Fundamental Plan for Establishing a Sound Material-Cycle Society

June 2018

This fundamental plan is reported to the Diet in accordance with Article 15, paragraph (6) of the Basic Act on Establishing a Sound Material-Cycle Society (Act No. 110 of 2000), which applies mutatis mutandis to the provisions of Article 15, paragraph (7) of the said act.

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Foreword

Conservation of the environment has become a highly important issue that relates to the very foundation of the survival of the human race. Economic and social activities based on mass-production and mass-consumption are generating mass-disposal and hence constituting a factor that inhibits environmental conservation and a sound material cycle. Today's society of mass-production, mass-consumption and mass-disposal is also deeply connected to global warming as a result of greenhouse gas emissions, threatening depletion of natural resources, destruction of nature caused by large-scale extraction of natural resources, and various other environmental issues.

In Japan, measures aimed at creating a "sound material-cycle society" where the consumption of natural resources is reduced and the environmental load is minimized to the fullest extent possible have been implemented in a comprehensive and structured manner under the Fundamental Plan for Establishing a Sound Material-Cycle Society (hereinafter referred to as the "Fundamental Plan"), formulated based on the Basic Act for Establishing a Sound Material-Cycle Society (Act No. 110 of 2000, hereinafter referred to as the "Basic Act").

However, although various efforts made by different actors to create a sound material-cycle society once resulted in increasing resource productivity[1] and cyclic use rate[2] at the inlet, and reducing final disposal amount[3], significantly, these indicators have been leveling off in recent years. There is a need to strengthen efforts to raise resource productivity, such as the 3Rs. It is also necessary to continue working on recovery and reconstruction from environmental pollution by radioactive materials discharged by the nuclear power plant accident associated with the Great East Japan Earthquake. Large-scale disasters that occurred almost every year following the Great East Japan Earthquake have also raised concerns over the possibility of even greater disasters than the catastrophe in the eastern Japan, such as a near-field earthquake in the Tokyo Metropolitan Area or a major earthquake along the Nankai Trough, making it important to develop a well-planned framework for disaster waste management.

In light of this current status of the development of a sound material-cycle society, in this Fourth Fundamental Plan, while the focus remains on activities proposed in the Third Fundamental Plan—such as ones aimed at establishing a sound material-cycle society with an eye on "quality" and integrating efforts to create a sound material-cycle society, low-carbon society, and a harmonious co-existence society—as core issues, the scope has been expanded further to incorporate economic and social considerations. In the world, which is facing various issues and becoming unstable due mainly to the rapid increase of population and economic growth particularly in emerging nations, international cooperation aimed at creating a sustainable society is being promoted, such as the adoption of the 2030 Agenda for Sustainable Development at the United Nations Sustainable Development Summit in September 2015. In Japan, the issues of declining population, low birthrate, and aging population are becoming serious, causing concerns over the decline of regional vitality. In economic terms, innovations of the fourth industrial revolution[5] are required to be incorporated into all industries and people's lives

in order to realize the government's Society 5.0[4] program, an attempt to solve various social issues through putting an end to Japan's prolonged stagnation since the collapse of the bubble economy in 1991 and realizing a society that is capable of providing the necessary goods and services to the people who need them at the required time and in just the right amount. These international and domestic economic and social situations are closely related to the creation of a sound material-cycle society, requiring the nation to address environmental, economic, and social considerations in an integrated manner.

For this reason, the Fourth Fundamental Plan first envisions the nation's future that is expected to be achieved through the integrated efforts to create a sound material-cycle society and a sustainable society, as well as through the incorporation of economic and social considerations, in Section 2.1. Based on this vision, the plan further describes what actions Japan should take with a view to: revitalizing regions through regional circulating and ecological sphere as a way to help address the decline of regional vitality and other issues (Section 2.2); ensuring thorough circulation of resources throughout the lifecycle[6] of goods and services in a manner that will not hinder environmental conservation and that will help accomplish the Society 5.0 program (Section 2.3); promoting proper waste treatment and restoring environments as essential actions for the creation of a sound material-cycle society (Section 2.4); and developing a well-planned framework for disaster waste management for possible future disasters (Section 2.5). The plan also provides a future vision on how Japan can implement these visions internationally to take the initiative in constructing an international framework for the circulation of resources and expand its waste management and recycling industries[7] overseas (Section 2.6). Finally, the plan also envisages the infrastructure required in the area of recycling to achieve these visions, including information, technology, and human resources (Section 2.7).

Furthermore, in the Fourth Fundamental Plan, targets—which are numerically specific where possible—are set for each of the above-mentioned seven directions in a backcasting-like manner from their future visions (Section 3); expected cooperation amongst and the roles of actors are described (Section 4); and specific details of state initiatives that should be pursued are provided (Section 5).

Based on this Fourth Fundamental Plan, the government will—through collaboration with other actors—implement a comprehensive range of measures aimed at creating a sound material-cycle society which guarantees conservation of the environment, including the promotion of the 3Rs, both domestically and internationally as a government-wide effort.

A sound material-cycle society cannot be created by the government alone. The Fourth Fundamental Plan gives details of what roles other actors are expected to play for each of the above-mentioned seven directions (Sections 4.2.2. to 4.2.6). It is expected that local governments, citizens, NPOs, NGOs, universities and other academic and research institutions, business operators, and other actors will also work in various ways toward creating a sound material-cycle society by adding their unique ideas and creativity while referring to their expected cooperation and roles described in Section 4, in order to turn the future visions provided in Section 2 into a reality.

1. Increasingly Complex Issues and Recent Response

1.1. The World Facing Increasing Uncertainty and Progressing International Cooperation

While mass production and mass consumption are prevailing the world over and rapid increase in population, economic development, and urbanization are progressing mainly in emerging nations, economic polarization is deepening with many people being left behind by economic growth and still suffering from poverty. War, terrorism, human-rights abuses, and other serious problems threatening regional peace and stability remain unsolved in some areas, and refugees and immigrants from such areas are causing friction in other areas over whether to accept them or not. There is also a tendency—while the world economy is becoming increasingly globalized and international interdependence is deepening—toward protectionism and introversion, which go against globalization.

From the viewpoint of the creation of a sound material-cycle society, there is a concern that—in addition to resource constraints that are expected to tighten in the medium- to long-term due to increasing population and growing economy worldwide—various issues will arise because of the economic growth and natural resource policies of China and other emerging nations, which include the rise of natural resource prices, deterioration in the grade of mineral resources[8], expansion of environmental destruction and health hazards caused by improper exploitation of natural resources and extraction of useful metals from waste in developing nations, and occurrence of disputes over natural resources. The supply-demand balance of food resources, which are indispensable for the survival of humankind, may also be strained in the medium- to long-term. Furthermore, while the world's undernourished population remains high, although decreasing, a large amount of food loss[9] is generated. Fossil fuel resources are consumed in large volume to secure the energy that underpins economic growth, and the resultant CO_2 emissions and other environmental impacts are leading to climate change, such as more frequent occurrence of drought, windstorms, and floods.

The consumption of resources and the generation of waste and harmful substances are increasing at a faster pace than the development of a framework, system, and technology for the creation of a sound material-cycle society mainly in developing nations, which may lead to the expansion of areas with deteriorating living conditions as well as to the improper import and export of waste and harmful substances without an international resource circulation framework. In particular, the rise in the volume of waste generated along with the increasing population and growing economy worldwide now has an impact on the oceans as well, and marine litter is adversely affecting marine organisms and fisheries, tourism and other sectors. In recent years, microplastics[10] in the ocean environment have begun posing a threat to the marine ecosystem and becoming a matter of international concern.

With these situations as a background, the United Nations Summit in September 2015 adopted the 2030 Agenda for Sustainable Development and set 17 Sustainable Development Goals (SDGs) to be attained by 2030 and 169 targets[11], while the member states committed to leave no one behind in their

implementation of the SDGs. The SDGs and targets are integrated and indivisible. For example, the target of reducing food losses is related to other different goals and targets such as ending hunger, improving resource efficiency, integrating climate change measures into national policies and planning, and partnership, and it is possible that they can be accomplished concurrently[12]. In December 2015, the Paris Agreement was adopted at the 21st Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, bringing all of the world's nations, industrialized and developing alike, together for the first time in history to submit their nationally determined targets for curbing greenhouse gas emissions. The parties also agreed on a fair and effective framework that commits them to exert their efforts to achieve their respective targets.

In the area of resource circulation, the Toyama Framework on Material Cycles was adopted at the G7 Toyama Environment Ministers' Meeting in May 2016. Under the G7 common vision to enhance resource efficiency and promote the 3Rs, it was agreed to integrate and promote measures on resource efficiency, the 3Rs, and other issues in a holistic manner, taking into account the lifecycle[6] approach and the environmental, economic and social aspects of sustainable development; promote Reduce and Reuse, in addition to Recycle; facilitate local revitalization by accommodating and utilizing local resources, goods, and energy based on collaboration among diverse local actors in each region; promote increased consumer awareness of the environmental and economic advantages of sustainable consumption; and advance cooperation with other countries and across the global supply chain. The parties also reaffirmed the importance of the G7 Action Plan to Combat Marine Litter adopted at the Elmau Summit in 2015. In May 2017, the 5-year Bologna Roadmap was adopted at the G7 Bologna Environment Ministers' Meeting, which contains the parties' agreement to improve resource efficiency indicators; further assess the potential greenhouse gas reductions of resource efficiency policies; develop policies or plans for reducing food loss and waste; and avoid the leakage of plastic into the seas and oceans. Furthermore, the G20 Hamburg summit in July 2017 discussed resource efficiency and marine debris for the first time at a G20 summit, where the leaders agreed—while basing their efforts on top of the efforts already made by G7 nations—to launch the G20 Resource Efficiency Dialogue to share good practice examples and policy options as well as the G20 Action Plan on Marine Litter, an initiative that contains the promotion of waste prevention, sustainable waste management, education and research, and other actions. In Asia and Pacific regions, a collaborative efforts by Asia-Pacific nations to promote the 3Rs are being advanced through Regional 3R Forums in Asia and the Pacific and other activities. Attempts at reducing marine debris are also being made through the Tripartite Environment Ministers Meeting (TEMM) among Japan, China, and South Korea, the North-West Pacific Action Plan (NOWPAP), and other initiatives.

The Strategic Approach to International Chemicals Management (SAICM)[13] is an initiative in which the management of hazardous substances within the lifecycle of electrical and electronic products is identified as an emerging policy issue. A new framework is planned to be adopted to replace the current SAICM in 2020.

These international cooperation initiatives aimed at developing a sustainable society are currently

underway in an increasingly unstable world where the rapidly expanding population and growing economy mainly in emerging nations, among other causes, are giving rise to various issues.

1.2. Dwindling Population, Low Birthrate, Aging Population, and Declining Regional Vitality in Japan

Japan is already facing unprecedented population decline, a falling birthrate, and population aging. The population is flowing into Tokyo and other major cities, but even in such large cities, it is expected that the population will decrease except for some areas. The population in regional areas is projected to decrease significantly—particularly in municipalities with a population of less than 10,000 where the population is expected to decrease by about 50% in 2050 over 2010 levels. The birthrate will also continue to fall with the working-age population expected to roughly halve in 2060 compared with the peak year of 1995. While the population will decrease, the ratio of those aged 65 and over to the total population is expected to increase to 1 in 3 in 2035 and 1 in 2.5 in 2060. Amid this situation, there is a concern that, while a shortage of working-age people, dwindling consumption in regions, and other factors will weaken regional economies, costs for social security as well as for the maintenance, management and renewal of infrastructure will expand, resulting in the increase in the number of declining regions. The aging of residents, depopulation, growing population flow into cities, and declining regions, among other factors, are also causing the regional function as a community of local residents to diminish and may lead to the rise in the number of people isolated from a circle of mutual assistance and confronted with poverty or other problems.

From the viewpoint of the creation of a sound material-cycle society, while the amount of municipal waste per capita generated and the final disposal amount[3] of industrial waste are steadily decreasing due to the promotion of the 3Rs and other efforts and the generation of waste is expected to fall along with the decline of the population, there is a concern that the labor shortage in waste disposal and resource circulation, insufficient recycling capacity of circulative resources[14], and other issues may emerge. In rural villages, the population is aging and declining at a faster rate than in urban areas and a labor shortage in the agriculture and forestry industries is causing increasing amounts of farmland and mountains to be abandoned, resulting in devastating *satochi* and *satoyama* areas, which have been formed along with the development of agriculture and forestry. Furthermore, waste from renewal construction of obsolete infrastructure is increasing, and depopulation and declining local economies are leading to a rising number of abandoned houses and stores which have to be demolished and disposed of as waste, causing concerns that waste for which it is not clear who should be responsible for its disposal may increase. While deteriorated houses and stores are abandoned without being properly repaired or utilized, new houses and large stores are constructed by consuming huge amounts of resources. The declining regional function as a community of local residents and the aging of the population may also cause various problems related to residential waste, particularly the rise in the number of communities in which the maintenance of garbage collection stations as well as garbage group collection and other collection practices are becoming increasingly difficult; the number of elderly

people physically unable to take their waste to collection points; and the number of people who are isolated from their community and hoard things, including garbage, in their houses.

To address these situations, various efforts are being made, including the improvement of waste disposal facilities to make them serve a wider area and for a longer lifetime; integration of waste disposal facilities; cooperation with the private sector; formation of local recycling zones; and implementation of eco-town projects. The Act on Special Measures concerning Promotion of Empty Dwellings Countermeasures (Act No. 127 of 2014; hereinafter referred to as the "Empty Dwellings Act") was established in 2015 to address the abandoned dwelling issue that can have a serious, adverse impact on the lives of local residents. In addition, an increasing number of municipalities (including the Special Cities in Tokyo; the same shall apply hereinafter) are initiating measures such as support for elderly people who have difficulty in taking waste to collection points, combined with checks on their well-being; and the enforcement of ordinances to deal with garbage hoarding cases.

In recent years, efforts to create high added value based on the unique characteristics of each region, such as circulative use of biomass[15] to produce energy, fertilizer, and animal feed and the branding of agricultural, forestry and fishery products, are also being made in order to promote the revitalization of regional economies.

1.3. Prolonged Stagnation of Japanese Economy and Society 5.0

Following the collapse of the bubble economy in 1991, Japan experienced two decades of prolonged economic stagnation, also known as the Lost 20 Years. During this period, Japan was overtaken by China in terms of gross domestic product (GDP) and fell to third place in the world, lagging far behind the United States and China, both of which kept growing throughout. In terms of GDP per capita, Japan was ranked second in the world in 2000 but fell to 27th in 2014. In recent years, the Japanese economy, which bottomed out in November 2012, has been on a moderate recovery trend with corporate earnings reaching a record high level, the employment and income environment improved, and labor shortage being at the same level as during the bubble economy. On the other hand, however, wages are rising only moderately and personal consumption is not as strong as expected from the level of improvement achieved in the employment and income environment. As for prices, although the Japanese economy is no longer on a deflationary trend, it has yet to fully break away from deflation and reach a stage at which steady and consistent inflation can be expected. The prolonged stagnation of the Japanese economy derived from sluggish growth of productivity that lasted for a long time and the lack of efforts for creating new demand. It is pointed out that, while Japanese companies were focusing mainly on enhancing the efficiency of their manufacturing processes and lowering prices through overseas production to retain their competitiveness in the increasingly intensifying competition against products from emerging nations, Western counterparts were addressing themselves to maintaining their high prices, with the United States committed to increasing profitability through launching new businesses and Europe striving to develop and establish product brands.

From the viewpoint of the creation of a sound material-cycle society, Japan's resource productivity[1]

increased significantly during the 10-year period from 2000 in which the Basic Act was enacted to 2009 because natural resource inputs decreased due to fewer large-scale public works projects amid the prolonged stagnation of the Japanese economy. However, natural resource inputs have plateaued and GDP has recovered only moderately ever since, resulting in resource productivity remaining flat.

A key to extricating the Japanese economy from its prolonged stagnation and achieving medium- to long-term growth with fewer amounts of resources is the fourth industrial revolution[5], which generates economic and social innovations by utilizing the Internet of Things (IoT)[16], big data[17], artificial intelligence (AI)[18], robots, and other technologies. Many countries have worked out their national-level strategies and plans for the fourth industrial revolution, such as Germany's Industrie 4.0, and Japan has also advocated the concept of Society 5.0[4], the nation's future vision of society presented in its Fifth Science and Technology Basic Plan, and has laid out its plan to realize Society 5.0 in its Japan Revitalization Strategy 2016, Growth Strategy 2017, and other plans in order to solve various social challenges by introducing the innovations of the fourth industrial revolution to every industry and aspect of social life. As the Growth Strategy 2017 states, under the traditional economic system, where the sources of competitiveness that generate added value were "things" and "money," most organizations and social systems were designed on the basis of "intensification" and "homogenization" which were considered to generate successful models. However, according to the strategy, with the progress of the fourth industrial revolution, the sources of value have shifted to "human resources" and "data" under the economic system of Society 5.0. In this system, high value is created where various things that exist "independently and dispersedly" are "integrated" through new technical innovation. The strategy describes Society 5.0 as an effort to resolve various social challenges by incorporating advanced technologies into all industries and aspects of social life and "only providing the necessary amount of required things and services at the required timing to the people who need them."

If the shift of sources of value from "things" and "money" to "human resources" and "data" and the integration of diverse things under Society 5.0 lead to creating high added value, great affluence can be created with fewer amounts of resources—in other words, high resource productivity can be realized. If the required things and services can be provided to people who need them at the required time and in just the right amount, unnecessary natural resource inputs and the generation of waste will be reduced. All these mean that the realization of Society 5.0 under the fourth industrial revolution will also lead to the creation of a sound material-cycle society.

There are already some movements that spearhead this trend in Japan and abroad. For example, in the areas of music and video, "goods" (CDs and DVDs) have been produced and consumed heretofore, but they are being replaced by direct online delivery from creators to their fans. Sharing services[19] for cars, offices, tools, camping equipment, and other "goods," where a number of people share existing products, rather than taking possession of newly produced products, are becoming popular. New business models are also emerging which utilize IoT and AI to provide maintenance management, preventive maintenance, repair service, replacement/reuse parts, and other services for jet engines, construction machinery, and other "goods" to enable their functions to keep working for as long time as possible,

rather than just selling such "goods."

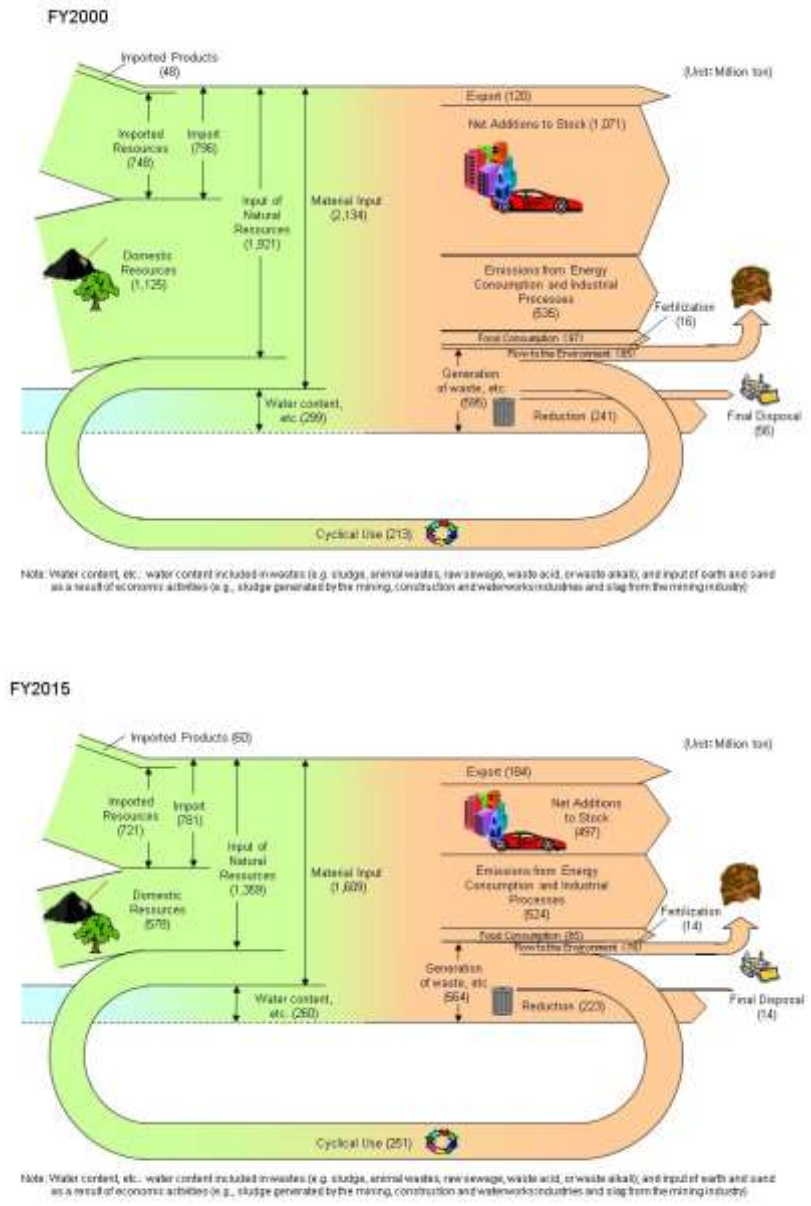
1.4. Progress in the Creation of a Sound Material-cycle Society and Recent Situation in Japan

In Japan, various actors, such as citizens, local governments, business operators, and the state, have been making their respective efforts toward creating a sound material-cycle society. Citizens' efforts include thorough sorting of garbage and resource recovery; local governments' efforts include the development of local recycling zones and monitoring and guidance on illegal dumping and improper waste treatment; business operators' efforts include proper waste treatment and promotion of the 3Rs, which constitute a part of their responsibility as waste-generating business operators[20], and design for environment (DfE)[22] under extended producer responsibility[21]; and the state's efforts include the development and operation of the relevant legal system and financial support. Thanks to these efforts, as well as due to the decrease in the number of large-scale public works projects and other factors, the creation of a sound material-cycle society was accelerated significantly for about 10 years after 2000 in which the Basic Act was enacted. The three material flow indicators which represent the status of the creation of a sound material-cycle society improved during about the decade after 2000 with resource productivity[1] up by about 50%, the cyclic use rate at the inlet[2] up by about 5 points, and final disposal amount[3] down by about 70%. As Figure 1 shows, the amount of materials in the flow from their input to final disposal in Japan decreased significantly, while those in the resource circulation flow increased. Furthermore, the reported number of illegal dumping cases fell significantly from 1,197 cases in the peak year of FY1998 to 131 cases in FY2016, indicating the progress in proper waste treatment. The restoration of people's living environments disrupted by illegal dumping or improper waste treatment is advancing through, for example, measures carried out or planned to be carried out in all the reported cases to eliminate such disruptions. In addition, the proper management and treatment of waste containing persistent organic pollutants (POPs)[25], such as asbestos and polychlorinated biphenyls (PCBs)[23], subject to the Stockholm Convention on Persistent Organic Pollutants (hereinafter referred to as the "POP Convention")[24], as well as mercury and waste containing mercury, agricultural chemicals stored underground, and other hazardous waste are being addressed by developing a necessary legal system, plans, and a management and treatment framework.

However, in recent years, all the indicators of resource productivity, cyclic use rate at the inlet, and final disposal amount are leveling off. While there are some items of waste, such as industrial scrap metal waste, that are recycled almost entirely with their room for improvement in recycling becoming smaller, there are also some items, including plastics and food waste, that require further 3R efforts. Furthermore, one major illegal dumping case in which more than 5,000 tons of waste was dumped, as well as three serious improper waste treatment cases, were reported in FY2016 alone, indicating that illegal dumping and improper waste treatment have not been totally eliminated. In 2016, an incident that severely damaged people's trust in food occurred[26], in which a food waste recycling contractor registered under the Act on Promotion of Recycling and Related Activities for Treatment of Cyclical Food Resources (Act No. 116 of 2000; hereinafter referred to as the "Food Recycling Act") unlawfully resold

food waste as food. There are also asbestos, PCBs, and other POP waste, mercury and waste containing mercury, agricultural chemicals stored underground, and other hazardous stock and waste which remain missing or which are left without proper management or treatment. This delay in proper management and treatment is causing great concern.

Fig. 1 Material flow in Japan (prepared by the Ministry of the Environment)



1.5. Recovery and Reconstruction from Environmental Pollution by Radioactive Materials Discharged by Nuclear Power Plant Accident

The Great East Japan Earthquake on March 11, 2011, caused extensive and catastrophic damage mainly to the Pacific coast areas in the Tohoku region, and the subsequent accident at Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Station resulted in the release of vast amounts of radioactive materials into the surrounding environment, forcing many affected residents to evacuate from the areas. In the disaster-stricken region, vigorous efforts were continuously made to recover from the radioactive pollution and reconstruct the livelihoods of the disaster victims. These efforts led to a major turning point when the whole area decontamination (which had been conducted based on the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials Discharged by the NPS Accident Associated with the Tohoku District-Off the Pacific Ocean Earthquake That Occurred on March 11, 2011 (Act No. 110 of 2011; hereinafter referred to as the "Act on Special Measures concerning the Handling of Pollution by Radioactive Materials")) was completed in the evacuation order areas excluding the Areas where Returning is Difficult by the end of March 2017, and when evacuation orders were lifted from all the Preparation Areas for Lift of Evacuation Order and Habitation Restricted Areas except Okuma Town and Futaba Town by April 1. As for the Areas where Returning is Difficult, the Act on Special Measures for the Reconstruction and Revitalization of Fukushima (Act No. 25 of 2012) was revised in 2017 to establish new systems including to promote revitalization and reconstruction of specific locations within the areas.

Soil and waste removed from within Fukushima Prefecture after decontamination works will be managed and stored intensively and safely in the Interim Storage Facility[27] under construction in Okuma Town and Futaba Town in the prefecture before their final disposal outside the prefecture within 30 years from the start of interim storage. The land acquisition for the Interim Storage Facility and the construction of the facility as well as sequential transportation of the removed soil and waste are steadily underway. The storage of the removed soil started in October 2017.

With regards to the final disposal of the removed soil and waste to be implemented outside Fukushima Prefecture, it is important to increase the volume of the soil and waste that can be recycled to maximum possible level and reduce the amount of final disposal by utilizing volume reduction and recycling technologies. For this reason, "Technology Development Strategy for Volume Reduction and Recycling of the Removed Soil" was formulated in April 2016 as a medium- to long-term policy to develop the technology and strategy for volume reduction and recycling of the removed soil.

As for "Waste within Countermeasures Areas [28]," all the waste that had been hindering residents from returning to their homes was removed and transported to temporary storage facilities by the end of FY2015, except the waste in the Areas where Returning is Difficult. When it comes to disaster waste, approximately 1.91 million tons of waste was carried to temporary storage facilities by the end of March 2018, and is being treated at temporary incineration facilities built by each municipality for volume reduction.

"Designated waste[29]" which is properly stored in incineration facilities, sewage treatment facilities, farmland, and other places on a temporary basis, needs the prompt development of a secure, long-run management system. In Fukushima Prefecture, the "specified waste" (Waste within Countermeasures Areas and Designated Waste) with 100,000 Bq/kg or less radioactive concentration is disposed in the Specified Waste Landfill Site, while the specified waste over 100,000 Bq/kg is stored in the Interim Storage Facility. The Specified Waste Landfill Site was nationalized in April 2016, and a safety agreement was concluded among the national government, the related towns, and the prefecture, in June 2016. After necessary construction work and other preparations were conducted, the transportation of specified waste to the site has started in November 2017. As regards designated waste generated in prefectures other than Fukushima Prefecture, on Miyagi, Tochigi, and Chiba prefecture, how to treat designed waste is under consideration taking into account their respective circumstances, while on Ibaraki and Gunma prefecture, it was decided in February and December 2016 respectively that dispersed storage of designated waste would be maintained until the waste would come to be able to treated in a phased manner including in terms of radioactive concentration. The Ministerial Ordinance for the Act on Special Measures concerning the Handling of Pollution by Radioactive Materials (Ministry of the Environment Ordinance No. 33 of 2011) was revised in April 2016 to set the process for cancellation of designated waste.

