significant impacts on ecosystems; conducting control and entry prevention measures for alien species; and protection and recovery of endangered species.. Also, restore marshlands and other ecosystems, as required. In addition, promote the creation of networks of ecosystems connected by water that ensure the connectedness of water bodies including rivers, lakes and marshes, marshlands, springs, ponds, canals, and paddy fields, and enable flora and fauna to move between them.

Regarding diseases affecting fish in inland waters, which are expected to undergo greater damage from an increase in temperature due to climate change, research the characteristics of pathogens and causative factors, and develop preventative measures utilizing the findings.

(3) Basic Adaptation Measures for Coastal Ecosystems

Based on the basic approaches introduced at the beginning of this chapter, implement the common efforts, as well as the following individual efforts.

Implement priority monitoring and conduct assessments of climate change impacts in tidal flats, salt marshes, seagrass beds, and coral reefs, especially where there is a high likelihood of impacts occurring.

Also, in order to conserve and restore healthy ecosystems with high adaptability to climate change, endeavor to bolster measures to protect biological diversity that have been implemented to date, by considering the projected impacts of climate change; examples include reviewing and properly managing protected areas in places including national and quasi-national parks; conducting control and entry prevention measures for alien species; and protection and recovery of endangered species. Also, restore ecosystems such as tidal flats, as required. In addition, promote the conservation and restoration of areas including coastlines, tidal flats, salt marshes, seagrass beds, and coral reefs, and promote the creation of networks of ecosystems.

Regarding the occurrence of red tide plankton, continue studies and research about the relationship with climate change.

(4) Basic Adaptation Measures for Marine Ecosystems

Based on the basic approaches introduced at the beginning of this chapter, implement the common efforts, and continue to conduct priority monitoring specifically for important marine areas, as well as studies and research relating to the relationship between climate change and the occurrence of red tide plankton.

(5) Basic Adaptation Measures for Phenology

Based on the basic approaches introduced at the beginning of this chapter, continuous monitoring to ascertain changes in phenology, including flowering of plants will be implemented. Additionally, participative monitoring will be promoted with cooperation from others, including research institutes and NPOs, while working toward ensuring and developing human resources.

(6) Basic Adaptation Measures for Shifts in Distribution and Populations

Based on the basic approaches introduced at the beginning of this chapter, the common efforts, as well as the following individual efforts will be implemented.

Monitoring to accurately ascertain shifts in species distribution and populations will be enhanced. Priority monitoring will be implemented to assess species living in alpine zones and coastal areas particularly where there is a high likelihood of impacts occurring as well as wildlife such as the sika deer which are having serious impacts on ecosystems due to increasing populations, and exotic species.

Also, in order to conserve and restore healthy ecosystems, endeavor will be made to bolster measures to protect biodiversity that have been implemented to date such as managing wildlife populations including the sika deer; conducting control and entry prevention measures for alien species; and protection and recovery of endangered species considering the projected impacts of climate change. Additionally, the creation of networks of ecosystems to secure routes for flora and fauna to migrate and spread will be promoted. When doing so, concerns about leading to expansion of the range of alien species and sika deer, and the impacts on native species will be considered.

Furthermore, concerning national programs such as Programs for the Rehabilitation of Natural Habitats and Maintenance of Viable Populations for endangered species of wild fauna and flora in Japan, impacts of climate change will be considered on the next reviews of these programs, and existing objectives and measures will be confirmed whether or not they are still appropriate.

5.3.2.4 Natural Disasters, Coastal Areas

(1) Basic Adaptation Measures for Water Disasters

(Basic Approach to Adaptation Measures)

Regarding natural hazards that could occur relatively frequently, continue to steadily promote improvements that have been ongoing to date for construction of levees, flood control structures, and sewer systems, and conduct maintenance and upgrades as appropriate. The goal of these efforts is to prevent the occurrence of water disasters. When doing so, while referring also to measures of other countries and considering possible future climate-change-induced increases in natural hazards, promote efforts in an adaptive way, such as improvements and maintenance that can provide additional measures that—to the extent possible—avoid rework.

Regarding natural hazards that exceed the capacity of facilities, endeavor to reduce risk by making improvements in facilities' operations, design and implementation procedures; promote urban and local development in ways that consider disaster risk reduction; and endeavor to enhance preparedness for actions such as evacuations, emergency operations, and business continuity. Through these efforts, aim to reduce damages to human life, property, society, and the economy to the greatest extent possible. Also, regarding promotion of measures concerning aspects such as urban design and evacuations, based on inundation scenarios for various natural hazards, promote measures with stakeholders such as local governments, businesses, and residents having an awareness of what kinds of damage can occur.

In particular, for natural hazards that significantly exceed the capacity of facilities, aim for the protection of human life to the greatest extent possible and to avoid catastrophic damage to society and the economy, through voluntary collaboration among stakeholders, including the national government, local governments, public utilities, and businesses, considering worst-case scenarios, and by developing measures with an emphasis on non-structural measures.

(Assessment of Disaster Risks)

It is important that the key actors in the implementation of measures, including local governments, businesses, and residents, promote measures with an awareness of what kind of damage may occur and with what frequency of occurrence; therefore, provide detailed disaster risk information that is comprehensible from the perspective of each actor. Additionally, prepare and provide inundation scenarios for not just one, but various magnitude of natural hazards, and present information about the frequency of occurrence of inundation above floor level and potential risks to human life, as well as information about such aspects as the capacity and state of preparedness of facilities. Also, make use of various fora in which each actor participate to share disaster risk information and to promote measures.

Regarding detailed damage scenarios needed for each actor to promote measures, consider local conditions, including the concentration of population and property in flood plains; the location of infrastructures, lifelines, hospitals, and welfare facilities; the structure and location of industries; and the aging of the population.

In order to consider measures that include worst-case scenarios, target probable maximum level in the probable inundation zones, and target not only inundation from flood but also inland water and storm surges. When doing so, provide information not only on depth of inundation but also duration, to enable local governments, businesses, governing bodies, and residents to consider evacuation and other actions.

a) Disaster prevention measures to address natural hazards that occur relatively frequently

Regarding natural hazards that occur relatively frequently, steadily promote disaster prevention measures to prevent the occurrence of water disasters by continuing to steadily promote improvements that have been ongoing to date for facilities, and conduct maintenance and upgrades as appropriate.

(Steady Improvements to Facilities)

Continue to steadily implement improvements of facilities including dykes, flood control facilities, and sewer systems. When doing so, endeavor to promote improvements effectively and efficiently, based on disaster risk assessments. Also, review aspects such as the objectives and details of facilities plans, as required, with consideration of factors such as increases in the frequency of occurrence of heavy rainfalls in recent years.

(Improvements in Capacity of Existing Facilities)

Endeavor to significantly improve the capacity of existing stock, through actions such as dam upgrading; strengthening, repairing, and maintaining existing sewer facilities; and improving water storage facilities.

(Enhancement of Maintenance and Upgrades)

Making use of information and communication technologies (ICT), ascertain in detail the condition of river, sewer system, and other facilities. Also, endeavor to make use of video monitoring (close-circuit television, or CCTV) and other technologies to obtain information about flood and inland water.

In order to maintain and secure the required water storage capacity, continue to promote measures to cope with deposition in dam reservoirs.

(Installation of Remote Control for Facilities such as Water Gates)

Promote the installation of features such as remote control and automation for operation of facilities such as water gates, in order to ensure their reliable operation and the safety of operators.

(Comprehensive Sediment Management)

Consider the objectives of sustainable sediment management in terms of the entire sediment transport system, and promote initiatives for comprehensive sediment management, including preservation of sediment connectivity through dams and dredging sand as beach replenishment material, and the use of sand bypasses to ensure the continuity of longshore sediment transport.

(No-regret design)

Endeavor to design facilities to avoid, to the extent possible, rework and to be able to adaptively keep up with increases in natural hazards, such as through the selection of structural designs that can easily be modified, and reinforcement of foundations and other components before it becomes necessary. Do this in order to be able to easily respond even if natural hazards increase due to climate change and additional works, including replacement of facilities, become necessary in the future.

(Improving Climate Change Projection Technologies for Facilities Plans and Designs)

Undertake efforts such as improving climate change projection technologies, because it is necessary to have detailed scenarios for the impacts of climate change when designing facilities in ways that will avoid rework.

(Considering the Impacts of Sea-Level Rise, as well as Sediment and Wood Debris Runoff)

Clarify the increased risk of damage from storm surges and high waves accompanying climate-change-induced sea-level rise, as well as impacts from factors such as inundation accompanying constrained inland drainage conditions. Also, clarify climate-change-induced changes in sediment and wood debris runoff volumes, and the impacts on river channels, etc.

(Integrating Control of River and Sewer System Facilities)

In order to promote integrated control of river and sewer system facilities, promote improvements such as culverts to connect existing river and sewer facilities, and improvements in facilities such as joint-use (river/sewer) water storage facilities.

b) Disaster-reduction Measures to Cope with Natural Hazards that Exceed the Capacity of Facilities

Regarding natural hazards that exceed the capacity of facilities, endeavor to reduce risk by making improvements in facilities' operations, design and implementation procedures; promote urban and local development in ways that consider disaster risk reduction; and endeavor to enhance preparedness for actions such as appropriate evacuations, smooth emergency operations, and business continuity. Through this, mobilize the full line and capacity of measures, and undertake disaster reduction measures to reduce damage as much as possible.

1) Improving aspects such as facilities' operations, design, and maintenance/upkeep procedures

Regarding natural hazards that exceed the capacity of facilities, endeavor to reduce the effect of disasters by promoting conventional measures with additional consideration for risk of excessive flood, and make improvements in facilities' operations, design and implementation procedures.

(Enhancing Observation and Other Functions)

Endeavor to improve and deploy observation equipment in order to reliably observe hydrologic/hydraulic parameters such as water levels of rivers and sewer systems.

(Enhancing and Strengthening Flood Defense Systems)

During flood events, provide flood defense managers with detailed information about critical section for flood fighting and high-risk section for flood prevention. Also, provide notification about water levels of not only flood in rivers but also inland water and storm surges. In addition, improve facilities that serve as staging areas in response to flood and inland water, and stockpile flood defense supplies, equipment, and materials.

(Securing Evacuation Sites that Make Use of River Management Facilities)

In order to contribute to smooth and rapid evacuations, endeavor to identify and secure evacuation sites and routes, making use of facilities such as river management facilities, including dykes and river disaster management station.

(Checking/Reviewing Plans including River Infrastructure Improvement Plans based on Disaster Risk Posed by Various Natural Hazards)

For natural hazards of various levels up to the probable maximum magnitude, review river improvement plans as required so that they may provide details and procedures for optimal river improvements, considering from the perspective of disaster reduction, and also considering factors such as balances between upstream and downstream areas, as well as between main channels and tributaries. In addition, in order to respond to impacts such as increasingly intense and frequent localized torrential rainfall events, based on detailed disaster risk assessments from inundation simulations, etc., promote the formulation of measures to inundation prevention plans for sewer systems from both the structural and non-structural perspectives.

(Designing Levees to Delay Collapse)

Consider designs of levees that can delay collapse and ensure the greatest amount of time possible for evacuation and other actions, including the perspective of improving the reliability of levees that have already been constructed.

(Making the Most Use of Existing Facilities)

For existing dams, consider methods of operation to achieve the maximum performance from their flood control capabilities. Also, by improving the accuracy of forecasts of rainfall amounts in the upstream catchment area of dams and flow volumes into dam reservoirs, endeavor to further optimize dam operation.

Regarding measures for inland water, consider approaches for operation of sewer pipe networks and drainage pumps that make use of resources such as information on water levels.

(Inspecting Large Structures)

Regarding large structures such as dams and weirs, conduct inspection on any possible damages and/or their impacts on the structure, considering the possible occurrence of natural hazards exceeding the design capacity, such as the probable maximum flood, and implement measures as required.

2) Integrating with Urban Development/Local Development

In urban areas and mountain regions, endeavor to reduce the damages from disasters by promoting urban and local development that considers disaster risk, taking the opportunity of reconstructing towns and regions as population declines.

(Comprehensive Flood Measures)

Promote comprehensive inundation measures, such as securing the water storage and retention capacity of watersheds.

(Water Induced Disaster Prevention Measures Considering Land Use Restrictions)

Promote water induced disaster reduction measures that consider regulation of land uses restrictions, while also considering local opinions; for example, a combination of structural improvements such as ring dykes, and non-structural measures such as the regulation of land uses.

(Measures against Inundation in Underground Spaces)

Promote measures against inundation and secure evacuation from underground spaces of such as the installation of waterstop and appropriate guidance for evacuation from underground facilities by facilities managers in order to prevent inundation to important underground facilities and secure time for evacuation from underground spaces.

(Providing/Sharing Detailed Disaster Risk Information)

Provide disaster risk information in a form that is easy for recipients to understand, in order to contribute to urban and local development, private sector investment, and ingenuity of living, whilst promoting initiatives to provide information by making use of a variety of opportunities to do so, in cooperation with the related organizations.

(Urban Development/Living based on Disaster Risk Information)

When it comes to promoting compact urban development, encourage living and urban functions to be located in areas with low disaster risk, by indicating which areas have a high level of disaster risk.

(Measures to Reduce Inundation in Cooperation with Urban Development/Local Development)

In areas where urban functions and housing are already concentrated but with relatively high disaster risk, with the appropriate allocation of roles, promote river improvements to reduce disaster risk, and promote prioritized actions such as improvements in sewer systems, conducted efficiently in collaboration with multiple municipalities, as well as installation of water stop boards, rainwater storage and infiltration facilities, etc., by private sectors.

(Restraining the Extent of Flooding in Cooperation with Urban Development/Local Development)

Consider frameworks to restrain the extent of flooding, in cooperation with urban and local development, such as care/protection of secondary levees, natural levees, and continuous dikes, as well as the construction of secondary levees by municipalities and other bodies.

3) Preparing for Evacuation, Emergency Operations, Business Continuity

Regarding natural hazards that exceed the capacity of facilities, endeavor to enhance preparedness for actions such as appropriate evacuations, smooth emergency operations, and business continuity. In particular, for natural hazards that significantly exceed the capacity of facilities, considering worst-case scenarios, develop measures with an emphasis on non-structural measures, through voluntary collaboration among stakeholders including the national government, local governments, public utilities, and businesses.

(Supporting Municipal Leaders to Issue Evacuation Advisories Appropriately)

Enhance structures and programs so that the national and prefectural governments could support municipal governments in times of emergency, and provide detailed information relating to disaster risk in dangerous locations even during non-emergency times.

(Providing Easy-to-Understand Information to Facilitate Evacuation)

To communicate clearly to residents about the degree of urgency of risks such as rising river water levels due to floods and an increase in rainfall amounts, or storm surges from typhoons and cyclones, endeavor to provide information so that recipients can easily understand; for example, by providing an organized relationship between disaster prevention information and the degree of urgency.

(Enhancing Pre-disaster Initiatives to Promote Facilitation and Acceleration of Evacuation)

Regarding hazard maps, endeavor to ensure the displayed information is easy for residents and others to understand, and in the streets, promote the installation of signs that indicate information such as the expected depth of inundation, the location's elevation, the direction of evacuation, and the name and distance to an evacuation area.

(Enhancing Preparedness for Evacuation and Rescues)

Formulate disaster prevention action plans to enable evacuations, rescue and emergency operations, and emergency transportation, in cooperation with relevant stakeholders such as national and local governments, and public utilities. These time-series disaster management operation plan should be based on damage assessment, such as the number of fatalities and possibility of persons being isolated during times of large-scale water disasters, etc.

(Strengthening Support/Relief Systems for Municipalities during Times of Disaster)

Strengthen support systems for municipalities implemented by the Technical Emergency Control Force (TEC-FORCE) and other entities.

(Formulating Business Continuity and Related Plans by Organizations Involved in Disaster Prevention, Public Utilities, etc.)

In order for the organizations to be able to continue activities such as emergency response, reconstruction and recovery, consider measures to promote the implementation of measures to prevent the inundation of important facilities (e.g., municipal offices and other government buildings, fire stations, police stations, and hospitals), the preparation of their backup functions, and the formulation of business continuity plans. Also, consider measures to promote the participation of public utilities in disaster prevention action plans in order to reduce the damage as much as possible, and to recover as quickly as possible.

(Restraining the Extent of Flooding; Draining Floodwaters)

In the event of a large-scale water disaster, to restrain the extent of flooding damage and for early reconstruction and recovery, it is very important to quickly drain the floodwaters away. Plan floodwater drainage in advance, and promote efforts to improve drainage gates for rapid drainage of floodwaters, to waterproof equipment including drainage pumping stations, to secure access routes for purposes such as fuel replenishment, and to secure auxiliary electrical power supplies and fuel stockpiles.

(Improving Disaster Prevention Awareness among Businesses; Preparing BCPs for Flood Damage)

In order to reduce damage to businesses and to quickly resume business operations after a flood event, consider policies to promote the implementation of business continuity plans (BCPs) for flood damage and measures against inundation.

(Improving Institutional Arrangements for Disaster Response through Collaboration among All Stakeholders)

Develop time-series operation plan among responsible agencies, including national and local governments, and public utilities, for scenarios of events such as large-scale flooding due to natural hazards that significantly exceed the capacity of facilities.

(Promoting Studies and Research)

As natural hazards are expected to increase due to the impacts of climate change, promote research relating to topics including the following: quantitative assessments of the increasing natural hazards, and ways to deal with the magnitude of their probability of occurrence; improving the methods of determining the probable maximum magnitude of natural hazards; and new approaches to flood prevention and reduction plans. Also, as sediment runoff is expected to increase, promote research about impacts on river channels, etc.

Regarding increased risks of water disasters due to climate change, promote research relating to the potential for new adaptation measures not addressed by existing programs and methods, through efforts such as analysis of the state of use of flood insurance.

c) Measures in the Agriculture Sector

In the agriculture sector, to cope with increases of intense of torrential rainfall and other impacts, make efforts to maintain and improve disaster prevention and disaster risk reduction capabilities of agricultural areas, through appropriate combinations of material and non-material measures, including promoting the prevention of flood damage and other damage on agricultural land by improving facilities such as drainage pumping stations and drainage canals; ascertaining which facilities and regions are highly vulnerable to flooding; implementing risk assessments, including the development of hazard maps; and promoting the development of business continuity plans for facilities managers. In the process, conduct the measures efficiently through the effective use of existing facilities and activation of local community capabilities.

Since climate change projections have a high degree of uncertainty and the basis for concrete discussions based on future projections is limited, conduct projections and assessments of medium- and long-term impacts based on new scientific findings, accompanying progress made in climate change research.

(2) Basic Adaptation Measures for Storm Surges and High Waves

a) Harbors and Fishing Ports

(Basic Approach to Adaptation Measures)

Based on a report entitled “Appropriate State of Port and Harbor Policies and Measures for Climate Change due to Global Warming” (Submission from the Transportation Policy Council, March 2009, in Japanese) and taking into account socioeconomic activities and land uses in areas on both water-side areas and the land side, endeavor to limit the extent of risks on water-side and land-side areas from storm surges and other events, and to maintain port and harbor activities, by strategically and adaptively promoting the optimal combinations of the following types of structural and non-structural measures. Also, incorporate climate change adaptation into various types of programs and plans, and promote the implementation of adaptation measures effectively, through coordination with a variety of other policies and efforts (mainstreaming of adaptation measures).

(Common Items for Ports and Harbors: e.g., Monitoring, Impact Assessments, Information Provision)

Implement weather and marine monitoring, regularly assess the impacts of climate change by conducting simulations of projections for inundation due to storm surges and high waves, and provide the information to the related institutions. Use hazard maps and other means to notify port and harbor users and other about increases in disaster risks due to increases in storm surge anomalies and stronger waves as a result of increases in typhoon strength, as well as sea-level rise; and assess the impacts of decreased cargo handling efficiency associated with sea-level rise. Formulate plans relating to evacuation for businesses and other entities on water-side areas and residents on the land side, and promote actions, including the implementation of trainings In addition, on water-side areas, make an effort to coordinate evacuations and operational rules for land locks (formulated by coastal management authorities), to support smooth evacuation actions by users and other.

(Adaptation Measures for Impacts on Outlying Facilities such as Breakwaters and Other Structures, and on Port and Harbor Functions)

If reviews of natural hazards are required as a result of monitoring results and other information, by reviewing designs in response, maintain the important functions of facilities including moorings and breakwaters. Promote actions including improvements to make structures more robust, so that they can perform well for disaster reduction even in the event of natural hazards that exceed the scale of design parameters, in cases where there are concerns about significant impacts on human life, property, or socioeconomic activities resulting from damage to structures such as breakwaters and dikes. Where there are concerns about the possible infilling of navigation channels and anchorages due to the impacts of climate change, implement measures to prevent infilling, including the construction of groins. Implement trainings based on the port and harbor business continuity plans (BCPs) formulated at each port and harbor in collaboration with stakeholders in order to maintain the important functions of ports and harbors even after the occurrence of a disaster, and aim to enhance the BCPs through reviews, as appropriate.

(Adaptation Measures for Impacts on the Water-Side Areas: E.g., Wharfs, Cargo Handling Areas, Industrial Lands)

Ascertain and assess the performance of coastal protection facilities and port and harbor facilities, and organize information so that that it can contribute to actions that include consideration of high-risk locations. Consider optimal approaches to upgrades and other actions, so that adaptation can be conducted progressively, without requiring large additional costs in response to gradual increases in natural hazards as a result of climate change. Share information with related areas about observed tide levels and waves, to contribute to evacuation decisions. Consider providing detailed information relating to disaster risk, in order to encourage actions such as investments by businesses and other bodies for self-protection and disaster prevention. If land reclamation by landfill is being done where the future rise in sea levels is acknowledged to be significant, while considering the compatibility with factors such as the use of the water level of seawalls and the path of goods, endeavor to ensure that ground surface levels will be sufficient to minimize the risk of inundation, giving prior consideration to increases in storm surge anomalies and stronger waves as a result of increases in typhoon intensity. Promote efforts such as measures to prevent runaway cranes, in anticipation of changes in wind conditions due to climate change.

(Adaptation Measures for Impacts on the Land Side (Land-side Areas))

Ascertain and assess the performance of coastal protection facilities and port and harbor facilities, and organize information so that it can contribute to actions that include consideration of high-risk locations. Consider optimal approaches to upgrades and other actions, so that adaptation can be conducted progressively without requiring large additional costs in response to gradual increases in natural hazards as a result of climate change. Consider how to achieve the use of privately-owned facilities (e.g., parapet walls, sheds, warehouses, and green spaces) for evacuation and as facilities to prevent or reduce the incursion of seawater. In the medium- and long-term, reconstruct the protection lines in coastal areas by taking advantage of opportunities such as chances to reallocate land uses, and promote a shift toward land uses with lower disaster risk from storm surges and other events.