The nationwide issues referred to in Section 1.2 are particularly notable in the areas affected by the Great East Japan Earthquake. In facing these issues, various efforts aimed at creating sustainable communities have been started across the region in the course of the reconstruction from the disaster.

1.6. Frequent Occurrence of Large-scale Disasters and Delay in Waste Treatment Planning

Japan has undergone large-scale disasters almost every year since the occurrence of the Great East Japan Earthquake in 2011, raising concerns over the possibility of even much larger-scale disasters than the catastrophe in eastern Japan, such as a near-field earthquake in the Tokyo Metropolitan Area or a major earthquake along the Nankai Trough. Recent years have also frequently seen rainfalls with precipitation rates exceeding 50 mm per hour, and increasingly localized, concentrated, and intensified rainfalls are causing catastrophic floods and landslides. There are concerns that floods, landslides, and drought may become more frequent and severer due to climate change.

From the viewpoint of the creation of a sound material-cycle society, the large amount of waste generated after large-scale disasters poses a serious issue as its proper, prompt treatment is indispensable for early recovery and reconstruction of the affected areas. Under severe situations, the collection, transportation, and the delay in treatment of garbage and human waste generated from households or evacuation centers may become an issue because of the shutdown of waste treatment facilities or human waste treatment facilities or due to too many people living in prolonged evacuation.

Under these circumstances, the government has defined 45 "worst events that should never happen" in the Fundamental Plan for National Resilience, formulated under the Basic Act for National Resilience

Contributing to Preventing and Mitigating Disasters for Developing Resilience in the Lives of the Citizenry (Act No. 95 of 2013). The progress of measures is ascertained and plans for promoting programs are reviewed for improvement using Key Performance Indicators (KPIs)[30] to ensure adherence to the Action Plan developed in every fiscal year and to enhance national resilience. One of the "worst events that should never happen" is "Circumstances where recovery and reconstruction are delayed significantly due to delay in treatment of a large amount of disaster waste," and a KPI used to measure the progress of efforts to prevent such event is the ratio of local governments that have a disaster waste treatment plan in place to the total number of local governments. The Ministry of the Environment has conducted various activities aimed at increasing the ratio, which include the implementation of model projects designed to accelerate local governments' efforts to develop a plan; the establishment of regional block conferences with the Regional Environment Office in each regional block serving as the secretariat; and the preparation of guidelines and manuals. However, as of the end of 2016, the ratio of municipalities with a disaster waste treatment plan was as low as 24%, making it difficult to achieve the numerical target of 60% by 2018.

1.7. Change in Public Consciousness

With regards to public consciousness regarding "goods," people are beginning to put greater stress on spiritual affluence than material affluence with the ratio of people who value inner wealth more than material wealth having increased since 1980. The share of household budget spent on services is rising, and an increasing number of people are expressing their desire to spend more money on dining and socializing than on goods. People's behavior in purchase of goods is also changing as the number of people who attach greater weight to high quality and long life span than low prices is increasing, while the number of those who value low prices more is decreasing. New diverse lifestyles that place emphasis on simply enjoying daily lives without being obsessed with possessing goods, such as sharing a house, food, and other necessities with friends and living with only essential items, are emerging.

As for public consciousness regarding social contribution, the percentage of people who are interested in contributing to society exceeded those who are not so much in the late 1980s and steadily increased to reach 69% in FY2007. The figure subsequently decreased somewhat to 63% in FY2017. About 30 to 40% of those interested in social contribution were expressing their intent to be involved in activities to protect nature and the environment, such as environment beautification and recycling, but their percentage has been on a decreasing trend since it reached 40% in FY2007 and FY2008, shrinking to 29% in FY2017. As this indicates, people's awareness of social contribution and level of interest in nature and environment protection activities were rising until around 2009 but has decreased in recent years.

When it comes to public consciousness regarding a sound material-cycle society, the percentage of those interested in waste-related issues remained high at over 80% after FY2007 but has been gradually decreasing since FY2013 to 67% in FY2017. With regard to 3R activities, while more than 60% of citizens are taking specific actions, such as sorting of garbage, use of refillable products, and carrying

their own shopping bags instead of using shops' plastic bags, the percentage of those who refrain from buying disposable or unnecessary products, use their own chopsticks in restaurants or purchase reused/recycled products remains as low as 20% or less. On the other hand, however, unique fun-filled 3R activities, such as cleanup after soccer games and other events, sports-like cleanup competitions, and cleanup by idol groups and their fans, are also appearing.

Under these situations, the state, local governments, NPOs, NGOs, business operators, and others are collaborating with each other to promote a change in citizens' awareness and lifestyles and encourage them to take specific actions toward creating a sound material-cycle society. Such collaborative activities include the provision of diverse information on websites, PR activities, hosting of events, and commendations.

1.8. Securing of Workforce for Resource Circulation and Proper Waste Treatment

It is becoming increasingly important to ensure that waste disposal businesses, who are an essential player in resource circulation, can maintain stable financial health and pursue business growth and upgrading, as well as that, under the current situation in which the workforce in administrative services is shrinking along with depopulation in Japan, municipalities will secure and develop human resources, and improve their skills to continue to play their role. Amid the decreasing working-age population nationwide, government, both at the national and local levels, where the number of workers engaging in technical duties is decreasing in the course of government's efforts to increase operational efficiency, is required to promote active cross-departmental collaboration. Many companies—waste disposal businesses in particular, most of which are small to medium-sized enterprises—are also facing a labor shortage and are therefore required to enhance their productivity and other operational efficiencies while also improving their work environments, compensation, and other working conditions to create an attractive workplace.

In the area of the treatment of municipal waste, municipalities, which have the responsibility for the overall management of municipal waste[31] generated from within their boundaries, are required to promote cooperation among the departments of their offices as well as with various partners including other local governments and the private sector to advance proper resource circulation and treatment. There is, therefore, a need for municipalities to take a comprehensive approach to secure and develop human resources who are capable of coordinating and building partnership with various actors. As regards the treatment of industrial waste, because the competitive environment of the industrial waste disposal industry in which "bad money drives out good[32]" remains the same, it is important to ensure that good industrial waste disposal businesses which are committed to proper treatment of industrial waste, upgrading of resource circulation practices, reduction of carbon emissions, and other sustainability efforts will be fully recognized and can establish a stable financial base. Toward this end, ensuring that the responsibility of waste-generating business operators[20], including the payment of proper compensation, will be exercised and building good partnership between industrial waste disposal

businesses and waste-generating business operators are also important.

2. Medium- to Long-term Directions toward Establishment of a Sound Material-cycle Society

To establish a sound material-cycle society, it is critical for each actor to share a common understanding on the medium- to long-term directions to be taken to establish a sound material-cycle society and fulfill their respective roles through mutual cooperation and collaboration with a view to realizing a sustainable society.

We aim to create a sound material-cycle society as described below through the steadfast efforts of each actor.

2.1. Integration of Efforts toward Creating a Sound Material-cycle Society into Those for a Sustainable Society

【Background and issues】

We cannot exist nor can we develop the economy and society without the earth.

Humankind opened up the unexplored frontiers, acquired land abundant with natural resources, cultivated land to produce food and goods, and created technologies, systems, and frameworks to utilize natural resources to supply food and goods, which enabled their population to grow and their economy and society to develop. Nations that were able to build up these efforts, win the competition with other nations, and bring areas rich in natural resources and areas with a population large enough to consume huge amounts of food and goods produced into the sphere of their influence have become economically and materially affluent, equipped with advanced technologies, systems, and frameworks for mass-production and mass-consumption.

In the course of the development of such a mass-production and mass-consumption society, various problems have emerged and are threatening the very foundation of the survival of humankind. Territorial conflicts over the control of areas with abundant natural resources and high consumption capacities have often led to war. In areas that are marginalized in such conflicts or that are placed under the influence of developed nations and have no choice but to supply the only natural resource they have or simple labor power to other nations at low cost, development has lagged behind and people are suffering from various problems such as poverty, political turmoil, violence, and suppression of human rights. Mass-production and mass-consumption have also necessitated the exploitation of land to mine large amounts of natural resources and produce huge quantities of food and goods, resulting in the destruction of nature; have generated a large volume of harmful substances and waste, polluting the environment; and have increased emission of greenhouse gases through the use of large amounts of fossil fuels as the source of energy, leading to climate change. Nature destruction, environmental pollution, and climate change are having a serious impact on all living things on the earth including humankind. Mass-production and mass-consumption and their accompanying, above-mentioned problems are, as stated in Section 1.1,

spreading across the world and increasing uncertainty.

We cannot allow mass-production and mass-consumption to spread any further in the world. There are almost no unexplored frontiers left for us to secure large amounts of natural resources. Under the principle of the 2030 Agenda for Sustainable Development which commits the UN member states not to leave anyone behind in their implementation of the SDGs, vying for the monopolization of natural resources on the earth is intolerable. Nature destruction and environmental pollution are taking place throughout the world including the oceans, increasing the number of natural disasters that are suspected to be associated with climate change. Humankind's impact on the earth and the accompanying risks are already surfacing particularly in terms of climate change, and some even point out that the risks have reached the level at which people can no longer conduct their normal activities safely.

【Future vision】

Our goal is to achieve a shift from technologies, systems, and frameworks for mass-production and mass-consumption to those that require only the minimum natural resources to produce all the food and goods needed by people and that promote sustainable use of such food and goods—in other words, a sound material-cycle society with high resource productivity[1]—to generate affluence, as well as to help develop such a sound material-cycle society globally. It will be a world where there is no conflict over natural resources and everyone can use natural resources in a sustainable manner; where everyone can secure the necessary food and engage in sound economic and social activities to be free from poverty; and where environmental impact will remain below the environmental capacity of the earth, and the healthy, safe lives of current and future generations and freely functioning ecosystems will be assured. Only through achieving this goal and realizing the above-mentioned world can we hope to save the world where we are losing new frontiers to exploit and our environmental footprint is about to exceed the environmental limits of the earth.

To achieve the goal, citizens, the state, local governments, NPOs, NGOs, business operators, and other actors will cooperate with each other to address environmental considerations (such as cyclical use, low-carbon, and harmony with nature), economic considerations (such as natural resources, industry, and agriculture and fisheries), and social considerations (such as welfare and education) in an integrated manner.

Through this environmental policy, efforts will be made to advance: regional revitalization through the formation of diverse regional circulating and ecological sphere (Section 2.2); thorough resource circulation throughout the lifecycle[6] of goods and services (Section 2.3); proper waste treatment as well as the restoration of the environment damaged by waste, etc. or the Great East Japan Earthquake (Section 2.4); a well-planned framework for disaster waste management for possible future disasters (Section 2.5); and an international framework for the circulation of resources and overseas expansion of Japan's waste management and recycling industries[7] (Section 2.6). The infrastructure that supports the above-mentioned policies will also be fully developed (Section 2.7).

2.2. Regional Revitalization through the Formation of Diverse Regional Circulating and Ecological Sphere

【Background and issues】

As stated in Section 1.2, depopulation, declining birthrate, and aging population are progressing at an unprecedented rate in Japan, and their impact is becoming visible and serious in various locations nationwide. To build a sound material-cycle society with high resource productivity[1] in this situation, it is important to recycle circulative resources[14] (such as livestock waste, food waste, sewage sludge, plastics, and metal) on a scale that best suits the type of resource and the characteristics of the region—in a small local network or a wider network, whichever is optimal—in order to reduce the environmental burden to the extent technologically and economically feasible. Renewable resources (such as wood as well as geothermal power, wind power, hydroelectric power and other renewable energy sources) which can be obtained by conserving, interfering only moderately, and maintaining forests, the countryside, rivers, and the sea in the region, must also be utilized continuously in the region. Furthermore, creating sustainable and vibrant communities where stock built up in the region (such as roads, railways, and other infrastructure as well as houses, shops, and other buildings) will be managed properly and used wisely for as long a time as possible to reduce resource input and waste generation, is also important.

By utilizing these circulative, renewable, and stock resources effectively, a region needs to promote the circulation of its natural environment, materials, human resources, and funds within itself to enhance its local ownership and charm for its revitalization.

【Future vision】

As stated above, the goal is to create an independent and distributed society which utilizes circulative, renewable, and stock resources as well as the region's human resources and funds in a way that matches the region's characteristics, while developing regional circulating and ecological sphere in which the region and its neighboring regions will be complementary to each other in their efforts to revive the natural connections among forests, the countryside, rivers, and the sea[33] and strengthen the economic connection through flow of funds, exchanges of people, and other means, with a view mainly to achieving resource circulation, biodiversity, a low-carbon society, and regional revitalization. To successfully form regional circulating and ecological sphere, continuous cooperation among local citizens, business operators, NPOs, NGOs, government, experts, and other actors is essential. Various actors will collaborate with each other to restore a community of local residents and aim to solve the local problems mentioned in Section 1.2 together, which are caused by the declining regional function as a community and the aging of the population.

In Japan, as referred to in Section 1.6, large-scale disasters have frequently occurred in recent years, causing catastrophic damage to disaster-vulnerable areas. While large quantities of disaster waste have to be treated and huge amounts of funds and resources need to be spent for the restoration and reconstruction of the affected areas, as explained in Section 1.2, the decline of regional vitality caused

by depopulation, low birthrate, and aging of the population is expected to make it even more difficult to secure sufficient workforce, funds and resources for restoring, developing, and maintaining disaster prevention infrastructure. In the era when the population was increasing, even disaster-vulnerable areas, such as steep land susceptible to collapse and areas prone to flooding, were turned into housing lots carelessly by using significant levels of workforce, funds, and resources. As the population has entered a decreasing phase, however, such careless development of disaster-vulnerable areas will be avoided to conserve or restore their rich natural environment, while ways to utilize disaster-resistant areas will be explored (encouraging regions to develop resilient communities in the areas will be one option), with full attention to the residents' attachment to their communities as well as to the local history and culture. Through this policy, it is aimed to reduce disaster waste generation; decrease resource input for restoring, developing, and managing disaster infrastructure; conserve and restore natural environments; create networked compact low-carbon communities; and improve regional disaster prevention capabilities.

【Specifics of the future vision】

More specifically, in farming, mountain and fishing villages, a cycle of local production and local consumption will be established. In this cycle, livestock waste as well as food and other waste sorted and collected will be utilized as circulative resources and turned into fertilizer, feed, and other materials, which will be, in turn, used to produce agricultural, forestry, marine, and other products that will be consumed within the region. Circulative resources that cannot be converted into fertilizer, feed, or other materials, as well as unused forest thinnings and other renewable resources, will be used as an energy source for the region to create a cycle of locally-produced and locally-consumed energy. These cycles for local production and local consumption will stimulate fund flows within the region, leading to regional revitalization. These cycles for local production and local consumption will also enable sustainable agriculture, forestry, and fisheries which require only a sustainable level of interference with nature, contributing to the conservation of *satochi*, *satoyama* and other ecological habitats. The creation of a region having rich nature and cycles for local production and local consumption will also provide a place for environmental education and eco-tourism, generating an opportunity for exchanges between cities and farming, mountain and fishing villages through cooperation with tourism and other businesses.

Where farming, mountain and fishing villages are situated close to cities, food waste, sewage sludge, and other circulative resources supplied in stable quantities from the urban areas will be either turned into fertilizer, feed, and other materials for use in the villages to produce agricultural, forestry and marine products that will be consumed in the cities, or transformed into energy, depending on the characteristics of the region. This cycle connecting villages and cities will encourage sustainable interaction of people in the rural and urban areas, as well as urban residents' purchase of high added-value, branded agricultural, forestry, and marine products allowing funds to flow back to the villages. The cycle will thus help revitalize the villages and provide urban dwellers with opportunities to enjoy products from and experience the lives of the villages.

In cities, food waste, mowed grass, sewage sludge, and other circulative resources will be utilized for

electric power generation, agriculture, and other businesses as fertilizer, feed, phosphorus resources, and energy sources, realizing resource circulation that matches the regional characteristics. Plastics, metal, and other similar waste will also be recycled efficiently through a wide network that connects arterial industries—such as cement, steel, non-ferrous metal refinery, and paper-making—and venous industrial clusters and venous industries with advanced recycling technology, such as eco-towns and Recycling Ports. In particular, the collection of rare metals and other scarce resources, which are available only in small quantities but with high added-value, the detoxification of hazardous waste, and other unique technologies will be employed to utilize circulative resources. Difficult-to-recycle combustible waste will be utilized efficiently in multiple phases; for instance, the waste will be first converted into energy thoroughly at incineration facilities, and then any residues will go for recycling. The venous waste management and recycling industries[7] and the logistics industry which support the above-mentioned wide networks will be developed and contribute to regional revitalization.

2.3. Thorough Circulation of Resources throughout the Lifecycle of Goods and Services

【Background and issues】

As stated in Section 1.1, emerging nations are experiencing rapid economic growth and their technological standards are catching up with and even surpassing those of developed countries. On the other hand, in Japan, as pointed out in Section 1.2, regions are losing their vitality due to depopulation, low birthrate, and aging of the population. Domestic demand is decreasing, and securing engineers with the range of skills required for *suriawase* (coordination) and other talents capable of underpinning Japan's manufacturing base is becoming increasingly difficult. Furthermore, as stated in Section 1.7, Japanese citizens' lifestyles and needs are diversifying and the pattern of their consumption behavior is shifting from owning goods to experiencing high-quality services. In this situation, as stated in Section 1.3, the sources of competitiveness that generate added value have shifted from "things" and "money" to "human resources" and "data" along with the progress of the fourth industrial revolution[5], and Japan is facing an era where the integration of diverse things will lead to creating high added value.

Economic development has heretofore been achieved by exploiting large amounts of natural resources to produce considerable quantities of various things for consumption and disposing of waste in nature after use. The consequence of this material flow of the current economic society based on mass-production and mass-consumption is the variety of issues mentioned in Sections 1.1 and 2.1. In nature, materials circulate among air, water, soil, organisms, and others, and ecosystems maintain a delicate balance. To ensure that this circulation of materials is in harmony with nature and that this delicate balance of ecosystems will be maintained into the distant future, the material flow of economic society must ultimately fulfill the following three rules: firstly, the pace at which wood and other renewable resources are used must not exceed the pace at which the resources are reproduced in nature; secondly, the pace at which metal resources, fossil resources, and other non-renewable resources are used must not exceed the pace at which alternative renewable resources are developed so that their replacement

with sustainable renewable resources can be made before their depletion; and thirdly, the pace at which materials that are likely to undermine their circulation in harmony with nature and the delicate balance of ecosystems are released to nature must not exceed the pace at which they are absorbed and detoxified in nature.

【Future vision】

To make sure to achieve economic development in Japan while realizing the ultimate material flow of economic society which is in harmony with nature, there is a need to break away from the traditional economic system where the sources of competitiveness that generate added value are “things” and “money” and efficient economic activities through “intensification” and “homogenization” are considered to be successful models. The goal is to change the current material flow of the economic society to a more optimum material flow that will enable the thorough circulation of resources throughout the lifecycle[6] of goods and services in a manner that will not hinder environmental conservation. Toward this end, the innovations of the fourth industrial revolution will be introduced to every industry and aspect of society to bring about a shift in focus of Japan’s economy from quantity to quality to enhance value-added productivity (labor productivity based on value added). In addition, new business models that will generate high added-value by focusing on “human resources” and “data” as the sources of value and integrating various things that exist “independently and dispersedly” will prevail to provide the necessary goods and services to the people who need them at the required time and in just the right amount.

【Specifics of the future vision】

More specifically, each stage of the lifecycle of goods and services will be optimized as described below from the viewpoint of consumers by considering what, when, and what quantity of goods/services will be needed by consumers.

(Optimization of use stage)

High-quality services that will be needed by individual consumers who wish to lead a fulfilling life throughout their lifetime will be provided at the required time and in just the right amount, using the minimum quantity of goods, consuming the minimum amount of energy, and generating the minimum level of environmental impact. Because of this, instead of traditional business models intended to create demand among many consumers and produce and sell significant quantities of goods to gain earnings, new business models will prevail, which are close to individual consumers and generate long-term earnings by, for example, providing the minimum necessary goods for services and checking, repairing, replacing, reusing, or otherwise maintaining the goods to extend the life of their functions for long-time use of the services.

(Optimization of distribution stage)

Lean distribution infrastructure and information infrastructure will be in place, which will enable consumers to receive the necessary goods and services at the required time and in just the right amount with minimum energy consumption and environmental impact. Because of this, new business models utilizing new technologies and systems will prevail. These technologies and systems will include matching systems based on various data on suppliers and consumers, optimization of distribution channels, and sharing platform that allows multiple users to share goods and services based on various data on the users.

(Optimization of production stage)

For services that allow consumers to use the goods they need which consume minimum amounts of natural resources and energy and generate minimum environmental impact throughout their lifecycle, the goods will be produced at the required time and in just the right amount. Because of this, new business models will prevail, which swiftly analyze real-time data on the production, distribution, and use of each item of goods to optimize the timing and quantity of production, as well as which fulfill the extended producer responsibility[21] of adopting design for environment[22] (this design will include facilitating easy repair, replacement, disassembly, sorting, updating, and other operations based on data on use and disposal). These business models will enhance brand value.

(Optimization of resource securing stage)

The ratio of safe circulative resources[14] and renewable resources to minimize total resources used for the production of goods will be maximized to restrict the use of natural resources and harmful substances. Where the use of natural resources is inevitable, alternation of nature, energy consumption, and environmental impact at the time of mining, transportation, and other operations will be minimized. When circulative resources and renewable resources are used, efficiency of their transportation will be maximized. Sufficient care will be taken particularly when using renewable resources so that the pace of their use will not exceed that of reproduction in nature.

(Optimization of overall lifecycle)

To establish material flow in which resources will be recycled thoroughly throughout the lifecycle of goods and services, optimizing each stage separately will not be sufficient; optimizing the overall lifecycle will also be required. Major players who are expected to play a leading role in the optimization of the overall lifecycle will be producers of goods who can decide design, and timing and quantity of production of, goods, as well as distributors and retailers who can connect producers and consumers and integrate information on the both. For business activities, sharing information among producers, waste-generating business operators, and waste disposal businesses will also be important.

Various actors will cooperate with each other and combine a broad range of efforts to optimize the overall lifecycle. The efforts exerted mainly by producers, distributors, retailers, waste disposal businesses, and trade associations will include voluntary activities, certification of sustainable resources

and materials and green procurement based on such certification, and economic incentives to promote voluntary activities. The efforts by business operators, trade associations, and government agencies will include sharing information with consumers and the enforcement of regulatory measures.

As part of other efforts to optimize the overall lifecycle, information on safety, such as that on harmful substances contained in goods, information on the circulation of resources, including disassembly and treatment methods, and other necessary information will be shared properly among relevant business operators.

(Optimization of disposal stage)

Materials determined as not necessary in each stage will be reused to the extent technologically and economically feasible, those that cannot be reused but can be recycled will be recycled, and those that cannot be recycled but from which energy can be recovered will be treated in such a way to recover energy. Only materials for which reuse, recycling, or energy recovery are impossible will be sent to final disposal after undergoing volume reduction and other intermediate treatment processes. This order of priority in the processing of materials will be changed as necessary by taking into account energy consumption, environmental impact, and other factors, in order to ensure the optimization of this stage.

Particular focus will be given to the materials named in the subsections below to ensure that they will be recycled thoroughly throughout the lifecycle of goods and services in a manner that will not hinder environmental conservation. These materials are mainly those that are problematic from the viewpoints of environmental impact and generation of waste or that can contribute to the mitigation of climate change.

2.3.1. Plastics

Plastic waste will be reduced to a minimum through such efforts as encouraging consumers to use their own shopping bags rather than shops' plastic bags, reducing one-use cups, and promoting reuse—such as the use of reusable cups. Used plastic containers will be treated properly—rather than littered or illegally dumped, which may spoil the beauty of scenery and adversely affect the environment if flowing into oceans and breaking down into micro plastics[10]. Used plastic containers will then undergo high-quality recycling, and recycled materials, which will be high in demand in the market, will be sold at high prices and recycled again and again for repeated use.

In the case of plastic waste for which incineration is the only available option for treatment, or in the case when biomass-derived plastics[34] become widely used and are incinerated, it will be ensured that thermal recycling will be implemented. Biodegradable plastics[35] will be used for sheets for agriculture, food waste collection bags, and other applications that should preferably have biodegradability.

These efforts, as well as the 3Rs of plastics, will lead to, among others, reducing greenhouse gas emissions, decreasing the reliance on fossil resources, and mitigating the impact on oceans and other natural environments, while also helping invigorate resource circulation and other related industries.

2.3.2. Biomass (food, wood, etc.)

Unused forest thinnings, livestock waste, sewage sludge, and other biomass[15] will be converted thoroughly into fertilizer, energy, and other products. Further progress will be made in research and development for producing cellulose nanofiber and other high added-value chemical products from biomass.

Efforts to reduce food loss[9], where food that is still edible is disposed of, will be made thoroughly. Cycles for local production and local consumption will also be formed, in which food waste generated will be turned thoroughly into feed, fertilizer, energy, and other products, which will, in turn, be used to produce agricultural, forestry and marine products that will be consumed within the region.

2.3.3. Base metals, rare metals, and other metals

Metals will be collected thoroughly from the four categories of home appliances subject to the Act on Recycling of Specified Kinds of Home Appliances, small-size home appliances, and all other products containing metals to fully exploit urban mining[36], while minimizing the extraction of natural resources.

For batteries used in a wide range of products, the collection network will be expanded with due consideration of safety, and their proper reuse, recycling, and disposal will be progressed.

2.3.4. Earth and rocks, construction materials

Mixed cement will become even more widely used, while useful metals will be collected in each production process of cement.

The development of high-quality social stock—such as existing houses repaired to extend their life expectancy as well as to achieve low carbon emissions and greater resilience—will help prevent the generation of construction and demolition waste (CDW) including excavated soil. Sorting and recycling of demolition waste will be implemented thoroughly when buildings and other structures are demolished.

Industrial byproducts generated during steel-making, such as steel slag, will also be utilized effectively wherever possible.

Sand and soil generated during the construction of waterways and other similar work will be used effectively for conservation and improvement work for the oceanic environment. Thorough efforts will be made to reduce the amount of such sand and soil delivered to final disposal sites or dumped into the oceans.

2.3.5. Products and materials introduced widely as a measure against global warming and other environmental problems

The reuse, recycling, and disposal of a rapidly increasing volume of waste from photovoltaic power generation facilities will be implemented in a proper and steadfast manner.

For new products and materials that are being adopted widely at a rapid pace, such as lithium-ion batteries and carbon fiber-reinforced plastics[37], 3R technologies will be developed and a system for

proper reuse, recycling, and disposal will be built.

2.4. Continued Promotion of Proper Waste Treatment and Environmental Restoration

2.4.1. Continued promotion of proper waste treatment

【Background and issues】

Proper waste treatment is undeniably indispensable from the viewpoints of the conservation of living environments and the improvement of public health and needs to continue to be promoted.

However, the situation surrounding waste treatment is changing. Changes in the social structure, such as the declining population, are reducing the generation of municipal waste, but at the same time also causing the number of workers in government services—including those engaging in waste treatment—to decrease. The aging of population is also forcing some local governments to alter their waste collection systems. The changing characteristics of waste and the increasing frequency and severity of disasters caused by climate change are generating various issues, requiring measures to mitigate and adapt to climate change and measures to manage disaster waste to be implemented in an integrated manner throughout the waste treatment process from collection and hauling to final disposal in order to solve the issues concurrently. The number of cases of illegal dumping and improper treatment of waste has decreased significantly compared with the peak reached in around 2000, showing that a certain level of achievement has been attained, but they have yet to be totally eliminated and some of them are even serious and malicious. Furthermore, the urgent need to address the issue of decreasing remaining capacity at final disposal sites, as well as the management of waste for which proper treatment is difficult, such as POPs[25] (asbestos, PCBs[23], etc.), mercury and waste containing mercury, and agricultural chemicals stored underground, must be continued to be dealt with in accordance with laws, regulations, or guidelines. There is also a need to establish an environment that facilitates waste-generating business operators to select good waste disposal businesses.

【Future vision】

With the above-mentioned situation in mind, it is aimed to appropriately develop systems, frameworks, and technologies for proper waste treatment. For industrial waste in particular, a sound competitive environment will be established.

【Specifics of the future vision】

More specifically, a waste treatment system that keeps abreast of changes in the social structure will be developed with a view to, among others, promoting the design and implementation of a waste collection and hauling system that is friendly to an increasing number of elderly households as well; encouraging local governments to cooperate with other parties in various fields; and upgrading, and increasing the energy efficiency of, the monitoring of waste treatment processes using IoT[16] and AI[18]. For waste treatment facilities, which constitute the core of municipal waste treatment, stock management will be implemented in such a way to enhance efficiency of treatment, with due consideration to the

declining population and other changes in society. The stock management will include such activities as sophisticating the facilities using information technology and other advanced technologies, integrating them, and making them serve a wider area and for a longer lifetime. The facilities will also function as an energy center and disaster prevention base in each region, contributing to regional revitalization and other development through cooperation with other concerned parties. Electricity generated at and residual heat from the facilities, including small and medium-sized ones, will be utilized to a greater extent, the energy recovery efficiency of the facilities will be increased, and waste biomass[15] will be used more actively. The final disposal amount[3] will be reduced further through 3R efforts, which will also help secure, and prolong the operational years of, final disposal sites. For waste requiring final disposal, necessary final disposal sites will be secured appropriately. Illegal dumping and improper treatment of industrial waste will also be reduced to zero by ensuring that waste-generating business operators will, among others, strengthen the traceability[39] of waste using electronic manifests[38] and information technology; and building monitoring systems in cooperation with relevant organizations and the private sector, as well as through other efforts. Furthermore, as waste disposal businesses will establish a stable financial base and maintain steady ongoing business by increasing their productivity through such efforts as the securing, development, and improved treatment of human resources and the enhancement of added value of their business, environmental industries in the area of recycling will become sound and vibrant.

Proper recycling will be implemented through the setting and compliance with standards on the safety of recycled and other products (in the case of recycling of food containers, the safety of food will be secured first and foremost). Environmental risks of chemical substances will be reduced further throughout the lifecycle[6] of products from manufacturing and import to use, recycling, and disposal. In addition, the locations of POP waste (including waste of asbestos and PCBs, whose production has been prohibited), mercury and waste containing mercury, and agricultural chemicals stored underground will be monitored, and their management or disposal will be carried out in a well-planned manner.

2.4.2. Environmental restoration through waste management

【Background and issues】

As stated in Section 1.1, marine debris is adversely affecting marine organisms, fisheries, tourism, and others and recently raising a concern about the impact of microplastics[10] on the ecosystem, attracting international attention. In Japan, although measures have been taken to collect, treat, and prevent the generation of marine debris that drifts ashore, this has not led to solving the marine debris issue totally, and the knowledge on the distribution of microplastics and their impact on the ecosystem is not sufficient. As for land on which waste was dumped illegally or treated improperly, efforts have been made to remove its threats to the conservation of the surrounding living environments but have yet to be completed in most cases. Furthermore, as pointed out in Section 1.2, the declining population is likely to lead to an increase in abandoned houses and stores, garbage hoarding, and other issues, generating a concern that this may lead to the deterioration of the regional living environment.

【Future vision】

In the light of the above-mentioned situation, it is aimed to promote the control of the generation of, and the understanding of the current status of, marine debris as well as its collection and treatment, in order to work toward solving the marine debris issue. At the same time, it will be ensured that any problems hindering the conservation of living environments surrounding the land on which waste was dumped illegally or treated improperly will be eliminated, and that abandoned houses and stores will be demolished and removed appropriately to help restore the regional environment.

【Specifics of the future vision】

More specifically, the issue of marine debris including microplastics will be basically responded to with a focus on preventive activities that will promote—in addition to the collection and treatment of marine debris—the suppression of its generation as well as understanding its distribution in the ocean, its impact on the ecosystem, and its other actual status, by involving the cooperation and participation of diverse actors, such as the state, local governments, experts, citizens, companies, and private organizations. Based on the recognition that the marine debris is also an international issue, international cooperation, mainly with Asian nations, will be promoted. As for land on which waste was dumped illegally or treated improperly, it will be ensured that efforts are made to eliminate problems hindering the conservation of the surrounding living environments, and lessons learned from such past cases will be channeled into eradicating illegal dumping and other violations. In regions where the number of abandoned houses and stores and garbage hoarders is on the increase, such properties will be first maintained and managed appropriately as mentioned in Section 2.2. to use them as wisely and for a long time as possible. Deteriorating properties that are difficult to reuse in the region will be demolished and removed before they spoil the city landscape or collapse or cause other danger, and waste generated therefrom will be recycled as much as possible before it is disposed of properly. Then, the regional environment will be restored for the purposes that best benefit the region, such as the restoration of security and landscapes, regional revitalization, and recovery of nature.

2.4.3. Environmental restoration from the Great East Japan Earthquake

【Background and issues】

As stated in Section 1.5, since vast amounts of radioactive materials were released from Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Station after the earthquake into the surrounding environment, vigorous efforts have been continuously exerted to recover from the environmental pollution and reconstruct the livelihoods of the disaster victims. These efforts have led to a major turning point when area decontamination was completed in the evacuation order areas excluding the Areas where Returning is Difficult by the end of March 2017, and when evacuation orders were lifted from all the Preparation Areas for Lifting of Evacuation Order and Habitation Restricted Areas except Okuma Town and Futaba Town by April.

However, the reconstruction is still only the way and more efforts are needed to achieve the goal of the reconstruction in Fukushima and other affected areas as early as possible.

【Future vision】

In the light of the above-mentioned situation, the national government will steadily advance proper treatment of waste contaminated by radioactive materials and treatment of contaminated soil including reducing in volume and recycling, in cooperation with local governments and other related parties, and in harmonious way across the government, in order to achieve environmental restoration in the areas.

Furthermore, the reconstruction of the affected areas will be advanced in a future-oriented manner through the circulation of resources, including the utilization of electricity and heat generated from waste disposal facilities and the enhancement of recycling technologies, and the regional circulating and ecological sphere referred to in Section 2.2 will also be formed in the affected areas, with a view to revitalizing the region.

2.5. Development of Well-planned Framework for Disaster Waste Management

【Background and issues】

In Japan, as referred to in Section 1.6, large-scale disasters have occurred almost every year in recent years, and the delay in treatment of garbage and human waste generated from households due to the damage of waste disposal facilities, as well as the treatment of large amounts of disaster waste generated, is becoming a serious issue. The possible occurrence of a near-field earthquake in the Tokyo Metropolitan Area or a major earthquake along the Nankai Trough in the not-so-distant future is also projected, and the significant delay in recovery and reconstruction of the affected areas which may be caused by the lack of capacity to treat the huge quantities of disaster waste is feared as an intolerable, worst-case scenario that should never happen at the time of a major disaster. As explained in Section 1.2, the decreasing generation of waste in normal times due to the declining population and the shortage of workforce for waste treatment and circulation recycling are, together with other factors, leading to integrating waste disposal facilities and making them serve a wider area. Because of this tendency, the number of cases in which the volume of disaster waste generated at the time of a disaster surpasses the capacity of any single municipality to cope with may increase in the future.

【Future vision】

In the light of the above-mentioned situation, the resilience of the waste treatment system will be enhanced in advance of the occurrence of a disaster. The system will consist of multiple levels of networks—the local government level (Section 2.5.1), regional-block level (Section 2.5.2), and national level (Section 2.5.3) so that, while the municipalities will play a leading role at the time of a disaster, they also can access a regional-level or national-level network of cooperation depending on the scale of the disaster for proper and swift treatment of disaster waste. As described in Section 2.3, disaster waste

will be treated with thorough circulation of resources in mind at all times.

【Specifics of the future vision】

2.5.1. Acceleration of the enhancement of disaster waste management on the local government level

Each municipality will take the initiative in, among others, selecting candidates for disaster waste temporary storage sites; formulating a disaster waste management plan including a plan for the continuity of municipal waste treatment operations in the event of a disaster; enhancing the resilience of the main municipal waste treatment facilities to be used on the occurrence of a disaster at an early stage; building a framework for the collaboration with partial-affairs-associations, waste disposal businesses, waste disposal business associations, and other organizations; and informing the citizens of what they should do with waste, including how to sort waste. In addition to these initiatives, each municipality will also ensure that their employees take part in training as part of their ongoing efforts to keep enhancing their disaster response at all times.

These preparations will allow municipalities to maintain proper treatment of municipal waste and implement proper and swift disposal of disaster waste in the majority of frequently occurring disasters by cooperating with partial-affairs-associations, waste disposal businesses, waste disposal business associations, and other organizations and gaining the understanding of the citizens.

A relationship of trust between municipalities and other relevant authorities of different levels, such as the prefectural government of their prefecture, Regional Environment Office of their region, and the Ministry of the Environment, will also be developed and maintained to allow municipalities to request their support in the case of a disaster that cannot be responded to on the municipality level.

Each prefectural government will take the initiative in formulating a prefectural-level disaster waste management plan and building a framework for collaboration with municipalities, waste disposal businesses, waste disposal business associations, and other organizations, while also organizing training for local government employees in their respective prefectures, as part of their ongoing efforts to keep enhancing their disaster response at all times. These preparations will allow prefectural governments to maintain proper treatment of municipal and industrial waste and implement proper and swift disposal of disaster waste in their prefecture in many large-scale disasters by—without needing to wait for a request from a disaster-affected municipality in the case of an urgent situation—promptly taking such actions as dispatching their employees to the affected areas; developing a wide-area waste treatment system within the prefecture; and undertaking clerical work associated with disaster waste treatment on behalf of municipalities severely impacted by the disaster. A relationship of trust with other relevant authorities, such as the Regional Environment Office of their region and the Ministry of the Environment, will also be developed and maintained to allow prefectural governments to request their support without delay in the case of a disaster that cannot be responded to on the prefectural level.

2.5.2. Development of regional-level cooperation network for disaster waste management

Regional Environment Offices will take the initiative in establishing regional block conferences, each of which represents the prefectural governments, major municipalities, and other actors in the regional block, to formulate a disaster waste management action plan and build a cooperation network within the region in preparation for a large-scale disaster, while also organizing training regarding how the actors can cooperate within the regional block, as part of their ongoing efforts to keep enhancing their disaster response at all times.

These preparations will allow Regional Environment Offices to maintain proper treatment of municipal and industrial waste and implement proper and swift disposal of disaster waste in their regional block in large-scale disasters by—without needing to wait for a request from the local government governing the disaster-affected areas in the case of an urgent situation—promptly taking such actions as dispatching a support team made up of the staff from the competent Regional Environment Office and supporting local governments to the affected areas; and developing a wide-area waste treatment system within the regional block.

A relationship of trust with the Ministry of the Environment and other national-level authorities will also be developed and maintained to allow Regional Environment Offices to request their support without delay in the case of a disaster that cannot be responded to on the regional-block level.

2.5.3. Development of national-level cooperation network for disaster waste management

The Ministry of the Environment will engage in such activities as exploring necessary technical developments based on lessons learned from disasters that occur almost every year; preparing guidelines, manuals, and other documents concerning waste treatment at the time of a disaster; building a national-level support framework centering around the Disaster Waste Treatment Support Network (D.Waste-Net), a network of experts and nationwide organizations specializing in disaster waste; and providing financial support to enhance the resilience of waste disposal facilities. In addition to these activities, the ministry will also dispatch lecturers to training organized by local governments and implement model projects that will lead the way for regional efforts, among other support activities, as part of its ongoing efforts to keep enhancing national-level disaster response at all times. Other ministries will also continue their efforts to develop a wide-area disaster waste treatment system that utilizes Recycling Ports and other ports. These preparations will allow the Ministry of the Environment to maintain proper treatment of municipal and industrial waste and implement proper and swift disposal of disaster waste nationwide in large-scale disasters by—without needing to wait for a request from the local government or the Regional Environment Office governing the disaster-affected areas in the case of an urgent situation—promptly taking such actions as dispatching a support team made up of experts from D.Waste-Net and the staff from the ministry to the affected areas; implementing wide-area coordination operations including arrangements for vehicles for waste collection and hauling; building a national-level waste

treatment network including marine transportation; and providing financial support for disaster waste treatment and the recovery of damaged waste disposal facilities. In the case of a particularly severe, large-scale disaster, where a municipality cannot dispose of waste in a smooth and swift manner even with guidelines on disaster waste treatment, various forms of support, and preferential measures, there will be a system in place that enables the state to undertake disaster waste management on behalf of the municipality, among other measures, to ensure the proper and prompt disposal of the waste.

2.6. Development of Proper International Framework for Circulation of Resources and Overseas Expansion of Waste Management and Recycling Industries

【Background and issues】

As stated in Section 1.1, concerns for the global future include resource constraints which will tighten in the medium- to long-term due to increasing population and growing economies worldwide; rapid increase in the consumption of resources, generation of waste, and emission of harmful substances particularly in developing nations, which will lead to the deterioration of living environments in an increasing number of regions; increase in the improper import and export of waste and harmful substances; increase in droughts, windstorms, and floods due to the impact of climate change caused by CO_2 emissions and other factors; and marine debris which is adversely affecting marine organisms and fisheries, tourism and other sectors. Furthermore, as pointed out in Section 1.4, Japan may find itself in a position to lead the world in the area of circulation of resources because in Japan, the formation of a sound material-cycle society will be progressed: a legal system concerning resource circulation will be instituted; industries with technologies for advanced recycling and proper waste treatment—essential technologies that support a sound material-cycle society—will be agglomerated; and new markets that reflect a shift in focus in recycling from quantity to quality, such as high value-added waste disposal business and treatment and recycling of new products and materials, will be cultivated.

【Future vision】

In the light of the above-mentioned situation, a proper international framework for the circulation of resources will be built under Japan's initiative (Section 2.6.1), and Japan's prominent waste management and recycling industries[7] will be expanded overseas (Section 2.6.2), in order to create a world with high resource efficiency that will be developed sustainably with a smaller amount of resources and that will assure healthy and safe lives for current and future generations and rich ecosystems. By taking the initiative in efforts aimed at realizing this kind of world, Japan also can revitalize its economy and secure resources at the same time.

【Specifics of the future vision】

2.6.1. Development of proper international framework for the circulation of resources

Japan will lead international efforts to promote resource efficiency, the 3Rs, measures against marine debris, and proper import and export of waste, etc., while also preventing improper export of waste, etc. and facilitate proper import of waste, etc. with resource potential from nations that do not possess the capacity for proper waste treatment. These efforts will result in the development of a proper international framework for the circulation of resources.

More specifically, at the opportunities of G7 and G20 etc., Japan will lead discussions on the promotion of resource efficiency, the 3Rs, and measures against marine debris and contribute to the significant enhancement of resource efficiency worldwide, helping develop the global economy sustainably without increasing the consumption of natural resources and environmental impact. Japan will also play a major role in the prevention of illegal import and export of hazardous waste based on the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (hereinafter referred to as the "Basel Convention")[40] and other agreements by promoting proper treatment of electric, electronic, and other devices containing harmful substances as well as by strengthening border controls to prevent improper exports, among other efforts. In addition to these efforts, Japan will also contribute greatly to such international initiatives as the development of a framework for environmentally sound management (ESM) which will be instrumental in international resource circulation as well as the promotion of mutual recognition of facilities that meet ESM standards, and all these contribution by Japan will lead to the reduction of illegal import and export of waste to zero. Furthermore, international dialogs and cooperation will also be promoted at government, local government, private sector, and other levels. Such cooperation will include the formation of an international resource circulation network, in which Japanese waste management and recycling industries[7] will play a core role by actively accepting waste electronic substrates and other waste that is difficult for developing nations to properly dispose of but has resource potential.

2.6.2. Overseas expansion of waste management and recycling industries

While the environmental and economic benefits of resource circulation will be communicated internationally and grassroots-level exchanges and support aimed at enhancing citizens' environmental awareness will be implemented abroad, the overseas expansion of a package of Japan's superior framework, systems, technologies, and other innovations concerning the circulation of resources will be encouraged, contributing to the creation of a sound material-cycle society and the improvement of living environments in developing nations, as well as to the alleviation of global resource constraints.

More specifically, the long-term environmental and economic benefits of introducing Japan's prominent framework, systems, and advanced technologies will be communicated to developing nations in Asia and other regions in cooperation with international organizations to build momentum toward the creation of a sound material-cycle society globally. Furthermore, grassroots-level exchanges and support aimed at enhancing citizens' environmental awareness will be carried out in cooperation with NGOs and

other supportive organizations to increase the number of citizens who understand the importance of the creation of a sound material-cycle society and become actively involved in sorting of waste and other activities toward that end in developing nations.

These efforts will also help clarify the needs in developing nations that must be addressed to create a sound material-cycle society, and a package including all the activities required to meet such needs from feasibility study to construction and maintenance for Japan's prominent framework, systems, technologies, and other innovations will be promoted worldwide. Through this overseas expansion, Japan will support developing nations in their efforts to create a sound material-cycle society and improve their living environments, as well as help the world to alleviate resource constraints, build an international resource circulation network, and achieve economic development.

2.7. Development of Infrastructure in the Area of Recycling

【Background and issues】

As stated in Section 1.3, in the current times in which sources of added value are shifting from "things" and "money" to "human resources" and "data," the development of infrastructure for information, technology, and human resources is very important.

Also, as mentioned in Section 1.2, there is a concern that the declining population will put downward pressure on workforce supply for waste treatment and resource circulation as well as on the financial resources of local governments. In addition, as referred to in Section 1.3, while information technology is developing rapidly to spawn new industries, Japan's international competitiveness is falling.

As pointed out in Section 1.7, people are beginning to put greater stress on spiritual affluence than material affluence and prefer experiences to possessions. Individuals' interest in creating a sound material-cycle society, which was increasing until around 2009, is still not leading to actual action. At the same time, however, new diverse lifestyles—such as ones based on sharing and minimalism rather than on possessions—that may be linked to the creation of a sound material-cycle society, as well as various new attempts—for example, environmental conservation activities focusing more on fun and networking among the participants than on the activities' significance as community service or social contribution, are emerging.

【Future vision】

In the light of the above-mentioned situation, and in order to support the achievement of the future visions described in Sections 2.1 to 2.6, it is aimed to keep the information infrastructure updated with social changes at all times (Section 2.7.1), develop the necessary technologies continuously (Section 2.7.2), and nurture human resources capable of playing key roles in a sound material-cycle society (Section 2.7.3). Through these efforts, an environment that encourages various actors to take action toward creating a sound material-cycle society with a high level of awareness of its importance will be established.

【Specifics of the future vision】

2.7.1. Development of information infrastructure in the area of recycling

Information that allows for environmentally-conscious consumption of goods will be provided in an easy-to-understand manner for consumers. Such information will include information on safety (e.g. harmful substances and hazardous materials contained); information for long and appropriate use of goods (e.g. maintenance and repair methods); information for proper recycling and waste treatment (e.g. waste sorting and disposal methods); and information on the environmental impact of products throughout their lifecycle[6]. Information for reuse, sharing, remanufacturing[41], and other sustainable practices (e.g. usage of products, overhaul method, quantity and quality of recycled products and parts), as well as information required for proper recycling (e.g. quantity and quality of circulative resources[14], harmful substances contained), will be shared with relevant business operators and consumers. Electronic manifests[38], information on permits and licenses, and other big data[17] concerning waste will be utilized by relevant business operators and administrative agencies mainly to ensure proper treatment of waste and increase the efficiency of resource circulation. A business environment that facilitates waste-generating business operators and waste disposal businesses to share information, including that on proper costs, will be developed. Information used to monitor and assess material flow and stock for natural resources, circulative resources, waste, and other materials will be collected by administrative agencies supervising and research institutes and researchers studying resource circulation. All this information will be computerized and handled properly and efficiently using information technology.

2.7.2. Technological development and utilization and application of the latest technologies in the area of recycling

To achieve the future visions described in Sections 2.1 to 2.6, the development of technologies specified in the table below will be advanced by leveraging information technology and other latest technologies. Even with a declining population, Japan will show strong international competitiveness thanks to innovations derived from its information technology and other technological capabilities. A framework and technologies that ensure thorough resource circulation throughout the lifecycle[6] of new materials and products developed by the latest technologies—including ones developed in other areas—will be in place as mentioned in Section 2.3 to prevent the spread of such new materials and products from requiring the input of large amounts of natural resources, generating large quantities of waste, or causing other environmental conservation problems.

Medium- to long-term directions	Technological development examples
2.3. Thorough circulation of resources throughout the lifecycle of goods and services	・Technological development for promoting the spread of business models based on the 2Rs[43] which focus on servicizing[42], remanufacturing[41], reuse, sharing, and other sustainability practices ・Technological development for promoting the spread of bioplastics[44] ・ Development for advanced shredding and sorting technologies to optimize resource collection ・Development of 3R technologies for new products and materials that are spreading rapidly
2.4. Continued promotion of proper waste treatment and environmental restoration	・ Technological development for safe and stable operations and increased efficiency of waste disposal facilities, etc. (including AI[18] and IoT[16]) ・ Increase in the level of utilization of waste energy including increased efficiency of waste power generation ・ Technological development for facilitating the development of waste power generation networks ・Enhancement of efficiency of collection and hauling based on sensing technology ・Development of technologies for risk reduction and management for proper treatment of hazardous waste
2.5. Development of well-planned framework for disaster waste management	・Technological development for proper treatment and recycling of harmful substances, hazardous materials, and hard-to-manage waste that are expected be generated in the event of a disaster ・Upgrading of techniques for information management and sharing for disaster waste treatment based on ICT ・Development of techniques for quick estimation of generated disaster waste from satellite and aerial images

2.7.3. Development of human resources as well as dissemination and enlightenment in the area of recycling

To achieve the future visions described in Sections 2.1 to 2.6, human resources with various talents, such as specialized knowledge on waste treatment and resource circulation, the capability of coordinating among various actors to balance their different interests and help them form partnerships,

and new ways of thinking that break out of established molds to create and implement new systems, will be developed in each region and play an active role in creating a sound material-cycle society. In such a future, waste disposal businesses will also have workers with various expertise and high motivation and gain trust widely from the public as an indispensable presence in the community. The firms will also establish themselves as a significant contributor to the local economy mainly through employment and business expansion and achieve sound growth. Furthermore, everyone in each region—while they live in diverse ways—will be given abundant opportunities to learn how their lifestyles affect the environment and take part in activities to create a sound material-cycle society. They can also access necessary information to make their daily lives more environmentally-considerate and lightheartedly enjoy environmentally-sustainable lifestyles in manners that match their intention, values, and way of living. As people will deepen their awareness of their responsibility as waste generators, behaviors based on the concept of "Mottainai," where people will have gratitude and respect for the blessings from the precious earth and utilize things all the way to the end of their lifespans without wasting their essential value, will prevail across all activities in people's lives, such as selection and consumption of goods and services.

3. Indicators and Numerical Targets for Establishment of a Sound Material-cycle Society

In order to establish a sound material-cycle society, it is necessary to accurately gain an overall picture of the amounts of resources extracted, consumed, and disposed of and make the necessary improvements. As material flow indicators to obtain the overall picture allowing for further improvements, in this Fourth Fundamental Plan, "resource productivity[1]," "cyclical use rate," and "final disposal amount[3]" will be used as in the First to Third Fundamental Plans to represent the three dimensions of material flow—"inlet," "circulation," and "outlet," respectively—(primary indicators) and numerical targets are set for each of them. As for cyclical use rates, both the rates calculated with Japan's total materials input as the denominator ("cyclical use rate at inlet[2]") and the rates calculated with the generation of waste, etc. as the denominator ("cyclical use rate at outlet[45]") will be used as representative indicators, with numerical targets set for each of them.

To accurately measure and evaluate the progress of each actor's efforts to achieve the medium- to long-term directions specified in Chapter 2 and encourage their further efforts, in the Fourth Fundamental Plan, primary indicators, as well as numerical targets where possible, are set for each objective provided for each medium- and long-term direction. In the case of indicators for which no numerical targets are set, their progress will be monitored for the time being. As the primary indicators for each objective of the medium- and long-term directions, material flow indicators for the status of improvements and other conditions with regard to material flows made by actors' efforts where possible, as well as indicators for the monitored progress of actors' efforts, are set.

In addition, supplementary indicators—as specified in Exhibit 2 attached at the end of this Plan—are also set as a means of assisting the analysis of factors that have led to, and other forms of assessment of, the results of primary indicators. As with the case of primary indicators, numerical targets are set where possible, such as when they can be set based on numerical targets of primary indicators or when they are already set in other plans. In the case of supplementary indicators for which no numerical targets are set, their progress will be monitored for the time being.

As explained above, because indicators are set for each objective of the medium- to long-term directions in the Fourth Fundamental Plan, new indicators, such as "the number of local governments working toward developing a regional circulating and ecological sphere[52]," are newly added. Furthermore, to enable comparison and verification with the SDG indicators adopted by the United Nations General Assembly in July 2017 after discussions at the UN Statistical Commission and other fora, SDG indicators that are also relevant to the Fourth Fundamental Plan, such as "household food loss," are added (However, because the SDG indicator estimation method is not finalized as of this writing, comparison and verification will be performed in the light of progress of international discussions on the method). In addition, of the indicators included in the attached table of the SDGs Implementation Guiding Principles adopted by the Japanese government's SDGs Promotion Headquarters in December 2016, ones that are relevant to the Fourth Fundamental Plan, such as "Area of forests under a long term forest management plan," are added. Indicators marked with "※" in Tables 2 to 22 and Exhibit 2 are new indicators added to the Fourth Fundamental Plan.

Table 1. Definitions of indicators used in the Fourth Fundamental Plan

	Type of indicator	Primary indicator	Supplementary indicator
3.1.Indicators regarding overall picture of a sound material-cycle society	Material flow indicators	Indicators for understanding and improving overall material flows in the economic society	Indicators that supplement the primary indicators defined at left
3.2.Indicators regarding the progress of efforts toward establishing a sound material-cycle society	Material flow indicators by objective	Indicators for understanding the status of improvements and other conditions with regard to material flow in order to accurately measure and evaluate the progress of each actor's efforts to achieve the medium- to long-term directions and encourage their further efforts	Indicators that supplement the primary indicators defined at left
	Effort indicators by objective	Indicators for understanding the progress of actors' efforts in order to accurately measure and evaluate the progress of each actor's efforts to achieve the medium- to long-term directions and encourage their further efforts	Indicators that supplement the primary indicators defined at left

3.1. Indicators Regarding Overall Picture of a Sound Material-cycle Society

As stated earlier, the primary material flow indicators regarding the overall picture of a sound material-cycle society are "resource productivity[1]," "cyclical use rate at inlet[2]," "cyclical use rate at outlet," and "final disposal amount[3]."