(Adaptation Measures for Impacts on the Clearance Under Bridges)

If the future rise in sea levels is acknowledged to be significant, properly ascertain the degree of sea-level rise, indicate traffic ban areas and times, endeavor to prevent vessels from colliding with structures including bridges and water gates, and endeavor to relocate port and harbor functions (for example, by placing mooring facilities on the seaward side of bridges where there are concerns about clearance).

b) Coasts

(Basic Approach to Adaptation Measures)

Endeavor to limit any increases in disaster risk from storm surges and other events and conserve land along coastlines, by accurately identifying signs of impacts from climate change through marine monitoring, considering the medium- and long-term trends in socioeconomic activities and land uses on the land side, and strategically and flexibly promoting the optimal combination of the following structural and non-structural measures.

(Disaster Risk Assessments, and Measures in Response to Disaster Risks)

In order to respond to increases in storm surge anomalies and stronger waves as a result of factors such as increases in the number of large typhoons believed to be partly induced by climate change, determine areas that have high disaster risk along a continuous protection line in consideration of the status of the land side uses and state of improvement of coastal protection facilities; clarify the disaster risks, and promote measures with the optimal combination of structural and non- structural measures in response to the disaster risks.

(Responses to Natural Hazards that Exceed Protection Levels)

Promote research and studies relating to impacts on decreases in safety of shore protection facilities if they are affected by excessive natural hazards from storm surges; promote improvements to make dykes and other structures more robust, while considering factors such as the conditions in the land side; and also, develop non-material measures such as timely information transmission to support appropriate evacuation from storm surges and other events.

(Strategic Development of Measures to Address Increasing Natural Hazards)

If sea-level rise is acknowledged due to the impact of climate change, conduct measures in an adaptive way, including facilities improvements and upgrades, giving prior consideration to responses to future sea-level rise. Also, in response to gradual increases in natural hazards due to climate change, promote consideration of topics including technology development relating to adaptation, including having the adaptability to heighten levees by improving the foundations of structures, with prior consideration of future loads if the elevations of levees are raised.

(Strengthening Responses to Advancing Coastal Erosion)

Promote efforts including improvements in structures to facilitate proper sediment balance by longshore sediment transport. Also, promote wide-area and comprehensive measures through collaboration with the related institutions, including collaboration on integrated sediment transport control measures of rivers, from upstream down to the coast.

(Coordination with Measures and Actors in Other Sectors)

Incorporate climate change adaptation measures into various systems and plans, and promote the implementation of adaptation measures effectively through coordination with a variety of other policies and efforts (mainstreaming of adaptation measures). Specifically, endeavor to expand comprehensive, efficient, and effective measures that harmonize shore protection from disasters, improvements and conservation of the coastal environment, and appropriate public use of coasts, while also seeking coordination with the relevant government sectors, private sector, and residents, who all bear responsibility for the land side along coastlines, including evacuation, land use plans, and other disaster prevention and disaster reduction measures. Also, endeavor to identify innovative examples of adaptation measures in other countries, and consider introducing the applicable measures in Japan.

c) Fishing Ports, Fishing Villages, Coastal Protection Forests

Continue to systematically promote raising the elevation of fishing port facilities, including breakwaters and port handling facilities, and to improve coastal protection facilities by having more robust structures. Also, in terms of coastal disaster-prevention forests, development of the growth base which takes into account disaster mitigation effects against storm surges and coastal erosion, and enhancement of functions of facilities, including tide embankments will be promoted.

d) Promoting Research and Technology Development

Promote technology development on topics including levees, based on the impacts on facilities in the event of excessive natural hazards, and promote development of new technologies for measures against coastal erosion. Also, promote studies and research relating to adaptation in the coastal sector, including the development of quantitative methods to assess the disaster reduction functions of ecosystems in coastal areas.

(3) Basic Adaptation Measures for Sediment-related Disasters

(Measures to Address Increased Frequency of Sediment-related Disasters)

Considering the expectation that the frequency of occurrence of sediment-related disasters will increase in due to climate change, prioritize the promotion of improvements in facilities and equipment in locations that can be most effective in protecting human life, and implement improvements in evacuation sites and routes, public facilities, and facilities that protect socioeconomic activities. Also, utilize existing facilities effectively; for example, by removing deposited sediment as appropriate from check dams. Furthermore, consider the most practical plans and design methods for facilities, as well as materials used.

Also, sediment-related disasters are difficult to predict accurately, as there are complex triggers and factors associated with their occurrence, so it is important to promote both structural and non-structural measures in a unified way.

Based on an Amendment of the "Sediment Disaster Prevention Act," promote the designation of sediment-related disaster hazard areas, announce the results of basic surveys even at the stage prior to that designation, and inform residents at an early stage regarding sediment-related disaster dangers. In addition, endeavor to improve and strengthen warning and evacuation systems through actions such as the provision of support for the formulation of hazard maps and disasters prevention action plans, and promote the development of human resources in residents and local government personnel that are knowledgeable about to sediment-related disasters, through awareness-raising.

(Measures for Sediment-related Disasters with Short Warning/Evacuation Lead Times)

Endeavor to disseminate accurate information about sediment-related disasters, through hands-on disaster prevention trainings and disaster prevention educations, in order to ensure adequate awareness about such matters as dangerous locations, refuge locations, and directions to move and to ensure that the residents can evacuate immediately. Also, consider matters such as improving Sediment Disaster Alert, and the utilization of various means of information collection and sharing, including social media.

(Measures for Sediment Transport Events Exceeding Design Scale)

Consider factors such as the location and design of check dams and other structures so that their disaster reduction functions can be extended, even by a small amount of time. Also, through coordination of both structural and non-structural measures, consider factors such as ways more residents can be given more time for evacuation, and how evacuation sites and routes can be secured.

(Measures for Deep-Seated Catastrophic Landslide and Other Events)

Strengthen national land monitoring systems by the use of satellites and other equipment, and promote improvements in crisis management systems that can more quickly detect the occurrence of events such as deep-seated landslides and natural damming of a river. Also, promote the use of new technologies, including the use of airborne electromagnetic surveys. In cases where there is concern about significant damage due to natural damming of a river and other events, endeavor to accelerate responses and improve the quality of response, through measures such as urgent surveys, and the provision of information about these results to municipalities based on their results; implementation of hands-on trainings in collaboration with the related institutions; and the use of unmanned aerial vehicles (UAV).

(Measures for Sediment-related Disasters in Places that Do Not Clearly Exhibit Valley Topography)

In order to identify locations that require priority measures, consider methods to assess risk levels, and consider the optimal designs of structures for those locations.

(Debris Flows that Cross Watershed Boundaries)

Properly estimate the volume and extent of debris flows that cross over watershed boundaries, and consider the use of structural and non- structural measures as a result of the estimates.

(Measures for Disasters from Woody Debris)

Consider the use of open type check slit sabo dams, the installation of capturing driftwood facilities, and the reconstructing of existing closed type check dams to open type check dams if they currently do not have log capture capabilities.

(Headwaters Management)

Endeavor to strengthen national land monitoring systems by routinely accumulating detailed topographical and other data obtained through satellite and aerial laser surveys. In addition, from the perspective of national land management, promote erosion and sediment control projects in rural areas and green belt projects on hillsides near urban areas in order to prevent land degradation in upstream areas.

(Land Use and Housing with Consideration of Disaster Risk)

Encourage safer land use by promoting the designation of sediment disaster hazard areas and publishing basic survey results. In particular, promote efforts to ensure the safety of facilities used by people who require special assistance, and disaster prevention centers.

Also, in areas with particularly high disaster risk, promote structural design standards based on designation of special sediment-related disaster hazard zones, make regulations to discourage activities such as housing development, and resettle housing from those areas to safe areas, through the use of relocation works project for hazardous buildings standing near steep slopes.

(Promote Studies and Research)

Regarding sediment-related disasters, promote research relating to ways to notify the affected municipalities and residents more accurately about disaster prevention information, combined with information about the urgency of disaster risk, and information including the occurrence of disaster events, rainfall conditions, and sediment-related disaster hazard areas.

Regarding avalanche disasters, continue monitoring parameters such as snowfall and snow cover, because there have been cases of an extremely rapid increase in heavy snowfall in recent years in regions that usually do not have much snow, in addition to changes in both the amount and quality of snowfall, associated with climate change; also, promote more research relating to impacts of heavy snowfall and avalanche disasters.

(4) Basic Adaptation Measures for Other Impacts (e.g., Strong Winds)

As increases are expected in strong winds and strong typhoons due to climate change, starting in the near future (2015–2039), in response to stronger typhoons associated with climate change, continue to promote the introduction of low-cost weather-resistant houses that are disaster resistant; and in response to tornadoes, promote the use of information to provide notification when weather conditions are prone to produce violent gusts and tornadoes, and promote actions to ensure personal safety in cases where signs of approaching cumulonimbus clouds have been observed. Also, promote studies and research relating to impacts of climate change including impacts on strong winds, as well as adaptation measures, and endeavor to collect scientific findings.

5.3.2.5 Human Health

(1) Basic Adaptation Measures for Heat Stress

Regarding the correlation between climate change-induced temperature increases and mortality risk, continue efforts to collect scientific findings.

Based on climate change-induced impacts on heat illness, under the Inter-Minister Meeting for Heat Illness and through collaboration among the relevant government ministries and agencies, provide meteorological information, implement actions including appropriate information provision relating to topics such as cautionary alerts, awareness raising regarding prevention and treatment, and status of outbreaks of heat illness, in various situations including emergency response, education, health care, labor, agriculture, forestry and fisheries industries, and everyday life. More specifically, continue conducting studies and announcing the number of heat illness patients transported by ambulance, as well awareness raising for the purpose of prevention. As for measures against heat illness at schools, continue reaching out to bodies such as boards of education to bring attention to prevention of heat illness incidents. As for workers engaged in the agriculture, forestry and fisheries industries work under harsh working conditions, such as under a scorching sun and on steep slopes. Thus, measures to reduce workload on such workers will be taken by proactively introducing robot technology and the ICT, as well as high-performance machinery. Continue promoting measures to address heat illness in the workplace, including the manufacturing and construction industries.

(2) Basic Adaptation Measures for Infection

Regarding the correlation between infectious diseases and climate change, because there are only a limited number of examples and many factors involve uncertainty, make an effort to collect scientific findings about aspects such as the correlation between an increase in temperature and changes in the risk of occurrence of infectious diseases.

Also, in order to continue preventing the occurrence and limiting the spread of mosquito-borne infectious diseases, based on the Special Guidance on Mosquito-borne Diseases (April 28, 2015), prefectural governments and other bodies are to strive to implement measures including ongoing fixed-point observation in areas where mosquito vectors of infectious diseases occur, measures targeting sources of larvae, extermination of adult insects, and calling attention to mosquito-prevention measures; also, they are to make efforts to understand trends in the occurrence of infectious diseases.

(3) Basic Adaptation Measures for Other Human Health Impacts

With regard to the risk that diarrhea outbreaks will occur if water becomes contaminated in closed water bodies and rivers downstream in the event of overflows of combined sewer systems due to the combined impacts of increases in temperature and air pollution as well as localized torrential rainfall, continue promoting water quality improvement measures such as air pollution prevention and measures to upgrade combined sewer systems, and make active efforts to collect scientific findings. Regarding impacts on vulnerable populations and health impacts without leading to clinical symptoms, make active efforts to collect scientific findings, as current findings are insufficient relating to the impacts of climate change.

5.3.2.6 Industrial and Economic Activity

(1) Basic Adaptation Measures for Industrial and Economic Activity

As there are currently few examples regarding the impacts of climate change on industries such as manufacture, energy demand and supply, commerce, and medical, strive to collect scientific findings. Also, based on the findings obtained, through provision of information relating to climate change impacts, promote adaptation efforts by businesses between the public and private sectors, as well as the development of adaptation technologies.

(Adaptation Measures for Distribution)

Raise awareness about Business Continuity Plan (BCP) Guidelines formulated in FY 2014 through collaboration between shippers and the distribution/logistics industries, in order to promote the development of BCPs. Also, in order to facilitate the storage of relief supplies during times of disaster, promote the conclusion of “Relief Supplies Storage Agreements” between the stakeholders including local governments and storage businesses, and expand and review lists of private sector distribution and logistics centers. In addition, from the perspective of promoting rail freight transport, develop collaborative countermeasures among the stakeholders to deal with the occurrence of cargo damage in the event of disasters such as typhoons, avalanches, and landslides.

(2) Basic Adaptation Measures for Finance and Insurance

Regarding efforts to address natural disasters, the Seventh Mid-Term Business Plan (FY 2015–2017) of the General Insurance Association of Japan states “Promote efforts to maintain and improve the soundness of the insurance industry by upgrading risk management for natural disasters.” Continue to pay attention to initiatives to improve risk management among insurance companies, and efforts of the General Insurance Association of Japan.

Also, continue making efforts to collect scientific findings relating to the impacts of climate change.

(3) Basic Adaptation Measures for Tourism

In order to ensure the safety of travelers, including foreign nationals, promote the establishment of multilingual relief centers for times of disaster, in collaboration with stakeholders including regional tourism associations and international exchange organizations; promote the preparation of disaster evacuation support plans for tourism and accommodation facilities; and provide disaster information, alerts, damage information, evacuation approaches, and other information using tools such as mobile phone apps, and Internet portal sites. In addition, recognizing the need to promote the signing of agreements regarding the utilization of accommodation facilities as evacuation centers during times of disaster, reach out to disaster risk reduction departments of local governments, in cooperation with the relevant government ministries and agencies. In addition, in order to prevent damage to the brand or reputation of regions not directly affected by a disaster, seek to minimize the socioeconomic damage to regions near the disaster affected region by means such as the provision of accurate information on the disaster status, and transportation via channels such as websites, overseas travel fairs, and travel promotion assistance programs to attract incoming travelers.

For tourist industries such as skiing and coastal leisure industries, because of the importance of taking regional characteristics into account when considering adaptation measures, promote actions including the development of adaptation measures by local governments.

(4) Basic Adaptation Measures for Other Impacts (e.g., Overseas Impact)

Regarding other impacts (including overseas impacts), as the degree of confidence about the impacts of climate change has been assessed as low, make an effort to collect scientific findings.

(Utilizing Arctic Sea Route)

Due to the expected reduction of sea-ice area in the Arctic Ocean as a result of climate change, the potential to utilize Arctic Sea Route is attracting international attention. Therefore, promote environmental improvements toward utilization of the Arctic Sea Route by stakeholders including shipping companies, and based on the framework of the China-Japan-Korea Ministerial Conference on Transport and Logistics, strive for mutual cooperation through information exchange relating to Arctic Sea Route.

5.3.2.7 Life of Citizenry, Urban Life

(1) Basic Adaptation Measures for Urban Infrastructure, Critical Services

Water Supply, Transportation, and Other (Adaptation Measures for Distribution/Logistics)

Raise awareness about Business Continuity Plan (BCP) Guidelines formulated in FY 2014, in order to promote the development of BCPs through collaboration between shippers and the distribution/logistics industries. Also, in order to facilitate the storage of relief supplies during times of disaster, promote the conclusion of “Relief Supplies Storage Agreements” between stakeholders including local governments and storage businesses, and expand and review lists of private sector distribution/logistics centers. In addition, from the perspective of promoting rail freight transport, develop collaborative countermeasures among the stakeholders to deal with the occurrence of cargo damage in the event of disasters such as typhoons, avalanches, and landslides.

(Adaptation Measures for Rail Transport)

Based on information including hazard maps, in underground stations and other places where inundation damage can be anticipated, promote measures against inundation such as entrances, exits and tunnels; in addition, promote measures against rock fall and avalanches, as well as conservation of coastlines and other areas, in order to prevent impacts such as coastal erosion due to increases in risks of storm surges and high waves, including sediment-related disasters due to more severe heavy rainfall disasters affecting rail facilities.

Water stop board

Tide protection door

Figure 5-16 Prevent inundation of underground station

(Adaptation Measures for Ports and Harbors)

To ensure the functioning of marine transportation, which sustains Japan’s economy and citizens’ livelihoods, as measures against impacts such as inundation damage and reductions in cargo handling efficiency associated with sea-level rise, maintain essential functions such as mooring facilities, breakwaters, and tide embankments. In addition, promote efforts such as measures to prevent runaway cranes, in preparation for changes in wind conditions due to climate change. In order to maintain the function of logistics of ports and harbors in times of disaster and to minimize the impacts on the supporting industries, endeavor to maintain the essential functions of facilities and aim to improve or enhance business continuity plans (BCPs) formulated at each port and harbors through the provision of risk information to businesses and other stakeholders and the implementation of trainings.

(Adaptation Measures for Airports)

Regarding airports in coastal areas, from the perspective of protecting human life, prepare hazard maps based on inundation scenarios associated with events such as storm surges, consider systems to provide disaster risk information, and endeavor to make them fully known to airport users and other stakeholders. Also, consider and endeavor to reconfigure airport snow removal systems in consideration of factors such as changes in snow quality in recent decades.

(Adaptation Measures for Roads)

Develop safe and reliable road networks and remove utility poles along routes, so that the road networks can serve as emergency transportation routes for quick movement of police, fire and the Self Defense Forces. Improve disaster risk reduction capabilities of “Michi-no-Eki” resting areas.

In a time of disaster, quickly comprehend the situation of damage, reopen damaged roads and provide quick recovery treatment to support lifesaving activities and emergency transportation. Also, in the event of road restrictions or other controls, provide information in a timely way by using information and communication technologies (ICT).

(Adaptation Measures for Water Supply Infrastructure)

Considering concerns about climate change impacts on the water supply infrastructure, secure backup systems including water system interconnections; promote equipment and facilities upgrades to be resistant to natural disasters, including through upgrading of aging pipes with earthquake-resistant water pipes that are also able to withstand natural disasters such as water disasters; also, improve systems to be able to take timely and appropriate emergency response measures and conduct repairs in the event of a reduction or halt of water supplies due to reasons such as damage to facilities.

(Adaptation Measures for Waste Disposal Facilities)

Considering concerns that climate change may have impacts on waste disposal facilities, which are part of the social infrastructure, from the perspective of enhancing the resilience of regional waste treatment systems as the preparedness during peacetime, promote improvements by municipalities and other stakeholders to make waste disposal facilities more resistant to flood disasters and other natural disasters, and promote the development of coordination and support systems among the local governments and the related institutions.

(Adaptation Measures for Traffic Safety Facilities)

In order to secure safe and smooth traffic in times of disaster, promote improvements of traffic safety facilities including traffic control centers, traffic monitoring cameras, vehicle detectors and traffic information boards, and implement traffic controls including road closures quickly and effectively. Also, promote preparation of traffic lights with additional power supply devices which prevent outages of traffic lights due to a power failure when a disaster occurs.

(Studies and Research)

Regarding impacts of climate change on infrastructure and critical services, as there are few examples of specific assessments and the level of confidence is low, promote research and endeavor to collect scientific findings.

(2) Basic Adaptation Measures for Life with Sense of Culture and History

Phenology, Traditional Events / Local Industry

Some impacts of climate change may include impacts on phenology, traditional events, and local industries. To undertake regional adaptation, it is important to properly consider these issues. Promote the provision of related information to the regions, and the sharing of information among the stakeholders. In addition, implement phenological monitoring, including parameters such as plant flowering and autumn foliage.

Regarding impacts of climate change on traditional events and local industries, as there are few examples of specific assessments and the level of confidence has been assessed as low, promote research and endeavor to collect scientific findings.

(3) Basic Adaptation Measures for Others (Impact on Life due to Heat Stress)

(Basic Approach to Adaptation Measures)

In order to mitigate the heat island effect, promote continuation of feasible measures, and also implement measures that quickly produce results. In addition, recognizing that long-term actions are needed to mitigate the heat island effect, monitor its actual conditions, and conduct technical studies and research for measures against the heat island effect.

(Improving Ground Cover Using Vegetation and Water)

Endeavor to improve ground cover, in order to avoid high temperature on the ground surface due to reductions in green space and water surfaces (which have an effect of suppressing an increase in temperature) and due to the ground surface being covered with structures and pavement.

Specifically, promote the use of tools such as green space policies that require greenery to cover at least a certain ratio of total area in the case of new construction or expansion of buildings on large sites, and promote greening through subsidies and other programs relating to housing and building improvements; also, promote greening in places such as private lands, buildings and structures by using tools such as comprehensive building design systems that provide for increased floor-area ratio (or floor space ratio) for large buildings that have a certain ratio of open space. In addition, promote improvements of urban parks, and greening of public spaces such as roadways and wastewater treatment plants, as well as government building grounds, and promote greening on rooftops when rental housing operated by Urban Renaissance Agency is being rebuilt. In addition, urban farmland is an important component of green space in cities, and since it plays a role in land and environmental conservation, including its role in mitigating the heat island effect, promote the conservation of urban farmland in urban areas and surrounding regions.

Endeavor to expand water surface area by supporting efforts such as efforts of local governments to expand the use of water from wastewater treatment such as for small streams and for maintaining river flows, as well as promoting the installation of rainwater storage and ground permeation facilities.

In addition, evaluate the effectiveness of road surfacing technologies that keep surface temperature from rising, and endeavor to further develop details of comprehensive packages of steps for preventing temperature rise on roads, including road greening, to provide a comfortable environment.

(Reducing Artificial Exhaust Heat from Human Activities)

Promote greater energy efficiency of housing and buildings, based on the Act on Improvement of Energy Consumption Performance of Buildings; promote the diffusion and greater use automobiles with superior environmental performance, to contribute to the reduction of waste heat from automobiles; promote the use of public transportation, including modes such as urban rail, urban monorail, new transportation systems, and trolleys; and work to improve the efficiency of energy-consuming equipment. Also, promote traffic flow measures that make smart use of road networks, in order to make roads more comfortable for driving, without road congestion. Promote a modal shift from truck to rail and coastal shipping, and endeavor to boost the efficiency of truck transport through means such as consolidated collection and delivery. In addition, promote the effective use of heat from wastewater, by means such as providing support for project formulation for wastewater heat utilization, promoted under public-private liaison councils.

(Improving Urban Design (Including Creation of Wind Paths from Green Spaces and Water Surfaces))

By promoting use of the “Urban Design Guidelines to Mitigate the Heat Island Effect” (in Japanese), which indicate factors to consider in order to utilize wind paths flowing over urban areas, promote urban planning—adapted to the respective scale of region, city, district—that incorporates appropriate measures, including improvements of urban design and ground cover, and reductions in artificial waste heat.

Also, promote the creation of networks of water and green space in urban areas by promoting efforts based on the “Grand Design for Urban Environmental Infrastructure in the National Capital Region” and “Grand Design for Urban Environmental Infrastructure in the Kinki Metropolitan Region” (both in Japanese), conserving green space through programs such as the “Special Green Space Conservation Zone Program,” improving green belts on urban slopes, and improving streams through the reuse of rainwater and treated wastewater.

(Lifestyle Improvements)

Regarding improvements in lifestyle, promote efforts geared toward improving lifestyles from the perspective of aiming to limit the generation of urban heat (for example, implementing citizen activities to spray water onto streets for the cooling effect; promoting the popularity of “green curtains” of living plants; promoting the installation of energy-efficient products; and promoting the practice of wearing lighter clothing in summer); and endeavor to make automobile use more efficient (through promotion of eco-drive).

(Strengthening Observation/Monitoring Systems and Promoting Research)

Conduct observation and monitoring of the heat island effect, analyze the driving factors, publish the findings through “Heat Island Monitoring Reports” and other channels, and endeavor to improve the information. Promote the development and diffusion of the Comprehensive Assessment System for Built Environment Efficiency (CASBEE), and conduct research and studies on technologies relating to urban planning, in order to effectively deal with the heat island effect. Also, because monitoring and changes over time of ground cover and the status of land use are important for assessing the spread of urbanization and to assess the heat island effect, detailed land cover maps are being produced and published with a spatial resolution of 30 m, using data from “Daichi” Earth observation satellites. In the future, promote further improvements in land cover classification maps through means such as upgrading the algorithms used.

(Promoting Adaptation Measures to Mitigate the Impacts on Human Health)

In order to help reduce heat stress by escaping from heat, calculate current and projected WBGT (Wet Bulb Globe

Temperature) heat indexes nationwide, based on meteorological data, and publish the information on websites, with other heat illness prevention information.

5.4 Monitoring and Framework for Assessment

In the context of uncertainty about factors such as the significance and urgency of climate change impacts, responses to climate-related risks involve decision making in the midst of a social environment that is experiencing changes such as a declining population and aging society. To avoid rework, and to promote timely and appropriate adaptation, iterative risk management will be conducted for the Adaptation Plan. Specifically, adaptation will be promoted by using an adaptive approach that involves a repeated cycle of conducting ongoing observation, monitoring, and projection of climate change and its impacts; based on their results and on literature review and other actions, ascertaining the latest scientific findings; implementing regular assessments of climate change and its impacts; and based on the results of those impact assessments, considering and implementing adaptation measures in each sector, monitoring the state of progress, and making revisions as required.

5.4.1 Observation and Monitoring of Climate Change and Its Impacts

In order to promote adaptation measures, and also based on Japan's Earth Observation Promotion Strategy, it is essential to observe and monitor data relating to climate change impacts (including temperature, precipitation, and other and data relating to climate change), as well as data such as agricultural crop yields, water resources, ecosystems, and the occurrence of flood and inland water, and to make that information widely available. Thus, the Government will implement this observation and monitoring, with cooperation from actors including local governments and the private sector.

5.4.2 Projection and Assessment of Climate Change and Its Impacts

The projection and assessment of climate change and its impacts on Japan are to be conducted on an ongoing basis, by conducting reviews of literature such as the observational and monitoring results of (1) above, IPCC Assessment Reports, the latest research reports in Japan and overseas, and reports published by governments; and by implementing projection calculations using the latest climate models and impact models on a global and a regional scale. These projection and assessment results are to be published, and disseminated nationwide. Also, along with information relating to observation, monitoring, projection, and impact assessments, and information relating to uncertainty, an effort is to be made to organize the information centrally, and make it available in form that is convenient for users.

5.4.3 Consideration of Adaptation Measures and Systematic Implementation based on Results of Climate Change and its Impacts

Basic measures relating to adaptation in each sector are to be established as indicated in 5.3, based on such input as the Climate Change Impact Assessment Report and the status of measures that have a connection with climate change. In addition, the relevant government ministries and agencies are to systematically implement concrete measures based on the basic adaptation measures in each sector.

5.4.4 Managing Progress and Revising the Adaptation Plan

(Managing Progress of the Adaptation Plan)

To respond appropriately under uncertainty to the long-term issue of climate change impacts, it is necessary to have ongoing monitoring of the state of progress of this Adaptation Plan and the latest scientific findings, and to manage progress of the Adaptation Plan. However, in other countries that have already formulated an adaptation plan, many issues have been raised with regard to development of approaches to manage progress with their plans; Japan also lacks adequate findings and experience on these matters. Thus, after formulating this Adaptation Plan, with a time frame of approximately one year, studies will be conducted to examine the approaches being used in other countries to manage progress, and based on the findings, there will be a systematic consideration of approaches to ascertain the state of progress of the Adaptation Plan. Regarding the result of studies, "Report for managing progress of the Adaptation Plan in other countries" was published in December 2016[81].

Based on consideration of trial approaches to monitor the state of progress mentioned above, and based on international trends, an effort will be made to develop approaches for progress management of the Adaptation Plan as a whole.

(Revising the Adaptation Plan)

As for revisions of this Plan, an assessment of climate change impacts is to be implemented and formulated approximately every five years, while taking future international trends into account, and based on the results of the said impact assessment, the status of each measure and other factors, the Plan is to be revised as required. However, if new issues emerge at any time relating to the Adaptation Plan as a whole, or if new findings are obtained that could have an impact on the basic adaptation measures relating to individual sectors, a revision of this Adaptation Plan is to be considered at that time, as required.

5.5 Progress and Result of Adaptation Action

As described in 5.4, a trial monitoring for adaptation measures implemented in FY2016 has been conducted in order to consider how to track the progress of adaptation measures. In October 2017, after formulating the Adaptation Plan, the "Inter-Minister Meeting of the relevant ministries and agencies on adaptation for climate change impacts" summarized a "Trial monitoring report for the National Plan for Adaptation to the Impacts of Climate Change". The following descriptions are based on the report.

In the trial monitoring, all measures in the seven sectors (agriculture; forest/forestry; fisheries; water environment/water resources; natural ecosystems; natural disasters/coastal areas; human health; industrial and economic activities; and life of citizenry/urban life) and basic actions are categorized into 56 measure groups, and the progress of all measures implemented in FY2016 has been tracked by the preparation of individual sheet on each measure group by each ministry and agency. Within 56 measures groups, indicator have been set up in the 38 measure groups (but there are some cases that the indicator has been set for only a partial action/project in such measure groups). The quantitative indicator has been set in the 36 measure groups and qualitative indicator has been set in the 13 measure groups.

Preparing and publication of the monitoring report will be effectively worked to provide information to citizens as well as will be occasions for each ministry and agency to track the progress of measures in the Adaptation Plan by themselves and to review the measures as needed. Therefore, the monitoring for the Adaptation Plan will be continued to conduct annually in the same manner at the Inter-Minister Meeting, and the progress of the measures will be tracked and published on fiscal year basis.

As for the indicators to track the progress of the measures, for the time being, it is appropriate that each ministry and agency will set output indicator for each measure and publish the progress in order to ensure transparency.

In doing so, it is preferred to set quantitative indicator, however, qualitative indicator can be also used for some measures. On the other hand, it is important to deepen the consideration so that the assessment of effects of adaptation measure by each sector can be done in the future. From now on, based on the research trends on the outcome indicator and assessment approach of adaptation measures as well as other countries' consideration progress, the consideration will be continued whether or not it is possible to assess the effects of adaptation measure in Japan.

Concerning to conduct the monitoring work of the Adaptation Plan, it is important to take into account the consistency with schedule and contents of the monitoring of the governmental measures in each sector, policy assessment of whole government, and governmental projects review, from a view of effectiveness of monitoring work and securing

[81] http://www.env.go.jp/earth/tekiou/shinchokukanri2.pdf

of workability because adaptation measures by each sector in the Adaptation Plan are basically integrated into the governmental measures in each sector.

Given the above, as for the monitoring policy for measures implemented after FY2017, the consideration will be deepened to conduct necessary improvements such as setting of indicator to track the progress of all measures in principle, taking into account the consistency with the monitoring of governmental measures in each sector.

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Chapter 6

Financial, Technological and Capacity-building Support

6.1 Overview

Japan has implemented various support projects to assist developing countries, especially those making efforts to reduce GHG emissions as well as those which are vulnerable to the negative impacts of climate change. 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 to provide for developing countries total 1.6 trillion yen (approx. USD 16 billion) by mobilizing Official Development Assistance (ODA), Other Official Flows (OOF), and Private Finance (PF) for mitigation and adaptation during the 3-year period between 2013 and 2015 to strengthen "partnership" with various countries and stakeholders. This commitment was achieved in approximately one year and a half.

In November 2015, at COP21, Japan announced the "Actions for Cool Earth (ACE) 2.0" and committed to providing approximately 1.3 trillion yen of public and private climate finance to developing countries in 2020. Japan continues its efforts toward a goal of mobilizing jointly USD 100 billion per year including both public and private finance by 2020 as the long-term finance.

In addition, at the 7th Pacific Islands Leaders Meeting, Japan held "climate change and development forum" and the participants exchanged their views on the ways to use climate finance effectively in Pacific islands. Further, in 2017, in order to establish a decarbonised and a resilient society, Japan announced "Japan's Assistance initiatives to Address Climate Change 2017", which shows Japan's vision and specific programs to accelerate climate change measures and sustainable development in developing countries.

Under these efforts, financial support from Japan in two years from 2015 to 2016 reached approximately USD 23.3 billion (public finance amounted approximately USD 19.5 billion, private finance amounted approximately USD 3.8 billion).

Furthermore, at the G20 summit in November 2014, Japan announced USD 1.5 billion contributions to the Green Climate Fund (GCF). After approval of a bill stipulating the necessary measures for the contribution, Japan signed an agreement with the GCF secretariat to contribute 1.5 billion USD. This enabled GCF to start funding.

6.2 National Approach to Tracking and Reporting Provision of Support to non-Annex Parties

The main types of climate change finance from Japan are as follows (1) grant aid; (2) loan; (3) technical assistance; (4) contribution to international organizations; (5) OOF; and (6) private finance. 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 Japan International Cooperation Agency (JICA) are implementing agencies of the types (1)-(3). The type (4) is contributions to the environment related funds and development organizations such as Global Environment Facility (GEF), Green Climate Fund(GCF), the World Bank, United Nations Development Programme (UNDP), which are implementing agencies of this type of assistance. Regarding type (5), relevant Japanese ministries and Japan Bank for International Cooperation (JBIC) are the main implementing agencies and type (6) is private finance mobilized by co-finance of JBIC. The Ministry of Foreign Affairs gathers abovementioned information from the relevant ministries and institutions and compiles the Japanese climate change finance information.

Japan made a list of tangible examples of projects which contribute to climate change mitigation and adaptation in developing countries using the OECD Rio marker as one of the references. Based on the above list, Japan councils and reports projects contributing to climate change mitigation and adaptation. The scope of Japan's support in addressing climate change is non-Annex I countries of the UNFCCC. Climate-specific funds are specifically those assessed to support climate change measures (mitigation, adaptation and cross-cutting).

In this report, Japan's climate finance is newly committed or contributed during the reporting period, in 2015 and 2016, therefore, it is "new and additional". Japan defines new and additional climate finance as newly committed or disbursed finance which contributes to climate change measures in developing countries. Japan seeks new funding from the Diet on an annual basis. Climate finance reported by Japan is newly committed or disbursed finance during a given period. In other words, we do not include previously committed or disbursed climate finance. In addition, funds reported as committed are those that have been appropriated by Congress or cabinet decisions, or for which a commitment is made by a diplomatic agreement but not yet actually paid during the reporting period. Funds reported as disbursed are those that have been actually transferred to recipient countries.

6.3 Finance

6.3.1 Measures to Ensure the Resources to Address the Needs of non-Annex I Parties

434 projects have been implemented in as many as 91 countries as of December 2016. Through the Japanese Embassies and JICA's overseas offices stationed in a number of developing countries, the Japanese Government has been developing projects in close consultation with the government of developing countries and international organizations in response to the needs of recipient countries. Japan has been providing assistance through various channels, including grant aid, concessional loan and technical assistance, taking into account local economic situations and content of projects.

In addition, Japan has actively engaged in adaptation support for Pacific islands which are especially vulnerable to the negative impacts of climate change and implemented 44.1 million USD to address climate change in those areas.

6.3.2 Assistance through Bilateral and Regional Frameworks and Multilateral Channels

6.3.2.1 Overview

The main components of our assistance which amount to USD 22.3 billion as of December 2016 are as follows. It should be noted that Japan’s assistance for developing countries accords importance to establishing a mechanism that not only ensures the effective use of public financing, but also facilitates the mobilization of private financing. Large-scale projects on infrastructure, such as the introduction of facilities with high energy efficiency and for renewable energy, and the construction of electric power transmission facilities, will require massive investment, and thus leveraging the private financing would be crucially important (this is why Japanese private financing of over USD 3.8 billion had been mobilized for assistance to developing countries, as of December 2016). Japan will also assist the capacity building to improve access to funds such as Green Climate Fund (GCF), Least Developed Countries Fund (LDCF) and Special Climate Change Fund (SCCF) by providing study and training sessions.

a. Mitigation: USD 21.13 billion

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.

・Geothermal power plant planning (Kenya, Bolivia and Turkey : USD 942 million)

・Projects for solar electricity generation system (Jordan, Egypt :USD 178 million)

・Promotion of biomass energy (Indonesia,: USD 0.24 million)

・Electric transmission installment planning (8 countries including Myanmar, Viet Nam, India, Sri Lanka : USD 1.92 billion)

b. Adaptation: USD 1.9 billion

Strengthening developing countries’ capability to cope with natural disasters caused by climate change, and providing necessary equipment and facilities to take precautionary measures against and to recover from natural disasters including floods and droughts.

・Improvement of capabilities to cope with natural disasters caused by climate change (17 countries including Myanmar, Lao PDR, Cambodia and Philippines: USD 116 million)

・Flood control measures (Pakistan, Colombia: USD 5.97 million)

・Development of Irrigation facilities and capacity building for irrigated agriculture (India, Afghanistan, Tanzania and Madagascar: USD 35 million)

・Water supply planning (14 Countries including Iraq, Sri Lanka: USD 100 million)

c. Mitigation and Adaptation: USD 537 million

Assisting developing countries to tackle climate change issues (both mitigation and adaptation) by providing contribution to the multilateral fund and program loan to address climate change.

・Climate Change Program Loan (USD 218 million)

d. REDD+: USD 7.07 million

Assisting developing countries to conduct a survey on forest resources, formulate forest management plan and facilitate afforestation including through the provision of equipment necessary for such activities.

・Implementation of Forest conservation and capacity building (Asia, Africa, Peru, Guatemala : USD 2.86 million)

Table 6-1 Provision of public financial support: summary information in 2015 (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:	247,676.99	2,576.51	84.09	11,411.53	0.00	2,155.22	22.42	0.73	99.40	0.00
Multilateral climate change funds	15,000.00	2,576.51	84.09	10,719.97	0.00	130.53	22.42	0.73	93.38	0.00
Other multilateral climate change funds	NE	2,576.51	84.09	273.42	0.00	NE	22.42	0.73	2.38	0.00
Multilateral financial institutions, including regional development banks	196,780.76	NE	NE	NE	NE	1,712.33	NE	NE	NE	NE
Specialized United Nations bodies	35,896.23	NE	NE	691.56	NE	312.36	NE	NE	6.02	NE
Total contributions through bilateral, regional and other channels		860,218.00	120,838.00	34,649.00			7,485.36	1,051.50	301.51	
Total	247,676.99	862,794.51	120,922.09	46,060.53		2,155.22	7,507.78	1,052.23	400.91	

Footnotes

The unit of JPY is "million yen" and the unit of USD is "million dollars".

The exchange rate is 114.92 JPY/USD.

Each Party shall provide an indication of what new and additional financial resources they have provided, and clarify how they have determined that such resources are new and additional. Please provide this information in relation to table 7(a) and table 7(b).
Documentation Box: **New and Additional Climate Finance** Japan defines new and additional climate finance as newly committed or disbursed finance which contributes to climate change measures in developing countries. Japan seeks new funding from the Diet on annual basis. Climate finance reported by Japan is newly committed or disbursed finance during a given period. In other words, we do not include previously committed or disbursed climate finance.

Table 6-2 Provision of public financial support: summary information in 2016 (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:	249,982.13	2,576.51	174.59	18,851.55	0.00	2,175.28	22.42	1.52	164.06	0.00
Multilateral climate change funds	15,000.00	2,576.51	174.59	18,418.12	0.00	130.53	22.42	1.52	160.29	0.00
Other multilateral climate change funds	NE	2,576.51	79.02	249.07	0.00	NE	22.42	0.69	2.18	0.00
Multilateral financial institutions, including regional development banks	197,595.73	0.00	0.00	NE	NE	1,719.42	0.00	0.00	NE	NE
Specialized United Nations bodies	37,386.40	0.00	0.00	433.43	0.00	325.33	0.00	0.00	3.77	0.00
Total contributions through bilateral, regional and other channels		1,137,860.00	63,650.00	27,851.00			9,901.31	553.85	242.36	
Total	249,982.13	1,140,436.51	63,824.59	46,702.55		2,175.28	9,923.73	555.37	406.42	

Footnotes

The unit of JPY is "million yen" and the unit of USD is "million dollars"

The exchange rate is 114.92 JPY/USD.

Each Party shall provide an indication of what new and additional financial resources they have provided, and clarify how they have determined that such resources are new and additional. Please provide this information in relation to table 7(a) and table 7(b).
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6.3.2.2 Multilateral Channels

a. Cooperation with International Organizations

・Cooperation with UNDP (Adaptation)

Through UNDP, Japan has been implementing a grant aid project including activities such as providing technical support for managing natural disaster risk to climate change in Haiti.

・Cooperation with the Global Adaptation Network (GAN) and the Asia Pacific Adaptation Network (APAN) (Adaptation)

Supports GAN and APAN, established according to proposed by UNEP, to enhance collaboration and to share knowledge on climate change adaptation among policy-makers and practitioners in the Asia-Pacific region and the world.

・ Contribution to GEF (Mitigation/Adaptation)

Japan made a contribution 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 made a contribution to the Global Climate Fund (GCF), which is a fund for supporting reduction of greenhouse gases and addressing impacts of climate change in developing countries

Table 6-3 Provision of public financial support: contribution through multilateral channels in 2015 (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	247,676.99	2,155.22	14,072.13	122.55					
Multilateral climate change funds	15,000.00	130.53	13,380.57	116.53					
1. Global Environment Facility	15,000.00	130.53	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund									
3. Special Climate Change Fund									
4. Adaptation Fund									
5. Green Climate Fund	NE	NE	10,319.92	89.90	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
6. UNFCCC Trust Fund for Supplementary Activities	NE	NE	126.63	1.10	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
7. Other multilateral climate change funds	NE	NE	2,934.02	25.53					
(1) The Multilateral Fund for the Implementation of the Montreal Protocol	NE	NE	2,515.96	21.89	Disbursed	ODA	Grant	Mitigation	Cross-cutting
(2) Vienna Convention and the Montreal Protocol	NE	NE	60.55	0.53	Disbursed	ODA	Grant	Mitigation	Cross-cutting
(3) Asia Pacific Adaptation Network(APAN) and Global Adaptation	NE	NE	84.09	0.73	Disbursed	ODA	Grant	Adaptation	Cross-cutting
(4) Asia-Pacific Network for Global Change Research(APN)	NE	NE	273.42	2.38	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Multilateral financial institutions, including regional development banks	196,780.76	1,712.33	NE	NE					
1. World Bank	15,021.46	130.71	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. International Finance Corporation	703.99	6.13	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
3. African Development Bank	768.10	6.68	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
4. Asian Development Bank	8,484.98	73.83	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
5. European Bank for Reconstruction and Development	131.76	1.15	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
6. Inter-American Development Bank	708.10	6.16	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
7. Other	170,962.37	1,487.67							
(1) International Development Association	111,398.55	969.36	NE	NE	Disbursed	ODA	Equity	Cross-cutting	Cross-cutting
(2) African Development Fund	14,420.82	125.49	NE	NE	Disbursed	ODA	Equity	Cross-cutting	Cross-cutting
(3) Asian Development Fund	39,269.74	341.71	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(4) Fund for Special Operations (IDB)	736.76	6.41	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(5) African Development Bank	3,137.15	27.30	NE	NE	Disbursed	ODA	Equity	Cross-cutting	Cross-cutting
(6) Inter-American Development Bank	1,999.35	17.40	NE	NE	Disbursed	ODA	Equity	Cross-cutting	Cross-cutting
Specialized United Nations bodies	35,896.23	312.36	691.56	6.02					
1. United Nations Development Programme	34,687.80	301.84	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. United Nations Environment Programme	1,208.43	10.52	NE	NE	Disbursed	ODA, OOF	Grant	Cross-cutting	Cross-cutting
3. Other	NE	NE	691.56	6.02					
United Nations Framework Convention on Climate Change	NE	NE	670.68	5.84	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
Intergovernmental Panel on Climate Change	NE	NE	20.88	0.18	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
Other									

Footnotes

The unit of JPY is "million Yen". The unit of USD is "million dollars"

The exchange rate is 114.92 JPY/USD. Values converted from Japanese Yen to USD using the 114.92 yen/US dollar rate may not match the total USD amount reported due to rounding.

Table 6-4 Provision of public financial support: contribution through multilateral channels in 2016 (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	249,982.13	2,175.28	21,602.65	188.00					
Multilateral climate change funds	15,000.00	130.53	21,169.22	184.23					
1. Global Environment Facility	15,000.00	130.53	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund	NE	NE	95.57	0.83	Disbursed	ODA	Grant	Adaptation	Cross-cutting
3. Special Climate Change Fund									
4. Adaptation Fund									
5. Green Climate Fund	NE	NE	18,021.35	156.82	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
6. UNFCCC Trust Fund for Supplementary Activities	NE	NE	147.70	1.29	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
7. Other multilateral climate change funds	NE	NE	2,904.60	25.29					
(1) The Multilateral Fund for the Implementation of the Montreal	NE	NE	2,515.96	21.89	Disbursed	ODA	Grant	Mitigation	Cross-cutting
(2) Vienna Convention and the Montreal Protocol	NE	NE	60.55	0.53	Disbursed	ODA	Grant	Mitigation	Cross-cutting
(3) Asia Pacific Adaptation Network(APAN) and Global Adaptation	NE	NE	79.02	0.69	Disbursed	ODA	Grant	Adaptation	Cross-cutting
(4) Asia-Pacific Network for Global Change Research(APN)	NE	NE	249.07	2.18	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Multilateral financial institutions, including regional development banks	197,595.73	1,719.42	NE	NE					
1. World Bank	15,913.15	138.47	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. International Finance Corporation	2,904.67	25.28	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
3. African Development Bank	751.66	6.54	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
4. Asian Development Bank	6,758.01	58.81	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
5. European Bank for Reconstruction and Development	296.76	2.58	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
6. Inter-American Development Bank	1,261.59	10.98	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
7. Other	169,709.89	1,476.76	NE	NE					
(1) International Development Association	111,843.45	973.23	NE	NE	Disbursed	ODA	Equity	Cross-cutting	Cross-cutting
(2) African Development Fund	14,485.30	126.05	NE	NE	Disbursed	ODA	Equity	Cross-cutting	Cross-cutting
(3) Asian Development Fund	39,269.74	341.71	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
(4) African Development Bank	3,207.81	27.91	NE	NE	Disbursed	ODA	Equity	Cross-cutting	Cross-cutting
(5) Inter-American Investment Corporation	903.59	7.86	NE	NE	Disbursed	ODA	Equity	Cross-cutting	Cross-cutting
Specialized United Nations bodies	37,386.40	325.33	433.43	3.77					
1. United Nations Development Programme	36,221.19	315.19	NE	NE	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. United Nations Environment Programme	1,165.21	10.14	NE	NE	Disbursed	ODA, OOF	Grant	Cross-cutting	Cross-cutting
3. Other	NE	NE	433.43	3.77					
United Nations Framework Convention on Climate Change	NE	NE	413.02	3.59	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
Intergovernmental Panel on Climate Change	NE	NE	20.41	0.18	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting
Other									

Footnotes

The unit of JPY is "million Yen". The unit of USD is "million dollars"

The exchange rate is 114.92 JPY/USD. Values converted from Japanese Yen to USD using the 114.92 yen/US dollar rate may not match the total USD amount reported due to rounding.