As mentioned in Section 1.4, for a period of about a decade from 2000, the year in which the Basic Act was enacted, Japan saw a significant development in the creation of a sound material-cycle society thanks to the efforts made by various actors, with resource productivity improving by about 50% (see Figure 2), the cyclical use rate at inlet and the cyclical use rate at outlet rising by approximately 5 points (see Figure 3) and 7 points (see Figure 4), respectively, and the final disposal amount decreasing by about 70% (see Figure 5). However, in recent years, resource productivity, the cyclical use rate at inlet, and the final disposal amount have all been leveling off.

In the light of this situation, as well as under the assumption that all of the relevant actors will share the medium- and long-term directions and work toward achieving them in a steadfast manner and in

consideration of expected social and economic changes, such as a decrease in waste along with the declining population and the government's outlook for the nation's GDP, the numerical targets are set as shown in Table 2, which Japan aims to accomplish by the target year of FY2025.

Table 2. Material flow indicators (primary indicators) regarding overall picture of a sound material-cycle society and numerical targets

Indicator	Numerical target	Target year	Remarks
Resource productivity	Approx. ¥490,000/ton	FY2025	Inlet
Cyclical use rate at inlet	Approx. 18%	FY2025	Circulation
Cyclical use rate at outlet	Approx. 47%	FY2025	Circulation
Final disposal amount	Approx. 1.3 million tons	FY2025	Outlet

Figure 2. Development of resource productivity (prepared by the Ministry of the Environment)

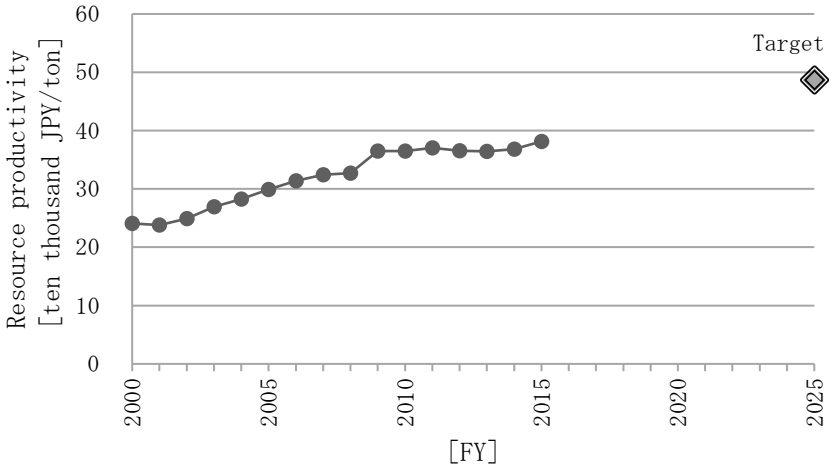


Figure 3. Development of cyclical use rate at inlet (prepared by the Ministry of the Environment)

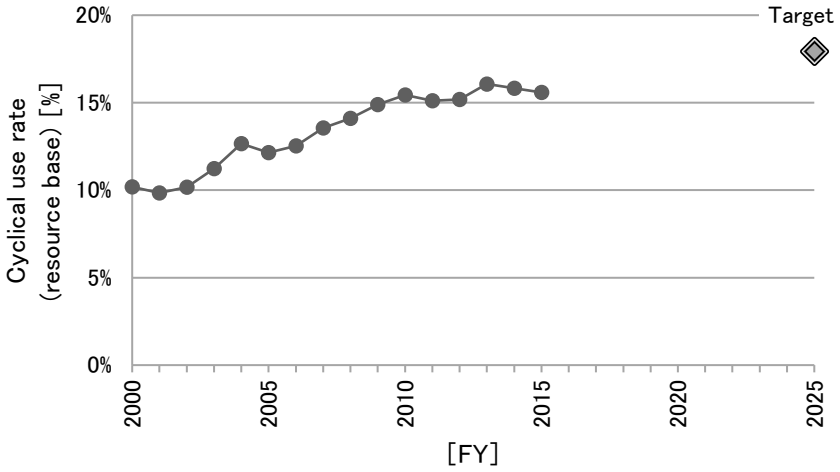


Figure 4. Development of cyclical use rate at outlet (prepared by the Ministry of the Environment)

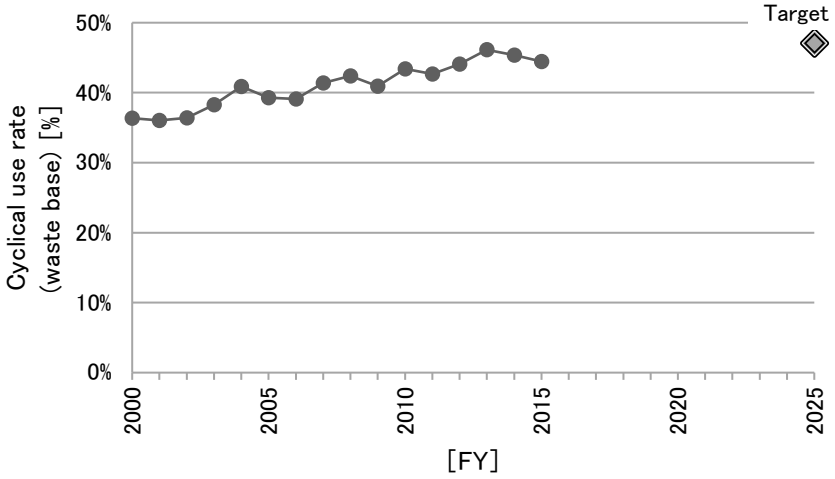
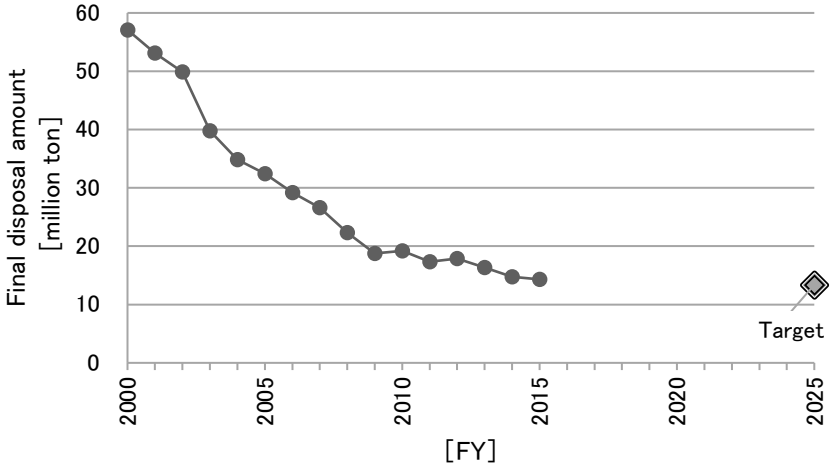


Figure 5. Development of final disposal amount (prepared by the Ministry of the Environment)



3.2. Indicators Regarding the Progress of Efforts toward Establishing a Sound Material-cycle Society

3.2.1. Indicators regarding the integration of efforts toward creating a sound material-cycle society into those for a sustainable society

Of the efforts made by the actors to address the environmental, economic, and social considerations in an integrated manner as mentioned in Section 2.1, the integration of efforts toward the environmental and economic considerations will be aimed at achieving more production with less consumption of natural resources across industry and expanding the size of the market for businesses working for a sound material-cycle society. For this objective of integrating efforts toward environmental and economic considerations, “resource productivity by industry (in terms of primary resources converted)” and “market size of business related to sound material-cycle society business” are adopted as primary indicators with the former being a material flow indicator by objective and the latter being an effort indicator by objective.

“Resource productivity by industry (in terms of primary resources converted)” is an indicator

calculated using raw material input (RMI), the estimated weight of all raw materials (primary resources) required for the production of imported products and parts. This indicator helps to grasp the amount of resources consumed in the economic activities of each industry more precisely. It should be noted that while this indicator is effective in analyzing the tendency and making comparisons within the same industry producing the same type of products, it is not suitable for comparison between fundamentally different industries.

The "market size of business related to sound material-cycle society business" was expanding between 2000 and 2008 but shrunk significantly in 2009 due to the impact of the economic recession. Although it has been on a recovery trend ever since, achieving the numerical target of almost doubling the market size by FY2020 compared to FY2000 is becoming extremely difficult. For this reason, the target year has been extended to FY2025 with the numerical target remaining the same.

Table 3. Material flow indicator by objective (primary indicator) regarding the integration of efforts toward environmental and economic considerations and its numerical target

Indicator	Numerical target	Target year	Remarks
※ Resource productivity by industry (in terms of primary resources converted)	**－**	**－**	

Table 4. Effort indicator by objective (primary indicator) regarding the integration of efforts toward environmental and economic considerations and its numerical target

Indicator	Numerical target	Target year	Remarks
Market size of business related to sound material-cycle society business	**Almost double from FY2000**	**FY2025**	

Aiming to reduce food loss[9] not just through environmental considerations but also through social considerations is important. As mentioned in Section 1.1, reducing food loss as an SDG has a possibility of leading to simultaneously accomplishing other different goals and targets such as ending hunger and partnership, as well as helping to solve environmental problems. For this target of integrating efforts toward environmental and social considerations, therefore, "generation of household food loss" and "generation of commercial food loss" are adopted as primary indicators with both together being a material flow indicator by objective.

The numerical target for the "generation of household food loss" is to decrease the generation by half compared to FY2000 by the target year of FY2030, based on the corresponding SDG's target to "By 2030, halve per capita global food waste at the retail and consumer levels." The numerical target for the "generation of commercial food loss" will be set in the basic policy for the Food Recycling Act.

Table 5. Material flow indicators by objective (primary indicators) regarding the integration of efforts toward environmental and social considerations and their numerical targets

Indicator	Numerical target	Target year	Remarks
※ Generation of household food loss	**Decrease by half from FY2000**	**FY2030**	Comparison and verification with the corresponding SDG indicator
※ Generation of commercial food loss	**To be set in the basic policy for the Food Recycling Act**		Comparison and verification with the corresponding SDG indicator

Even in the environmental considerations alone, enhancing the integration of efforts toward cyclical use, low-carbon, and harmony with nature is also important. As regards cyclical use and low-carbon, greenhouse gas emissions from the waste sector need to be reduced more than ever, while greenhouse gas emissions from other sectors will also be reduced even further through such efforts as utilizing more waste as raw materials and fuels and increasing the efficiency of waste power generation. For this objective of integrating efforts toward cyclical use and low-carbon, "emission of greenhouse gas from the waste sector" and "reduction of greenhouse gas emissions from other sectors through the utilization of waste as raw material and fuel as well as a source of power generation[46]" are adopted as primary indicators with both together being a material flow indicator by objective. The "average power generation efficiency of garbage incineration facilities constructed or improved during the specified period[47]"is also adopted as a primary indicator and an effort indicator by objective.

The indicator of "average power generation efficiency of garbage incineration facilities constructed or improved during the specified period" covers garbage incineration facilities constructed or improved between FY2018 and FY2022, and the numerical target as shown in Table 7 is set, in alignment with the Waste Treatment Facility Preparation Plan.

Table 6. Material flow indicators by objective (primary indicators) regarding the integration of efforts toward cyclical use and low-carbon and their numerical targets

Indicator	Numerical target	Target year	Remarks
Emission of greenhouse gas from the waste sector	**—**	**—**	
Reduction of greenhouse gas emissions from other sectors through the utilization of waste as raw material and fuel as well as a source of power generation	**—**	**—**	

Table 7. Effort indicator by objective (primary indicator) regarding the integration of efforts toward cyclical use and low-carbon and its numerical target

Indicator	Numerical target	Target year	Remarks
※ Average power generation efficiency of garbage incineration facilities constructed or improved during the specified period	**21%**	**FY2022**	Waste Treatment Facility Preparation Plan

As regards cyclical use and harmony with nature, it is aimed to advance the utilization of domestically-produced biomass[15] such as unused forest thinnings and proper forest maintenance. For this target of integrating efforts toward cyclical use and harmony with nature, the "ratio of domestically-produced biomass resources to total natural resources input[48]" and the "area of forests for which specific forest management plans are formulated" are adopted as primary indicators with the former being a material flow indicator by objective and the latter being an effort indicator by objective.

Table 8. Material flow indicator by objective (primary indicator) regarding the integration of efforts toward cyclical use and harmony with nature and its numerical target

Indicator	Numerical target	Target year	Remarks
Ratio of domestically-produced biomass resources to total natural resources input	―	―	

Table 9. Effort indicator by objective (primary indicator) regarding the integration of efforts toward cyclical use and harmony with nature and its numerical target

Indicator	Numerical target	Target year	Remarks
※ Area of forests for which specific forest management plans are formulated	―	―	SDGs Implementation Guiding Principles

3.2.2. Indicators regarding regional revitalization through the formation of diverse regional circulating and ecological sphere

To achieve regional revitalization through the formation of regional circulating and ecological sphere as explained in Section 2.2, it is aimed to ensure that citizens will actively work on the reduction and sorting of their garbage, among other efforts to help to decrease the generation of their household waste, that business operators will actively work on the reduction and sorting of their general business waste, among other efforts to decrease the generation of their overall business waste, and that many local governments will actively work on the formation of regional circulating and ecological sphere. For this objective of revitalizing the regions through the formation of diverse local recycling networks, "per-

capita waste generation per day[49]," "per-capita household waste generation per day[50]," and "business waste generation[51]" are adopted as primary indicators and material flow indicators by objective. The "number of local governments working on the formation of local recycling networks[52]" is also adopted as a primary indicator and an effort indicator by objective.

The numerical targets for the "per-capita waste generation per day," "per-capita household waste generation per day," and "business waste generation" are set as shown in Table 10 with the target year being FY2025. These numerical targets have been calculated with a view to achieving greater reduction levels than at present.

Table 10. Material flow indicators by objective (primary indicators) regarding regional revitalization through the formation of diverse regional circulating and ecological sphere and their numerical targets

Indicator	Numerical target	Target year	Remarks
Per-capita waste generation per day	**Approx. 850 g per capita/day**	**FY2025**	
Per-capita household waste generation per day	**Approx. 440 g per capita/day**	**FY2025**	**Basic Waste Management Policy[53]**
Business waste generation	**Approx. 1.1 million tons**	**FY2025**	

Table 11. Effort indicator by objective (primary indicator) regarding regional revitalization through the formation of diverse regional circulating and ecological sphere and its numerical target

Indicator	Numerical target	Target year	Remarks
※ **Number of local governments working on the formation of local recycling networks**	―	―	

3.2.3. Indicators regarding thorough circulation of resources throughout the lifecycle of goods and services

It is aimed to reduce the input of natural resources at inlet and promote cyclical use at outlet through thorough circulation of resources throughout the lifecycle[6] of goods and services as described in Section 2.3. The primary indicator adopted for measuring the reduction of the natural resources input at inlet is "per-capita consumption of natural resources in terms of primary resources converted[54]," while the "cyclical use rate at outlet[45]" as mentioned in Section 3.1 is adopted for the outlet. This is because the "per-capita consumption of natural resources in terms of primary resources converted" will be compared and verified with its corresponding SDG indicator, "material footprint per capita," in the light of future development of international discussions on estimation and other analysis methods for the SDG indicator.

It is also aimed to promote the development of reuse, car sharing[55], and other sharing services and the

expansion of the market in the use and distribution stages of the lifecycle described in Section 2.3, while also encouraging design for environment[22] to be adopted widely in the production stage. For this objective of promoting the thorough circulation of resources throughout the lifecycle of goods and services, the "market size of reuse," "market size of sharing (car sharing, etc.)," and "development of guidelines for product assessment (design for environment) by industries" are adopted as primary indicators and effort indicators by objective.

Table 12. Material flow indicators by objective (primary indicators) regarding the thorough circulation of resources throughout the lifecycle of goods and services and their numerical targets

Indicator	Numerical target	Target year	Remarks
Per-capita consumption of natural resources in terms of primary resources converted	―	―	**Comparison and verification with the corresponding SDG indicator**
Cyclical use rate at outlet	**Approx. 47%**	**FY2025**	As in Table 2

Table 13. Effort indicators by objective (primary indicators) regarding the thorough circulation of resources throughout the lifecycle of goods and services and their numerical targets

Indicator	Numerical target	Target year	Remarks
Market size of reuse	―	―	
Market size of sharing (car sharing, etc.)	―	―	
Development of guidelines for product assessment (design for environment) by industries	―	―	

For the promotion of the thorough recycling of materials throughout the lifecycle of goods and services described in Sections 2.3.1 to 2.3.5, it is aimed to improve the cyclical use rate of each material and reduce the generation of waste, etc. and final disposal amount[3]. For biomass[15], food loss will be reduced, while for earth, rocks, and construction materials, efforts will be made to prolong the life of facilities. For this objective of promoting the thorough recycling of materials throughout the lifecycle of goods and services, the "cyclical use rate at inlet[2] for each of the four types of resources[56] (biomass, metals, non-metallic minerals)," "cyclical use rate at outlet[45] by type of waste, etc. (plastic waste, biomass, metals, non-metallic minerals)," "final disposal amount by type of waste, etc. (plastic waste, biomass, metals, non-metallic minerals)," and "generation of household food loss," and "generation of commercial food loss" are adopted as primary indicators and material flow indicators by objective. In addition, the "establishment rate of life extension plans for individual facilities (individual facility plan)" is adopted as a primary indicator and an effort indicator by objective.

The numerical target for the “establishment rate of life extension plans for individual facilities (individual facility plan)” is set in alignment with the Priority Plan for Infrastructure Development as shown in Table 15 with the target year being FY2020.

Table 14. Material flow indicators by objective (primary indicators) regarding the thorough recycling of materials throughout the lifecycle of goods and services and their numerical targets

Indicator	Numerical target	Target year	Remarks
※ Cyclical use rate at inlet for each of the four types of resources (biomass, metals, non-metallic minerals)	**－**	**－**	
※ Cyclical use rate at outlet by type of waste, etc. (plastic waste, biomass, metals, non-metallic minerals)	**－**	**－**	
※ Final disposal amount by type of waste, etc. (plastic waste, biomass, metals, non-metallic minerals)	**－**	**－**	
Implementation rate of recycling of cyclical food resources	**Food processing 95%, food wholesale 70%, food retail 55%, food service 50%**	**FY2019**	Basic policy for the Food Recycling Act
※ Generation of household food loss	**Decrease by half from FY2000**	**FY2030**	As in Table 5; Comparison and verification with the corresponding SDG indicator
※ Generation of commercial food loss	**To be set in the basic policy for the Food Recycling Act**		As in Table 5; Comparison and verification with the corresponding SDG indicator

Table 15. Effort indicator by objective (primary indicator) regarding the thorough recycling of materials throughout the lifecycle of goods and services and its numerical target

Indicator	Numerical target	Target year	Remarks
※ Establishment rate of life extension plans for individual facilities (individual facility plan)	**100%**	**FY2020**	**Priority Plan For Infrastructure Development**

3.2.4. Indicators regarding continued promotion of proper waste treatment and environmental restoration

For the continued promotion of proper waste treatment and environmental restoration explained in Section 2.4, it is aimed to eliminate illegal dumping and improper waste treatment, encourage the use of electronic manifests[38], and secure appropriate final disposal sites. For this objective of promoting proper waste treatment and environmental restoration, the "amount of illegal dumping" and "amount of waste treated improperly" are adopted as primary indicators and material flow indicators by objective, while the "number of illegal dumping cases," "number of improper waste treatment cases," "diffusion rate of electronic manifests," "number of remaining sustainable years of municipal waste final disposal sites[57]" and "number of remaining sustainable years of industrial waste final disposal sites" are also adopted as primary indicators and effort indicators by objective.

The diffusion rate of electronic manifests has been increasing every year with an annual increment of about 5% since FY2011, reaching 53% in FY2017. As the use of electronic manifests is made partially obligatory under the revised Waste Management and Public Cleansing Act (Act No. 137 of 1970; hereinafter referred to as the "Waste Management Act"), the spread of its use will be encouraged further. Hence, the numerical target as shown in Table 17 is set with the target year being FY2022, the sixth year after the previous target year.

While the previous targets for the "number of remaining sustainable years of municipal waste final disposal sites" and the "number of remaining sustainable years of industrial waste final disposal sites" have been accomplished, renewed efforts to further reduce the final disposal amount[3] and secure final disposal sites are required because the new development of final disposal sites is becoming difficult and the impact of the renewal of infrastructure and other construction works necessitated for the Tokyo Olympics and Paralympics can be expected. For this reason, the numerical target as shown in Table 17 is set for the "number of remaining sustainable years of municipal waste final disposal sites" in alignment with the Waste Treatment Facility Preparation Plan with the target year being FY2022. Because the numerical target for the "number of remaining sustainable years of industrial waste final disposal sites" requires further examination in the light of the social trends mentioned above and the economic situation, the target for the time being as shown in Table 17 is set with the target year being FY2020. The target for FY2020 onwards will be decided later.

Table 16. Material flow indicators by objective (primary indicators) regarding the continued promotion of proper waste treatment and environmental restoration and their numerical targets

Indicator	Numerical target	Target year	Remarks
Amount of illegal dumping	**－**	**－**	
※ Amount of waste treated improperly	**－**	**－**	

Table 17. Effort indicators by objective (primary indicators) regarding the continued promotion of proper waste treatment and environmental restoration and their numerical targets

Indicator	Numerical target	Target year	Remarks
Number of illegal dumping cases	**－**	**－**	
※ Number of improper waste treatment cases	**－**	**－**	
Diffusion rate of electronic manifests	**70%**	**FY2022**	
※ Number of remaining sustainable years of municipal waste final disposal sites	**Maintain the same level as in FY2017 (20 years)**	**FY2022**	**Waste Treatment Facility Preparation Plan**
※ Number of remaining sustainable years of industrial waste final disposal sites	**The number of years required for the final disposal of 10 years' worth of volume of waste**	**FY2020**	**Basic Waste Management Policy[53]**

3.2.5. Indicators regarding the development of well-planned framework for disaster waste management

For the development of a well-planned framework for disaster waste management as explained in Section 2.5, it is aimed to increase the ratio of local governments with a disaster waste management plan—which constitutes the basis of a disaster waste management framework—in place to the total number of local governments. Therefore, for this objective of developing a well-planned framework for disaster waste management, the ratio is adopted as a primary indicator and an effort indicator by objective. As stated in Section 1.6, the target ratio of 60% on the municipality level, which municipalities were expected to fulfill by 2018, is becoming extremely difficult to achieve due to their lack of knowledge of disaster waste and for other reasons. It has therefore been decided to extend the target year to FY2025 to allow municipalities to continue to pursue their efforts to achieve the numerical target of 60%. When it comes to prefectural governments, on the other hand, the ratio is 57% as of the end of

FY2016. The formulation of disaster waste management plans by prefectural governments is essential to encourage municipalities to do the same, and thereby accelerating the construction of disaster waste management frameworks on the local government level. For this reason, the target ratio for prefectures is set at 100% with the target year being FY2025.

Table 18. Effort indicator by objective (primary indicator) regarding the development of well-planned framework for disaster waste management and its numerical target

Indicator	Numerical target	Target year	Remarks
※ Ratio of local governments with a disaster waste management plan in place	**Prefectural governments: 100% Municipalities: 60%**	**FY2025**	**National resilience plans**

3.2.6. Indicators regarding the development of proper international framework for circulation of resources and overseas expansion of waste management and recycling industries

For the development of a proper international framework for the circulation of resources and overseas expansion of waste management and recycling industries[7] as explained in Section 2.6, it is aimed to promote international cooperation in environmental areas including resource circulation and overseas business expansion of waste management and recycling industries. For this objective, the “number of nations with which a memorandum of understanding or other agreement on environmental cooperation (including that for resource circulation) is signed” and the “number of project of overseas expansion of waste management and recycling industries” are adopted as primary indicators and effort indicators by objective.

Table 19. Effort indicators by objective (primary indicators) regarding the development of a proper international framework for circulation of resources and overseas expansion of waste management and recycling industries and their numerical targets

Indicator	Numerical target	Target year	Remarks
※ Number of nations with which a memorandum of understanding or other agreement on environmental cooperation (including that for resource circulation) is signed	―	―	
※ Number of projects of overseas expansion of waste management and recycling industries	―	―	

3.2.7. Indicators regarding the development of infrastructure in the area of recycling

To promote the development of information infrastructure in the area of recycling as mentioned in Section 2.7.1, there is a need to further accelerate the use of electronic manifests[38] which provide basic data. For this objective, therefore, the "diffusion rate of electronic manifests," which is referred to in Section 3.2.4 as well, is adopted as a primary indicator and an effort indicator by objective.

Table 20. Effort indicator by objective (primary indicator) regarding the development of information infrastructure in the area of recycling and its numerical target

Indicator	Numerical target	Target year	Remarks
Diffusion rate of electronic manifests	**70%**	**FY2022**	**As in Table 17**

There is also a need to provide continuous support for high-quality research that will support technological development in the area of recycling as mentioned in Section 2.7.2. For this objective, the "ratio of research projects with the result of ex-post evaluation being S or A in the Environment Research and Technology Development Fund (ERTDF) program (sound material-cycle field)" is adopted as a primary indicator and an effort indicator by objective.

Table 21. Effort indicator by objective (primary indicator) regarding technological development and utilization and application of the latest technologies in the area of recycling and its numerical target

Indicator	Numerical target	Target year	Remarks
※ Ratio of research projects with the result of ex-post evaluation being S or A in the Environment Research and Technology Development Fund (ERTDF) program (sound material-cycle field)	―	―	

Through the development of human resources as well as dissemination and enlightenment in the area of recycling as explained in Section 2.7.3, it is desired that citizens' awareness and behavior for a sound material-cycle society should be enhanced. The Third Fundamental Plan aimed to achieve the following two targets: (1) to raise the level of public awareness on waste reduction, cyclical use, and green purchase[58] to about 90% of respondents of surveys and polls on their awareness and behavior toward establishing a sound material-cycle society; and (2) to increase the ratio of citizens who conduct some kind of specific 3R activities by 20% compared to the results of the poll executed in FY2012[59]. However, these targets have yet to be accomplished, necessitating further efforts to achieve them.

For this reason, the same indicators as in the Third Fundamental Plan—"reduction of waste generation and awareness for cyclical use and green purchase" and "implementation rate of specific 3R actions"—are adopted as primary indicators and effort indicators by objective. The numerical targets are also the same as shown in Table 22 with the target year being FY2025.

Table 22. Effort indicators by objective (primary indicators) regarding the development of human resources as well as dissemination and enlightenment in the area of recycling and their numerical targets

Effort indicator by objective	Numerical target	Target year	Remarks
Reduction of waste generation and awareness for cyclical use and green purchase	**Approx. 90%**	**FY2025**	
Implementation rate of specific 3R actions	**Increase by approx. 20% from the FY2012 poll**	**FY2025**	

3.3. Issues that Need to Be Addressed

3.3.1. Data management for indictors

To accurately monitor the status of Japan's material flows, the proper management of data on amounts

of cyclical use must be carried on. Because comprehensive data on amounts of cyclical use at inlet and amounts of circulative resources[14] that are legally not regarded as waste are particularly difficult to be obtained by waste departments of local governments alone, collaborative effort with other related departments for data management will be promoted.

Furthermore, because efforts toward the formation of local recycling networks are expected to be diversified, while a variety of new businesses are expected to be established to expand the size of the sound material-cycle society business market, methods for proper data management which are abreast with such changing trends will be explored and reviewed flexibly. Methods for evaluating such efforts and various effects brought about by such businesses will also be examined.

Methods for the proper management of data on material flows for solar panels and other new diffusing products will also be explored to promote such data management.