6.3.2.3 Bilateral and Regional Frameworks Channels

a. Grant Aid in Bilateral Cooperation

・Prevention of Disaster and Rehabilitation (Adaptation)

In 38 countries, Japan provided a variety of assistance such as measures taken for adaptation to climate change including large scale typhoon or cyclone; supports for introduction of meteorological observing equipment and system for building emergency information transmission structure, including relevant technical assistance, promotion of economic and social development efforts by vulnerable countries which are working on the improvement of the disaster preventing ability, the rehabilitation from natural disasters and disaster prevention, through providing grant aids for the provision of necessary materials and equipment, etc.

In Mauritius, Bangladesh and Pakistan, Japan has provided support in the installation of meteorological observing equipment and others as a part of measures against climate change and disaster prevention. In addition, in Myanmar and Sri Lanka, Japan held seminars on the development of disaster resilient communities for educational institutions, community residents and the others. Japan provided emergency relief supplies including foods, Non-Food Items, learning support goods and others for flood victims in Myanmar and Malawi.

・Water Supply (Adaptation)

Japan supports constructing and repairing the water supply facilities in the areas which have been suffering from drought caused by climate change. For example, in Rwanda, Japan has been cooperating in constructing and repairing the water supply facilities and providing equipment including two intake facilities, one deep-well water supply facility, distribution pipelines and public tap stand in Eastern three provinces where the safe water access rate remains at 66.6%. In addition, in Rwanda, Japan supports to provide educational activities for promoting sanitation awareness and improve capacity for their maintenance and management. In Koror State, the biggest city in Palau, Japan supports to improve the stability of water supply through the rehabilitation of old water supply and sewage systems.

・Support for Agriculture (Adaptation)

In the southwest of Alaotra Lake located in Madagascar, Japan supports to ensure a stable supply of irrigation water through rehabilitating irrigation facilities and contributed to expansion in rice production and improvement of the living environment. In Afghanistan, Japan has been cooperating in developing organizational capacity of the Ministry of Agriculture Irrigation and Livestock (MAIL), expanding and improving irrigation facilities, and spreading elite plant potatoes.

・Training of human resources in climate change field (Mitigation/Adaptation)

Japan supports to create a Pacific Climate Change Center (PCCC) at the main office of the Secretariat of the Pacific Regional Environment Programme (SPREP) in Samoa. The PCCC will function as a base for human resource training in the field of climate change in Oceania to improve the resiliency of the region to environmental and climate change.

b. Loan Support in Bilateral Cooperation

・Introduction of Renewable Energy (Mitigation)

Japan contributes to sustainable development through the introduction of renewable energy to mitigate climate change effects as well as enhancing power supply. Japan has been cooperating in the construction of geothermal power plants in Laguna Colorada, Bolivia, and in Olkaria, middle area of Kenya. In Egypt, Japan supports to construct photovoltaic power plant and related facilities at the Hurghada Wind Power Plant, which is located in Hurghada City, in order to increase power supply, stabilize the network, and encourage the use of renewable energy. In Honduras, Japan contributes to stabilize electricity supply through rehabilitating and empowering the facilities of the existing Cañaveral and Río Lindo Hydroelectric Power Plants which provides 24% of the total electricity in Honduras.

・Improvement of Energy Access through the Maintenance of Electricity Transmission Equipment (Mitigation)

Japan has been cooperating in reducing GHG emissions by electrification of local areas and the improvement of transmission efficiency, while aiming for a transfer to clean energy. In Myanmar, in order to achieve reduction of power distribution loss rate and contribute to reducing GHG, Japan contributed to achieving stable power supply in Yangon area where there is the biggest electricity demand through rehabilitation and improvement of substations for distributions and development of substation equipment. In Odisha, India, in order to meet the expanding power demand due to the strong economic growth, Japan has been cooperating in improving transmission efficiency and stabilize power supply through repairing and reinforcing transmission lines and substations. In Sri Lanka, Japan supports to reduce transmission losses through constructing transmission lines on which Japan has a comparative advantage, in Greater Colombo and surrounding areas.

・Climate Change Program Loan (Mitigation/Adaptation)

Japan’s ODA loan aid is implemented by JICA, and one of its characteristic programs is Climate Change Program Loan (CCPL). This project helps to develop a multi-year national climate change policy of developing countries (the “policy matrix”) based on policy dialogues, and supports the implementation of those policies. In this process, Japan applies various ODA schemes such as loan aid or technical assistance. Japan monitors the implementation of the policy matrix every year, and considers the possibilities of extending loans. Japan is currently implementing the operation in Vietnam, using the Program Loan.

c. Technical Assistance in Bilateral Cooperation

・Prevention of Disaster and Rehabilitation (Adaptation)

In Colombia, Japan supports to develop a national disaster risk management system to reduce disaster risks including measures to address flood risks. In Mozambique, Japan supported to enhance the capacity for weather forecasting and early warning service, based on quality-controlled data.

・Water Supply (Adaptation)

In Rwanda and Kenya, Japan contributed to improving their capacity to reduce non-revenue water (NRW) through capacity building of planning for NRW reduction and supported to obtaining necessary knowledge and skills.

・Introduction of Energy Saving and Renewable Energy (Mitigation)

In Pakistan, Japan has been supporting the development of policy actions for Minimum Energy Performance Standard (MEPs) and Labelling systems in order to promote energy efficiency to meet the expanding demand for power. In Ethiopia, Japan supports to develop stable geothermal power source by improving capacity of public institutes on test drilling management and potential analysis. In Indonesia, Japan implemented technology development to cultivate grass plants suitable for bio-energy and useful materials in degraded Alang-alang grasslands, through rehabilitation of the degraded fields and conservation to productive agricultural or biomass production fields. In Fiji, Kiribati, Marshall, Tuvalu and Micronesia, Japan supported to capacity enhancement to formulate appropriate policy actions for introducing and expanding renewable energy and also improved the efficiency of the Hybrid Power Generation System that consists of Diesel Engine Generators (DGs) and renewable energy generators. Moreover in Fiji, Japan provided regional energy efficiency capacity development support for Pacific Countries, aiming to reduce the overall fuel consumption in the Region.

・Promotion of REDD+ Efforts (Adaptation/Mitigation)

In Cambodia and Myanmar, Japan provides technical supports to monitor forest carbon stocks for REDD+. In Peru and Kenya, Japan provides assistance in building capacity for sustainable forest management through improving the capacity of REDD+ implementing agencies. In addition, in Guatemala, Japan supports to implement capacity building for indigenous people to conserve forests in a sustainable way in order to prevent deforestation and forest degradation due to population expansion and agriculture toward implementation of pilot projects for forest conservation and improvement of administrative function on REDD+ as well as the formulation of REDD+ projects.

Table 6-5 Provision of public financial support: contribution through bilateral, regional and other channels in 2015 (CTF Table 7(b))

No.	Recipient country/ region/project/programme	Total amount Climate-specific Japanese yen - JPY	Total amount Climate-specific USD	Status	Funding source	Financial instrument	Type of support	Sector	Additional information
	Total contributions through bilateral, regional and other channels	1,015,705.00	8,838.37						
1	Afganistan	2,687.00	23.38	Committed, Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster, Agriculture	
2	Afcanistan, Kyrgyzstan, Tajikistan	596.00	5.19	Committed	ODA	Grant	Adaptation	Agriculture	
3	Antigua and Barbuda	584.00	5.08	Committed	ODA	Grant	Mitigation	Fishing	
4	Antigua and Barbuda	100.00	0.87	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
5	Africa	23.00	0.20	Disbursed	ODA	Grant	Mitigation	Energy, Forestry	
6	Asia	2,221.00	19.33	Committed, Disbursed	ODA,OOF	Grant	Mitigation	Cross-cutting	
7	Asia	36.00	0.31	Committed	ODA	Grant	Cross-cutting	Forestry	
8	Asia, Pacific	64.00	0.56	Disbursed	ODA,OOF	Grant	Adaptation	Cross-cutting	
9	Asia, Pacific	5,179.00	45.07	Disbursed	OOF	Grant	Mitigation	Cross-cutting, Energy	
10	Bangladesh	45,284.00	394.05	Committed	ODA,OOF	Grant, Concessional loan	Mitigation	Energy, Transport, Water and sanitation, Cross-cutting	
11	Bangladesh	44,351.00	385.93	Committed, Disbursed	ODA,OOF	Grant, Concessional loan	Adaptation	Prevention and resoration of disaster	
12	Bhutan	1,956.00	17.02	Committed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
13	Bolivia	50.00	0.44	Committed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
14	Brazil	15,125.00	131.61	Committed, Disbursed	OOF	Non-Concessional loan	Mitigation	Energy	
15	Brukina Faso, Paraguay	33.00	0.29	Committed	ODA	Grant	Mitigation	Agriculture	
16	Cambodia	41.00	0.36	Committed, Disbursed	OOF	Grant	Mitigation	Cross-cutting	
17	Cambodia	3,008.00	26.17	Committed, Disbursed	ODA,OOF	Grant	Adaptation	Water and sanitation, Forestry	
18	Cambodia	72.00	0.63	Committed	OOF	Grant	Cross-cutting	Forestry	
19	Cambodia, Viet Nam	69.00	0.60	Disbursed	OOF	Grant	Mitigation	Energy, Cross-cutting	
20	Cameroon	173.00	1.51	Disbursed	ODA	Grant	Cross-cutting	Forestry	
21	Chile	61.00	0.53	Committed, Disbursed	OOF	Grant	Mitigation	Energy	
22	China	107.00	0.93	Disbursed	ODA, OOF	Grant	Mitigation	Water and sanitation, Cross-cutting	
23	Cook Islands	100.00	0.87	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting	
24	Colombia	8.00	0.07	Committed	OOF	Grant	Mitigation	Agriculture	
25	Colombia	91.00	0.79	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	

No.	Recipient country/ region/project/programme	Total amount Climate-specific Japanese yen - JPY	USD	Status	Funding source	Financial instrument	Type of support	Sector	Additional information
26	Costa Rica	29.00	0.25	Committed	OOF	Grant	Mitigation	Cross-cutting	
27	Developing countries	249.00	2.17	Committed, Disbursed	ODA,OOF	Grant	Mitigation	Energy, Cross-cutting, Forestry, Prevention and resoration of disaster	
28	Developing countries	16.00	0.14	Disbursed	ODA	Grant	Adaptation	Cross-cutting	
29	Developing countries	50.00	0.44	Disbursed	ODA	Grant	Cross-cutting	Forestry, Cross-cutting	
30	Global	93.00	0.81	Disbursed	OOF	Grant	mitigation	Energy	
31	Djibouti	32.00	0.28	Disbursed	OOF	Grant	Adaptation	Prevention and resoration of disaster	
32	Dominica	166.00	1.44	Committed	ODA	Grant	Mitigation	Fishing	
33	Dominican Republic	300.00	2.61	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
34	Ecuador	500.00	4.35	Disbursed	ODA	Grant	Mitigation	Transport	
35	El Salvador	5,000.00	43.51	Committed	ODA	Concessional loan	Adaptation	Prevention and resoration of disaster	
36	Ethiopia	16.00	0.14	Disbursed	ODA	Grant	Mitigation	Energy	
37	Fiji, Vanuatu, Samoa	22.00	0.19	Disbursed	OOF	Grant	Adaptation	Cross-cutting	
38	Fiji, Vanuatu, Samoa, Tonga, Solomon	124.00	1.08	Disbursed	OOF	Grant	Adaptation	Prevention and resoration of disaster	
39	Georgia	500.00	4.35	Disbursed	ODA	Grant	Mitigation	Transport	
40	Haiti	4,233.00	36.83	Committed, Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
41	Honduras	16,000.00	139.23	Committed	ODA	Concessional loan	Mitigation	Energy	
42	India	124,321.00	1,081.80	Committed, Disbursed	ODA,OOF	Concessional loan	Mitigation	Transport, Agriculture, Prevention and resoration of disaster	
43	India	34,001.00	295.87	Committed, Disbursed	ODA	Grant, Concessional loan	Adaptation	Agriculture, Prevention and resoration of disaster	
44	India	19,064.00	165.89	Committed	ODA	Concessional loan	Cross-cutting	Water and sanitation	
45	Indonesia	638.00	5.55	Committed, Disbursed	ODA,OOF	Grant	Mitigation	Energy, Forestry, Water and sanitation, Cross-cutting	
46	Indonesia	120.00	1.04	Committed, Disbursed	ODA,OOF	Grant	Adaptation	Agriculture, Prevention and resoration of disaster, Cross-cutting	
47	Indonesia	9.00	0.08	Committed	ODA	Grant	Cross-cutting	Forestry	
48	Indonesia, Paraguay	46.00	0.40	Disbursed	ODA	Grant	Adaptation	Agriculture	
49	Iran	30.00	0.26	Disbursed	OOF	Grant	Mitigation	Cross-cutting	
50	Iraq	34,417.00	299.49	Committed	ODA	Concessional loan	Mitigation	Water and sanitation	

No.	Recipient country/ region/project/programme	Total amount		Status	Funding source	Financial instrument	Type of support	Sector	Additional information
		Climate-specific							
		Japanese yen - JPY	USD						
51	Jamaica	100.00	0.87	Committed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
52	Jordan	9,323.00	81.13	Disbursed	ODA,OOF	Grant, Non-Concessional loan	Mitigation	Energy	
53	Kenya、Ethiopia	340.00	2.96	Committed, Disbursed	OOF	Grant	Mitigation	Energy,cross-cutting	
54	Kenya	272.00	2.37	Committed, Disbursed	ODA,OOF	Grant	Adaptation	Forestry, Prevention and resoration of disaster	
55	Kyrgyz Republic	11,915.00	103.68	Committed	ODA	Concessional loan	Adaptation	Prevention and resoration of disaster	
56	Lao Peple's Democratic Republic	2,182.00	18.99	Committed, Disbursed	OOF	Grant	Mitigation	Prevention and resoration of disaster	
57	Lao Peple's Democratic Republic	58.00	0.50	Committed	ODA	Grant	Cross-cutting	Forestry	
58	Lao People's Democratic Republic, Cambodia	32.00	0.28	Committed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
59	Central and South America, Pacific	75.00	0.65	Committed	OOF	Grant	Mitigation	Cross-cutting	
60	Malawi	272.00	2.37	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
61	Malaysia	30.00	0.26	Committed	OOF	Grant	Mitigation	Cross-cutting	
62	Maldives	21.00	0.18	Disbursed	OOF	Grant	Mitigation	Energy	
63	Maldives	500.00	4.35	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
64	Marshall Islands	100.00	0.87	Disbursed	ODA	Grant	Adaptation	Cross-cutting	
65	Mauritius	190.00	1.65	Committed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
66	Mexico	86.00	0.75	Committed, Disbursed	ODA,OOF	Grant	Mitigation	Agriculture, Cross-cutting	
67	Micronesia	100.00	0.87	Disbursed	ODA	Grant	Adaptation	Cross-cutting	
68	Mongolia	85.00	0.74	Committed, Disbursed	ODA, OOF	Grant	Mitigation	Cross-cutting	
69	Mongolia	40.00	0.35	Disbursed	OOF	Grant	Adaptation	Cross-cutting	
70	Mozambique	17.00	0.15	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
71	Myanmar	71,992.00	626.45	Committed, Disbursed	ODA,OOF	Grant, Concessional loan	Mitigation	Energy, Cross-cutting	
72	Myanmar	2,719.00	23.66	Committed, Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster, Water and sanitation	
73	Myanmar	29.00	0.25	Committed	ODA	Grant	Cross-cutting	Forestry	
74	Nepal	9.00	0.08	Committed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
75	Pacisic Islands	7.00	0.06	Disbursed	ODA	Grant	Mitigation	Energy	

No.	Recipient country/ region/project/programme	Total amount Climate-specific Japanese yen - JPY	USD	Status	Funding source	Financial instrument	Type of support	Sector	Additional information
76	Pakistan	4,239.00	36.89	Committed, Disbursed	ODA	Grant	Mitigation	Water and sanitation, Energy	
77	Pakistan	3,037.00	26.43	Committed	ODA	Grant	Adaptation	Prevention and resoration of disaster, Agriculture	
78	Pakistan, Sri lanka, Mongolia, Nepal, Bangladesh	60.00	0.52	Disbursed	OOF	Grant	Mitigation	Energy	
79	Palau, Indonesia, Fiji, Samoa	10.00	0.09	Disbursed	ODA	Grant	Adaptation	Cross-cutting	
80	Palau	1,843.00	16.04	Committed	ODA	Grant	Adaptation	Water and sanitation	
81	Papua New Guinea	26,942.00	234.44	Committed	ODA	Concessional loan	Mitigation	Energy	
82	Papua New Guinea	300.00	2.61	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
83	Indonesia, Papua New Guinea, Peru	9.00	0.08	Disbursed	ODA	Grant	Mitigation	Forestry	
84	Philippines	242,020.00	2,105.99	Committed	ODA,OOF	Concessional loan	Mitigation	Transport, Energy	
85	Philippines	13.00	0.11	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster, Forestry	
86	Rwanda	1,013.00	8.81	Committed	ODA	Grant	Adaptation	Water and sanitation	
87	Sain Kitts and Nevis	184.00	1.60	Committed	ODA	Grant	Mitigation	Fishing	
88	Sain Kitts and Nevis	100.00	0.87	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
89	Samoa	13.00	0.11	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting	
90	Saudi Arabia	80.00	0.70	Disbursed	OOF	Grant	Mitigation	Water and sanitation,cross-cutting	
91	Senegal	788.00	6.86	Committed	ODA	Grant	Adaptation	Water and sanitation	
92	Singapore	6.00	0.05	Disbursed	ODA	Grant	Mitigation	cross-cutting	
93	Singapore	6.00	0.05	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
94	South Africa	15,125.00	131.61	Committed	OOF	Non-Concessional loan	Mitigation	Energy	
95	Sri Lanka	70,358.00	612.23	Committed	ODA	Concessional loan	Mitigation	Energy, Transport	
96	Sri Lanka	68.00	0.59	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
97	Tanzania	21,232.00	184.75	Committed	OOF	Non-Concessional loan	Mitigation	Energy	
98	Tajikistan	265.00	2.31	Committed	ODA	Grant	Adaptation	Water and sanitation	
99	Thaniland	38,924.00	338.71	Committed, Disbursed	ODA, OOF	Grant, Concessional loan	Mitigation	Energy, Transport, cross-cutting	
100	Turkey	19,176.00	166.86	Committed, Disbursed	OOF	Non-Concessional loan	Mitigation	Energy	

No.	Recipient country/ region/project/programme	Total amount		Status	Funding source	Financial instrument	Type of support	Sector	Additional information
		Climate-specific							
		Japanese yen - JPY	USD						
101	Tuvalu	100.00	0.87	Disbursed	ODA	Grant	Adaptation	Cross-cutting	
102	Vanuatu, Kiribati, Tuvalu, Solomon Islands	136.00	1.18	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
103	Uganda	38.00	0.33	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
104	Uganda, Tanzanisa, Djibouti, Ethiopia	8.00	0.07	Disbursed	ODA	Grant	Mitigation	Energy	
105	Uzbekistan	11,872.00	103.31	Committed	ODA	Concessional loan	Mitigation	Agriculture	
106	Viet Nam	80,148.00	697.42	Committed, Disbursed	ODA, OOF	Grant	Mitigation	Energy, Water and sanitation, Cross-cutting, Other	
107	Viet Nam	58.00	0.50	Disbursed	ODA	Grant	Adaptation	Agriculture	
108	Viet Nam	15,045.00	130.92	Committed, Disbursed	ODA	Grant, Concessional loan	Cross-cutting	Forestry, Cross-cutting	

Custom Footnotes

The unit of JPY is "million Japanese Yen", and the unit of USD is "million US dollars".

The exchange rate is 114.92 JPY/USD. Values converted from Japanese Yen to USD using the 114.92 yen/US dollar rate may not match the total USD amount reported due to rounding.

Table 6-6 Provision of public financial support: contribution through bilateral, regional and other channels in 2016 (CTF Table 7(b))

No.	Recipient country/ region/project/programme	Total amount Climate-specific Japanese yen - JPY	Total amount Climate-specific USD	Status	Funding source	Financial instrument	Type of support	Sector	Additional information
	Total contributions through bilateral, regional and other channels	1,229,361.00	10,697.52						
1	Afganistan	47.00	0.41	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
2	Africa	333.00	2.90	Committed, Disbursed	ODA	Grant, Equity	Mitigation	Energy	
3	Asia	1,260.00	10.96	Disbursed	OOF	Grant	Mitigation	Cross-cutting	
4	Asia Pacific	35.00	0.30	Disbursed	OOF	Grant	Adaptation	Cross-cutting	
5	Asia Pacific	16.00	0.14	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting	
6	Bahamas	200.00	1.74	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
7	Bangladesh	97,059.00	844.58	Committed, Disbursed	ODA, OOF	Concessional Loan, Non-Concessional Loan	Mitigation	Energy, Water and sanitation	
8	Bangladesh	16,996.00	147.89	Committed	ODA	Concessional Loan	Adaptation	Prevention and resoration of disaster	
9	Barbados	100.00	0.87	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
10	Benin	60.00	0.52	Disbursed	OOF	Grant	Mitigation	Forestry	
11	Bolivia	61,485.00	535.02	Committed	ODA	Concessional Loan	Mitigation	Energy	
12	Cambodia, Myanmar, Peru	70.00	0.61	Committed	OOF	Grant	Cross-cutting	Forestry	
13	Cambodia	2,325.00	20.23	Committed, Disbursed	ODA, OOF	Grant, Other	Mitigation	Transport, Energy, Cross-cutting	
14	Cambodia	8.00	0.07	Disbursed	OOF	Grant	Adaptation	Forestry	
15	China	22.00	0.19	Disbursed	ODA	Grant	Mitigation	Cross-cutting	
16	Columbia	8.00	0.07	Committed	OOF	Grant	Mitigation	Agriculture	
17	Pacific	28.00	0.24	Disbursed	OOF	Grant	Mitigation	Energy	
18	Costa Rica	300.00	2.61	Disbursed	ODA	Grant	Mitigation	Transport	
19	Developing countries	8,400.00	73.09	Committed, Disbursed	OOF	Grant	Mitigation	Cross-cutting	
20	Dominica Republic	200.00	1.74	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
21	Egypt	95,274.00	829.05	Committed	ODA	Concessional Loan	Mitigation	Transport, Energy	
22	El Salvador	226.00	1.97	Disbursed	ODA	Grant	Adaptation	Transport	
23	Ethiopia	4.00	0.03	Disbursed	ODA	Grant	Mitigation	Energy	
24	Ethiopia	789.00	6.87	Disbursed	ODA	Grant	Adaptation	Water and sanitation, Prevention and resoration of disaster	
25	Fiji, Vanuatu, Samoa	37.00	0.32	Disbursed	OOF	Grant	Adaptation	Cross-cutting	

No.	Recipient country/ region/project/programme	Total amount		Status	Funding source	Financial instrument	Type of support	Sector	Additional information
		Climate-specific							
		Japanese yen - JPY	USD						
26	Fiji	9.00	0.08	Disbursed	ODA	Grant	Mitigation	Energy	
27	Fiji	300.00	2.61	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
28	Global	309.00	2.69	Disbursed	ODA, OOF	Grant	Mitigation	Transport, Energy, Forestry, Cross-cutting	
29	Global	37.00	0.32	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of Disaster, Cross-cutting	
30	Global	76.00	0.66	Disbursed	ODA	Grant	Cross-cutting	Forestry	
31	Guatemala	48.00	0.42	Disbursed	OOF	Grant	Mitigation	Forestry	
32	Grenada	100.00	0.87	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
33	Haiti	468.00	4.07	Disbursed	ODA	Grant	Adaptation	Water and sanitation, Prevention and resoration of disaster	
34	India, Nepal, Samoa, Sri Lanka, Thailand, Bangladesh	38.00	0.33	Disbursed	OOF	Grant	Adaptation	Cross-cutting	
35	India	103,669.00	902.10	Committed, Disbursed	ODA	Grant, Concessional Loan	Mitigation	Transport, Energy	
36	India	4,652.00	40.48	Committed	ODA	Concessional Loan	Adaptation	Agriculture	
37	Indonesia, Lao P.D.R., Cambodia	28.00	0.24	Committed	ODA	Grant	Cross-cutting	Forestry	
38	Indonesia, Nepal, Senegal, Brazil	56.00	0.49	Committed	ODA	Grant	Cross-cutting	Forestry	
39	Indonesia Philippines	35.00	0.30	Disbursed	OOF	Other	Mitigation	Energy	
40	Indonesia	267,190.00	2,325.01	Committed, Disbursed	ODA, OOF	Grant, Non-Concessional Loan	Mitigation	Energy, Forestry, Cross-cutting	
41	Indonesia	143.00	1.24	Disbursed	ODA, OOF	Grant	Adaptation	Prevention and resoration of disaster, Cross-cutting	
42	Indonesia, Paraguay	39.00	0.34	Disbursed	OOF	Grant	Adaptation	Agriculture	
43	Iran	27.00	0.23	Disbursed	OOF	Other	Mitigation	Cross-cutting	
44	Iran	5.00	0.04	Disbursed	OOF	Other	Adaptation	Prevention and resoration of disaster	
45	Kenya, Ethiopia, Mexico, Chile, Costa Rica, Palau, Maldives	80.00	0.70	Committed	ODA	Grant	Mitigation	Cross-cutting	
46	Kenya	45,733.00	397.96	Committed, Disbursed	ODA, OOF	Concessional Loan, Other	Mitigation	Energy	
47	Kenya	89.00	0.77	Disbursed	ODA	Grant	Adaptation	Water and sanitation	
48	Kenya	82.00	0.71	Disbursed	ODA	Grant	Cross-cutting	Forestry	
49	Kenya, Ethiopia,	100.00	0.87	Disbursed	OOF	Grant	Mitigation	Energy	
50	Kiribati	3,805.00	33.11	Committed	ODA	Grant	Adaptation	Transport	

No.	Recipient country/ region/project/programme	Total amount Climate-specific Japanese yen - JPY	USD	Status	Funding source	Financial instrument	Type of support	Sector	Additional information
51	Lao P.D.R., Cambodia	27.00	0.23	Committed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
52	Lao P.D.R., Philippines, Thailand, Viet Nam, Indonesia, Malaysia	77.00	0.67	Disbursed	OOF	Other	Mitigation	Cross-cutting	
53	Lao People's Democratic Republic	40.00	0.35	Committed	OOF	Other	Mitigation	Forestry	
54	Lao People's Democratic Republic	7.00	0.06	Disbursed	OOF	Other	Adaptation	Agriculture	
55	Latin America and the Caribbean	5,440.00	47.34	Committed	OOF	Non-Concessional Loan	Mitigation	Energy	
56	Madagascar	106.00	0.92	Committed	ODA	Grant	Adaptation	Agriculture	
57	Malawi	593.00	5.16	Disbursed	ODA, OOF	Grant	Adaptation	Forestry, Prevention and resoration of disaster	
58	Malaysia	7.00	0.06	Disbursed	OOF	Other	Mitigation	Cross-cutting	
59	Maldives	36.00	0.31	Disbursed	OOF	Other	Mitigation	Energy	
60	Maldives	600.00	5.22	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
61	Mexico	5,484.00	47.72	Committed, Disbursed	OOF	Non-Concessional Loan	Mitigation	Energy, Cross-cutting	
62	Micronesia	1,193.00	10.38	Committed	ODA	Grant	Mitigation	Energy	
63	Mongolia, Bangladesh, Viet Nam, Lao PDR, Cambodia, Myanmar	100.00	0.87	Committed	ODA	Grant	Mitigation	Cross-cutting	
64	Mongolia	6,665.00	58.00	Committed, Disbursed	ODA, OOF	Grant, Concessional Loan	Mitigation	Energy, Cross-cutting	
65	Mongolia	32.00	0.28	Disbursed	OOF	Grant	Adaptation	Cross-cutting	
66	Morocco	16,347.00	142.25	Committed	ODA	Concessional Loan	Cross-cutting	Agriculture	
67	Myanmar	60.00	0.52	Disbursed	OOF	Other	Mitigation	Energy, Water and sanitation, Cross-cutting	
68	Myanmar	65.00	0.57	Disbursed	ODA, OOF	Grant, Other	Adaptation	Agriculture, Prevention and resoration of disaster	
69	Myanmar	26.00	0.23	Committed	ODA	Grant	Cross-cutting	Forestry	
70	Nigeria	1,317.00	11.46	Committed	ODA	Grant	Mitigation	Transport	
71	North and Latin America	15.00	0.13	Disbursed	ODA	Grant	Mitigation	Energy	
72	Oman	6.00	0.05	Disbursed	OOF	Other	Adaptation	Agriculture	
73	Pakistan	5,994.00	52.16	Committed	ODA	Grant, Concessional Loan	Mitigation	Energy	
74	Panama	29,575.00	257.35	Committed	ODA	Concessional Loan	Mitigation	Transport	
75	Papua New Guinea	620.00	5.40	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	

No.	Recipient country/ region/project/programme	Total amount		Status	Funding source	Financial instrument	Type of support	Sector	Additional information
		Climate-specific							
		Japanese yen - JPY	USD						
76	Peru	170.00	1.48	Disbursed	ODA,OOF	Grant	Cross-cutting	Forestry	
77	Philippines	50.00	0.44	Disbursed	OOF	Other	Mitigation	Energy, Transport	
78	Philippines	45.00	0.39	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
79	Philippines	10.00	0.09	Disbursed	OOF	Grant	Cross-cutting	Cross-cutting	
80	Qatar	138,067.00	1,201.42	Disbursed	OOF	Non-Concessional Loan	Mitigation	Energy	
81	Rwanda	2,219.00	19.31	Committed	ODA	Grant	Mitigation	Transport	
82	Rwanda	101.00	0.88	Disbursed	ODA	Grant	Adaptation	Water and sanitation	
83	Saint Kitts and Nevis	200.00	1.74	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
84	Saint Vincent and the Grenadines	200.00	1.74	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
85	Samoa	962.00	8.37	Committed	ODA	Grant	Cross-cutting	Cross-cutting	
86	Senegal	27,663.00	240.72	Committed, Disbursed	ODA	Grant, Concessional Loan	Adaptation	Water and sanitation	
87	Singapore	5.00	0.04	Disbursed	ODA	Grant	Adaptation	Cross-cutting	
88	South Africa	4.00	0.03	Disbursed	ODA	Grant	Mitigation	Energy	
89	Sri Lanka	76.00	0.66	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
90	Sudan	3,248.00	28.26	Committed, Disbursed	ODA	Grant	Adaptation	Water and sanitation	
91	Tajikistan	1,172.00	10.20	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
92	Thailand	167,475.00	1,457.32	Committed, Disbursed	ODA, OOF	Grant, Concessional Loan	Mitigation	Energy, Transport, Water and sanitation, Cross-cutting	
93	Timor Leste	102.00	0.89	Disbursed	ODA	Grant	Adaptation	Forestry	
94	Uganda	50.00	0.44	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
95	United of Republic of Tanzania	118.00	1.03	Disbursed	ODA	Grant	Adaptation	Water and sanitation	
96	Viet Nam, Lao P.D.R.	8.00	0.07	Committed	ODA	Grant	Cross-cutting	Forestry	
97	Viet Nam	90,284.00	785.62	Committed, Disbursed	ODA, OOF	Grant, Concessional Loan	Mitigation	Transport, Cross-cutting	
98	Viet Nam	300.00	2.61	Disbursed	ODA	Grant	Adaptation	Prevention and resoration of disaster	
99	Viet Nam	10,000.00	87.02	Committed	ODA	Concessional Loan	Cross-cutting	Cross-cutting	

Custom Footnotes

The unit of JPY is "million Japanese Yen", and the unit of USD is "million US dollars".

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6.3.2.4 Private Financial Flows

In order to further promote climate change action, Japan has also been working on establishing a mechanism to leverage private investment by use of public finance. Co-financing by JBIC with the private sector and trade insurance by NEXI are the examples of utilizing private finance. Private finance also plays an important role to tackle climate change as its total amount is over USD 3.8 billion as of December 2016.

a. Other Official Flow, Including Co-funding with Private Sector

In April 2010, JBIC launched a new operation named ‘GREEN’ (Global action for Reconciling Economic growth and Environmental preservation) of which primary purpose is to support projects with favorable impact on the preservation of the global environment. Under the ‘GREEN’ operation, JBIC implements support through utilizing united loans, guarantees and equity investment while mobilizing private funds.

<Features>

In every project under the ‘GREEN’ operation, JBIC conducts its own accounting measures named ‘J-MRV Guidelines’ for reduction impact of GHG emission. The objective of this accounting method is to quantify and to check the amount of reducing GHGs by relevant projects in developing countries.

<Examples>

JBIC has provided finance needed for the environment-related projects (improving energy efficiency project or renewable energy project) to financial institutions, such as Türkiye Kalkınma Bankası A.Ş. in Turkey, Banco Nacional de Comercio Exterior, S.N.C. in Mexico, Banco Nacional de Desenvolvimento Econômico e Social in Brazil and The Standard Bank of South Africa Limited in South Africa. In funding of JBIC, co-finance with private finance institutions is applied as its principle, by which further mobilization of private financing has been facilitated.

6.4 Technology Development and Transfer

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

6.4.1 Innovation of low-carbon technology and promotion of its dissemination

In order to contribute to significant global emission reduction through innovation, based upon National Energy and Environment Strategy for Technical Innovation towards 2050 adopted in April 2016, Japan will promote the development of innovative technology with great reduction potential and impact in a long-term perspective. For example, Japan will promote research and development, demonstration, and model projects regarding manufacturing, transporting/storing and utilizing energy carriers such as hydrogen, the future power electronics using gallium nitride (GaN), Carbon Capture and Storage (CCS), and Carbon Capture and Utilization (CCU).

Japan will also accelerate innovation through “Innovation for Cool Earth Forum (ICEF)”, the global platform to promote discussions and cooperation on innovation in energy and environmental technology among worldwide academic, industrial and public sectors. Furthermore, Japan will promote demonstration projects to create innovations for drastically reconstructing advanced low-carbon technology in accordance with specific characteristics of developing countries. Japan also will create co-innovation projects by incorporating the needs of developing countries and the seeds provided by Japanese industries, taking an initiative of dispatching business missions to developing countries, and accelerate collaboration of private companies and local governments on both sides. Japan will foster further innovation by sharing information on dissemination of innovative technology and its effectiveness.

Japan will promote the dissemination of advanced low-carbon technology with public-private partnership through Joint Crediting Mechanism (JCM), in which Japan has established partnerships with 17 partner countries and supported more than 100 projects. Japan will also support both the introduction of waste power generations as one of the environmental infrastructure and waste management system as a package. Japan will support the optimization of existing infrastructure and operation and maintenance (O&M) by private companies thorough utilizing Internet of Things (IoT), which contributes to emission reduction and the visualization of reduction effects. In addition, in order to implement large-scale projects and wider dissemination of low-carbon technology, Japan will enhance collaboration with public finance of, among others, JICA and JBIC, and will enhance capacities and carry out feasibility studies for project formation to improve the 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 will provide support based upon its knowledge and promote understanding of the importance of the programs implemented in developing countries.

6.4.2 Implementation of adaptation projects

Through collaboration with Japanese cooperation organizations or governmental financial institutions including Japan International Cooperation Agency (JICA) and Japan Bank of International Cooperation (JBIC) and international development and financial institutions, Japan will support adaptation projects based on priorities and needs of each country, while diversifying the financial resources, including mobilization of private finance.

In order to enhance the resilience to climate change, Japan will support the 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 sustainable and stable food supply, provide the support to agricultural insurance for smallholder farmers vulnerable to climate change. Japan's support extends to ecosystem-based adaptation for coastal protection by utilizing ecosystems such as coral reefs and mangroves. Being mindful of the situation among SIDS, which are vulnerable to climate change, Japan will carry out 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.

6.4.3 Emissions Reduction in Oversea Countries by Diffusing Technologies

Japan will promote the global "application" of existing low-carbon technologies. Accelerating the diffusion of such technologies and verifying the reduction effect by the technologies will realize the further emission reduction of greenhouse gasses and new economic growth simultaneously.

6.4.3.1 Joint Crediting Mechanism (JCM)

Japan establishes and implements the JCM in order both to appropriately evaluate contributions from Japan to GHG emission reductions and removals in a quantitative manner achieved through the diffusion of low carbon technologies, products, systems, services, and infrastructure to developing countries as well as implementation of mitigation actions in developing countries, and to use them to achieve Japan's emission reduction target.

Since Japan and Mongolia signed a bilateral document in January 2013 for the first time to start the JCM, the number of partner countries has increased to 17. There are more than 120 GHG emission reduction projects being implemented on the ground so far and the accumulated emission reductions from these projects are expected to be about 7 Mt-CO_2 (Preliminary estimation towards the period by 2030FY). At this point there are about 20 registered projects among which 8 projects issued JCM credits. Furthermore, more than 40 MRV methodologies (methods for calculating GHG emission reductions) have been approved as a step towards project registration. Japan will continue to support the further formulation of JCM projects in collaboration with relevant ministries and agencies.

6.4.3.2 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 of energy efficiencies of LED lightings etc. thus will contribute to the international standardization onwards. In addition, the government will provide supports on institutional arrangements for enhancing 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

・Utilization of Satellites

The government aims to launch a new GHG observing satellite GOSAT-2 which has the state-of-the-art technologies (successor to GOSAT) in FY 2018. The government will provide supports on usage of satellite GHG data for the validation of national GHG inventions in each country by monitoring GHG emission at country level or mega-city regions and large scale point sources, leading to enhance the technology of MRV (Measurement, Reporting and Verification).

・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).

6.4.3.3 Other Supports for Developing Countries

In developing countries in particular, addressing deforestation and forest degradation due to illegal logging, expanding agricultural land and other factors are urgent issues. Leveraging its knowledge and expertise, Japan will actively support Reducing Emissions from Deforestation and Forest Degradation (REDD+) including sustainable management of forests in developing countries, which will contribute to forest conservation in those countries.

Furthermore, in order to achieve compatibility between environmental protection and economic growth in developing countries, Japan will promote cooperation through a co-benefits approach that will contribute to both environmental pollution reduction and greenhouse gas emissions reduction, which is a global concern.

6.4.4 Projects related to provision of support for technology development and transfer

Information on Japan's projects on the provision of support for technology development and transfer is shown in Table 6-7.

In addition, as an example of success story related to project to facilitate the transfer of environmentally sound technologies, the description of "Promotion of Green Hospital by improving efficiency and environment in national hospitals in Vietnam" and "Introduction and expansion of Amorphous high efficiency transformer usage in power distribution systems in Viet Nam (JCM Model project)" implemented by Japan is shown in Table 6-8.

Table 6-7 Provision of support for technology development and transfer (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	Cambodia	Mitigation and Adaptation	Project for Facilitating the Implementation of REDD+ Strategy and Policy	Agriculture	Public	Public	Implemented	The Project aims for formulation of the REDD+ systems and the roadmaps in Cambodia to implement the environmental management in accordance with the strategies and policies of REDD+.
2	Cambodia, Laos	Adaptation	Study for rural disaster prevention plan in research projects on global environment problem in agriculture and rural villages overseas	Disaster prevention	Public	Private and Public	Implemented	To improve the disaster prevention effect in rural villages in developing countries, develop a system for disaster prevention adapted to climate change and a method to develop a rural disaster prevention plan.
3	Cambodia, Myanmar	Mitigation and Adaptation	Project to accelerate REDD-plus activities by private sector	Forestry	Public	Private and Public	Implemented	This project aims to promote and accelerate full-scale REDD-plus activities by Japanese private sector through developing scientific solutions of the entry barriers
4	India	Mitigation	Study for Sophistication of efficiency management of thermal power plants (Implementation of real-time unit performance management service using IoT)	Energy	Public	Private and Public	Planned	This project aims to introduce the real-time unit performance management service to two 500MW subcritical units recommended by the Ministry of Power of India and to apply the service to coal-fired power plants throughout India. This will contribute to international CO_2 emission reductions.
5	Indonesia	Mitigation	Application of a Tribrid System to Base Transceiver Stations	Industry	Public	Private and Public	Implemented	Applying tribrid technology to BTSs in Indonesia can reduce CO_2 emissions by suppressing the usage of electric generators powered by diesel fuel and grid-supplied electricity.
6	Indonesia	Mitigation	Study for CCUS (CO_2-EOR) projects development in the South Sumatra region on the Republic of Indonesia under Joint Crediting Mechanism(JCM)	Energy	Public	Private and Public	Planned	To conduct a CCUS (CO_2-EOR) utilizing WAG technology in South Sumatra, as a major CCUS player in Indonesia. Additionally, any carbon credit acquired through the project shall be applied for JCM.
7	Indonesia, Philippine, Uzbekistan, Botswana, Colombia	Mitigation and Adaptation	Project for promoting sustainable forest management in developing countries	Forestry	Public	Private and Public	Planned	Japan disseminates business models on forest conservation through sustainable utilization of forest resources in a way that will create added economic value in developing countries.
8	Lao PDR	Mitigation	Sustainable Forest Management and REDD+ Support Project	Forestry	Public	Public	Implemented	This Project aims for contribution of strengthening the capacity of forest management in Lao PDR through renovation of REDD+ strategy and the establishment of Forest Resource Information database in order to enhance sustainable forest management.
9	Laos	Mitigation	FY2015 JCM Feasibility Study (Programme for the Establishment of Low-Carbon Historic City in Vientiane, based on City-to-City Cooperation between Vientiane Capital and Kyoto City）	Cross-cutting	Public	Public	Implemented	Conducting feasibility studies for creating JCM projects (renewable energy and waste management) and establishing Action Plan in collaboration with public-private partnerships in order to provide comprehensively experiences and systems of Kyoto City, which is globally known as historic and environment-friendly city, as well as Japanese environmental technology to Vientiane city, the capital of Laos. Through this initiative, it aims to build a low-carbon historic city model using JCM.
10	Laos	Mitigation	Laos Energy Efficient Datacenter (LEED) Project In Lao People’s Democratic Republic	Industry	Public	Private and Public	Implemented	GHG emission has been dramatically increased in the IT industry. The project called ‘LEED’ aims to demonstrate effectiveness of Japanese high energy efficiency technologies in developing countries whose IT demand is expected to increase, facilitating their diffusion and contributing to GHG emission reduction.

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
11	Laos, Philippines, Thailand, Viet Nam, Indonesia, Malaysia	Mitigation	Feasibility Study of Project to Demonstrate to Advanced Low-carbon Technology Innovation for Further Development in Developing Countries in Asia Region	Cross-cutting	Public	Private and Public	Implemented	Feasibility study for creating projects through consideration of technology change and matching between specific needs in developing countries in Asia region and seeds of Japanese low-carbon technologies.
12	Maldives	Mitigation	Study for Wind Energy Project for Remote islands in the Maldives	Energy	Public	Private and Public	Implemented	To examine the feasibility of the project to install Japanese 300kW wind turbines along with the micro-grid system founded in the ample experience in Japanese islands to islands in Maldives, which leads to the decrease on the dependency on diesel oils and to the emission reduction of GHG. The scope of study includes the examination of the site conditions such as wind resource assessment, basic system design, drafting of preliminary project plans and the development of MRV.
13	Myanmar	Mitigation	FY2015 JCM Feasibility Study (JCM Project Formulation Study through City-to-City Collaboration in Yangon）	Cross-cutting	Public	Public	Implemented	Providing support for developing the low carbon development policy society in Yangon and conducting feasibility study of JCM projects based on the technologies and experiences of Kawasaki City which has a lot of practices in low carbon city development in domestically and internationally. In addition, it aims to produce projects which contribute to low carbonization in collaboration with Green Innovation Cluster established by Kawasaki City.
14	Philippines	Mitigation	Study for Small-Scale Geothermal Power Generation Project in the Philippines and Other Countries	Energy	Public	Private and Public	Implemented	Small-scale geothermal plants will be introduced to unutilized geothermal wells in the Philippines and other countries which have significant geothermal resources and considerable experience with utilizing geothermal power, a power source known to help reduce CO2 emissions.
15	Saudi Arabia	Mitigation	Feasibility Study on CCUS projects in Saudi Arabia	Energy	Public	Private and Public	Implemented	This Study embraces examination of feasibility of 1) policies related to JCM that will contribute to CCS(Carbon dioxide Capture and Storage) technology diffusion, and 2) applicability of CCUS project in East region of Kingdom of Saudi Arabia and Riyadh area, where the implementation of CO2 emission reduction project through CCS is expected.
16	Saudi Arabia	Mitigation	Feasibility study on JCM Project using solar panel cleaning robot for arid region	Energy	Public	Private and Public	Planned	This study is to introduce a solar panel cleaning robot in Saudi Arabia's large-scale photovoltaic power plant and automatically clean up dust without using water, minimizing energy consumption for cleaning and maintaining power generation efficiency.
17	Thailand	Mitigation	FY2015 JCM Feasibility Study (Promotion of Decarbonizing of Municipal Waste Management and Ecological Industrial Town in Rayong Prefecture (Kitakyushu-Rayong Cooperation Project)）	Cross-cutting	Public	Private and Public	Implemented	Pursue a compatible model which can strike a balance between CO2 emission reduction and securement of profit by selling electricity through conversion of waste incineration facility which Rayong Prefecture is planning to the waste to energy facility. In addition, pursue total management of waste and low-carbonization by energy and water saving in two industrial associations which is promoting ecological industrial town.
18	Thailand	Mitigation	Introduction of Energy Conservation Equipment and Energy Management Systems in Automobile Factories	Energy	Public	Private and Public	Implemented	This study is designed to verify the feasibility of introducing leading Japanese high-efficiency heat source machine technologies, such as heat pump technology and energy management systems (EMS), thereby contributing to greenhouse gas emissions reduction in Thailand.
19	Thailand	Mitigation	Study for Improvement of power generation efficiency by upgrading gas turbine in Thailand	Energy	Public	Private and Public	Planned	The study is to be conducted for the project to improve power generation efficiency by introducing "Upgrade Blade" and remote monitoring system to optimize O&M of the existing GTCC (gas turbine combined cycle) .
20	Thailand	Mitigation	Feasibility Study of Development and Standardization of Power Digital Solution for Utilities in ASEAN region（Thailand）	Energy	Public	Private and Public	Planned	This study is to figure out the reduction of emissions for NOx/SOx/CO2/etc. and to optimize the plant performance through the development of the Power Digital Solution at the existing coal fired power plant(s). Power Digital Solution will generally include Boiler Operation Optimization, Asset Performance Management, etc.