3.3.2. Improvement of indicator estimation methods

To more accurately estimate the share of imports in the raw material input (RMI), or the weight of raw materials (primary measures) required for the production of imported products, an improved method will be explored in the light of international trends.

Except for the utilization of waste as raw material and fuel as well as a source of power generation, efforts to reduce greenhouse gas emissions in the waste sector, such as Reduce, Reuse, sharing, and material recycling, are currently not taken into account for the estimation of the reduced amount of emissions. Therefore, methods to estimate the effect of those efforts will also be explored.

The low birthrate, aging population, the depopulation, and other social changes are expected to generate such tendencies as a change in the quality and quantity of waste and a decrease in the demand for circulative non-metallic mineral resources due to dwindling construction demand. The existing estimation methods will be reviewed to reflect these changes.

3.3.3. International comparison of indicators

In the light of the development of SDG indicators and the progress in the discussion among G7 and G20 nations regarding resource productivity, Japan's indicators will be compared with their international counterparts and reviewed for improvement as necessary.

Furthermore, because the industrial structure and the envisioned system of a sound material-cycle society differ largely among nations depending on their social and economic situations as well as their own circumstances that have created the need to develop a sound material-cycle society, international comparison based simply on a single indicator may lead to incorrect evaluation results regarding each nation's current status of the formation of such society. For instance, it is not fair if a comparison is made based on an indicator of mere cyclical use rate at outlet[45]—without taking thermal recycling into account—between a nation that used to rely almost 100% on direct landfill disposal and is now advancing cyclical use and a nation like Japan where a system has already been in place to incinerate almost all combustible waste in a hygienic manner and efforts are now being made to promote the use

of waste heat for power generation and other purposes. For this reason, a method that enables more comprehensive international comparison by using the cyclical use rate at outlet with thermal recycling also taken into account, direct landfill amount, and other indicators, will be examined.

3.3.4. Development of new indicators

As stated in Section 2.2, to ensure that the stock built up in the regions will be managed properly and used wisely for as long as possible to reduce resource input and waste generation, it is important to monitor the stock accumulated in society, as well as material flows. For this reason, while the classification of stock will be progressed, the development of indicators regarding the volume of stock accumulated in Japan by type and their usefulness, among others, will be examined.

To allow each actor to evaluate and improve their efforts toward creating a sound material-cycle society, indicators that clearly show their achievements are necessary. Therefore, indicators, such as ones that enable business operators to voluntarily measure how much they are decreasing their resource input and enhancing their productivity as well as that allow financial institutions, investors, and others who need to make decisions on their investments to evaluate the difficulty in securing resources, generation of hazardous waste, and other risks, will be explored.

4. Cooperation among Actors and Their Respective Roles

4.1. Cooperation among Actors

To create a sound material-cycle society, the state, local governments, citizens, NPOs, NGOs, business operators, and various other actors need to fulfill their respective roles. However, in order to bring together and make the most of knowledge and wisdom of these actors to keep their activities moving ahead, it is also essential for them not just to take action individually but also to work in cooperation toward solving problems.

Particularly during the process from the formulation to implementation of measures of the state and local governments, it is important to facilitate various actors to take part in the process and work closely together. For activities that require international cooperation, it is indispensable for participating actors to share information, exchange opinions vigorously, and unite their efforts that go beyond the boundaries between public and private sectors.

Furthermore, to integrate the efforts toward creating a sound material-cycle society into those for a sustainable society as stated in Section 2.1, it is important not just to work with actors in charge of recycling but also to cooperate closely with actors in charge of other environmental fields, such as low carbon and harmony with nature, actors in charge of economic fields, such as resources, industry, agriculture, forestry, and fisheries, and actors in charge of social fields, such as welfare and education. In the course of cooperating with each other, actors may face various challenges, including trade-offs among their objectives and efforts, collisions of their interests, technological problems, and high costs. To overcome such challenges, participating actors must bring together their wisdom to break through

technological and economic barriers and address the environmental, economic, and social considerations in an integrated manner.

To meet the above-mentioned needs, the state must coordinate the cooperation among the related government agencies as well as with local governments, business operators, NPOs, NGOs, and other relevant actors, and gather, compile, and widely disseminate information on successful advanced practices undertaken through the cooperation among the actors.

4.2. Role of Each Actor

4.2.1. Roles of the state

The state will, while promoting partnership with relevant actors, lead nationwide efforts toward establishing a sound material-cycle society by introducing and reviewing regulatory, economic, and other measures appropriately in response to changing circumstances.

At the same time, the state will promote proper operation of various legal systems and effective and efficient implementation of projects in accordance with the Basic Environment Act (Act No. 91 of 1993) and the Basic Act and through the government's collective efforts that fully mobilize cooperation among the government agencies.

The state will also, as a purchaser of goods and services like any other business operator, take the lead in the procurement in favor of reuse, recycled and other environment-friendly products through such means as green purchase[58] and green contracts, among other actions that will lead to the creation of a sound material-cycle society. When having to use natural resources, the state is also expected to choose suppliers with less alteration of nature, energy consumption, and environmental burden during extraction, transportation, and other operations.

More specific actions taken by the state to achieve the visions introduced in Sections 2.1 to 2.7 are described in Section 5.

4.2.2. Expected roles of local governments

Local governments will play the core role in establishing a sound material-cycle society in their respective regions and are expected to play an important role in ensuring proper cyclical use and disposal of waste and coordinating among participating actors.

Prefectural governments are expected to function as a coordinator for the municipalities in their jurisdiction from a broad perspective, while municipalities are expected to build a community-based recycling system that fully matches their local residents' lifestyles.

More specifically, with the aim of revitalizing their respective regions through the formation of diverse regional circulating and ecological sphere as explained Section 2.2, local governments are expected to play the central role in analyzing the status of circulative resources[14], renewable resources, and stock resources in their regions, constructing a system that facilitates cooperation with local residents, business operators, NPOs, NGOs, experts, and other actors, and leading the creation of a regional circulating and ecological sphere that reflects the local characteristics.

With the aim of ensuring thorough circulation of resources throughout the lifecycle[6] of goods and services as explained in Section 2.3, local governments are expected to support small and medium-sized enterprises, NPOs, NGOs, and others engaging in 3R activities; encourage the expansion of new sustainable businesses, which include such services as the inspection/repair/replacement/reuse of goods and sharing; and recommend and provide information on environmentally-considerate green products and services and locally-produced products.

Local governments are also expected to: (1) in terms of plastics, notify the public of the importance of reducing the discharge of plastic waste, ensure thorough sorted collection of PET bottles and plastic containers and packaging based on the Act on the Promotion of Sorted Collection and Recycling of Containers and Packaging (Act No. 112 of 1995; hereinafter referred to as the "Container and Packaging Recycling Act"), and promote measures to reduce the generation of plastic waste for each river basin to prevent the waste from discharging into rivers and the sea; (2) in terms of biomass[15], promote region-wide activities to reduce food loss[9] while also advancing the utilization of biomass in the region, such as the recycling of raw garbage and other waste for which recycling is scarcely performed at present, and further expansion of thermal recycling; (3) in terms of metals, notify the residents of how small waste home appliances are collected under the Act on Promotion of Recycling of Small Waste Electrical and Electronic Equipment (Act No. 57 of 2012; hereinafter referred to as the "Small Home Appliance Recycling Act") and provide a collection method highly convenient for residents, among other measures aimed at promoting the recycling of metals; and (4) in terms of earth, rocks, and construction materials, further promote the recycling of construction materials through, for example, the preferential use of recycled materials mainly for public works projects.

In addition to exerting the above-mentioned, material-by-material efforts, local governments are also expected to develop a system for collecting specified home appliances waste that retailers are not obliged to take back under the Act on Recycling of Specified Kinds of Home Appliances (Act No. 97 of 1998; hereinafter referred to as the "Home Appliance Recycling Act").

As in the case of the state, as a purchaser of goods and services like any other business operator and because of their responsibility to conserve nature and promote industry in their regions, local governments are also expected to take the lead in procurement in favor of reuse, recycled and other environment-friendly products through such means as green purchase[58] and green contracts, among other actions that will lead to the creation of a sound material-cycle society. When having to use natural resources, local governments are also expected to choose suppliers with less alteration of nature, energy consumption, and environmental burden during extraction, transportation, and other operations.

To ensure continued promotion of proper waste treatment and environmental restoration as explained in Section 2.4, local governments are expected to achieve: (1) strict enforcement of sorted collection of waste; (2) reduction of waste through, for example, the shift to charged municipal waste treatment services; (3) introduction and public disclosure of waste accounting; (4) further promotion of thermal recycling for waste power generation and production of methane from food waste; (5) proper management and monitoring of harmful substances; (6) provision of guidance and training for waste

disposal businesses and reuse and recycling business operators in the region as well as thorough guidance for waste-generating business operators regarding their responsibility; (7) provision of guidance for entities committing illegal waste treatment; (8) implementation of measures to collect and treat marine debris as well as to reduce the generation of marine debris in each river basin (including the surrounding land areas) to prevent it from discharging into the rivers or the sea; (9) removal of threats to the conservation of living environments posed by waste dumped illegally or treated improperly; and (10) implementation of countermeasures against abandoned dwellings under the Empty Dwellings Act.

To develop a well-planned framework for disaster waste management as explained in Section 2.5, local governments are expected to build a system that allows them to maintain proper treatment of municipal and industrial waste and implement proper and swift disposal of disaster waste in many large-scale disasters without relying on the state. Toward this end, they will make various preparations ahead of disasters, which include the formulation of a disaster waste management plan, enhancement of resilience of municipal waste treatment facilities at an early stage, building of a system that allows for collaboration with relevant organizations, other local governments, Regional Environment Office, and other actors; and implementation of training for their staff.

To promote a proper international framework for circulation of resources and overseas expansion of Japan's waste management and recycling industries[7] as explained in Section 2.6, local governments are expected to take measures for the proper storage of mixed metal scrap[60] and other hazardous waste equipment under the Waste Management Act revised in 2017, while also supporting the overseas expansion of waste management and recycling industries in their regions.

To develop infrastructure in the area of recycling as explained in Section 2.7, local governments are expected to, among others, keep updated with information on waste, etc., promote the computerization of information on permits and licenses and diffusion of electronic manifests[38], and provide the public in their regions with opportunities to receive environmental education and learn about the environment.

4.2.3. Expected roles of citizens

Citizens are expected to behave in a manner based on the recognition that they are a generator of waste, etc. themselves and responsible for the environmental loads produced by themselves and that they are a key player in the creation of a sound material-cycle society, as well as to work on changing their lifestyles to ones with less environmental impact.

As the Act on Promotion of Consumer Education (Act No. 61 of 2012) which came into effect in December 2012 stipulates, citizens as consumers are also expected to aspire to establish a consumer citizen society in which "consumers actively commit themselves to the creation of a just and sustainable society with mutual respect for the individuality of each consumer, as well as the diversity of consumer lifestyles and with an awareness of how their own consumption behavior could influence social and economic trends both at home and abroad, and the global environment at present as well as over future generations."

To support regional revitalization through the formation of diverse regional circulating and ecological

sphere as explained in Section 2.2, citizens are expected to cooperate with activities toward creating a regional circulating and ecological sphere through, for example, sorted discharge of residential waste that can be utilized as circulative resources[14] and active use of recycled products produced from circulative resources.

To support thorough circulation of resources throughout the lifecycle[6] of goods and services as explained in Section 2.3, citizens are expected to show environmentally-conscious consumption behaviors, which include (1) refraining from purchasing unnecessary things; (2) actively using such services as rental, leasing, sharing, and secondhand goods trading; (3) reducing waste containers and packaging by carrying their own shopping bags and bottles and choosing products with less packaging; (4) reducing food loss[9] by, for example, using up all ingredients and avoiding being excessively sensitive to freshness; (5) preferentially purchasing products made from wood and other renewable resources and recycled products; and (6) extending the life of goods to use them for as long as possible by, for example, using them carefully and utilizing maintenance and repair services. As a generator of waste, citizens are also expected to reduce and sort waste before discharging and actively cooperate with proper collection of resources, such as waste container and packaging collection at stores, waste paper group collection, small waste home appliance collection, and waste home appliance collection by retailers.

To support continued promotion of proper waste treatment and environmental restoration as explained in Section 2.4, citizens are expected to, among others, (1) discharge waste properly in accordance with the rules established by the local government; (2) avoid using business operators who collect and dispose of disused articles and bulky waste illegally; (3) be careful not to pollute the environment by littering and other environmental blights; and (4) properly maintain buildings, land, and others occupied or managed by individual citizens to keep them hygienic.

To support the development of a well-planned framework for disaster waste management as explained in Section 2.5, citizens are expected to cooperate with proper and swift disposal of disaster waste in their region, which includes understanding and cooperating with their local government in its formulation of a disaster waste management plan and other pre-disaster preparations, as well as proper discharge of waste in the event of a disaster.

To support the development of a proper international framework for the circulation of resources as explained in Section 2.6.1, citizens are expected to take such an attitude to avoid using business operators who collect and dispose of disused articles and bulky waste illegally so that the waste will not be exported improperly.

To support the development of human resources as well as dissemination and enlightenment in the area of recycling as explained in Section 2.7.3, every citizen is expected to be interested in the environment and resource circulation in their region and take particular actions, such as actively taking part in environmental education, environmental learning, and other environmental conservation activities, as well as cooperating with activities of NPOs, NGOs, and other private bodies.

4.2.4. Expected roles of NPOs, NGOs, etc.

The roles of NPOs, NGOs, and other private bodies are not just to conduct activities instrumental in creating a sound material-cycle society and engaging in community business or other initiatives in their regions. They are also expected to evaluate the economic and social activities of each actor from the viewpoint of whether or not they contribute to a sound material-cycle society and encourage the actors to improve their activities, as well as to promote actors' understanding of and involvement in the creation of a sound material-cycle society and coordinate their collaboration.

More specifically, for regional revitalization through the formation of diverse regional circulating and ecological sphere as explained in Section 2.2, private bodies are expected to leverage their capabilities to gather and disseminate information, their expertise, networks, and other unique strengths to perform various actions, including drawing up plans that cannot be devised by the government alone; encouraging relevant actors to collaborate, building a system of such collaboration, and continuously evaluating how it is working; and working toward the development of regional circulating and ecological sphere.

For the thorough circulation of resources throughout the lifecycle[6] of goods and services as explained in Section 2.3, private bodies are expected to, among others, promote reuse, sharing and the like by organizing flea markets or on other occasions, conduct activities instrumental in reducing food loss[9], such as organizing food banks[61] and food drives[62], and evaluate, and propose improvement ideas for, resource circulation initiatives taken by business operators and other actors striving to achieve thorough resource circulation.

For the continued promotion of proper waste treatment and environmental restoration as explained in Section 2.4, private bodies are expected to, among others, keep an eye on illegal dumping, improper waste treatment, and other offenses, conduct cleanups of city streets, rivers, coasts, and other places, investigate and analyze the status of littering, and other environmental conditions, and work to address the abandoned dwelling issue through such means as the collection and sharing of information on abandoned houses and the restoration of *kominka* or historical folk houses.

For the development of a well-planned framework for disaster waste management as explained in Section 2.5, private bodies are expected to support pre-disaster preparations and post-disaster waste management with the former including the building of collaboration with the municipalities responsible for disaster waste management and the latter including providing comprehensive and meticulous support, such as cleaning up affected houses and taking out trash.

For the development of a proper international framework for the circulation of resources and the overseas expansion of recycle industries[7] as explained in Section 2.6, private bodies are expected to take advantage of their own international networks to conduct various cross-border activities, including the investigation of international resource circulation, proposals for developing proper international resource circulation systems, and implementation of and support for grassroots-level exchanges.

For the development of infrastructure in the area of recycling as explained in Section 2.7, private bodies are expected to conduct such activities as the collection and delivery of in-depth information on

the resource circulation of their regions, review of local residents' lifestyles, dissemination and enlightenment regarding regional environmental conservation which includes the promotion of the 3Rs, and the provision of environmental education and learning opportunities.

4.2.5. Expected roles of universities and other academic and research institutions

Universities and other academic and research institutions are expected to enhance their academic and specialized knowledge, and provide objective and reliable information in an easy-to-understand manner, thereby encouraging and supporting decision-making on policies for the establishment of a sound material-cycle society and each actor's concrete actions.

More specifically, to support regional revitalization through the formation of diverse regional circulating and ecological sphere as explained in Section 2.2, the institutions are expected to, among others, research and develop technologies for the analysis of the status of, and the utilization of, circulative resources[14], renewable resources, and stock resources in their regions; support the building of cooperation with local residents, business operators, NPOs, NGOs, experts, and others to bring together these actors' expertise; and evaluate, and recommend improvement for, activities toward the creation of a regional circulating and ecological sphere.

To support the thorough circulation of resources throughout the lifecycle[6] of goods and services as explained in Section 2.3, the institutions are expected to conduct various activities that include the following: (1) research on, as well as analysis and projection of the current and future status of, the recycling of material flows and stock; (2) research and technological development that support new services (the inspection/repair/replacement/reuse of goods, sharing services, etc.), design for environment[22] and other upstream activities, and advanced recycling of waste, etc.; (3) evaluation of activities performed for the thorough recycling throughout the lifecycle of goods and services and proposal for improvement; and (4) evaluation of environmentally-considerate green products and services.

To support the continued promotion of proper waste treatment and environmental restoration as explained in Section 2.4, the institutions are expected to perform, among others, (1) research and technological development for advancing and automating techniques for understanding and forecasting the current and future distribution of harmful substances, marine litter, and other pollutions in the environment, and assessing and monitoring their impact on ecosystems; (2) research on social systems for proper collection, hauling, and treatment of waste; (3) research and technological development for proper treatment of waste; and (4) research and technological development for the removal of threats to the conservation of living environments posed by waste dumped illegally or treated improperly.

To support the development of a well-planned framework for disaster waste management as explained in Section 2.5, the institutions are expected to conduct various research and technological development activities including ones that support the estimation of the generation and the management capacity of disaster waste, proper storage of disaster waste, proper treatment of hard-to-manage disaster waste, and recycling and utilization of disaster waste, while also providing the necessary technical knowledge to

local governments and others involved in the construction of a disaster waste management framework and supporting their human resources development and other efforts.

To support the development of a proper international framework for the circulation of resources and the overseas expansion of waste management and recycling industries[7] as explained in Section 2.6, the institutions are expected to implement various activities including the following: (1) research on, as well as analysis and projection of the current and future status of, the international recycling of material flows and stock; (2) international research on frameworks and companies' initiatives in each country regarding resource efficiency, the 3Rs, and marine litter; (3) research on waste treatment in developing countries and technological assistance for the creation of a sound material-cycle society in those countries; and (4) technological assistance for NGOs providing overseas support and waste management and recycling industries aspiring to international expansion.

To support the development of infrastructure in the area of recycling as explained in Section 2.7, the institutions are expected to play a core role in the development of data and technologies in the area of recycling as an independent, specialized expert in order to support innovation toward creating a sound material-cycle society in Japan. They are also expected to communicate their academic and technical knowledge to citizens in an easy-to-understand manner, while also actively functioning as a coordinator for the collaboration among actors and working on environmental conservation and human resources development, among other activities, in their regions.

4.2.6. Expected roles of business operators

Producers, etc. are expected to fulfill their social responsibilities, which is considered crucial to sustainable development, by performing their business activities with due consideration to the environment. It is particularly important for them to meet the responsibility of waste-generating business operators[20] by fully complying with laws and preventing illegal dumping and improper waste treatment. They are also expected to fulfill their extended producer responsibility[21] by playing their part in realizing appropriate cyclical use and disposal of end-of-life products, while also making efforts to disclose information and otherwise increase transparency.

Waste disposal businesses are expected to, among others, handle waste as valuable resources and actively extract useful resources from waste for cyclical use, while ensuring the conservation of the surrounding living environment and the improvement of sanitary conditions.

Financial institutions and investors are expected to play such roles as adequately financing companies and NPOs striving to establish a sound material-cycle society and projects that will lead to such a society.

Apart from the above-mentioned efforts by individual businesses, efforts by trade associations are also important. On top of the efforts to reduce the final disposal amount[3] that have been made successfully to date, trade associations are expected to further deepen their industry-wide efforts by, among others, voluntarily setting targets—such as one for resource productivity—that match the circumstances of each industry.

More specifically, to support regional revitalization through the formation of diverse regional

circulating and ecological sphere as explained in Section 2.2, producers, etc. are expected to actively utilize circulative resources[14] as raw materials for their products and as a source of energy and strictly sort their waste to fulfill their responsibility as a generator of waste. Waste disposal and recycling businesses are expected to recycle waste, etc. properly. Financial institutions are expected to leverage their consulting function to act as a coordinator who connects different actors, such as waste-generating business operators, waste disposal and recycling businesses, and recycled product-user companies.

To support the thorough circulation of resources throughout the lifecycle[6] of goods and services as explained in Section 2.3, at the use and distribution stages, producers, retailers, rental and leasing services, venture enterprises, and other businesses are expected to develop and expand new business models—such as ones based on the inspection/repair/replacement/reuse of goods and sharing services[19] —by procuring funds from financial institutions and investors, rather than relying entirely on traditional business models centering around mass-production and mass-sales. Retailers, who are close to consumers, are expected to promote, among others, (1) active sales of reuse and recycled products; (2) less packaging; (3) reduced use of plastic bags and encouragement of shoppers to bring their own shopping bags; and (4) collection of milk cartons, PET bottles, food containers, and small home appliances within their shops.

At the production stage, producers, etc. are expected to work on such activities as (1) optimization of the volume and timing of production; (2) thorough implementation of design for environment[22] and indication of raw materials used; (3) replacement of disposable products with products for repeat use; (4) promotion of less packaging; (5) utilization of recycled materials; and (6) efficient use of resources and energy. Of these, the thorough implementation of design for environment is particularly important because, for example, the reduction of the weight of products at the manufacturing stage will result in the decrease in resource input and waste generation. The indication of raw materials used and easy-to-scrap design will also lead to efficient reuse and recycling.

At the stage of securing of resources, producers, etc. are expected to increase the ratio of circulative resources and renewable resources to total resources used to the maximum level, and, where the use of natural resources is inevitable, choose suppliers whose operations, such as mining and transportation, require the minimum alternation of nature and energy consumption and generate the minimum environmental impact.

To achieve the optimization throughout the above-mentioned lifecycle, producers and retailers in particular are expected to play a leading role. Financial institutions and investors are also expected to decide where to invest their funds in consideration of resource productivity and other environmental performance and provide funds to businesses that will lead to thorough circulation of resources throughout the lifecycle of products and services.

At the disposal stage, waste disposal and recycling businesses are expected to properly implement reuse, recycling, energy collection, intermediate treatment, and final disposal, among other recovery and disposal operations for waste generated from each stage.

Efforts expected to be made regarding different materials include the following: (1) as for plastics,

the use of bioplastics[44] and recycled plastics by producers, etc., the reduction of plastic containers, packaging, and bags as well as the collection of food containers and other waste by retailers, etc. and the recycling of plastic waste and the development of high added-value recycled plastics by recycling businesses, etc.; (2) as for biomass[15], the use of wood as materials for products and biomass as fuels by producers, etc., the reduction of food loss[9] and the recycling of food waste by food businesses, and the conversion of food waste to fertilizer, feed, and biogas by recycling businesses; (3) as for metals, the sorted collection by recycling businesses, etc. and the expanded and advanced use of recycled metals for electric furnace steel and other materials through the collaboration of producers, etc. and recycling businesses, etc., (4) as for earth, rocks, and construction materials, the prevention of generation of construction and demolition waste(CDW)and the use of recycled CDW by construction businesses, etc., the repair of existing houses by housing renovation businesses, etc., the sorting of demolition waste by demolition businesses, etc., and the recycling of CDW by recycling businesses; and (5) as for newly spreading products and materials, the construction of systems for proper reuse, recycling, and disposal through collaboration among related businesses.

For the continued promotion of proper waste treatment and environmental restoration as explained in Section 2.4, all business operators are expected to, among others, (1) dispose of waste properly in compliance with the Waste Management Act and other relevant regulations; and (2) properly maintain buildings, land, and others occupied or managed to keep them hygienic. Waste-generating business operators, etc. are expected to fully fulfill their responsibility by, for example, actively utilizing electronic manifests[38] and otherwise strengthening their traceability[39] as well as by outsourcing industrial waste treatment to trustworthy contractors. Waste disposal businesses are expected to handle waste as valuable resources and actively extract useful resources from waste for cyclical use, while ensuring the conservation of the surrounding living environment and the improvement of sanitary conditions. Industrial waste disposal businesses certified as excellent by the certification system established under the Waste Management Act are also expected to actively disseminate information.

For the development of a well-planned framework for disaster waste management as explained in Section 2.5, waste disposal, recycling, cement, transportation, and other businesses that are capable of collecting, hauling, and treating disaster waste are expected to build collaboration with their respective local governments in advance before a disaster strikes by signing an agreement or in any other forms to ensure that they can cooperate with the proper and swift disposal of waste on the occurrence of a disaster. Business operators owning unused land are expected to cooperate with their local government by making such land available for the temporary storage of disaster waste or other purposes.

For the development of a proper international framework for the circulation of resources and the overseas expansion of waste management and recycling industries[7] as explained in Section 2.6, all business operators involved in international resource circulation are expected to assure proper international resource circulation by complying with the Waste Management Act and the Act on Control of Export, Import and Others of Specified Hazardous Wastes and Other Wastes (Act No. 108 of 1992; hereinafter referred to as the “Basel Act”). Business operators with an international supply chain are

expected to maintain proper international resource circulation by observing the laws and regulations of each country across their supply chain. Waste disposal and recycling businesses with advanced technology are expected to actively accept harmful substances and waste that are difficult for developing nations to properly dispose of but has resource potential, while also contributing to advancing waste and 3R technologies in Asia and other nations, in order to expand their business overseas.

For the development of infrastructure in the area of recycling as explained in Section 2.7, in order to advance information infrastructure, producers and distributors, etc. are expected to provide consumers with safety information as well as information on ways to extend the life of goods to enable their use for as long as possible, proper recycling and waste management, and environmentally-considerate consumption, in an easy-to-understand manner. It is also expected that information necessary for reuse, sharing[19], remanufacturing[41], and proper recycling will be shared between related businesses and consumers. Furthermore, waste-generating business operators and waste disposal businesses are expected to share information particularly on proper expenses.

In order to advance technological development in the area of recycling, business operators are expected to keep evolving their resource circulation, waste treatment, and other technologies and properly manage them as their intellectual properties. At the same time, it is expected that technologies that can form the basis of and otherwise support a broad range of applications will be shared among as many business operators as possible. Business operators are particularly expected to drive innovations that will enhance Japan's resource productivity[1] significantly based on their information technology and other advanced technological capabilities.

In order to develop human resources as well as dissemination and enlightenment in the area of recycling, business operators are expected to nurture talents who are capable of supporting their business and efforts toward creating a sound material-cycle society. They are also expected to exert efforts to local residents' and other publics' understanding of their business and activities toward creating a sound material-cycle society by inviting the public to join a factory tour or other events, providing the public with easy-to-understand information, and through other means, while also working to promote dissemination and enlightenment toward establishing a sound material-cycle society. Furthermore, as part of their social contribution activities, they are expected to help develop human resources in the area of recycling and be involved in environmental conservation through collaboration with NPOs, NGOs, and other bodies.

5. State Initiatives

In light of the issues raised in Section 1, the state will take actions as stated below by around 2025 to achieve the numerical targets specified in Section 3 and realize the future visions described in Section 2.