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
21	Thailand, Myanmar, Uzbekistan	Mitigation and Adaptation	Project to disseminate forest regeneration technologies in developing countries	Forestry	Public	Private and Public	Planned	Japan disseminates forest regeneration technologies in devastated land or semiarid land of developing countries.
22	Viet Nam	Mitigation	FY2015 JCM Feasibility Study (The whole city low carbonization in Hai Phong City (Kitakyushu-Hai Phong Cooperation Project))	Cross-cutting	Public	Public	Implemented	Based on the cooperation framework between Hai phong city and Kitakyushu city, it aims to large reduction of GHG emissions with projects in the following 4 sectors: Energy sector, Cat Ba Island sector, Energy-Waste fusion sector and Greening growth promotion plan follow-up sector in order to promote low-carbonization of whole Hi phong city, .
23	Viet Nam	Mitigation	FY2015 JCM Feasibility Study (Ho Chi Minh City – Osaka City Cooperation Programme for Developing Low Carbon City)	Cross-cutting	Public	Public	Implemented	In order to discover JCM projects and encourage large-scale development, utilizing experience of Osaka city, provide support to develop Climate Change Countermeasure Action Plan of Ho Chi Minh city and conduct feasibility study to start promptly a large-scale JCM project. Low-carbon city formulation by integration of inter-city and public-private cooperation as well as development and realization of JCM projects are promoted.
24	Viet Nam	Mitigation	Energy Saving and Work Efficiency Improvement by Introducing a New Chip-on-Board LED System in Vietnam	Transport	Public	Private and Public	Implemented	Making to the energy conservation with the fishing boat in the Vietnamese country central part is proven by developing, and introducing highly effective and a high endurance special LED technology as fishing light.
25	Viet Nam	Mitigation	Study for demand response by high efficiency air conditioner cooperate with power sector	Energy	Public	Private and Public	Planned	This is an investigation of contribution to greenhouse gas (GHG) reduction by the combination of proposals for Vietnamese regulation and Japanese technologies , such as high efficiency air conditioner, energy management system, monitoring and control system of power company and demand response (DR) management. It will contribute disseminating the DR in Vietnam by consistent support for the construction, the operation and the settlement of these complex systems.
26	Viet Nam	Mitigation	Feasibility study of floating PV generation projects on existing hydroelectric dams	Energy	Public	Private and Public	Planned	The project introduces floating photovoltaic (PV) generation systems on the existing dam lakes in central to central-south of Vietnam. Conventional floating PV systems are located on stable ponds and their capacities are within several megawatts. In this study, the target is a bigger system with 20 MW capacity, considering how to solve following the technical issues and disseminate the project using a large number of dam lakes in Vietnam.
27	Viet Nam	Adaptation	The Project for Emergency Reservoir Operation and Effective Flood Management Using Water-related Disaster Management Information System	Water and sanitation	Public	Public	Planned	The Project will construct hydrological observation facilities to monitor the water level of rivers and dams and the rainfall in the basin of the Huong River, which flows through Central Vietnam, and will also construct a water-related disaster management information system to mitigate flood disasters in the general Huong River Basin.
28	Vietnam	Adaptation	DRR/CCA project in Dong Thap province（Phase1）	Disaster prevention	Public	Private	Implemented	This project aims to strengthen local capacity for disaster risk reduction (DRR) and climate change adaptation (CCA) in Dong Thap Province, Mekong Delta region of Vietnam. The project supports to establish a community-based disaster risk management system, improve safety of schools, and enhance the capacity of local government officials in charge.

Table 6-8 Description of project to facilitate the transfer of environmentally sound technologies

Project/programme title:

Promotion of Green Hospital by improving efficiency and environment in national hospitals in Vietnam (demonstration project)

Purpose:

This demonstration project has introduced about 1,000 energy efficient inverter air conditioners (ACs) at two state-owned hospitals in Vietnam, along with energy management systems to optimize these ACs efficiently. The project aims to demonstrate and verify these technologies as well as CO_2 emission reduction effects, anticipating a 35% energy saving as well as better ventilation of the entire hospital.

Recipient country:	Sector:	Total funding:	Years in operation:
Vietnam	Energy	USD 5M	2014-2017(4 years)

Description:

In this demonstration project, high efficiency performance inverter ACs, compliant to the energy efficiency labeling standard in Vietnam, are introduced in two state-owned hospitals, one located in Hanoi and the other in Ho Chi Minh City. Not only the inverter ACs were installed, but energy management system (EMS) was developed and installed to enhance the energy efficiency of the entire hospital.

Together with the EMS, improving the ventilation will lead to a better indoor air quality, thus contributing to modifying these hospitals into environmental friendly “Green Hospitals”. As one of the JCM Projects, the amount of CO_2 emission reduction as well as energy efficiency in the project is monitored and verified.

Factors that led to project/programme success:

The project contributes inclusive and sustainable climate action (energy efficiency, indoor air quality and proper treatment of wasted refrigerant) through much consultation with local stakeholders such as the hospitals, related ministries and governmental agencies such as Ministry of Natural Resources and Environment, Ministry of Industry and Trade, and test center of energy efficiency labelling standard in charge.

Technology transferred:

In this demonstration project, high efficiency performance inverter ACs, compliant with the energy efficiency labeling standard in Vietnam, were introduced in two state-owned hospitals, one located in Hanoi and the other in Ho Chi Minh City. Not only was the inverter ACs installed, but energy management system (EMS) was developed and installed to enhance the energy efficiency of the respective hospitals. Together with the EMS, improving the air ventilation with total enthalpy heat exchanger leads to a better indoor air quality free from heat loss, thus contributing to changing these hospitals into environmentally friendly “green hospitals”.

In Vietnam, Cooling Seasonal Performance Factor (CSPF) was introduced subsequent to the launch of the energy efficiency labeling standard. CSPF is a measure of the cooling efficiency calculated from total load and total energy consumption per year of operation. Using this method, the energy efficiency of inverter ACs can be evaluated accurately in public facilities such as hospitals, where air conditioning is needed all year round. Accordingly, this project includes the installation of CSPF-supporting Balanced Room-type Calorimeter at Testing and Verifications Centre for Industry/Institute of Energy and Mining Machine (TVCI/IEMM), the sole certification authority in Vietnam where efficiency of ACs will be verified.

In replacing ACs, a prevention plan is required to be prepared and implemented in order to ensure that hydro chlorofluorocarbon (HCFC) used as refrigerants are not released into the atmosphere when they are removed from conventional ACs. In consideration of environment integrity, such Eligibility Criteria has been established through the efforts of Japan and Vietnam, both of which are highly conscious of climate change issues. The removed refrigerant (HCFC) were depleted properly at a certified destruction plant in Vietnam.

Impact on greenhouse gas emissions/removals (optional):

878t-CO_2e/year (estimated amount of the credit issuance, not including the emission reduction through EMS, air ventilation with total enthalpy heat exchanger and HCFC depletion)

In fact, there must be regarded more GHG emission reduction effect such as EMS, air ventilation with total enthalpy heat exchanger and HCFC depletion.

Project/programme title:

Introduction and expansion of Amorphous high efficiency transformer usage in power distribution systems in Viet Nam (JCM Model project)

Purpose:

This project aims to reduce greenhouse gas emissions through introducing and expanding high-efficient Amorphous Distribution Transformers (AMDTs) in power networks of Vietnam.

Recipient country:	Sector:	Total funding:	Years in operation:
Vietnam	Energy	19 million USD (1USD=100JPY)	From 2014

Description:

This project has introduced more than 13,000 units of AMDTs in distribution power networks of southern, central and northern Vietnam, owned by local power companies of Electricity of Vietnam (EVN) and provincial based power companies. This helps reduce the country's CO_2 emissions from power generation source by reducing distribution losses.

Factors that led to project/programme success:

Steady outreach activities about benefits of AMDTs to local power companies was conducted,

Steady outreach activities to local and regional power companies that are involved in distribution development in Vietnam was conducted,

Improvement of distribution losses through the installation of AMDTs was well understood by technical officers of the local companies,

Support by Vietnam's policies for improving energy efficiency in its power distribution networks was in line with development of this project,

Self-manufacture and sales of AMDTs by Vietnamese venders were developed,

Environmental consciousness for stopping global warming was proposed and imbedded in the local power companies through JCM activities, in addition to energy saving, etc.,

Technology transferred:

The installed equipment is high efficient distribution transformers with Amorphous Core (non-crystalline metal) which can reduce up to one-third of no-load loss in power distribution line compared to conventional transformer with silicon steel lamination. AMDT has higher efficiency of electrical energy transformation compared to the silicon based transformers, contributing to stable power supplies of Vietnam by increasing total power generation outputs to meet the increased power demand.

AMDT is expected to contribute to a big energy saving effect by reducing no-load losses. For example, it is assumed that about 18MWh/year of power use can be reduced by replacing silicon based transformers (2,000kVA, 50Hz 22kV/6.6kV) with the same size AMDTs. (based on the same calculation, this project is expected to reduce a total 18,000MWh/year of power outputs by 2019. This equal to about 1,200,000 USD/year of energy cost saving).

Impact on greenhouse gas emissions/removals (optional):

9,532t-CO_2/year (estimated amount of the credit issuance)

6.5 Capacity-Building

6.5.1 Vision

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 decarbonised 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 the GHG emission extensively worldwide. Such efforts will also 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.

In order to transform the world into such 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 effect.

In order 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" reflecting on their challenges and needs, and contribute to the global reduction of the GHG emissions. Japan will incorporate the needs of each country and the seeds of technology and know-how acquired by Japanese private 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, further opportunities of co-innovation should be enhanced by visualizing those needs and seeds. It is important to develop institutions and capacities in developing countries and promote the engagement of private companies and local governments for implementing climate change activities. For this purpose, Japan has established "Partnership to Strengthen Transparency for Co-Innovation (PaSTI)".

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 such as the NDC Partnership.

6.5.2 Specific programs related to adaptation

6.5.2.1 Science-based development of adaptation plans and strategies

Risk evaluations based upon 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. Through providing latest technology and know-how obtained by its industry-government-academia partnership, Japan will support consolidation and dissemination of information on climate risk, establishment of risk evaluation methods, and development of national adaptation plans in developing countries.

More specifically, Japan will support impact assessment on climate change and development of national adaptation plans through bilateral collaboration. For example, Japan has promoted the establishment of the long-term risk evaluation methods on storm tides and waves caused by cyclones in small island developing states (SIDS) including the Republic of Fiji, the Republic of Vanuatu, and Samoa. Japan has supported to develop the system of Analysis and Mapping of Impacts under Climate Change for Adaptation and Food security (AMICAF)". In addition, Japan will promote human resource developments in the field of climate change by supporting construction and institutional development of the Pacific Climate Change Center in cooperation with the Secretariat of the Pacific Regional Environment Programme (SPREP), and strengthening the Climate Change International Technical and Training Center (CITC) in Thailand.

Japan will cooperate with developing countries in the Asia-Pacific region and the Asian Development Bank (ADB) to establish "Asia-Pacific Climate Change Adaptation Platform (AP-PLAT)," as the information base on climate risk and adaptation measures. Japan will also collaborate with the Global Centre of Excellence on Climate Adaptation (GCECA) to contribute to developing global bases for information on climate risk. As the foundation of these programs, Japan will also continue promoting research and development to upgrade climate models and establishment of global environment information platforms.

In order to promote international discussion 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 them 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 enhance further cooperation with each country.

6.5.2.2 Promotion of adaptation actions by non-state stakeholders

Private sector and local governments play important roles to respond to 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 matching of the needs of developing countries and its advanced technology and service by private companies in Japan, including disaster risk reduction infrastructure technology, early-warning technology and weather index insurance utilizing rainfall data estimated by satellites. Japan will promote adaptation actions of local governments in developing countries by supporting impact assessment and development of local adaptation plans, while involving local researchers, local governments, and communities.

6.5.3 Specific programs related to mitigation

6.5.3.1 Capacity building on development, implementation, and progress management of NDC

The Paris Agreement requires each country to prepare and submit nationally determined contribution (NDC) as well as pursue domestic mitigation measures to achieve the emission reduction target presented in NDC. Under the enhanced transparency framework to promote effective implementation, each country needs to monitor and report the status of implementation of measures. Toward implementation of the Paris Agreement, the needs have been increasing for institutional development and the capacity building in developing countries.

Japan will support institutional and capacity development to prepare GHG emission inventory as the prerequisite of mitigation measures, develop concrete plans and measures as well as review their progress, and establish policies to achieve the target. This support will encompass a system for mandatory accounting, report and disclosure of GHG emissions and the mechanism for development of emission reduction plans by private entities and evaluation of those plans by governments through utilization of ISO. Japan will provide those supports by utilizing its experience and know-how and collaborating with JICA, National Institute for Environmental Studies (NIES) and international initiatives such as NDC Partnership. 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.

In this regard, Japan will carry out some workshops and trainings to support the construction of the domestic systems to prepare GHG emission inventories and the improvement of its precision. Japan will also support submission, update and implementation of each country’s NDC through development of the precise emission reduction scenario and specification of the programs and the technology necessary to achieve successful reduction by utilizing evaluation models. In order to promote the improvement of transparency, Japan contributed to the Capacity Building Initiative for Transparency (CBIT). From now on, Japan will promote the effective utilization of CBIT by collaborating with the Global Environment Facility (GEF) in order to strengthen capacity of developing countries. Moreover, through continuous global monitoring by utilizing a series of GHG Observing Satellite "IBUKI" (GOSAT) and the development and dissemination of the monitoring methods by utilizing ICT, Japan will continue its scientific endeavor for measuring the amount of emissions of each country and securing the transparency of their reduction actions.

6.5.3.2 Promotion of mitigation actions taken by non-state actors

In order to enhance actions and innovation by cities and private sectors, Japan will implement cooperation projects and nurture mutual learning among cities in developing countries and Japan, and promote the private companies’ investment in low-carbon technologies in developing countries.

Japan will provide technical support to prepare GHG emission inventories at the city level, develop master plans and institutions towards low-carbon cities in developing countries by utilizing experiences and know-how of Japanese local governments and the coordination among cities both in developing countries and Japan. To assist Japanese companies working on climate change programs, Japan will support development and implementation of corporate's target consistent with Paris 2-degree target (Science-Based Target, SBT) as well as their activities to contribute to global emission reduction based on industry's action plan towards a low-carbon society, and promote emission reduction in the global value chain of Japanese companies in addition to domestic emission reduction.

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 chances, and back up programs led by private sectors. Japan will also promote Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD+) through public-private partnerships.

6.5.4 Partnership to Strengthen Transparency for Co-Innovation (PaSTI)

As mentioned above, Japan has established “Partnership to Strengthen Transparency for Co-Innovation (PaSTI) (Visualization Partnership),” in cooperation with developing countries and international organizations.

Based on the discussion during the COP23 preparation workshop, one of the official events of COP23 held in Fiji on September 25-26 in 2017, this partnership will combine concrete programs presented in the previous sections and provide support focusing on the following items to respond needs and urgent issues in developing countries. .

- Development and implementation of NDC and evaluation of its progress. (See 6.5.3.1 for the concrete programs.)
- Establishment and operation of climate risk information to improve transparency of adaptation activities. (See 6.5.2.1 for the concrete programs.)

Under these themes, Japan intends to start with the implementation of a pilot project with a couple of partnership countries in collaboration with other donors and international organizations.

In addition, Japan will conduct analysis and research for visualization of impacts of supports including the amount of financial support regarding transparency of support in order to enhance further mobilization of finance and cooperation with a view to the development of PaSTI.

6.5.5 Projects related to provision of capacity-building support

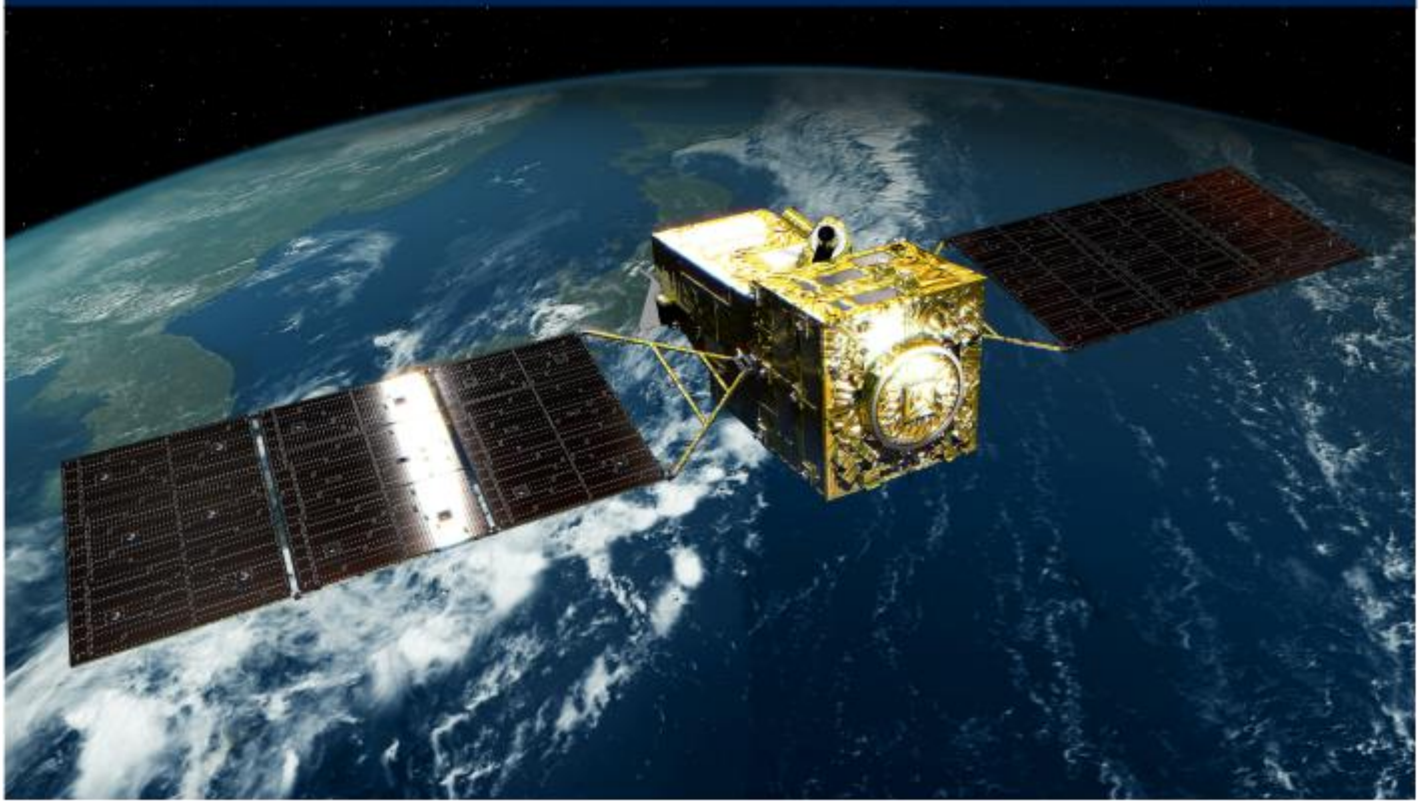
The detailed information on projects/programmes to promote capacity building in developing countries is shown in Table 6-9.

Table 6-9 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	Asia/Pacific	Multiple Areas	Asia-Pacific joint research /observation work of the Global Environment	Supports the Asia-Pacific Network for Global Change Research (APN) which is an intergovernmental network in the Asia-Pacific region to foster global change research, increase developing country participation in that research, and strengthen interactions between the science community and policy-makers.
2	Asia/Pacific	Adaptation	The Global Adaptation Network (GAN), the Asia-Pacific Adaptation Network (APAN)	Supports UNEP lead the Global Adaptation Network (GAN) and the Asia-Pacific Adaptation Network (APAN), to enhance capacity of policy-makers, practitioners and researchers in the Asia-Pacific region by sharing knowledge on climate change adaptation.
3	Asia/Pacific	Mitigation	The 14th and 15th Workshop on Greenhouse Gas Inventories in Asia (WGIA14, 15)	WGIA has been held organized by the Ministry of the Environment of Japan, National Institute for Environmental Studies and host countries' governments since 2003 for the purpose of the quality improvement of Greenhouse gas inventories in Asian countries and promotion of regional cooperation.
4	Bangladesh	Adaptation	Disaster Risk Management Enhancement Project	In Bangladesh where many natural disasters occur, this project aims to enhance the comprehensive disaster risk management of the Government of Bangladesh by recovering and rehabilitating infrastructure at high risk for natural disasters, providing equipment for emergency communication and relief, and establishing and implementing a scheme for the quick and effective recovery and rehabilitation, thereby contributing to the sustainable development of Bangladesh with the development of a disaster-resilient society.
5	East Timor	Adaptation	The Project for Community-Based Sustainable Natural Resource Management(CBNRM) PhaseII	This project contributes to enhance the capacity of key operational actors such as the NDFWM, NGOs and other relevant stakeholders through developing human resources, strengthening existing rules and establishing roadmaps aiming for community-based sustainable natural resource management.
6	El Salvador	Adaptation	The Project for Capacity Development of the Department of Climate Change Adaptation and Strategic Risk Management for Strengthening of Public Infrastructure, Phase II	This project aims to improve disaster risk management of road infrastructure through developing a standard document/manual on road disaster risks, implementing pilot projects and strengthening of the capacity of the Department of Climate Change Adaptation and Strategic Risk Management (DACGER)
7	Indonesia	Adaptation	Cooperation on Climate Change Impact Assessment for Local Adaptation Planning in the Republic of Indonesia	This project aims to cooperate on climate change impact assessment to formulate the local climate change adaptation plans under National Action Plan for Climate Change Adaptation (RAN-API) through capacity building for local authorities.
8	Mongolia	Adaptation	Supporting Impact Assessment and Adaptation planning on Climate Change in Mongolia	This project aims to support practical formulation for national climate change adaptation planning by cooperation of scientific technical impact assessment in Mongolia.
9	Mongolia, Bangladesh, Vietnam, Laos, Indonesia, Cambodia, Thailand, Myanmar, Malaysia, the Philippines, India, etc.	Mitigation	FY2015 Capacity Building for the Joint Crediting Mechanism	Capacity-building to implement JCM
10	Pakistan	Mitigation	The project for developing effective phasing out strategy/program of inefficient appliances to support energy standards and labeling regime in the Islamic Republic of Pakistan	This project contributes to establishing visions, strategies and action plans to make energy labelling mandatory.
11	Papua New Guinea	Mitigation	The Project for Enhancing Capacity to Develop a Sustainable GHG Inventory System for PNG	This project contributes to the capacity development of Climate Change and Development Authority (CCDA) to periodically prepare GHG inventories and promoting the understanding for GHG inventories in relevant organizations.
12	Peru	Multiple Areas	Project on Capacity Development for Forest Conservation and REDD+ Mechanisms	This project supports REDD+ activities and sustainable forest management through enhancing the capacity of target groups, including the Ministry of Environment and implementing agencies on REDD+, improving satellite technology, and through implementing pilot projects on forest protection.
13	Samoa	Multiple Areas	The Project for Construction of the Pacific Climate Change Center	Japan supports to build a Pacific Climate Change Center(PCCC) at the main office of the Secretariat of the Pacific Regional Environment Programme (SPREP) in Samoa. The PCCC will function as a base for human resource training in the field of climate change in Oceania to improve the resiliency of the region to environmental and climate change.
14	Samoa	Multiple Areas	Adviser for Pacific Climate Change	This project supports the development of seminar programs, based on the demands of capacity building for climate change measures in SPREP and Oceania countries.
15	Sri Lanka	adaptation	Capacity Building for community based rink reduction project	This project aims to strengthen community-disaster risk reduction system. It supports to implement community-level workshops for improving capacity of disaster risk reduction, making pamphlets and posters for making awareness of local residence, and implementing follow-up of the activities of the year before.
16	Tanzania	Adaptation	Project on the Revision of National Irrigation Master Plan	This project contributes to sustainable irrigation development through revising the National Irrigation Master Plan and formulating implementation plans.
17	Thailand	Multiple Areas	Project for Capacity Development to accelerate Low Carbon and Resilient Society realization in the Southeast Asia region	This project contributes to promoting climate change measures in Thailand and in the Southeast Asia region through capacity development for planning and implementing mitigation/adaptation training programmes in the Climate Change International Technical and Training Center (CITC).
18	Thailand	Adaptation	Supporting Adaptation planning on Climate Change in Thailand	This project aims to develop collaborating structure between related ministries and organizations to continuously gather, process and provide climate change risk and adaptation data which contribute to adaptation planning and implementation through capacity building.
19	Thailand, India, Vietnam, Indonesia, China, the Philippines, Hungary, Egypt, Mexico, Peru, etc.	Mitigation	Human resources development program for promoting export of low-carbon technologies	Support technical training using actual worksites in companies in Japan and send experts to overseas companies to promote the international application of Japanese infrastructures and businesses that are based on advanced low-carbon societies and reduce greenhouse gas emissions.
20	World	Multiple Areas	Capacity Building for National Forest Monitoring System to Promote REDD+ and Sustainable Forest Management	This project supports to implement seminars about national forest monitoring systems to realize REDD+ project.

Chapter 7

Research and Systematic Observation



7.1 Comprehensive Government Policies and Fundraising for Research and Systematic Observation

In the Kyoto Protocol Target Achievement Plan (formulated in April 2005 and altogether revised in August 2008) based on the Act on Promotion of Global Warming Countermeasures which set a framework on global warming countermeasures, there is a section on the "promotion of research on climate change and strengthening of observation and monitoring systems" which states that Japan will strengthen comprehensive observation and monitoring systems as a basic measure.

In addition, the basic principle in the National Plan for Adaptation to the Impacts of Climate Change (decided by Cabinet in November 2015) states that Japan will continuously enhance scientific knowledge through continuing implementation of observation and monitoring as well as projection and assessment, and promotion of studies and research. Furthermore, the Plan for Global Warming Countermeasures (decided by Cabinet in May 2016) states that Japan will enhance the promotion of research on climate change, and observation and monitoring system as basic measures of global warming countermeasures. The details of the measures are as follow.

Global environment conservation:

In April 2012, the Fourth Basic Environment Plan was decided by the Cabinet in accordance with the Basic Environment Law. This plan is aimed at realizing a low-carbon society, sound material-cycle society, and society in harmony with nature, while ensuring fundamental security and safety. One of the important and prioritized policies in this plan is the Climate Change Policy, with specific measures such as reducing CO_2 emissions from fuel combustion and other GHG emissions, and promoting carbon sink of forests and utilizing of biomass.

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 medium- and long-term perspectives.

Science technology

In January 2016, the Fifth Science and Technology Basic Plan (2016-2020) based on Basic Act on Science and Technology was decided by the Cabinet, and "Addressing economic and social challenges" was set as one of the four pillars of the plan. In this pillar, "Ensuring stable energy and improving energy efficiency", "Addressing global climate change" and "Responding to biodiversity loss" were set as important policy issues for which science technology innovation for problem solution should be promoted.

Based on the above, building of "Global environment information platform" has been implemented in collaboration with the relevant ministries, taking global environment information as big data to solve economic and social challenges caused by climate change.

To achieve "2 degrees Celsius target" mentioned in the Paris Agreement, it is essential to promote a radical innovation for GHG emission reduction globally. Therefore, in April 2016, "National Energy and Environment Strategy for Technological Innovation towards 2050" has been developed at Council for Science, Technology and Innovation (CSTI). In this strategy, looking ahead to 2050, promising and innovative technologies which have large potential and powerful impacts on reduction of CO_2 are identified and promotion system of long-term research and development are organized.

In addition, outcomes of global warming prediction in "Program for Risk Information on Climate Change" using the Earth Simulator as well as outcomes of natural science research related to global warming supported by "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) Assessment Report. Also a 5-year plan "Integrated Research Program for Advancing Climate Models" has been launched from FY2017 as a subsequent plan of "Program for Risk Information on Climate Change", 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 observation by satellites, aircrafts and ships. The following international and national observation activities are under way.

Internationally, "The Global Earth Observation System of Systems (GEOSS) 10-Year Implementation Plan" was formulated at the Third Earth Observation Summit held in February 2005 in Brussels, in accordance with an agreement reached at the Group of Eight (G8) Summit in Evian, France in June 2003. In addition, the establishment of "Group of Earth Observation" (GEO) which is an international framework to promote the GEOSS has been approved. Then, at the GEO ministerial-summit in Mexico City in November 2015, "GEO Strategic Plan 2016-2025" which includes 10-year plan after 2016 has been approved. Japan has been proactively contributing to the GEOSS development by serving as a member of the Executive Committee of the GEO, and participating in international GEOSS initiatives addressing global environmental issues such as water resource management, agricultural monitoring and forest monitoring. As Japan's another contribution, "Data Integration and Analysis System (DIAS)" developed 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 their impacts, was established in 1992 in response to outcomes of the Second World Climate Conference in 1990 sponsored by the World Meteorological Organization (WMO) and other international organizations. The new GCOS implementation plan (GCOS IP 2016) was made 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 members 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 toward the establishment of GEOSS, the 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 order to annually elaborate upon the Earth Observation Implementation Policy. Currently the relevant ministries and agencies as well as other concerned organizations are working together toward the realization of comprehensive, needs-driven Earth observation, based on the Implementation Policy, which is to be revised each fiscal year.

7.2 Research

7.2.1 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 on climate change are extremely significant measures that form the basis of these knowledge.

Measures (Priority Policies and strategies)

- ✓ Concerning important policy issues such as "Ensuring stable energy and improving energy efficiency", "Addressing global climate change" and "Responding to biodiversity loss" set as a part of "Addressing economic and social challenges" which is one of the four pillars of the Fifth Science and Technology Basic plan (adopted in January 2016), promote science technology innovation to solve the problems.
- ✓ As a part of "Addressing global climate change" mentioned above, promote the building of "Global environment information platform" by taking the global environment information as a big data to solve economic and social challenges caused by climate change.
- ✓ Regarding promising and innovative technologies which have large potential and powerful impact on the reduction of CO_2 identified in the "National Energy and Environment Strategy for Technological Innovation towards 2050" developed at Council for Science, Technology and Innovation (CSTI), identify the technology challenges and promote the development in mid-and-long-term.

Measures (Collaboration in researches)

- ✓ 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 five research areas targeted; (1) Climate Change and Climate Variability, (2) Biodiversity and Ecosystems, (3) Changes in the Atmospheric, Terrestrial and Marine Domains, (4) Resources Utilization and Pathways for Sustainable Development, and (5) Risk Reduction and Resilience. Within them, high demanded research themes are prioritized through discussion in sub-regional committee.
- ✓ 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 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.

7.2.2 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, 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 in accordance with a need of the Convention, Japan has addressed the reduction of these uncertainties mainly through the “Program for Risk Information on Climate Change” and by the “Environment Research and Technology Development Fund”. Also, in the “Program for Risk Information on Climate Change”, the fundamental information which is needed to manage climate change as a risk was created as well. The latest results from these projects will contribute to the report of the Working Group I of the IPCC Sixth Assessment Report which will be developed, and some of the projection results are being provided to developing countries for their regional adaptation studies. As a subsequent plan of “Program for Risk Information on Climate Change”, a 5-year plan of “Integrated Research Program for Advancing Climate Models” has been launched from FY2017 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, in order to exchange information and compare projection results.

7.2.3 Main Research Fields

7.2.3.1 Research on Climate Processes and the Climate System, Including Paleoclimate Research

Research and studies have been carried out on the following subjects: research on the spatio-temporal 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 Integrated Research Program for Advancing Climate Models, process studies focusing on the terrestrial ecosystem, mixed layers in the atmosphere or in the ocean, the precipitation process and so on are under way, with research results reflected in the development of climate models.

7.2.3.2 Climate Change Projection Modeling and Projection Studies

Climate change projection studies in the areas of projection model sophistication, quantification of uncertainties, and hazard 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”, utilizing super computer “Earth Simulator”, developments and projection studies of Japan’s many climate models are supported, and CMIP6 experiment which is necessary to prepare the IPCC Sixth Assessment Report is conducted in this project. Thus, climate change projection studies of Japan have contributed to the IPCC Sixth Assessment Report through creating scientific knowledge.

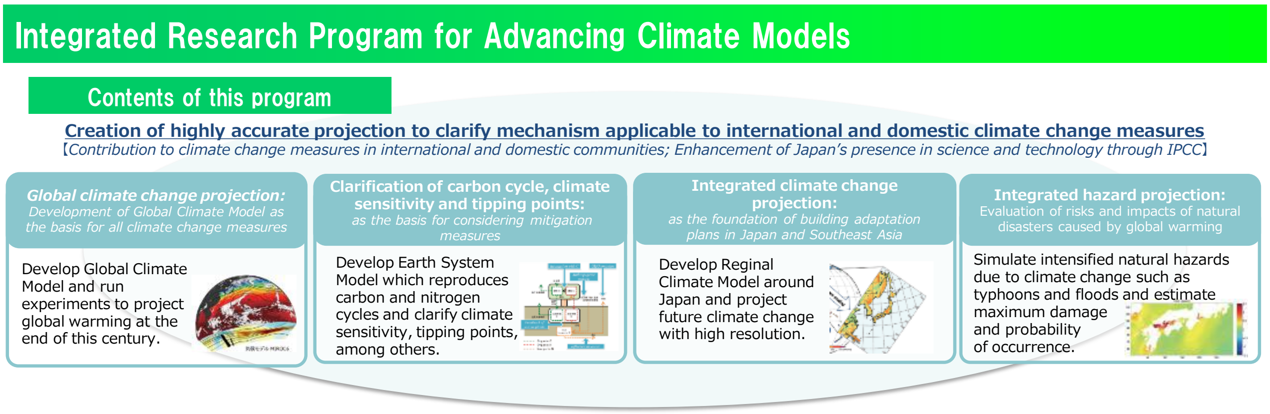


Figure 7-1 Overview of Integrated Research Program for Advancing Climate Models

7.2.3.3 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 examination of effects of impact projection and adaptation measures based on climate projection on the national and regional level, scientific support for 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.

7.2.3.4 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 relating to scientifically and socially reasonable risk management strategy and options on climate change considering constraints uncertainty, risk management option and social value decision etc. under climate change.

7.2.3.5 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") is conducting research to prepare the most effective and efficient basic data for implement 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.

7.3 Systematic Observation

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; and research, observation and monitoring on climate change are extremely significant measures that form the basis of these knowledge.

Measures

- ✓ Promote comprehensive measures on observation and monitoring of climate change under “Japan’s enforcement policy of earth observation in next decade” (decided by the Earth observation promotion task force in August 2015) based on the “Science and Technology Basic Plan (decided by the Cabinet in January 2016)” and the “Earth Observation Promotion Strategy (proposed by the CSTP, Council for Science, Technology and Innovation in December 2004)”. In the promotion, bearing in mind Japan’s contribution to the development of 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 “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 Joint World Meteorological Organization (WMO)/UNESCO Intergovernmental Oceanographic Commission (IOC) Technical Commission for Oceanography and Marine Meteorology (JCOMM), 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 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, decided by the Cabinet in April 2016. Japan actively participates in 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 satellite, aircrafts, ships, and ground-based observation in cooperation with international organizations and research projects.

7.3.2 Priority Fields

As for monitoring and observation on global warming, comprehensive monitoring and observation system to understand greenhouse gas, climate change and its influence have been strengthened based on "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 Council for Science.

In particular, Japan is conducting: observing GHGs at multiple points all over the world by Greenhouse Gases Observing Satellite "GOSAT" launched in January 2009; 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 ocean carbon dioxide observation network; monitoring of global warming impacts in areas vulnerable to climate change such as cryosphere and coastal, and integration of observational data and socioeconomic data etc.

7.3.3 Main Systematic Observations

7.3.3.1 Atmospheric Climate Observing Systems Including Atmospheric Constituent

Japan is continuously strengthening its observation and monitoring systems and other measures to scrutinize the temporal and spatial distribution of greenhouse gases such as CO_2, CH_4, N_2O, CFCs and tropospheric ozone based on Global Atmosphere Watch (GAW) as the atmospheric chemistry component of the GCOS. 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 rain-bearing cloud. In addition to highly accurate monitoring of atmospheric composition from the ground, ships and aircrafts, Japan launched the Greenhouse Gases Observing Satellite (GOSAT) in January 2009 and started providing observational data to monitor greenhouse gas absorption and emission state for each region. Furthermore, Japan has been developing the successor satellite GOSAT-2 since 2012, which features improved accuracy. In May 2012, Japan launched the Global Climate Observation Mission – Water (GCOM-W), which continuously observes water-related parameters such as water vapor and soil moisture, and has started providing its observation data. 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 Cloud-Aerosol Emission Mission (EarthCARE), development of the Global Climate Observation Mission – Climate (GCOM-C) which makes continuous global observations of climate changes using multi-band optical radiometers; development of a comprehensive system to trace, analyze and forecast changes in the Sun as well as in the Earth’s upper atmosphere; 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 Atmospheric 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 2018	14	7	7	6	
Number of stations providing data to the International Data Center	14	7	7	6	

*As of January 1, 2018, 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 Terrestrial Atmospheric Observing Systems for Climate (Land Surface Meteorological Observations)

System	Climate parameters	Total stations	Appropriate for characterizing national/ regional climates?			Time series stations [digitized]			Adequate quality control procedures?			Meta data available, total stations [digitized (%)]	Continuity Stations expected to be operational in 2018
			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	○			4 [4]	85 [85]	67 [67]	○			156 [100]	156
	Clouds	60	○			0 [2]	14 [58]	46 [0]	○			60 [100]	60
	Weather	154	○			1 [154]	86 [0]	67 [0]	○			154 [100]	154
	Humidity	156	○			3 [3]	85 [85]	68 [68]	○			156 [100]	156
	Precipitation	154	○			1 [1]	86 [86]	67 [67]	○			154 [100]	154
	Global solar radiation	49	○			10 [10]	39 [39]	0 [0]	○			49 [100]	49
	Sunshine duration	156	○			4 [4]	85 [85]	66 [66]	○			156 [100]	156
	Temperature	156	○			1 [1]	88 [88]	67 [67]	○			156 [100]	156
	Visibility	154	○			1 [154]	86 [0]	67 [0]	○			154 [100]	154
	Wind	155	○			4 [4]	85 [150]	66 [1]	○			155 [100]	155
Stations reporting internationally		53											
CLIMAT reporting Stations		53											

*As of January 1, 2018, including the Syowa Station in the Antarctic.

Table 7-3 Available Homogenous Data Sets for Land 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-2017	Japan Meteorological Agency
Surface meteorological observation daily mean/total data file	As above	As above	1880s-2017	Japan Meteorological Agency
Surface meteorological observation monthly mean/total data file	As above	As above	1880s-2017	Japan Meteorological Agency

*As of January 1, 2018.

Table 7-4 Atmospheric Observing Systems (Upper Air Meteorological Observations)

System	Total stations	Appropriate for characterizing national/regional climates?			Times Series Stations [digitized]				Adequate quality control procedures?			Meta data available, total stations [digitized (%)]	Continuity Stations expected to be operational in 2018
		Fully	Partly	No	5-10 years	10-30 years	30-50 years	More than 50 years	Fully	Partly	No		
Radiosonde stations	17	○			2 [2]	0 [1]	0 [13]	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, 2018, 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 area covered	Time series	Contact
Upper air meteorological observation daily mean/total data file	Humidity, temperature, wind, altitude	16 stations in Japan Data at standard atmospheric pressure levels	1988-2017	Japan Meteorological Agency
Upper air meteorological observation monthly mean/total data file	As above	As above	1951-2017	Japan Meteorological Agency

*As of January 1, 2018

Table 7-6 Atmospheric Constituent Observing Systems for Climate

System	Total stations	Appropriate for characterizing national climate?			Times series stations [digitized]				Adequate quality control procedures?			Meta data available, total stations [digitized (%)]	Continuity Stations expected to be operational in 2018
		Fully	Partly	No	10-20 years	20-30 years	30-50 years	More than 50 years	Fully	Partly	No		
CO_2	26	○			21 [21]	4 [4]	1 [1]	0	○			26 [100]	26
Vertical CO_2 distribution	41	○			40 [40]	0	0	0	○			41 [100]	41
Surface ozone	13	○			9 [9]	4 [4]	0	0	○			7 [100]	13
Total ozone	6	○			0	1 [1]	1 [1]	3 [3]	○			6 [100]	5
Vertical ozone distribution	4	○			0	1 [1]	2 [2]	1 [1]	○			4 [100]	2
Other greenhouse gases	25	○			22 [22]	3 [3]	0	0	○			25 [100]	25
Aerosols	7	○			3 [3]	4 [4]	0	0	○			7 [100]	7
Vertical aerosols distribution	21	○			13 [13]	0	0	0	○			21[100]	21

*As of January 1, 2018.

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 (BSRN)

System	Total stations	Appropriate for characterizing national climate?			Times series stations [digitized]				Adequate quality control procedures?			Meta data available, total stations [digitized (%)]	Continuity Stations expected to be operational in 2018
		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, 2018.

Total of the Meteorological Agency's observation stations (including the Syowa Station in the Antarctic).

7.3.3.2 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 changes. In addition, under international program 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; developing the successor satellite GOSAT-2 which features improved accuracy; providing observation data of Global Change Observation Mission - Water (GCOM-W) as well as data from the Dual-Frequency Precipitation Radar (DPR) to be on board the main satellite of Global Precipitation Mission (GPM) and hourly global precipitation distribution map named "GSMaP", which combines multiple data from earth observatory satellite and a weather-monitoring satellite HIMAWARI; developing Global Change Observation Mission - Climate (GCOM-C); implementing research into remote sensing technologies and other. In addition, data from geostationary meteorological satellites are utilized to monitor sea surface temperature.

7.3.3.3 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; development of the GOSAT-2, which features improved accuracy; analysis of crustal deformation and monitor of land use change (forest, crop land and others) by the Advanced Land Observing Satellite-2 (ALOS-2); stereoscopic observation of precipitation in rain-bearing cloud by Global Precipitation Mission (GPM); observation of amount of water vapor in the atmosphere and soil distribution by Global Change Observation Mission -Water (GCOM-W); development of the Global Change Observation Mission –Climate (GCOM-C), research into remote exploration technologies for carrying out terrestrial environmental observations of vegetation amounts (biomass), land use, changes in land coverage, ground moisture, and snow and ice. In addition, data from geostationary meteorological satellites are utilized 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.

7.3.3.4 Cryosphere Observing Systems for Climate

National Institute of Polar Research has been organized to promote general research based on observations in polar region. It has observation bases in Antarctic and Arctic to provide researchers in Japan with foundations of observations in Antarctic and Arctic as inter-university research institute. It addresses as well promotions of polar region science by public offering of joint research project as well as providing materials and information and so on.

7.3.3.5 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

7.3.3.6 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, projection information has been developed and it has promoted to use the data to solve the global-level problems such as climate change, disaster prevention, infectious disease in collaboration with private sector. Moreover, the DIAS is providing global monitoring information to all over the world through the framework "Group of Earth Observations" (GEO) which is promoting decision-making based on the global observation information.