5.1. Integration of Efforts toward Creating a Sound Material-cycle Society into Those for a Sustainable Society

(Addressing environmental, economic, and social considerations in an integrated manner)

○ Create an independent and distributed society which utilizes circulative, renewable, and stock resources as well as the region's human resources and funds in a way that matches the region's characteristics, while developing regional circulating and ecological sphere in which the region and its neighboring regions will complement each other in their efforts to revive the natural connections among forests, the countryside, rivers, and the sea[33] and strengthen the economic connection through flow of funds, exchanges of people, and other means, with a view mainly to achieving resource circulation, biodiversity, a low-carbon society, and regional revitalization.

○ Explore support measures to help waste disposal businesses to enhance productivity, which include the promotion of securing and nurturing of human resources, improvement of work environments and conditions, and enhancement of the added value of their business.

○ Explore measures to support the sound management and growth of the recycling business of the environment industry, which include the enhancement of waste-generating business operators' environmental awareness, development of excellent industrial waste disposal businesses, utilization of the excellent industrial waste disposal company certification system, increase in the registration rate of electronic manifests[38], and promotion of "green contracts."

○ Promote future-oriented initiatives, such as industry creation and regional revitalization in Fukushima Prefecture, particularly in the areas of recycling and renewable energy—areas in which the Ministry of the Environment has built a proven track record.

（Addressing environmental and economic considerations in an integrated manner）

○ Promote the establishment and spread of business models based on the 2Rs[43] which focus on servicizing[42], sharing[19], reuse, remanufacturing[41], and the like, while also evaluating as quantitatively as possible the impact of such business models on the creation of a sound material-cycle society (e.g. the reduction of natural resource input, waste generation, CO_2 emissions, and other data, and the improvement of resource productivity).

○ Implement the "Let's choose! 3R campaign" aimed at consumers in cooperation with many private-sector companies in supermarkets, drugstores, and other sites across Japan mainly during the 3R Promotion Month in October in order to increase the public's awareness of and call their action to practice the 3Rs. Also, invite companies to become Re-Style partner companies as a new form of cooperation with the private sector based on the Ministry of the Environment's Re-Style website in order to constantly provide information on and encourage people to implement the 3Rs and other activities toward a sound material-cycle society.

○ Develop an international resource circulation network mainly through recycle ports by, for example,

exporting circulative resources extracted from waste in Japan to nations that need such resources.

○ Support the international expansion of Japan's superior waste treatment and recycling infrastructure systems in accordance with the Infrastructure Systems Export Strategy and other policies. More specifically, conduct—in cooperation with local governments and other actors—feasibility studies for and follow up individual waste treatment and recycling projects in developing and emerging nations. Also organize training and workshops, dispatch experts, implement the verification of recycling technologies and systems prior to their introduction, and implement policy dialogues with local and central governments in other nations, all in an integrated manner.

○ Promote the export of high-quality environmental infrastructure that meets the needs of developing nations, which is developed by leveraging Japan's superior environmental technologies and systems, in accordance with the Basic Strategy for Overseas Development of Environmental Infrastructure formulated in July 2017. Implement all the support activities for this promotion, from top-level government involvement in sales through bilateral policy dialogues and regional forums to the development of frameworks and technologies for the project, and financing, as a package.

(Addressing environmental and social considerations in an integrated manner)

○ Evaluate how far compact, resilient communities, created in the light of the trend of declining population, will lead to the reduction of disaster waste generation and resource input required for the development, maintenance, and recovery of disaster-prevention infrastructure, among other effects, and explore necessary measures.

○ Conduct national campaigns in cooperation with local governments, business operators, and other actors to decrease household food loss[9] by half by 2030. Through this campaign, raise citizens' awareness of the need to reduce food loss, while also encouraging them to take specific actions when purchasing, cooking, or otherwise handling foodstuffs at home, which include buying only the amount that can be used up, eating without leaving anything, and utilizing unused food effectively.

○ Explore goals regarding food loss generated from other sources than households by taking the SDGs into consideration. Also, accelerate the reduction of food loss in every phase of the food cycle, from manufacturing to distribution and consumption, by promoting: business operators' initiatives to revise their business practices to eliminate any inefficiency across the entire food chain, which is difficult to be done by individual companies; the 3010 campaign and other activities led by local governments to reduce food waste left after parties; the spread of demand forecast services that utilize the latest technology; utilization of unused food generated during food business operators' production and distribution processes for people and facilities that need such food; and other efforts aimed at reducing food loss.

○ Promote the development and expansion of new applications for materials recycled properly from construction and demolition waste(CDW）, the generation of which is expected to increase in the future while, according to forecasts by research firms, the number of new housing starts will decrease. Enhance the stock value of existing infrastructure by, among others, extending its life expectancy, improving its disaster resistance ability, and increasing energy efficiency through relocation, renewal, repair, and other means. Promote the popularization of the long-life quality housing certification scheme for existing houses by, for example, offering preferential tax advantages to certified houses in order to develop high-quality housing stock that can be used for a long time. Effectively utilize existing buildings in sound condition by renovating and turning them into public facilities, such as ones for lodging and interaction as a means of regional revitalization or ones for medical and nursing care.

○ Explore a convenient waste treatment system in line with the aging society that helps elderly people to put out garbage easily.

○ Provide measures for the recycling of used adult paper diapers, the use of which is expected to increase along with the aging population, such as research on necessary technologies, support for those involved in the recycling, and the formulation of guidelines on the recycling.

○ Develop human resources for future waste management and recycling industries[7], who have expertise in waste treatment and resource circulation; who are capable of promoting and managing safety in operations effectively; who are considerate to the environment by working on the reduction of greenhouse gas emissions and other environmental efforts; and possess capabilities and knowledge to perform operations while at the same time paying full attention to how they can contribute to their local communities and economy.

○ Promote, in a comprehensive manner and with respect for the importance of collaborating with diverse actors, to encourage environmental education, conservation, and other activities to be conducted at households, schools, workplaces, regions, and all other places under the Act on the Promotion of Environmental Conservation Activities through Environmental Education (Act No. 130 of 2003; hereinafter referred to as the “Environmental Education Promotion Act”) with the aim of establishing a sustainable society.

○ Promote, in the light of the SDGs and the new Courses of Study (*Gakushu Shido Yoryo*) and in collaboration with diverse actors in each region, Education for Sustainable Development (ESD) to nurture people who can show willingness to solve environmental and other global issues on their own accord as if the issues were their own problems and contribute to the creation of a sustainable society. Also, endeavor to develop leaders who can drive ESD-based environmental education in each region.

(Addressing environmental considerations (circulation of resources and low carbon) in an integrated manner)

- Designate ports that can function as venous logistics and recycling bases as Recycling Ports and provide comprehensive support measures to facilitate wide-area recycling of circulative resources that cannot be recycled on a regional level, which include the development of port facilities, improvement of handling operations of circulative resources at the ports, and promotion of government-private sector collaboration. Also, build domestic and international venous logistics networks based on the Recycling Ports.

- Implement modal shifts in the transportation of circulative and renewable resources, such as one from land to sea transport, and increase the efficiency of the transportation by utilizing large ships and other means to reduce greenhouse gas emissions and transportation costs.

- Encourage concerned parties to thoroughly convert food cyclical resources that are generated even after efforts to cut food loss have been made into feed, fertilizer, or other materials that match the circumstances of each region. For food cyclical resources that are difficult to convert into feed or fertilizer, promote their utilization as sources of biogas power generation, heat, and other energies. When recycling food cyclical resources, ensure that countermeasures against improper treatment of food waste, etc. are strictly enforced.

- Utilize sand and soil generated during the construction of waterways and other similar work effectively to, among others, restore tidal flats and seaweed beds and reclaim sea bottom hollows[63], in order to improve water quality, secure biodiversity, and otherwise conserve, restore, and create favorable oceanic environments as well as to use seaweed beds and other ocean ecosystems as new sources to capture carbon (blue carbon). Also, reduce the amount of sand and soil delivered to final disposal sites or dumped into the oceans.

- Provide institutionalized support to promote and facilitate the recycling of a rapidly increasing volume of waste from photovoltaic power generation facilities and, if necessary, explore the introduction of a mandatory recycling program, while taking into account such factors as voluntary efforts by related businesses for the collection, proper treatment, and recycling and the trends in Europe.

- Promote the 3Rs, which is important to achieve low-carbon as well as circulation of resources. Drive the efficient recovery of energy for power generation from waste, etc. that cannot be reduced, reused, or recycled, through thermal recycling and methane production from raw garbage as well as through the diffusion of the certification system for entities equipped with waste heat recovery facilities. Also, accelerate the improvement and construction of waste disposal facilities and other necessary facilities around them so that they can function as independent and distributed regional energy centers when

necessary, such as when a disaster occurs.

Furthermore, advance technological development for efficient recovery of waste energy, and promote low carbon throughout the waste treatment system from collection and hauling to final disposal through, among other efforts, the thorough utilization of waste energy.

○ Support municipalities in their efforts to adapt themselves to climate change in the areas of waste and recycling in order to help them build a sustainable waste treatment system that is resilient against climate change.

○ Promote research and development on the adaptation to global-scale changes in cooperation with industry, academics, and other actors. Also, facilitate and increase the efficiency of disaster waste management through such means as utilizing the latest technologies including information technology and satellites.

○ Take necessary measures in advance of a large-scale disaster through collaboration among relevant government agencies to build a nationwide network for disaster waste management, including arrangements for marine transport.

(Addressing environmental considerations (circulation of resources and biodiversity) in an integrated manner)

○ Restrict the consumption of newly extracted natural resources by promoting the efficient, long-term, and cyclical use of resources in order to protect biodiversity and natural environments during the extraction of resources as well as to promote the circulation of resources. Also, promote the integration of consideration for the conservation of biodiversity and natural environments into resource production and extraction processes.

○ (The same as mentioned earlier) Utilize sand and soil generated during the construction of waterways and other similar work effectively to, among others, restore tidal flats and seaweed beds and reclaim sea bottom hollows, in order to improve water quality, maintain biodiversity, and otherwise conserve, restore, and create favorable oceanic environments as well as to use seaweed beds and other ocean ecosystems as new sources to capture carbon (blue carbon). Also, reduce the amount of sand and soil delivered to final disposal sites or dumped into the oceans.

○ Conduct investigation and research on the current status and other circumstances of marine litter including microplastics[10] , and support prefectural governments, municipalities, business operators, and other actors in their collection and treatment of marine litter (including driftwood and other litter generated in the event of a disaster) and their measures to control the generation of marine litter, subject to the Act on Promoting the Treatment of Marine Debris Affecting the Conservation of Good Coastal Landscapes and Environments to Protect Natural Beauty and Variety (Act No. 82 of 2009;

hereinafter referred to as the "Act on Promoting the Treatment of Articles that Drift Ashore") and other regulations. Also cooperate with the sharing of information and investigation and research, among other actions to combat against marine debris, through international frameworks, bilateral cooperation, and other agreements.

○ Maintain a system to dispatch a large dredging and oil recovery vessel to the scene of a large-scale oil spill accident in the waters around Japan as early as possible upon receiving a call for service from the Japan Coast Guard for swift and accurate oil recovery operations.

(Addressing environmental considerations (circulation of resources as well as measures against chemical substances and air, water, and soil pollution) in an integrated manner)

○ Explore measures to reduce the risk of harmful substances being mixed into recycled raw materials throughout the lifecycle[6] of products in collaboration with other efforts, such as upstream businesses' measures in handling chemical substances, and in the light of international trends including tightening regulations on harmful substances.

○ Develop and diffuse technologies for the evaluation of the hazardousness of waste, etc. containing chemical substances, including ones generated unintentionally, as well as for proper treatment of such waste, etc.

○ Explore measures to properly collect and treat asbestos, POP[25] waste, mercury and waste containing mercury, agricultural chemicals stored underground, and other hazardous stock and waste, which are linked with other measures to prevent water, air, soil, and other pollution and based on information on the said substances and waste containing the substances shared and owned among concerned parties, while taking into account the measures on chemical substances as a whole adopted at the product production, use, and disposal stages.

○ (The same as mentioned earlier) Conduct investigation and research on the current status and other circumstances of microplastics and other marine litter, and support prefectural governments, municipalities, business operators, and other actors in their collection and treatment of marine litter (including driftwood and other debris generated in the event of a disaster) and their measures to control the generation of marine litter, subject to the Act on Promoting the Treatment of Marine Debris Affecting the Conservation of Good Coastal Landscapes and Environments to Protect Natural Beauty and Variety (Act No. 82 of 2009; hereinafter referred to as the "Marine Debris Treatment Promotion Act") and other regulations. Also, cooperate with the sharing of information and investigation and research, among other actions to combat against marine debris, through international frameworks, bilateral cooperation, and other agreements.

○ Ensure collaboration among government agencies, and support local governments in collaboration

with industry on the occurrence of a disaster, to prevent chemical substances, as well as asbestos and other harmful, hazardous substances, from causing the deterioration of public health or a secondary disaster.

○ (The same as mentioned earlier) Maintain a system to dispatch a large dredging and oil recovery vessel to the scene of a large-scale oil spill accident in the waters around Japan as early as possible upon receiving a call for service from the Japan Coast Guard for swift and accurate oil recovery operations.

○ Keep updated with information on harmful substances, including international trends, and correctly implement risk communication[64] that allows concerned parties to share information and communicate with each other.

5.2. Regional Revitalization through the Formation of Diverse Regional Circulating and Ecological Sphere

○ (The same as mentioned earlier) Create an independent and distributed society which utilizes circulative, renewable, and stock resources as well as the region's human resources and funds in a way that matches the region's characteristics, while developing regional circulating and ecological sphere in which the region and its neighboring regions will complement each other in their efforts to revive the natural connections among forests, the countryside, rivers, and the sea[33] and strengthen the economic connection through flow of funds, exchanges of people, and other means, with a view mainly to achieving resource circulation, biodiversity, a low-carbon society, and regional revitalization.

○ Continue to make sure that municipalities are aware that they have overall responsibility for proper treatment of municipal waste and are responsible for properly formulating and implementing municipal waste treatment plans. Also, renew the awareness of waste-generating business operators and other responsible parties regarding their responsibility for disposing of waste generated in the course of their business activities.

○ Conduct activities aimed at maximizing the efficiency in the utilization of resources in each region by leveraging the existing systems, industries, technologies, human resources, and social capital in each region. The activities will include identifying issues and opportunities in the area of resource circulation in each region, supporting commercialization feasibility studies, preparing written guides on regional circular by issue and theme, promulgating best practices across the nation, and providing expert advice.

○ Support the creation of sound resource circulation business through the establishment of regional circulating and ecological sphere in such a way not just to promote recycling but also to lead to

expanding employment opportunities and improving the quality of lives of local residents. Also, encourage the restoration and revitalization of regional communities and the fostering of regional cultures through the establishment of regional circulating and ecological sphere by actively supporting regional efforts to develop human resources and create a network among residents.

○ Continue to promote the utilization of biomass[15] in each region by conducting various activities based on the Basic Plan for the Promotion of Biomass Utilization and in collaboration with concerned parties in each region. The activities will include further promoting the use of biomass as feed, fertilizer, and other materials, producing high value-added products, and converting biomass into renewable energies (e.g. biogas produced from livestock waste and food waste, and wood chips from unused forest thinnings) to use them as independent and distributed energy sources.

○ Promote sustainable agriculture, forestry and fisheries which focus on environmental conservation, such as, environmentally friendly agriculture including organic agriculture and, aquaculture instrumental in improving fishing ground environments, in consideration that agriculture, forestry and fisheries are production activities that utilize the benefit of nature through working on, using effectively, and improving natural cyclical function.

○ Increase demand for fertilizer and feed derived from food waste by emphasizing the unique features of the production and distribution processes of agricultural products produced with such fertilizer and feed and promoting the products strategically, while also prompting the development of food recycling loops based on the Food Recycling Act.

○ Promote the conversion from livestock, food, and other waste to biogas using methane fermentation technology; from food oil waste to biodiesel fuel; from unused forest thinnings to wood chips and pellets; and from organic sludge to solidified fuel, among other conversion possibilities. Also, implement research and development of technologies useful for these conversions.

○ Turn sewage-treatment plants into bases of biomass utilization in each region to promote the conversion from sewage sludge to an energy source alternative to fossil fuels which can be used as solidified fuel or for biomass power generation; the recycling of sewage sludge as fertilizer; and the co-digestion and utilization of sewage sludge and other biomass (such as food waste) to increase energy recovery efficiency.

○ Operate the wide-area certification system and the recycling certification system properly to recycle waste products, exhaustible resources, and other circulative resources that need to be treated over wide areas.

○ Gather and share information on efforts being made to develop and maintain the Eco Towns, a project that can be seen as a precedent attempt to create regional circulating and ecological sphere and that is currently attracting attention from abroad as well. The Eco Towns have been developed by taking advantage of the characteristics of each of the 26 approved zones since 20 years ago when the first Eco Town plan was approved. Continue to support Eco Towns in their solving various challenges by leveraging their stock of infrastructure and human resources accumulated over the past 20 years.

○ (The same as mentioned earlier) Designate ports that can function as venous logistics and recycling bases as Recycling Ports and provide comprehensive support measures to facilitate wide-area recycling of circulative resources that cannot be recycled on a regional level, which include the development of port facilities, improvement of handling operations of circulative resources at the ports, and promotion of government-private sector collaboration. Also, build domestic and international venous logistics networks based on the Recycling Ports.

○ (The same as mentioned earlier) Evaluate how far compact, resilient communities, created in the light of the trend of declining population, will lead to the reduction of disaster waste generation and resource input required for the development, maintenance, and recovery of disaster-prevention infrastructure, among other effects, and explore necessary measures.

5.3. Thorough Circulation of Resources throughout the Lifecycle of Goods and Services

○ Explore the establishment of standards on design for environment[22] by, for example, understanding the current status across all products regarding their design for environment, in order to promote the diffusion of design for environment that focuses on durability, ease of reusing or recycling, expanded use of recycled materials, among other sustainable features. Also, facilitate the expansion of combined efforts of producers, etc., recycling businesses, and other actors, which include those to reduce waste generated during production processes and expand the use of recycled raw materials, by utilizing 3D modeling and other latest technologies.

○ (The same as mentioned earlier) Promote the establishment and spread of business models based on the 2Rs[43] which focus on servicizing[42], sharing[19], reuse, remanufacturing[41], and the like, while also evaluating as quantitatively as possible the impact of such business models on the creation of a sound material-cycle society (e.g. the reduction of natural resource input, waste generation, CO_2 emissions, and other data, and the improvement of resource productivity).

○ (The same as mentioned earlier) Implement the “Let’s choose! 3R campaign” aimed at consumers in cooperation with many private-sector companies in supermarkets, drugstores, and other sites across Japan mainly during the 3R Promotion Month in October in order to increase the public’s awareness

of and call their action to practice the 3Rs. Also, invite companies to become Re-Style partner companies as a new form of cooperation with the private sector based on the Ministry of the Environment's Re-Style website in order to constantly provide information on and encourage people to implement the 3Rs and other activities toward a sound material-cycle society.

○ (The same as mentioned earlier) Restrict the consumption of newly extracted natural resources by promoting the efficient, long-term, and cyclical use of resources in order to protect biodiversity and natural environments during the extraction of resources as well as to promote the circulation of resources. Also, promote the integration of consideration for the conservation of biodiversity and natural environments into resource production and extraction processes.

○ Facilitate business operators to demonstrate their commitment to environmental considerations by encouraging them to, among others, introduce environmental management systems, prepare and disclose environmental reports[65], and lay infrastructure for the disclosure of environmental information.

○ Take the initiative in advancing green purchasing[58] and green contracts within the government and procure 3R products and products designed for the environment (products with reduced waste and reuse products in particular), while also actively using environmentally-considerate services, renewable energies, and the like. Also, work on the diffusion and promotion of green purchasing, while at the same time—in light of social trends—actively adding 3R requirements into decision-making criteria or otherwise incorporating the 3Rs as an essential criterion to tighten, enhance, and consolidate the criteria to accurately identify advanced recycled products and services considered to be instrumental in creating a sound material-cycle society.

○ (The same as mentioned earlier) Explore measures to reduce the risk of harmful substances being mixed into recycled raw materials throughout the lifecycle[6] of products in collaboration with other efforts, such as upstream businesses' measures in handling chemical substances, and in the light of international trends including tightening regulations on harmful substances.

○ (The same as mentioned earlier) Implement modal shifts in the transportation of circulative and renewable resources, such as one from land to sea transport, and increase the efficiency of the transportation by utilizing large ships and other means to reduce greenhouse gas emissions and transportation costs.

○ Utilize soil with naturally originating contamination or other contamination as prescribed in the Soil Contamination Countermeasures Act (Act No. 53 of 2002) for the reclamation of water body and others from the viewpoint of effective utilization of natural resources to reduce the consumption of

the resources, while observing relevant laws and regulations.

Conduct the following actions for each of the recycling acts:

○ Act on the Promotion of Effective Utilization of Resources (Act No. 48 of 1991; hereinafter referred to as the "Resource Effective Utilization Act"): Based on measures taken heretofore to promote the use of recycled resources and parts (e.g. the development of systems for collecting waste personal computers and compact rechargeable batteries discharged from households in 2003 and making it mandatory to provide information on materials contained in home appliances and personal computers in 2006), further promote the 3Rs, in the light of the recent efforts being made for the effective utilization of resources, in order to advance the establishment of a sound material-cycle society.

○ Container and Packaging Recycling Act: Based on opinions from the Central Environmental Council and the Industrial Structure Council in May 2016, further promote the 3Rs throughout the lifecycle of containers and packaging and in view of solving various concerned issues, in order to reduce environmental load and overall costs to society and promote the creation of a sound material-cycle society and the efficient use of resources.

○ Food Recycling Act: Based on opinions from the Central Environmental Council and the Council of Food, Agriculture and Rural Area Policies in October 2014, implement measures to prevent improper treatment of food and other waste, while at the same time promoting the cyclical use of food resources, in order to achieve targets specified in the basic policy of the act, such as the implementation rate of recycling of cyclical food resources.

○ Small Home Appliance Recycling Act: Promote the collection of waste small home appliances and the recycling of useful metals in the light of the revision of the act that will be initiated in FY2018 under the supplementary provisions of the act. Also, publicize the Tokyo 2020 Medal Project to manufacture the medals for the Tokyo Olympics and Paralympics in 2020 from scrap metals extracted from used consumer electronics (urban mining[36]) and encourage people across Japan to become involved in the project in order to develop and leave Olympic and Paralympic legacies.

○ Home Appliance Recycling Act: Drive various efforts in line with the report on the evaluation and review of the process in the implementation of the home appliance recycling system, which was compiled in October 2014 after the second revision of the act since its enforcement. Also, as the report recommends another revision be conducted after five years, check the implementation of the system and take necessary measures based on the results.

○ Act on Recycling, etc. of End-of-Life Vehicles (Act No. 87 of 2002; hereinafter referred to as the

"End-of-life Vehicles Recycling Act"): Implement various activities based on the future main directions decided at a joint meeting of the Central Environmental Council and the Industrial Structure Council in 2015 as the results of evaluation and review of the existing system, which are: promotion of the 3Rs for, and enhancement of the quality of, vehicles; development of a more stable and efficient end-of-life vehicles recycling system; and adaptation to changes in end-of-life vehicles recycling and international expansion. The activities will include exploring targets and indicators regarding reuse and recycling; conducting verification projects to verify the gist of the incentive program for automobiles incorporating design for environment and utilizing renewable resources (recycling fee discounts); reinforcing countermeasures against illegal dumping and inappropriate storage; and developing a next-generation end-of-life vehicle recycling framework.

○ Construction Material Recycling Act (Act No. 104 of 2000; hereinafter referred to as the "Construction Recycling Act"): Conduct the specific actions recommended by the report on the results of evaluation and review of the process in the implementation of the construction recycling system compiled in December 2008 and enforce the act, while also revising and adjusting the legal system flexibly in response to changing social and other trends.

Ensure that the thorough recycling of the materials mentioned below in particular, which are important in terms of the level of environmental load, the generation of waste, and the potential of contribution to the mitigation of climate change, will be implemented throughout the lifecycle of goods and services, as long as such recycling will not pose an impediment to environmental conservation.

5.3.1. Plastics

○ Draw up a plastic resources recycling strategy to promote the circulation of resources comprehensively and implement measures thereunder to decrease the reliance on non-renewable resources and replace them with renewable resources, as well as to collect used resources thoroughly for repeated cyclical use as far as the economic and technological capacity permits. These efforts are expected to facilitate the state to address a wide range of environmental issues such as resource and waste constraints, marine debris, and global warming and develop a domestic resource circulation system in response to China's and other countries' waste import restrictions, while also contributing to the creation of a sustainable society and passing on the rich environment to future generations.

○ The specific measures will include (1) the reduction of disposal containers and packaging, among other efforts to reduce the use of plastics to bring down the environmental load; (2) thorough, effective, and efficient collection and recycling of plastic resources, whether used or unused; and (3) promotion of bioplastics[44] in a comprehensive manner, including the enhancement of the practical applicability of, and the replacement of fossil fuel-derived plastics with, bioplastics.

5.3.2. Biomass (food, wood, etc.)

○ (The same as mentioned earlier) Conduct national campaigns in cooperation with local governments, business operators, and other actors to decrease household food loss[9] by half by 2030. Through this campaign, raise citizens' awareness of the need to reduce food loss, while also encouraging them to take specific actions when purchasing, cooking, or otherwise handling foodstuffs at home, which include buying only the amount that can be used up, eating without leaving anything, and utilizing unused food effectively.

○ (The same as mentioned earlier) Explore goals regarding food loss generated from other sources than households by taking the SDGs into consideration. Also, accelerate the reduction of food loss in every phase of the food cycle, from manufacturing to distribution and consumption, by promoting: business operators' initiatives to revise their business practices to eliminate any inefficiency across the entire food chain, which is difficult to be done by individual companies; the 3010 campaign and other activities led by local governments to reduce food waste left after parties; the spread of demand forecast services that utilize the latest technology; utilization of unused food generated during food business operators' production and distribution processes for people and facilities that need such food; and other efforts aimed at reducing food loss.

○ Based on the acknowledgment of the importance of accurately understanding the generation of food loss in Japan as basic data required for conducting activities to reduce food loss and evaluating the progress, support local governments in their investigation of the generation of food loss within their jurisdiction and, based on these data, increase the precision of estimates on the generation of food loss.

○ (The same as mentioned earlier) Encourage concerned parties to thoroughly convert food cyclical resources that are generated even after efforts to cut food loss have been made into feed, fertilizer, or other materials that match the circumstances of each region. For food cyclical resources that are difficult to convert into feed or fertilizer, promote their utilization as sources of biogas power generation, heat, and other energies. When recycling food cyclical resources, ensure that countermeasures against improper treatment of food waste, etc. are strictly enforced.

○ Promote the use of untapped resources—such as waste biomass[15] (wood chips, paper, etc.), as well as inedible parts of agricultural products (chaff, etc.) and unused forest thinnings which are generated from daily work in farming, mountain and fishing villages—for recycling into particle boards, paper, and the like and for utilization as energy sources.

○ (The same as mentioned earlier) Turn sewage-treatment plants into bases of biomass utilization in each region to promote the conversion from sewage sludge to an energy source alternative to fossil

fuels which can be used as solidified fuel or for biomass power generation; the recycling of sewage sludge as fertilizer; and the co-digestion and utilization of sewage sludge and other biomass (such as food waste) to increase energy recovery efficiency.

○ Continue to encourage concerned parties to convert livestock waste into fertilizer and other materials more than ever, while also promoting the use of biogas generated by methane fermentation as energy sources to produce heat and electricity, as well as residual heat from power generation.

○ Promote research and development of world-leading, innovative low-carbon technologies, such as white biotechnologies which utilize biomass to produce chemical and other products (cellulose nanofibers, etc.).

○ (The same as mentioned earlier) Increase demand for fertilizer and feed derived from food waste by emphasizing the unique features of the production and distribution processes of agricultural products produced with such fertilizer and feed and promoting the products strategically, while also prompting the development of food recycling loops based on the Food Recycling Act.

5.3.3. Base metals, rare metals, and other metals

○ Explore measures to diffuse design-for-environment practices that include reducing the use of types of minerals that have a great impact on the environment when extracted, increasing the reusability and recyclability of products, and expanding the use of recycled metals.

○ Construct a strategic resource circulation system that is based on integrated working between arterial and venous industries, by promoting research and development of innovative sorting, smelting, and other systems for waste small home appliances and effective utilization of information and other technologies to develop a network connecting those systems, in order to effectively leverage Japan's urban mining[36].

○ Support the development and introduction of advanced shredders, as well as advanced sorters capable of dealing with various alloy content, while also exploring the establishment of standards useful for expanding the use of secondary raw materials, in order to further promote the recycling of iron, aluminum, copper, and other base metals. Also, analyze the criticality of rare metals, rare-earth elements, and the like and undertake such activities as verifying collection systems and supporting the introduction of recycling equipment for highly-critical metals.

○ Implement investigation regarding material flows of batteries built in a wide range of products and support concerned parties in their efforts to improve collection networks that attach importance to safety, while also promoting the development of systems that facilitate proper reuse, recycling, and

disposal and that also allow for the collection of useful metals. For compact rechargeable batteries in particular, continue to promote safe collection and recycling by producers based on the Resource Effective Utilization Act.

○ Promote proper treatment and recycling of hazardous waste electrical and electronic equipment included in so-called "mixed metal scrap[60]" by, for example, strictly observing the obligations under the Waste Management Act revised in 2017, such as the proper storage of the equipment.

5.3.4. Earth and rocks, construction materials

○ Reduce the amount of construction and demolition waste(CDW) requiring final disposal by minimizing the generation of mixed wastes through such means as the continued promotion of sorting of demolition waste as well as by facilitating the recycling of mixed wastes and other CDW. Also, implement thorough sorting and treatment for asbestos and other harmful substances.

○ (The same as mentioned earlier) Promote the development and expansion of new applications for materials recycled properly from construction byproducts, the generation of which is expected to increase in the future while, according to forecasts by research firms, the number of new housing starts will decrease. Enhance the stock value of existing infrastructure by, among others, extending its life expectancy, improving its disaster resistance ability, and increasing energy efficiency through relocation, renewal, repair, and other means. Promote the popularization of the long-life quality housing certification scheme for existing houses by, for example, offering preferential tax advantages to certified houses in order to develop high-quality housing stock that can be used for a long time. Effectively utilize existing buildings in sound condition by renovating and turning them into public facilities, such as ones for lodging and interaction as a means of regional revitalization or ones for medical and nursing care.

○ Take necessary measures to promote the recycling and other waste management of waste gypsum boards, which are expected to increase in the future, as well as composite materials that are difficult to sort.

○ Promote the utilization of byproducts and waste generated from other industries for construction by supporting such efforts as collecting useful metals during the process of cement production; expanding proper use of byproducts, waste, and hard-to-manage waste as alternative raw materials for the production of cement or alternatives to fossil energy sources; and diffusing the use of blast-furnace slag and the like as a material mixed to produce cement, in order to reduce the final disposal amount[3] of industrial waste.

○ Work on the conservation and restoration of ocean environments, while also promoting the use of

industrial byproducts, including the effective utilization of steel slag, for port construction and other works while giving due consideration to the environment.

○ (The same as mentioned earlier) Utilize sand and soil generated during the construction of waterways and other similar work effectively to, among others, restore tidal flats and seaweed beds and reclaim sea bottom hollows[3], in order to improve water quality, secure biodiversity, and otherwise conserve, restore, and create favorable oceanic environments as well as to use seaweed beds and other ocean ecosystems as new sources to capture carbon (blue carbon). Also reduce the amount of sand and soil delivered to final disposal sites or dumped into the oceans.

○ Accelerate the development of a system that promotes the wide-area use of port construction materials (Super Phoenix Plan), in which surplus soil produced from construction in the Tokyo Metropolitan Area is used for landfill in ports and harbors across Japan.

5.3.5. Products and materials introduced widely as a measure against global warming

○ (The same as mentioned earlier) Provide institutionalized support to promote and facilitate the recycling of a rapidly increasing volume of waste from photovoltaic power generation facilities and, if necessary, explore the introduction of a mandatory recycling program, while taking into account such factors as voluntary efforts by related businesses for the collection, proper treatment, and recycling and the trends in Europe.

○ Support the development of technologies and the introduction of equipment that enable the 3Rs of new products and materials, such as rapidly diffusing lithium ion batteries and carbon fiber-reinforced plastics[37], while also promoting the construction of systems for proper reuse, recycling, and disposal. For small lithium ion batteries in particular, continue to encourage producers to collect and recycle the batteries under the Resource Effective Utilization Act, while at the same time promoting the increase of the recycling rate.

5.4. Continued Promotion of Proper Waste Treatment and Environmental Restoration

5.4.1. Continued promotion of proper waste treatment

○ (The same as mentioned earlier) Continue to make sure that municipalities are aware that they have overall responsibility for proper treatment of municipal waste and are responsible for properly formulating and implementing municipal waste treatment plans. Also renew the awareness of waste-generating business operators and other responsible parties regarding their responsibility for disposing of waste generated in the course of their business activities.

○ Develop stable and efficient systems for sustainable, proper treatment, reinforce climate change

mitigation and anti-disaster measures in waste treatment systems, and construct or improve waste disposal facilities in such a way to make them instrumental in creating new value in each region.

- Maintain on-going efforts to secure necessary final disposal sites based on the expected remaining capacity. Also, support activities to utilize effectively and reduce waste disposed of in final disposal sites.

- Monitor the tendency of municipal waste generation in wide areas beyond the boundaries of municipalities and encourage municipalities to take wide-area measures through collaboration with other municipalities and prefectural governments. While doing so, promote well-planned maintenance and renewal of existing waste disposal facilities by adopting stock management techniques to extend the life expectancy of the facilities.

- Make it possible to treat end-of-life products collected by product producers, etc. through a wider-area treatment network based on the appropriate utilization of, among others, the wide-area certification system for waste product treatment methods.

- (The same as mentioned earlier) Explore a convenient waste treatment system in line with the aging society that helps elderly people to put out garbage easily.

- (The same as mentioned earlier) Provide measures for the recycling of used adult paper diapers, the use of which is expected to increase along with the aging population, such as research on necessary technologies, support for those involved in the recycling, and the formulation of guidelines on the recycling.

- (The same as mentioned earlier) Promote the 3Rs, which is important to achieve low-carbon as well as circulation of resources. Drive the efficient recovery of energy for power generation from waste, etc. that cannot be reduced, reused, or recycled, through thermal recycling and methane production from raw garbage as well as through the diffusion of the certification system for entities equipped with waste heat recovery facilities. Also, accelerate the improvement and construction of waste disposal facilities and other necessary facilities around them so that they can function as independent and distributed regional energy centers when necessary, such as when a disaster occurs.

  Furthermore, advance technological development for efficient recovery of waste energy, and promote low carbon throughout the waste treatment system from collection and hauling to final disposal through, among other efforts, the thorough utilization of waste energy.

- (The same as mentioned earlier) Support municipalities in their efforts to adapt themselves to climate change in the areas of waste and recycling in order to help them build a sustainable waste treatment system that is resilient against climate change.

- Explore the development of a system that enables the treatment of municipal waste that is difficult to be managed at a municipality level (hard-to-manage materials for disposal) based on appropriate role-sharing among concerned parties.

- Further promote the diffusion of and compliance with the municipal solid waste management accounting standard, the guidance on the charged disposal of municipal waste, and the guidelines on municipal waste management systems aimed at establishing a sound material-cycle society, which provide various methods regarding municipal waste management, such as those for analyzing costs, charging, and establishing a sorting standard.

- While industrial waste final disposal sites should basically be developed by private sector initiatives, promote the development of waste disposal centers and other public sector involvement in cases where such involvement is required to maintain proper treatment of industrial waste.

- Take advantage of preferential taxation and other systems to advance the steadfast development of waste disposal facilities.

- Advance the computerization of information on procedures and other matters concerning waste, while also exploring measures to promote the use of various computerized information on waste, including electronic manifests[38].

- Further enhance the convenience of electronic manifests, encourage waste-generating business operators and industrial waste disposal businesses to adopt electronic manifests, and reinforce systems that help prevent data falsification or other improper uses of electronic manifests, while also exploring the reduction of economic burden for users, with the aim of further expanding the use of electronic manifests, which can function only when waste generators, collection and hauling businesses, and disposal businesses take part. Also, explore the phased expansion of the obligatory use of electronic manifests, in light of how well the current partial obligation is functioning.

- Operate an illegal dumping hotline to receive information on illegal dumping and improper disposal directly from citizens, and dispatch specialists on industrial waste to illegal dumping sites, as a means of supporting local governments in their efforts to pursue the liability of offenders and others involved.

- Work on the dissemination and enlightenment of activities to prevent, and strengthen supervision over, illegal dumping through such campaigns as the Nationwide Illegal Dumping Monitoring Week from May 30 (“Zero-Waste Day”) to June 5 (“Environment Day”) in cooperation with local governments.

○ Strengthen measures against business operators, exporters, and others who collect disused articles from households and other sources without authorization for improper treatment, export, or other wrongful conduct by, among other means, strictly enforcing the Waste Management Act and promulgating lawful disposal of disused articles.

○ (The same as mentioned earlier) Explore support measures to help waste disposal businesses to enhance productivity, which include the promotion of securing and nurturing of human resources, improvement of work environments and conditions, and enhancement of the added value of their business.

○ (The same as mentioned earlier) Explore measures to support the sound management and growth of the recycling business of the environment industry, which include the enhancement of waste-generating business operators' environmental awareness, development of excellent industrial waste disposal businesses, utilization of the excellent industrial waste disposal company certification system, increase in the registration rate of electronic manifests, and promotion of "green contracts."

○ Create sea surface disposal sites used for the final disposal of earth and sand generated from dredging of ports and harbors and waste that cannot be recycled, in a well-planned manner and without impairing the orderly development of ports and harbors.

○ Promulgate information on, and provide education regarding, the need to recycle end-of-life FRP boats and the recycling system operated by the trade association.

○ (The same as mentioned earlier) Explore measures to reduce the risk of harmful substances being mixed into recycled raw materials throughout the lifecycle[6] of products in collaboration with other efforts, such as upstream businesses' measures in handling chemical substances, and in the light of international trends including tightening regulations on harmful substances.

○ (The same as mentioned earlier) Develop and diffuse technologies for the evaluation of the hazardousness of waste, etc. containing chemical substances, including ones generated unintentionally, as well as for proper treatment of such waste, etc.

○ (The same as mentioned earlier) Explore measures to properly collect and treat asbestos, POP[25] waste, mercury and waste containing mercury, agricultural chemicals stored underground, and other hazardous stock and waste, which are linked with other measures to prevent water, air, soil, and other pollution and based on information on the said substances and waste containing the substances shared and owned among concerned parties, while taking into account the measures on chemical substances as a whole adopted at the product production, use, and disposal stages.

○ Promote accurate and proper treatment of PCB[23] waste to complete the disposal by the deadlines set by the Basic Plan for PCB Waste Treatment.

○ Promote environmentally-appropriate management and disposal of mercury and waste containing mercury based on the National Implementation Plan for Preventing Environmental Pollution of Mercury and in the light of the progress of international negotiations for the Minamata Convention on Mercury.

○ Continue to support prefectural governments in their formulation and implementation of plans for the treatment of agricultural chemicals stored underground, to ensure that POP waste will be treated properly in accordance with the POP Convention[24].

○ Work on chemical substances control based on the SAICM[13] National Implementation Plan to achieve the overall objective of SAICM of "the sound management of chemicals throughout their life‐cycle so that, by 2020, chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and the environment," while also carrying out measures that respond to the new framework that will replace current SAICM in 2020. More specifically, enhance eco-efficiency through such means as safe and efficient production of chemical substances, and promote the proper use of chemical substances to reduce their environmental impact. Also, ensure proper treatment during the disposal and recycling processes by, among others, providing appropriate information required for proper treatment.

5.4.2. Environmental restoration from waste, etc.

○ (The same as mentioned earlier) Conduct investigation and research on the current status and other circumstances of marine litter including microplastics[10] , and support prefectural governments, municipalities, business operators, and other actors in their collection and treatment of marine litter (including driftwood and other litter generated in the event of a disaster) and their measures to control the generation of marine litter, subject to the Act on Promoting the Treatment of Articles that Drift Ashore and other regulations. Also cooperate with the sharing of information and investigation and research, among other actions to combat against marine litter, through international frameworks, bilateral cooperation, and other agreements.

○ Collect and treat driftwood and other litter and oil spilled from ships and other sources in closed water areas to secure safe marine navigation and conserve the ocean environment.

○ Strictly operate the system for authorizing the normally-prohibited ocean dumping of land-generated waste and waste oil generated by ships and from other sources based on the Act on Prevention of Marine Pollution and Maritime Disaster (Act No. 136 of 1970; hereinafter referred to as the "Act on

Prevention of Marine Pollution") and reduce the volume of such waste dumped into oceans. Also, secure appropriate waste oil disposal facilities, and conduct strict investigation on business plans and the capability of performing required operations of those who apply to start waste oil disposal business.

○ Promote measures to eliminate neglected pleasure boats by enhancing mooring and storage capacity and, at the same time, implementing strict regulatory actions to strengthen the proper control of pleasure boats in port areas.

○ Develop systems for properly receiving waste generated onboard ships in ports and harbors in cooperation with waste disposal businesses as a way to prevent marine pollution.

○ Provide appropriate financial assistance for the environmental restoration from particular cases of illegal dumping and improper disposal of industrial waste that otherwise cannot be solved, using the funds reserved under the Waste Management Act.

Continue to provide financial support for cases of illegal dumping and improper disposal of industrial waste that took place before the enforcement of the revised Waste Management Act in 1997 and remain unsettled, pursuant to the Act on Special Measures concerning Removal of Environmental Problems Caused by Specified Industrial Wastes (Act No. 98 of 2003; hereinafter referred to as the "Act on Special Measures against Industrial Waste"). Through this support, facilitate local governments to take action smoothly for environmental restoration from illegal dumping and improper disposal of industrial waste.

○ Implement appropriate measures to remove, and otherwise protect the ocean environment from, oil and other hazardous liquids spilled from ships and other sources based on the Act on Prevention of Marine Pollution.

○ Support removal, utilization, and other countermeasures against abandoned houses implemented by municipalities under the Empty Dwellings Act, in such a way that is aligned with their empty dwelling countermeasure plans.

○ Support efforts by shopping district associations to make use of abandoned, empty stores, such as establishing business startup support centers and encouraging new stores to open, in order to help eliminate empty stores in shopping districts.

5.4.3. Environmental restoration from the Great East Japan Earthquake

○ Continue to put forward proper and safe treatment of waste contaminated by radioactive materials released on the occurrence of the accident of TEPCO Fukushima Daiichi Nuclear Power Station which followed the Great East Japan Earthquake as well as of soil and waste removed during the

decontamination work, pursuant to the Act on Special Measures concerning the Handling of Pollution by Radioactive Materials and the basic policy based thereon.

○ Continue to reduce and recycle waste within countermeasures areas[28] and to reduce designated waste[29] in a treatment process in Fukushima Prefecture. Also, continue to proceed with the project to dispose specified waste properly in an existing leachate-controlled type disposal site (former Fukushima Eco Tech Clean Center) ensuring safety and working to deepen the trust with the local residents.

○ Continue to coordinate including with local government and communities for the safe treatment of designated waste in prefectures other than Fukushima, taking the circumstances of each prefecture into consideration.

○ Continue to advance the development, verification, and other activities to realize volume reduction technologies, while also working together with relevant government agencies to promote, among others, the creation of users of recycled soil and waste after decontamination, in order to reduce the final disposal amount of decontaminated soil and waste.

○ (The same as mentioned earlier) Promote future-oriented initiatives, such as industry creation and regional revitalization in Fukushima Prefecture, particularly in the areas including recycling and renewable energy in which the Ministry of the Environment has made a positive achievement.

○ Explore how to deal with the Waste Management Act and other acts from which the provision that excludes their application from environmental pollution by radioactive substances has not been deleted under the Act on Arrangement of Relevant Acts to Prevent Environmental Pollution by Radioactive Substances (Act No. 60 of 2013), while taking into account the enforcement situation of the Act on Special Measures concerning the Handling of Pollution by Radioactive Materials is being executed.

5.5. Development of Well-planned Framework for Disaster Waste Management

○ Perform the local government-level, regional block-level, and national-level activities as described below in Sections 5.5.1 to 5.5.3 in order to develop resilient systems that will enable proper and swift treatment of disaster waste.

5.5.1. Acceleration of local government-level disaster waste management

○ Promote the formulation of disaster waste management plans by local governments, while also conducting model projects and other activities to support local governments to check and review their plans to ensure that their plans will include business continuity, setup for receiving outside support,

risk management, and others that are considered necessary from past experience of disaster waste management.

○ (The same as mentioned earlier) Ensure collaboration among government agencies, and support local governments in collaboration with industry on the occurrence of a disaster, to prevent chemical substances, as well as asbestos and other harmful, hazardous substances, from causing the deterioration of public health or a secondary disaster.

○ Encourage local governments to develop human resources in the area of disaster waste management and support them to conduct training by utilizing D.Waste-Net.

○ Support local governments, etc. to actively disseminate information to and provide various means and opportunities for communication with citizens to obtain their cooperation with proper discharge and other disaster waste management activities.

○ Support local governments to develop waste disposal facilities that can serve as disaster response bases in the event of a large-scale disaster to ensure the protection and hygiene of living environments.

5.5.2. Development of regional-level disaster waste management cooperative frameworks

○ Review the disaster waste management action plan of each of the eight regional blocks to allow for the on-going operation of regional block conferences nationwide and build wide-area cooperative frameworks beyond the boundaries of prefectures to manage their disaster waste collectively in the event of a disaster.

○ Conduct joint training and other practices in each regional block to develop systems that enable smooth waste management in the event of a disaster, while also sharing information, providing opportunities for people-to-people exchanges, holding educational seminars, and other activities that will help local governments to reinforce their anti-disaster measures.

○ Implement model projects that utilize wide-area transportation bases, large-scale waste disposal facilities, open spaces, and other available places within each regional block effectively and share the findings from the projects with other regional blocks.

○ Promote the reinforcement of systems to collect driftwood and other litter washed into oceans by typhoons or other causes by, for example, utilizing a wide-area network of floating litter recovery ships in order to secure safe marine navigation promptly.

5.5.3. Development of a national-level disaster waste management cooperative framework

○ Accumulate and verify—on an on-going basis—past experience of waste management during disasters across the nation to enhance the resilience of disaster waste disposal systems. Develop and operate information platform, in collaboration with D.Waste-Net members (National Institute for Environmental Studies, Japan Society of Material Cycles and Waste Management, Japanese Geotechnical Society, etc.), to allow local governments, the private sector, and others to utilize the accumulated information and lessons effectively.

○ (The same as mentioned earlier) Promote research and development on the adaptation to global-scale changes in cooperation with industry, academics, and other actors. Also, facilitate and increase the efficiency of disaster waste management through such means as utilizing the latest technologies including information technology and satellites.

○ Improve the way D.Waste-Net is operated to allow the users to make full use of its resources, while also enhancing the role of D.Waste-Net in non-emergency times.

○ Develop collaboration among the regional blocks so that they can cooperate with each other smoothly.

○ (The same as mentioned earlier) Take necessary measures in advance of a large-scale disaster through collaboration among relevant government agencies to build a nationwide network for disaster waste management, including arrangements for marine transport.

○ Promote the development of waste disposal facilities that can serve as disaster waste management bases in the event of a disaster.

○ Provide support on the occurrence of a disaster, such as dispatching a support team made up of experts from D.Waste-Net and staff from the Ministry of the Environment to the affected areas; implementing wide-area coordination operations including arrangements for vehicles for waste collection and hauling; building a national-level waste treatment network.

○ (The same as mentioned earlier) Maintain a system to dispatch a large dredging and oil recovery vessel to the scene of a large-scale oil spill accident in the waters around Japan as early as possible upon receiving a call for service from the Japan Coast Guard for swift and accurate oil recovery operations.

5.6. Development of Proper International Framework for Circulation of Resources and Overseas Expansion of Waste Management and Recycling Industries

5.6.1. Development of proper international framework for circulation of resources

○ Enhance resource efficiency and promote the 3Rs based on the Toyama Framework on Material Cycles adopted at the G7 Toyama Environment Ministers' Meeting in May 2016 and the 5-year Bologna Roadmap adopted at the G7 Bologna Environment Ministers' Meeting held in Italy in June 2017. Cooperate with activities of the G7 Alliance for Resource Efficiency, which serves as a forum where industry, the public sector, research institutions, consumers, and other stakeholders will share best practices. Also work on the harmonization of microplastics[10] monitoring techniques in the light of the G7 Action Plan to Combat Marine Litter adopted at the Elmau Summit in 2015 and the Toyama Environment Ministers' communique 2016.

○ Contribute to the collective efforts of G20 nations to enhance resource efficiency, promote the 3Rs, and advance marine debris management mainly through the implementation of the G20 Resource Efficiency Dialogue and the G20 Action Plan on Marine Litter, both of which were established at the summit in Hamburg, Germany, in July 2017.

○ Actively contribute to activities of the Organization for Economic Co-operation and Development (OECD), the United Nations Environment Programme International Resource Panel (UNEP IRP)[66], UNEP International Environmental Technology Centre (IETC)[67], Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC)[68], Basel Convention[40], and other international frameworks.

○ Join discussions on the international standardization of, among others, waste collection and solid waste-derived fuel.

○ Advance sharing of information and consensus building on 3R promotion mainly through the Regional 3R Forum in Asia and the Pacific and other activities, while also maintaining and updating basic data mainly through the compilation of State of the 3Rs in Asia and the Pacific, in order to help create a sound material-cycle society in the Asia-Pacific region with which Japan has strong ties. Also, accelerate the efforts to reduce marine debris among concerned nations through the Tripartite Environment Ministers Meeting (TEMM) among Japan, China, and South Korea, North-West Pacific Action Plan (NOWPAP), and other initiatives.

○ Cooperate with the activities of the African Clean Cities Platform, an initiative established by Japan in April 2017, and drive the sharing of knowledge and the maintenance and updating of information.

○ Cooperate with the analysis of environmental and economic impact of the introduction of waste

power generation facilities and the proper international recycling of waste electrical and electronic equipment, which will be implemented by the Economic Research Institute for ASEAN and East Asia (ERIA) based on the Japan-ASEAN Environment Cooperation Initiative proposed by Japan in September 2017.

○ Support the creation of a sound material-cycle society, the 3Rs, proper waste treatment, and other efforts by overseas nations to achieve environmental and hygienic improvement, in collaboration with local governments and other parties, and through such means as memorandum of cooperation, environmental policy dialogue, and bilateral joint committees and workshops, as well as dispatching of experts, acceptance of trainees, and other initiatives of the Japan International Cooperation Agency (JICA).

○ Support the international implementation and sustained use of the manuals and fact sheets for the environmentally sound management (ESM) of hazardous waste adopted at the thirteenth meeting of the Conference of the Parties to the Basel Convention, in cooperation with the signatories.

Take leadership, in Asia in particular, in consolidating collaboration among the nations to prevent illegal import and export by leveraging the workshops of the Asian Network for Prevention of Illegal Transboundary Movement of Hazardous Wastes, ERIA, and other activities.

○ Actively become involved in the development of guidelines on transboundary movements of electrical and electronic waste (e-waste) and used electrical and electronic equipment, revision of the guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with mercury or mercury compounds, and development and revision of the guidelines for the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants (POPs)[25], and other technical guidelines.

○ Promote the recycling of secondary resources (used lead batteries, electronic parts scrap, etc.) generated in Japan and abroad in a proper and steadfast manner by utilizing Japan's advanced technologies and through, among other means, the strict execution of the amended Basel Act. The amendments include the clarification of specified hazardous waste to prevent their illegal export; elimination of import approval procedures for electronic parts scrap; creation of a certification system for the import of waste, etc. with a relatively high level of hazard.

○ Make use of international recycling networks for recyclable resources that have limited use in Japan but have stable demand abroad, as long as it is guaranteed that the recycling will not cause environmental pollution in the export destination country.

○ (The same as mentioned earlier) Develop an international resource circulation network mainly

through Recycling Ports by, for example, exporting circulative resources extracted from waste in Japan to nations that need such resources.

○ Advance standardization in the area of resource efficiency in cooperation with other nations, aiming at a global society with high resource efficiency.

○ Create an environment that facilitates early effectuation of the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 (Ship Recycling Convention) and ensure strict execution of the convention after it goes into effect. The convention is expected to drive environmentally-sound and safe scrapping and recycling of ships globally, thereby facilitating the removal of old ships from the market to bring about the sustainable development of global maritime industries.

5.6.2. Overseas expansion of waste management and recycling industries

○ Disseminate the Japanese concept of "Mottainai" abroad to raise global awareness of respecting and carefully using materials. At the same time, support efforts to reduce the generation of waste by, for example, promoting the introduction of refrigeration and other facilities to prevent the decay of food products for people's daily consumption.

○ (The same as mentioned earlier) Support the international expansion of Japan's superior waste treatment and recycling infrastructure systems in accordance with the Infrastructure Systems Export Strategy and other policies. More specifically, conduct—in cooperation with local governments and other actors—feasibility studies for and follow up individual waste treatment and recycling projects in developing and emerging nations. Also, organize training and workshops, dispatch experts, implement the verification of recycling technologies and systems prior to their introduction, and implement policy dialogues with local and central governments in other nations, all in an integrated manner.

○ (The same as mentioned earlier) Promote the export of high-quality environmental infrastructure that meets the needs of developing nations, which is developed by leveraging Japan's superior environmental technologies and systems, in accordance with the Basic Strategy for Overseas Development of Environmental Infrastructure formulated in July 2017. Implement all the support activities for this promotion, from top-level government involvement in sales through bilateral policy dialogues and regional forums to the development of frameworks and technologies for the project, and financing, as a package.

○ Provide Japan's know-how regarding disaster waste management, while also working together with JICA and other organizations concerned to conduct such activities as developing support schemes for

disaster-affected countries.

5.7. Development of Infrastructure in the Area of Recycling

5.7.1. Development of information infrastructure in the area of recycling

○ Explore techniques and indicators that enable each actor to measure clearly and improve their efforts to create a sound material-cycle society. These techniques and indicators will include those for business operators to voluntarily evaluate how much productivity has improved with less input of resources, as well as for financial institutions, investors, and others who need to make decisions on their investments to evaluate the difficulty in securing resources, generation of hazardous waste, and other risks.

○ (The same as mentioned earlier) Keep updated with information on harmful substances, including international trends, and correctly implement risk communication[64] that allows concerned parties to share information and communicate with each other.

○ (The same as mentioned earlier) Facilitate business operators to demonstrate their commitment to environmental considerations by encouraging them to, among others, introduce environmental management systems, prepare and disclose environmental reports[65], and lay infrastructure for the disclosure of environmental information.

○ (The same as mentioned earlier) Advance the computerization of information on procedures and other matters concerning waste, while also exploring measures to promote the use of various computerized information on waste, including electronic manifests[38].