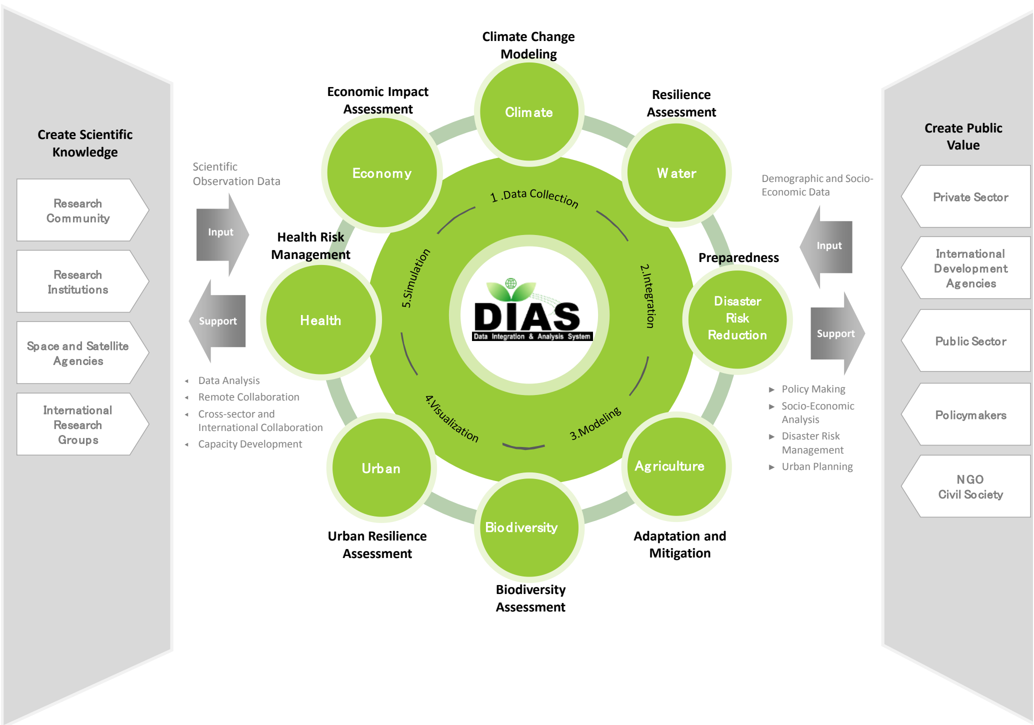
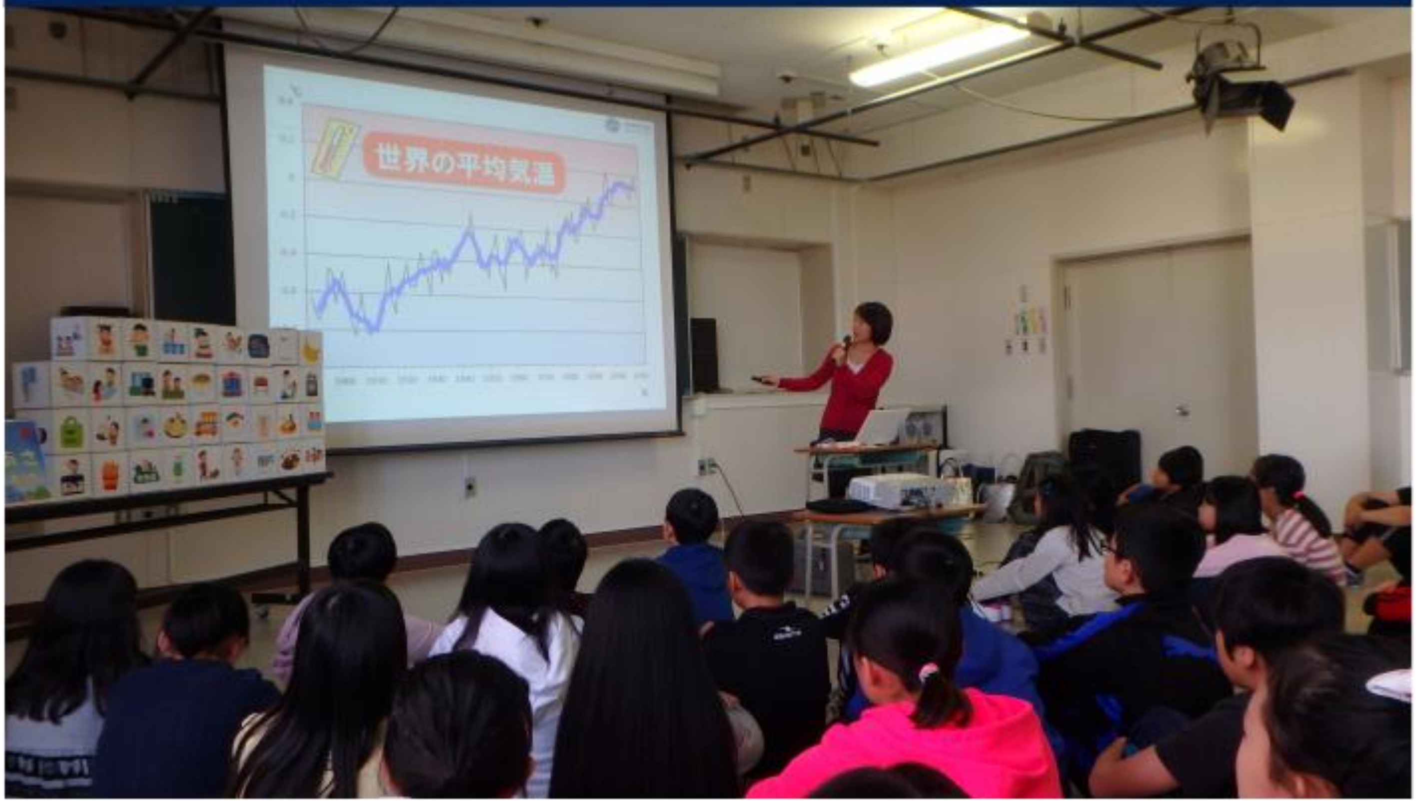


Figure 7-2 Overview of DIAS

Chapter 8

Education, Training, and Public Awareness



8.1 Approaches to Policies and Measures

CO_2 emissions have been consistently 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 that 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 the energy issues closely involved at home education, school education and social education. 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.

The Government of Japan will actively provide and share, 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. The Government of Japan will also carry 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.

8.2 Promotion of Environmental Education and Study

8.2.1 Outline

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 Low for promotion of Environmental Conservation Activities though Environmental Education established in June 2011 (herein after "the Low for Promotion of Environmental Conservation Activities"), from a global-level point of view and with the object of promotion of integrative development for environment conservation, economy and society. The government of Japan formulated basic policies for a promotion of environmental education based on the same low, in order to promote integrated measures related to the environmental education in which the public, private organizations and other could address the initiatives of environment conservation on their own initiative.

Also, given that "the United Nations Decade of Education for Sustainable Development (ESD)"(2005-2014) (hereinafter "UNDESD") was started based on Japan's proposal, the Interministerial Meeting on Education for Sustainable Development (ESD) was set up to promote activities of the measures related to ESD. Following the adoption of the Global Action Programme on ESD (hereinafter "GAP"), which is the follow-up program to UNDESD, the implementation plan of GAP in Japan was formulated in March 2016 and efforts are being made for its systematic implementation.

8.2.2 Specific Measures

8.2.2.1 Promotion of Environmental Education and Environmental leaning provided by Schools <Ministry of Education, Culture, Sports, Science and Technology>

- ✓ It is important to promote Environmental Education and Environmental Learning in order for students to be able to deepen understanding and interests on the environment and to conduct the measures in a proactive manner for environment conservation. In current courses of study, Japan upgraded the contents of environmental education, focusing on closely related subjects such as social studies, science, and technical and homemaking courses. Also in March 2017, the courses of study for elementary and junior high schools were revised to upgrade the contents of environmental education and the Government is continuously promoting Environmental Education and Environmental Learning at schools.

  The Government is also promoting following; school facilities and practice of energy conservation activities; conversion to renovated facilities from rebuilding, utilization of construction materials of lower environmental load for global warming countermeasures, the introduction of facilities as touchable educational materials which students could learn renewable energy such as solar power.

Furthermore, the Government is conducting environmental leadership training projects, designing GLOBE (Global Learning and Observations to Benefit the Environment) model schools and certificating eco-schools (environmentally friendly school).

8.2.2.2 Promotion of Environmental Education and Environmental Learning at any places

The Low for Promotion of Environmental Conservation Activities defines that the Government implements necessary measures to promote environmental educations in a manner that the public could deepen understanding and interests on the environment conservation through all opportunities from their infancy in accordance with their development stage. The relevant ministries and agencies are promoting environmental education and environmental leaning in not only schools but also various sites such as community learning centers, youth educational facilities, urban parks and forest.

- ✓ Operation of certification system “Experience Opportunity venues” <Ministry of the Environment>
  Based on the Low for Promotion of Environmental Conservation Activities, the Government has established system that the local governors certify by a 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 understandings and interests on the environment conservation. Presently 13 venues were certified all over Japan and number of people who experienced count approximately 27,000 in a year (FY2005). Concerning the certification, many business operators feel signification in the improvement of company value, coexistence with local communities, strengthening with schools. Also many schools have ideas that they can let the student participate with ease in the experience learning and it strengthen teachers’ scholastic ability.

- ✓ Environmental Education at community learning centers and other <Ministry of Education, Culture, Sports, Science and Technology>
  In order to help building 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, the Government disseminates information on good regional efforts nationwide to promote similar efforts.
  The government is also promoting environmental education at youth educational facilities by providing opportunities for hands-on environmental education and activities for experiences in nature utilizing rich natural environments.

- ✓ Environmental Education in Uran Parks <Ministry of Land, Infrastructure, Transport and Tourism>
  The Government is providing opportunities and venues for training of leaders and practitioners of environmental education and environmental learning which is working together with users, local communities and schools, and promoting development of urban parks to implement those activities. In order to improve awareness and encourage urban greening, the Government is establishing the Green Consultation Center.

- ✓ Promotion of initiatives for Forest Environmental Education Activities <Ministry of Agriculture, Forestry and Fisheries of Japan>
  The Government is promoting initiatives for forest environmental education activities providing opportunities to experience and learn about forest and forestry and activities to disseminate the excellence and significance of wood use.

  The government has also established “Forests for Students” as places in National Forests for experience-based activities led by schools. The Regional and District Forest Office of the Forestry Agency are implementing experience-based activities, provision of information and technical instruction.

8.2.2.3 Promotion of ESD Activities

- ✓ Holding the UNESCO World Conference on ESD < Ministry of Education, Culture, Sports, Science and Technology>

  In 2014, the final year of the UN Decade of ESD which was promoted by UNESCO as the leading agency, UNESCO and the Government of Japan, who advocated the UNDESD, jointly organized the UNESCO World Conference on ESD in Aichi - Nagoya, and in Okayama. In the Conference, the launch of GAP as the follow-up program to UNDESD was officially announced, and the establishment of UNESCO-Japan Prize on ESD funded by the Government of Japan was announced. This UNESCO-Japan Prize on ESD honors annually 3 outstanding projects related to ESD all over the world. In 2016, "Okayama ESD project" by the Okayama ESD Promotion Commission was selected one of the winners.

- ✓ Promotion of ESD centering on School Educations < Ministry of Education, Culture, Sports, Science and Technology>

  Ministry of Education, Culture, Sports, Science and Technology (MEXT) has been promoting ESD at various educational sites centering on school education. Especially UNESCO Associated Schools (Schools which practice international collaboration in order to realize UNESCO's ideals as set forth in the Constitution of UNESCO) have been positioned as the hubs to promote ESD. The number of UNESCO Associated Schools in Japan reached 1,034 as of November 2017 while it was only 19 as the beginning of UNDESD.

  Specific supports being implemented include: necessary support for UNESCO Associated Schools' activities (such as providing human resources and information, promoting exchanges); "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; ESD Consortium projects which the boards of education, universities, UNESCO Associated Schools and other stakeholders form a consortium and promote ESD practices in the regions and the exchange among UNESCO Associated Schools domestically and internationally; teacher trainings using "A Guide to Promoting ESD"; and ESD Youth Conference which provides opportunities to deepen the knowledge and exchanges in debate for the subject of ESD by youth generations who practice various activities.

- ✓ Building "ESD Promotion Network" <Ministry of the Environment>

  In order to realize a sustainable society, ESD Activity Support Center as National level hub function and Local ESD Project support centers as wide-area block hub function have been established to promote, in various level and cross-sectoral way, ESD in cooperation with Stakeholders who work initiatives related to ESD as core activities at local regions. The Government of Japan promotes the following initiatives in cooperation with Local ESD operation bases gaining cooperation from local stakeholders;

  1) Gathering and publishing ESD related information 2)Support ESD Activities 3) Promote ESD practice ESD learning exchange 4)Promotion of fostering of human resources.

8.3 Activities for Promoting the Prevention of Global Warming

8.3.1 Outline

In order to mitigate global warming, it is necessary for each member of the public to modify their own lifestyle, and this requires public awareness and action.

The Government of Japan will encourage voluntary actions by each individual citizen by strongly appealing to public awareness. This will be done through the appropriate provision of information using diverse methods. In doing so, the government will work 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 will contribute to the limitation of greenhouse gas emissions or the promotion of sink measures.

8.3.2 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 will disseminate 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 various global warming prevention actions including setting heaters and air conditioners to appropriate temperatures.

As one example of these efforts, the Government of 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 28C° in the summer and set the heating to 20C° in the winter, and to 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 Law Concerning the Promotion of the Measures to Cope with Global Warming, 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 2017, 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 Law Concerning the Promotion of the Measures to Cope with Global Warming, activities which are aiming 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 and so on.

- ✓ 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 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 various 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 in various media.

- ✓ Measures Focusing on Ozone Layer Conservation Promotion Month

September has been designated Japan’s Ozone Layer Conservation Promotion Month, which is associated with the International Day for the Preservation of the Ozone Layer on September 16. Various ozone layer conservation and global warming prevention related activities have been promoted, including those focused on reducing emissions of ozone layer depleting substances and the fluorinated gases such as HFCs. Some types of activities include the distribution of brochures and posters, the holding of briefing meetings on Act on Rational Use and Proper Management of Fluorocarbons to raise public awareness about the recovery of fluorinated gases, and the commendation of companies and organizations that have contributed to ozone layer conservation and the mitigation of global warming.

- ✓ 3R Awareness Campaign

In order to disseminate and promote 3R awareness, the Government of Japan operates the website “Re-Style” to help improving 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-giving 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 at the National Convention.

- ✓ 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 as well as to induce consumer behavior promoting emission reductions through choices of lower-emission products and services, the Government of 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 amount of CO_2 emitted, 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 measures” 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.

- ✓ Measures for Renewable Energy

For public relations regarding the Feed-in Tariff introduced in July 2012, the Government of Japan hosts briefing sessions and symposiums, utilizes media such as the Internet and radio, runs advertisements, uploads information on Facebook and Twitter, as well as creates content and holds events regarding Japan’s general renewable energy policy.

- ✓ Provision of Information Related to Nuclear Power

  Since the incident occurred at Fukushima Daiichi Nuclear Power Plant, the Government of Japan has been steadily carrying out public relations activities, for promoting public understanding as well as 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)” an initiative to disseminate the importance of wood use to consumers and 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 re-discovery of the excellence and value of wood from consumers’ viewpoints, 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 greening campaigns such as national greening campaigns during Greenery Month, Urban Greening Month, etc., as well as promoting the establishment of private sector forests, greening activities funded through charity collections, and urban greening funds.

- ✓ Development of the National Movement for Fostering Beautiful Forests in Japan

  With broad public understanding and cooperation, the government is promoting to build a rich, green, recycling-oriented society that promotes appropriate forest development through use of timber, fostering lively activities of people and robust communities to support forests, and a wide range of participation by urban citizens and businesses in afforestation activities.

- ✓ 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 including the creation of pamphlets, etc., concerning global warming issues, energy conservation measures such as 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 distributing the Automobile Fuel Efficiency List, showing fuel efficiency and carbon dioxide emissions from vehicles, and by providing the latest information through the Internet.

- ✓ Provision of Information on the Current Status and Future Projections 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 projections, such as “Climate Change Monitoring Report”, “Global Warming Projections”, “Report on, Extreme Weather” and “Stop Global Warming”.

  In March 2017, the government published “Global Warming Projections Vol. 9,” which shows more detailed global warming projections over Japan compared to previous volumes by using advanced global and regional climate models (horizontal resolution 5km

  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 “Greenhouse Gas Bulletin” by the WMO (The Japanese translation is also published by the Japan Meteorological Agency). Greenhouse Gas Bulletin is distributed at the Conference of the Parties to the UNFCCC and being used as fundamental information on global climate change countermeasure.

Furthermore, the Japanese translation of the Summary for Policymakers (SPM) of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) has also been prepared and published.

- ✓ Awareness Campaign for Ethical Consumption

In order to raise awareness nationwide on the importance of "ethical consumption," which refers to the sustainable consumer behavior in buying or using products, the Consumer Affairs Agency holds the symposium "Ethical Lab" annually throughout Japan.

8.4 Support for Environmental NGOs

8.4.1 Outline

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 while preserving the original intent of their activities.

8.4.2 Specific Measures

- ✓ Model Projects for Creating Local Recycling Zones

The Ministry of the Environment is soliciting applications for advanced projects that private sector entities and businesses undertake through collaboration with local governments toward establishing a sound material-cycle society and that can serve as models of "projects for creating local recycling zones" for other areas. By implementing these as demonstration projects, the Ministry is striving to discover and support local efforts toward forming a recycling-oriented society.

- ✓ Japan Fund for the Global Environment

The Japan Fund for the Global Environment was transferred from the jurisdiction of Japan Environment Corporation to that of the Environmental Restoration and Conservation Agency of Japan in April 2004. Every year the Fund provides about 200 subsidies and other support for global warming prevention, recycling, and nature conservation-related activities undertaken by environmental NGOs both within Japan and abroad.

- ✓ 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, etc.

Based on the Law for Promotion of Environmental Conservation Activities through Environmental Education, etc., business operators, NPOs, and others are given information including seminars and exhibitions and provided places to communicate in order to promote environmental preservation activities, etc., so that nations, private organizations, and the national and local governments will be able to cooperate with each other on an equal footing.

- ✓ Support for sustainable forest management in developing countries

The Forestry Agency has been promoting support for forest conservation and reforestation projects implemented by NGOs and the strengthening of cooperation with NGOs.

- ✓ Provision of Opportunities for Forest Growing Activities

The Forestry Agency has been providing opportunities for leader training as well as safety and technical training to groups involved in forest growing activities and also setting venues for such activities within national forests.

Acronyms and Abbreviations

	Terms	Definition
A	AAU	Assigned Amount Units
	ACE	Actions for Cool Earth
	AD	Activity Data
	ADB	Asian Development Bank
	AGCM	Atmospheric Global Climate Model
	ALOS	Advanced Land Observing Satellite
	AMICAF	Analysis & Mapping of Impacts under Climate Change for Adaptation & Food Security
	APAN	Asia Pacific Adaptation Network
	AR4	IPCC Fourth Assessment Report
	ARD	Afforestation, Reforestation and Deforestation
	A-USC	Advanced Ultra-supercritical
B	BAT	Best Available Technology
	BAU	Business As Usual
	BCP	Business Continuity Planning
	BEMS	Building Energy Management System
	BPT	Best Practice Technologies
	BR	Biennial Report
	BRT	Bus Rapid Transit
C	CASBEE	Comprehensive Assessment System for Built Environment Efficiency
	CBIT	Capacity Building Initiative for Transparency
	CCPL	Climate Change Program Loan
	CCRA	Climate Change Risk Assessment
	CCS	Carbon Capture and Storage
	CCU	Carbon Capture and Utilization
	CDV	Clean Diesel Vehicle
	CERs	Certified Emission Reductions
	CFC	Chlorofluorocarbons
	CH_4	Methane
	CM	Cropland Management
	CNG	Compressed Natural Gas
	CNGV	Compressed Natural Gas Vehicle
	CO	Carbon monoxide
	CO_2	Carbon dioxide
	CO_2 eq.	Gas Emission in CO_2 equivalent
	COP	Conference of Parties
	CPR	Cloud Profiling Radar
	CRF	Common Reporting Format
	CSPF	Cooling Seasonal Performance Factor
	CTF	Common Tabular Format
	CY	Calendar Year
D	DAC	Development Assistance Committee
	DESD	Decade of Education for Sustainable Development
	DO	Dissolved Oxygen
	DPR	Dual-frequency Precipitation Radar
E	EF	Emission Factor
	EMS	Eco-drive Management Systems
	EMS	Energy Management System
	EOR	Enhanced Oil Recovery
	ERUs	Emission Reduction Units
	ESCO	Energy Service Company
	ESD	Education for Sustainable Development
	ESG	Environmental, Social, Governance
	EST	Environmentally Sustainable Transport

	Terms	Definition
	EV	Electric Vehicle
F	FCV	Fuel Cell Vehicle
	FM	Forest Management
	FEMS	Factory Energy Management System
	FY	Fiscal Year
G	GAN	Global Adaptation Network
	GAW	Global Atmosphere Watch
	GCECA	Global Centre of Excellence on Climate Adaptation
	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
	GEO	Group of Earth Observation
	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
	GOOS	Global Ocean Observing System
	GOSAT	Greenhouse gases Observing Satellite
	GPM	Global Precipitation Measurement
	GRA	Global Research Alliance
	GREEN	Global action for Reconciling Economic growth and Environmental preservation
	GWP	Global Warming Potential
H	HCFC	Hydrochlorofluorocarbon
	HFCs	Hydrofluorocarbons
	HEMS	Home Energy Management System
	HHV	Higher Heating Value
	HOB	Heat Only Boiler
	HV	Hybrid Vehicle
	HWP	Harvested Wood Products
I	ICAO	International Civil Aviation Organization
	ICEF	Innovation for cool earth Forum
	ICT	Information and Communication Technology
	IGFC	Integrated coal gasification fuel cell combined cycle
	IMO	International Maritime Organization
	IoT	Internet of Things
	IPCC	Intergovernmental Panel on Climate Change
	IPPU	Industrial Processes and Product Use
	IRENA	International Renewable Energy Agency
	ISO	International Organization for Standardization
	ITS	Intelligent Transport System
	ITTO	The International Tropical Timber Organization
J	JBIC	Japan Bank of International Cooperation
	JCM	Joint Crediting Mechanism
	JICA	Japan International Cooperation Agency
	JNGI	Japanese National GHG Inventory
K	KP	Kyoto Protocol
L	LCCM	Life Cycle Carbon Minus
	LED	Light Emitting Diode
	LNG	Liquefied Natural Gas
	LPG	Liquid Petroleum Gas
	LRT	Light Rail Transit
	LULUCF	Land-Use, Land-Use Change and Forestry

	Terms	Definition
M	MAFF	Ministry of Agriculture, Forestry and Fisheries
	MEPS	Minimum Energy Performance Standards
	METI	Ministry of Economy, Trade and Industry
	MIC	Ministry of Internal Affairs and Communications
	MLIT	Ministry of Land, Infrastructure and Transport and Tourism
	MOE	Ministry of the Environment
	MOFA	Ministry of Foreign Affairs of Japan
	MRV	Measurement, Reporting and Verification
N	N_2O	Nitrous oxide
	NAMA	Nationally Appropriate Mitigation Action
	NC	National Communication
	NDC	Nationally Determined Contribution
	NEAR-GOOS	North East Asian Regional Global Ocean Observing System
	NEB	Non-Energy Benefit
	NF_3	Nitrogen trifluoride
	NHRCM	Nonhydrostatic Regional Climate Model
	NIES	National Institute for Environmental Studies
	NIR	National Inventory Report
	NMVOC	Non-methane volatile organic compounds
	NOx	Nitrogen oxides
O	O&M	Operation and Maintenance
	ODA	Official Development Assistance
	ODS	Ozone Depleting Substance
	OOF	Other Official Flow
P	PDCA	Plan–Do–Check–Act
	PF	Private Flows
	PFCs	Perfluorocarbons
	PHV	Plug-in Hybrid Vehicle
Q	QA/QC	Quality Assurance / Quality Control
	QAWG	Quality Assurance Working Group
	QC	Quality Control
R	R&D	Research and Development
	RCP	Representative Concentration Pathways
	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
	RV	Revegetation
S	SBI	Subsidiary Body for Implementation
	SDGs	Sustainable Development Goals
	SECURE	Stand-by Emergency Credit for Urgent Recovery
	SF_6	Sulfur hexafluoride
	SIDS	Small Island Developing States
	SO_2	Sulfur Dioxide
	SOx	Sulfur Oxides
	SPREP	Secretariat of the Pacific Regional Environment Programme
U	UAV	Unmanned Aerial Vehicle
	UN	United Nations
	UNDP	United Nations Development Programme
	UNEP	United Nations Environment Programme
	UNFCCC	United Nations Framework Convention on Climate Change
	USD	United States Dollar
V	VOC	Volatile Organic Compounds
	VVVF	Variable Voltage Variable Frequency
W	WAG	Water-Alternating-Gas
	WBGT	Wet Bulb Globe Temperature
	WCRP	World Climate Research Programme

	Terms	Definition
	WG	Working Group
	WGIA	Workshop on Greenhouse Gas Inventories in Asia
	WMO	World Meteorological 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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