○ Further improve indicators mentioned in Section 3, while in parallel promoting the improvement and management of data that provide supporting evidence to the indicators.

5.7.2. Technological development and utilization and application of the latest technologies in the area of recycling

○ Increase efficiency in waste collection through a combination of IoT[16] and data analysis technologies and promote the diffusion of advanced sorting and other systems that make full use of sensing, robot, and AI[18] technologies in order to enhance productivity of waste management and recycling industries[7], while also addressing the shortage of manpower caused by the declining population.

○ Promote the sophistication of waste energy utilization technologies.

○ Support the development of technologies and the introduction of equipment that enables the 3Rs of new products and materials, such as rapidly diffusing photovoltaic power generation equipment,

lithium ion batteries and carbon fiber-reinforced plastics[37].

○ Support the development of technologies to reduce the risk of and manage hazardous waste that is not suitable for recycling, in order to ensure its proper treatment.

○ Identify and address issues associated with the technological development for proper treatment and recycling of harmful substances, hazardous materials, and hard-to-manage waste that are expected be generated in the event of a disaster.

○ Identify and address issues associated with the upgrading of techniques for information management and sharing for disaster waste treatment based on ICT.

○ Identify and address issues associated with the development of techniques for quick estimation of the generation of disaster waste from satellite and aerial images.

○ (The same as mentioned earlier) Promote research and development of world-leading, innovative low-carbon technologies, such as white biotechnologies which utilize biomass[15] to produce chemical and other products (cellulose nanofibers, etc.).

○ Promote the accumulation of scientific knowledge and the development of technologies required for propelling environmental policies to create a sustainable, sound material-cycle society.

5.7.3. Development of human resources as well as dissemination and enlightenment in the area of recycling

○ Support activities of promoters of waste reduction appointed under the Waste Management Act as well as of officials in charge of promotion of reduction of waste containers and packaging discharged (3R Promotion Meister) appointed under the Container and Packaging Recycling Act and promote the dissemination and enlightenment of the 3Rs in general and cooperation between business operators, consumers, and other actors.

○ (The same as mentioned earlier) Develop human resources for future waste management and recycling industries[7], who have expertise in waste treatment and resource circulation; who are capable of promoting and managing safety in operations effectively; who are considerate to the environment by working on the reduction of greenhouse gas emissions and other environmental efforts; and possess capabilities and knowledge to perform operations while at the same time paying full attention to how they can contribute to their local communities and economy.

○ Organize the 3R Promotion National Convention, which is intended to accelerate efforts by local

governments and build and upgrade cooperation with a wide range of parties concerned in order to promote the creation of a sound material-cycle society through the 3Rs. Also, collaborate with the 3R Promotion Forum, Reduce, Reuse, Recycle Promotion Council, and other private 3R organizations.

○ Operate the Re-Style website（http://www.re-style.env.go.jp）throughout the year. With “Pass on our limited natural resources to future generations. What can we do now?” as the key message, the website is designed to directly communicate to citizens, particularly young people, the importance of natural resources and the 3Rs through persuasive content including subcultural topics to raise their awareness and call on them to take action. Also, organize Re-Style FES! events in linkage with the website throughout Japan as a way to directly encourage people in each region to be more conscious of and practice the 3Rs.

○ (The same as mentioned earlier) Implement the “Let’s choose! 3R campaign” aimed at consumers in cooperation with many private-sector companies in supermarkets, drugstores, and other sites across Japan mainly during the 3R Promotion Month in October in order to increase the public’s awareness of and call their action to practice the 3Rs. Also, invite companies to become Re-Style partner companies as a new form of cooperation with the private sector based on the Ministry of the Environment’s Re-Style website in order to constantly provide information on and encourage people to implement the 3Rs and other activities toward a sound material-cycle society.

○ Continue to create the Handbook on Resource Recycling Legislation and Trends in 3R and distribute it to relevant organizations to promote dissemination and enlightenment toward establishing a sound material-cycle society, while also distributing the handbook to the public upon request for environmental education on the 3Rs. Also, continue to introduce examples of 3R practices and related laws and regulations, publish reports of various investigations, loan out DVDs produced for dissemination and enlightenment, and provide other information on 3R policies on the dedicated website (http://www.meti.go.jp/policy/recycle/).

○ Continue to work on dissemination and enlightenment activities to communicate the current status, issues, and other information on food loss to consumers in an easy-to-understand manner to deepen their understanding as part of cooperative efforts by related government agencies to reduce food loss.

○ (The same as mentioned earlier) Promote, in a comprehensive manner and with respect for the importance of collaborating with diverse actors, to encourage environmental education, conservation, and other activities to be conducted at households, schools, workplaces, regions, and all other places under the Environmental Education Promotion Act with the aim of establishing a sustainable society.

○ Improve and expand the “Place for Experiences opportunities” as defined in the Environmental

Education Promotion Act to enlighten citizens about a sound material-cycle society by, for example, deepening their understanding and renewing their awareness.

○ Further promote environmental education at schools including that for the creation of a sound material-cycle society, based on the Courses of Study (*Gakushu Shido Yoryo*), and in such a way that matches each stage of the development of pupils and students.

○ Promote the development of environmental-friendly schools (Eco School) that can be used for environmental education.

○ (The same as mentioned earlier) Promote, in the light of the SDGs and the new Courses of Study (*Gakushu Shido Yoryo*) and in collaboration with diverse actors in each region, Education for Sustainable Development (ESD) to nurture people who can show willingness to solve environmental and other global issues on their own accord as if the issues were their own problems and contribute to the creation of a sustainable society. Also, endeavor to develop leaders who can drive ESD-based environmental education in each region.

6. Effective Implementation of This Plan

6.1. Cooperation among responsible government agencies

The government policies on the establishment of a sound material-cycle society are interconnected in many cases. To efficiently and effectively execute such policies, government agencies need to make collective efforts, rather than working separately. For this reason, government agencies will drive their measures in close collaboration with each other and exchange information not just among themselves but also with their local branch bureaus and departments at all times, particularly for policy areas for which multiple government agencies are responsible, such as the utilization of biomass[15] and assistance to the building of a sound material-cycle society in Asian nations.

Moreover, since the independency, originality, and ingenuity of various actors are important in creating a sound material-cycle society, the government will enhance collaboration not just internally but also with various outside actors.

6.2. Evaluation and Review of the Progress of this Plan by the Central Environmental Council

The Central Environmental Council will appropriately conduct evaluation and review of the progress of the measures based on this Plan about once every two years to ensure the steady implementation of this Plan.

6.3. Schedule of Enforcement of Laws and Implementation of Measures (Exhibit 1 Schedule)

The government will ensure the enforcement of individual laws to build a sound material-cycle society in a well-planned manner according to the schedule (Exhibit 1) attached. The government will also actively evaluate its policies, appropriately review its measures, and revise and improve the measures as necessary.

Exhibit 1　Schedule of Enforcement of Laws

	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	Remarks
Basic Act for Establishing a Sound Material-Cycle Society	Development of Fourth Fundamental Plan					Review of Fourth Fundamental Plan	
Waste Management Act							Evaluation and review based on supplementary provisions of the revised act (2017) in or after FY2025
Act on the Promotion of Effective Utilization of Resources							
Container and Packaging Recycling Act			Evaluation and review				
Home Appliance Recycling Act		Evaluation and review					
Small Home Appliance Recycling Act	Evaluation and review						
Construction Recycling Act			Evaluation and review				
Food Recycling Act	Evaluation and review						
End-of-life Vehicle Recycling Act			Evaluation and review				
Act on Special Measures against Industrial Waste						Temporary legislation until FY2022	
Act on Special Measures concerning Promotion of Proper Treatment of PCB Wastes				Evaluation and review			
Act on Promotion of Procurement of Eco-Friendly Goods and Services by the State and Other Entities	Review of designated procurement items to which the state, etc. will give priority when procuring as well as of their criteria						
Note: The period of evaluation and review of each act above is an approximation for reference only.							

Exhibit 2　Indicators and Numerical Targets for the Establishment of a Sound Material-cycle Society

Boldface: Primary indicators; Fine letters: Supplementary indicators; ※: New indicators added to the Fourth Fundamental Plan

Indicator		Numerical target	Target year	Remarks		
Overall picture of a sound material-cycle society	Inlet	Material flow indicator	**Resource productivity** [1]	**Approx. 490,000 yen/ton**	**FY2025**	
			Resource productivity excluding the input of non-metallic mineral resources [69]	Approx. 700,000 yen/ton	FY2025	
			Resource productivity in terms of primary resources converted [70]	—	—	
			※ Consumption of natural resources [71]	—	—	Comparison and verification with the corresponding SDG indicator
			Per-capita consumption of natural resources in terms of primary resources converted [54]	—	—	Comparison and verification with the corresponding SDG indicator
	Circulation	Material flow indicator	**Cyclical use rate at inlet** [2]	**Approx. 18%**	**FY2025**	
			Cyclical use rate at outlet [45]	**Approx. 47%**	**FY2025**	
			Cyclical use rate at outlet for municipal waste [72]	Approx. 28%	FY2025	Basic Waste Management Policy [53]
			※ Cyclical use rate at outlet for municipal waste for industrial waste [73]	Approx. 38%	FY2025	Basic Waste Management Policy
	Outlet	Material flow indicator	**Final disposal amount** [3]	**Approx.13 million tons**	**FY2025**	
			※ Generation of municipal waste	Approx. 38 million tons	FY2025	Basic Waste Management Policy
			※ Final disposal amount of municipal waste	Approx. 3.2 million tons	FY2025	Basic Waste Management Policy
			※ Generation of industrial waste	Approx. 390 million tons	FY2025	Basic Waste Management Policy
			Final disposal amount of industrial waste	Approx. 10 million tons	FY2025	Basic Waste Management Policy

Indicator		Numerical target	Target year	Remarks		
Integration of efforts toward creating a sound material-cycle society into those for a sustainable society	Integration of efforts toward environmental and economic considerations	Material flow indicator by objective	※ Resource productivity based on the consumption of natural resources in terms of primary resources converted [74]	―	―	Comparison and verification with the corresponding SDG indicator
			※ Resource productivity by industry (in terms of primary resources converted)	**―**	**―**	
		Effort indicator by objective	**Market size of business related to sound material-cycle society business**	**Almost double from FY2000**	**FY2025**	
			Number of business operators that have set goals towards improving resource productivity	―	―	
	Integration of efforts toward environmental and social considerations	Material flow indicator by objective	**※ Generation of household food loss**	**Decrease by half from FY2000**	**FY2030**	**Comparison and verification with the corresponding SDG indicator**
			※ Generation of commercial food loss	**To be set in the basic policy for the Food Recycling Act**		**Comparison and verification with the corresponding SDG indicator**
		Effort indicator by objective	※ Ratio of consumers who are aware of the issue of food loss and working on its reduction, as found in a consumer awareness survey	―	―	SDGs Implementation Guiding Principles
	Integration of efforts toward cyclical use and low-carbon	Material flow indicator by objective	Resource productivity of fossil resources [75]	―	―	
			Emission of greenhouse gas from the waste sector	**―**	**―**	
			Reduction of greenhouse gas emissions from other sectors through the utilization of waste as raw materials and fuel as well as sources for power generation [46]	**―**	**―**	
			※ Domestic shipment of biomass plastics	1.97 million tons	FY2030	Plan for Global Warming Countermeasures
			※ Amount of municipal plastic waste incinerated (dried basis)	2,458, 000 tons	FY2030	Plan for Global Warming Countermeasures

Indicator		Numerical target	Target year	Remarks		
			※ Cyclical use rate at outlet by type of waste, etc. (biomass [15])	—	—	
			※ Amount of RPF produced	1,003,000 tons	FY2030	Plan for Global Warming Countermeasures
		Effort indicator by objective	**※ Average power generation efficiency of garbage incineration facilities constructed or improved during the specified period [47]**	**21%**	**FY2022**	**Waste Treatment Facility Preparation Plan**
			Capacity of waste power generation, total waste power generation	—	—	
			※ Amount and rate of waste heat utilized	—	—	
	Integration of efforts toward cyclical use and harmony with nature	Material flow indicator by objective	**Ratio of domestically-produced biomass resources to total natural resources input [48]**	**—**	**—**	
			※ Amount of fuel wood utilized	8 million tons	FY2025	Basic Plan for Forest and Forestry
			※ Cyclical use rate at outlet by type of waste, etc. (biomass)	—	—	The same indicator as that which appeared earlier but this time for biomass
		Effort indicator by objective	※ Amount of natural stock (area of forests)	—	—	SDGs Implementation Guiding Principles
			※ Growing stock of forests	—	—	SDGs Implementation Guiding Principles
			※ Area of forests protected by law	—	—	SDGs Implementation Guiding Principles
			※ Area of forests for which specific forest management plans are formulated	**—**	**—**	**SDGs Implementation Guiding Principles**
			※ Self-sufficiency rate of wood supply	—	—	
			※ Certification regarding sustainable use of resources acquired [76]	—	—	
Formation of diverse regional circulating and ecological sphere		Material flow indicator by objective	※ Generation of municipal waste	Approx. 38 million tons	FY2025	Basic Waste Management Policy; the same indicator as that which appeared earlier

Indicator	Numerical target	Target year	Remarks		
		Cyclical use rate at outlet for municipal waste	Approx. 28%	FY2025	Basic Waste Management Policy; the same indicator as that which appeared earlier
		※ Final disposal amount of municipal waste	Approx. 3.2 million tons	FY2025	Basic Waste Management Policy; the same indicator as that which appeared earlier
		※ Generation of industrial waste	Approx. 390 million tons	FY2025	Basic Waste Management Policy; the same indicator as that which appeared earlier
		※ Cyclical use rate at outlet for municipal waste for industrial waste	Approx. 38%	FY2025	Basic Waste Management Policy; the same indicator as that which appeared earlier
		Final disposal amount of industrial waste	Approx. 10 million tons	FY2025	Basic Waste Management Policy; the same indicator as that which appeared earlier
		Per-capita waste generation per day [49]	**Approx. 850 g/person/day**	**FY2025**	
		Per-capita household waste generation per day [50]	**Approx. 440 g/person/day**	**FY2025**	**Basic Waste Management Policy**
		Business waste generation [51]	**Approx. 1.1 million tons**	**FY2025**	
	Effort indicator by objective	※ **Number of local governments working on the formation of regional circulating and ecological sphere[52]**	**—**	**—**	
		Number of fundamental recycling plans drawn up by local governments	—	—	
		Ratio of local governments providing household waste collection for a fee	—	—	

Indicator	Numerical target	Target year	Remarks		
		※ Number of prefectures and municipalities with biomass utilization promotion plans in place	47 prefectures and 600 municipalities	FY2025	Basic Act for the Promotion of Biomass Utilization
		※ Number of municipalities selected as biomass industrial cities	—	—	
Thorough circulation of resources throughout the lifecycle of goods and services	Material flow indicator by objective	**Per-capita consumption of natural resources in terms of primary resources converted**	**—**	**—**	**The same indicator as that which appeared earlier; comparison and verification with the corresponding SDG indicator**
		Cyclical use rate at outlet	**Approx. 47%**	**FY2025**	**The same indicator as that which appeared earlier**
		※ Resource productivity by industry (in terms of primary resources converted)	—	—	The same indicator as that which appeared earlier
		※ Input of renewable resources	—	—	
		※ Cyclical use rate at inlet for each of the four types of resources [56]	—	—	
		※ Generation of waste, etc. by type	—	—	
		※ Cyclical use rate at outlet by type of waste, etc.	—	—	
		※ Cyclical use rate at outlet by material/product	—	—	
		Reuse rate of bottles	—	—	
		※ Final disposal amount by type of waste, etc.	—	—	
		※ Amount of material stock by material/product	—	—	

Indicator		Numerical target	Target year	Remarks		
			Recycling rate of specified home appliances	Air conditioner 80%; TV (CRT) 55%; TV (LCD/PDP) 74%; refrigerator/freezer 70%; washing machine/clothes dryer 82%	In or after FY2015	Home Appliance Recycling Act
			Rate of specified home appliances waste collected	56% in the total of all the specified items	FY2018	Basic policy for Home Appliance Recycling Act
			Recycling rate of the specified items generated from end-of-life vehicles	Automobile shredder residue 70%; airbag-related products 85%	In or after FY2015 for the automobile shredder residue target	Automobile Recycling Act
		Effort indicator by objective	※ Rate of materials added to stock [77]	—	—	
			Average use years of durable consumer goods	—	—	
			Rate of refills/replacements shipped	—	—	
			Market size of reuse	**—**	**—**	
			Market size of sharing (car sharing [55] etc.)	**—**	**—**	
			※ Number of registered members of major online platforms for C-to-C reuse	—	—	
			Implementation rate of green purchasing [58]	—	—	
			Number of Eco-Action 21 [78] certifications issued	—	—	
			Publication rate of environmental reports [65]	—	—	
			Development of guidelines for product assessment (design for environment) by industries	**—**	**—**	
	Plastics	Material flow indicator by objective	※ Generation of waste, etc. by type (plastic waste)	—	—	The same indicator as that which appeared earlier

Indicator		Numerical target	Target year	Remarks		
			※ Amount of plastic container and packaging waste sorted and collected	―	―	Container and Packaging Recycling Act
			※ Cyclical use rate at outlet by type of waste, etc. (plastic waste)	**―**	**―**	**The same indicator as that which appeared earlier**
			※ Domestic shipment of biomass plastics	1.97 million tons	FY2030	The same indicator as that which appeared earlier; Plan for Global Warming Countermeasures
			※ Amount of municipal plastic waste incinerated (dried basis)	2,458,000 tons	FY2030	The same indicator as that which appeared earlier; Plan for Global Warming Countermeasures
			※ Final disposal amount by type of waste, etc. (plastic waste)	**―**	**―**	**The same indicator as that which appeared earlier**
		Effort indicator by objective	Ratio of people carrying their own shopping bags instead of using shops' plastic bags	―	―	
			※ Number of local governments collecting containers and packaging, and ratio of consumers sorting and otherwise properly discharging their waste to the total population (plastics)	―	―	Container and Packaging Recycling Act
	Biomass (food, wood, etc.)	Material flow indicator by objective	**※ Generation of household food loss**	**Decrease by half from FY2000**	**FY2030**	**The same indicator as that which appeared earlier**
			※ Generation of commercial food loss	**To be set in the basic policy for the Food Recycling Act**		**The same indicator as that which appeared earlier**
			※ Targets for the control of food waste generation [79]	Targets set by public notice issued under the Food Recycling Act	FY2019	

Indicator		Numerical target	Target year	Remarks		
			※ Cyclical use rate at inlet for each of the four types of resources (biomass)	**－**	**－**	**The same indicator as that which appeared earlier**
			※ Cyclical use rate at outlet by type of waste, etc. (biomass)	**－**	**－**	**The same indicator as that which appeared earlier**
			※ Amount of fuel wood used	8 million tons	FY2025	The same indicator as that which appeared earlier; Basic Plan for Forest and Forestry
			※ Final disposal amount by type of waste, etc. (biomass)	**－**	**－**	**The same indicator as that which appeared earlier**
			※ Amount of paper container and packaging waste sorted and collected	－	－	Container and Packaging Recycling Act
		Effort indicator by objective	※ Number of local government members of the National Oishii Tabekiri Campaign Network Conference	－	－	
			※ Ratio of consumers who are aware of the issue of food loss and are working on its reduction, as found in a consumer awareness survey	－	－	SDGs Implementation Guiding Principles; the same indicator as that which appeared earlier
			Implementation rate of recycling of cyclical food resources	**Food processing 95%; food wholesale 70%; food retail 55%; food service 50%**	**FY2019**	**Food Recycling Act**
			※ Number of local governments collecting containers and packaging, and ratio of consumers sorting and otherwise properly discharging their waste to the total population (paper)	－	－	Container and Packaging Recycling Act

Indicator		Numerical target	Target year	Remarks		
	Metals	Material flow indicator by objective	**※ Cyclical use rate at inlet for each of the four types of resources (metals)**	**－**	**－**	**The same indicator as that which appeared earlier**
			Cyclical use rate of metal resources at inlet based on the TMR indicator, which includes hidden flows [80]	－	－	
			※ Cyclical use rate at outlet by type of waste, etc. (metals)	**－**	**－**	**The same indicator as that which appeared earlier**
			※ Final disposal amount by type of waste, etc. (metals)	**－**	**－**	**The same indicator as that which appeared earlier**
			※ Amount of waste compact rechargeable batteries collected and their recycling rate	－	－	
			Amount of small waste electrical and electronic equipment collected	140,000 tons/year	FY2018	Basic policy for the Small Home Appliance Recycling Act
			Amount of small waste home appliances collected and recycled by approved businesses	－	－	
		Effort indicator by objective	Number of local governments collecting small waste electrical and electronic equipment, and ratio of consumers sorting and otherwise properly discharging their waste to the total population	－	－	Basic Waste Management Policy
	Earth and rocks, construction materials	Material flow indicator by objective	**※ Cyclical use rate at inlet for each of the four types of resources (non-metallic minerals)**	**－**	**－**	**The same indicator as that which appeared earlier, but this time for non-metallic minerals**
			※ Amount of glass container and packaging waste sorted and collected	－	－	Container and Packaging Recycling Act
			※ Cyclical use rate at outlet by type of waste, etc. (non-metallic minerals)	**－**	**－**	**The same indicator as that which appeared earlier, but this time for non-metallic minerals**

Indicator		Numerical target	Target year	Remarks		
			Recycling rate of specified construction waste [81]	Set for each type of waste	FY2018	Construction Recycling Act
			※ Final disposal amount by type of waste, etc. (non-metallic minerals)	**－**	**－**	**The same indicator as that which appeared earlier, but this time for non-metallic minerals**
		Effort indicator by objective	※ Number of local governments collecting container and packaging waste, and ratio of consumers sorting and otherwise properly discharging their waste to the total population (glass)	－	－	Container and Packaging Recycling Act
			※ Establishment rate of life extension plans for individual facilities (individual facility plan)	**100%**	**FY2020**	**Priority Plan For Infrastructure Development**
			※ Ratio of long-life quality housing to new housing total	20%	FY2025	Basic Plans for Living (national plans)
	Products and materials introduced widely as a measure against global warming	Effort indicator by objective	※ Reuse rate and recycling rate of solar panels	－	－	
			※ Number of verification projects regarding the 3Rs for newly diffused products	－	－	
Continued promotion of proper waste treatment and environmental restoration	Continued promotion of proper waste treatment	Material flow indicator by objective	**Amount of illegal dumping**	**－**	**－**	
			※ Amount of waste treated improperly	**－**	**－**	
			※ Amount of asbestos waste (intermediate treatment, final disposal)	－	－	
			※ Amount of mercury waste (intermediate treatment, final disposal)	－	－	
		Effort indicator by objective	**Number of illegal dumping cases**	**－**	**－**	
			※ Number of improper waste treatment cases	**－**	**－**	

Indicator		Numerical target	Target year	Remarks		
			※ Number of asbestos waste treatment facilities (intermediate treatment, final disposal)	―	―	
			※ Number of mercury waste treatment facilities (intermediate treatment, final disposal	―	―	
			Number of industrial waste disposal businesses approved as high quality	―	―	
			Diffusion rate of electronic manifests [38]	**70%**	**FY2022**	
			※ Number of remaining sustainable years of municipal waste final disposal sites [57]	**Maintain the same level as in FY2017 (20 years)**	**FY2022**	**Waste Treatment Facility Preparation Plan**
			※ Number of remaining sustainable years of industrial waste final disposal sites	**Number of years required for the final disposal of 10 years' worth of waste volume**	**FY2020**	**Basic Waste Management Policy**
	Environmental restoration	Material flow indicator by objective	**Amount of illegal dumping**	―	―	The same indicator as that which appeared earlier
			※ Amount of waste treated improperly	―	―	The same indicator as that which appeared earlier
		Effort indicator by objective	**Number of illegal dumping cases**	―	―	The same indicator as that which appeared earlier
			※ Number of improper waste treatment cases	―	―	The same indicator as that which appeared earlier
			※ Number of municipalities with plans for abandoned houses, etc. in place to the total number of municipalities	Approx. 80%	FY2025	Basic Plans for Living (national plans))
Development of a well-planned framework for disaster waste management		Effort indicator by objective	**※ Ratio of local governments with a disaster waste management plan in place [82]**	**Prefectural governments: 100% Municipalities: 60%**	**FY2025**	**Fundamental Plan for National Resilience**

Indicator		Numerical target	Target year	Remarks		
			※ Ratio of facilities whose operations can be resumed in the event of a disaster [83]	50%	FY2025	Fundamental Plan for National Resilience
			※ Ratio of waste incineration facilities taking measures against deterioration [84]	85%	FY2025	Fundamental Plan for National Resilience
			※ Rate of progress in the construction of temporary disaster waste storage facilities [85]	70%	FY2025	Fundamental Plan for National Resilience
			※ Implementation rate of training regarding disaster waste [86]	Prefectural governments: 80% Municipalities: 60%	FY2025	Fundamental Plan for National Resilience
			※ Ratio of major cities discussing measures for the management of hazardous waste in the event of a disaster [87]	100%	FY2025	Fundamental Plan for National Resilience
Development of proper international framework for circulation of resources and overseas expansion of waste management and recycling industries	Development of proper international framework for circulation of resources	Material flow indicator by objective	Amount of circulative resources exported/imported [14]	—	—	
			※ Amount of secondhand goods exported/imported	—	—	
		Effort indicator by objective	※ Prices of circulative resources exported/imported	—	—	
			※ Number of nations with which a memorandum of understanding or other agreement on environmental cooperation (including that for resource circulation) is signed	—	—	
	Promotion of the overseas expansion of waste management and recycling industries	Effort indicator by objective	**※ Number of projects of overseas expansion of waste management and recycling industries**	**—**	**—**	
			Number of local governments collaborating with overseas cities regarding the creation of a sound material-cycle society	—	—	

Indicator		Numerical target	Target year	Remarks		
Development of infrastructure in the area of recycling	Development of information infrastructure in the area of recycling	Effort indicator by objective	**Diffusion rate of electronic manifests**	**70%**	**FY2022**	**The same indicator as that which appeared earlier**
	Technological development and utilization and application of the latest technologies in the area of recycling	Effort indicator by objective	**※ Ratio of research projects with the result of ex-post evaluation being S or A in the Environment Research and Technology Development Fund (ERTDF) program (sound material-cycle field)**	**－**	**－**	
			※ Number of supported research projects	－	－	
	Development of human resources as well as dissemination and enlightenment in the area of recycling	Effort indicator by objective	**Reduction of waste generation and awareness for cyclical use and green purchase**	**Approx. 90%**	**FY2025**	
			Implementation rate of specific 3R actions	**Increase by approx. 20% from the FY2012 poll**	**FY2025**	
			※ Ratio of consumers who are aware of the issue of food loss and are working on its reduction, as found in the Basic Survey on Consumer Life	－	－	SDGs Implementation Guiding Principles; the same kind of indicator as that which appeared earlier

Exhibit 3 Explanatory Notes

[1] resource productivity = GDP/input of natural resources

Input of natural resources is defined as the total amount of domestic and imported natural resources and imported products (direct material input (DMI)). Resource productivity represents a comprehensive indicator of how effectively each industry is increasing production with a smaller amount of natural resources and how people are utilizing resources in their daily activities—in other words, how much wealth is being produced with less resources—by calculating the real gross domestic product (real GDP) per certain amount of input of natural resources. For international comparison, attention must also be paid to the difference of industrial structure.

[2] cyclical use rate at inlet = amount of cyclical use/(input of natural resources + amount of cyclical use)

Cyclical use rate at inlet represents the share of cyclical use (amount reused/recycled) to total input in the economy and society.

[3] final disposal amount: Amount of landfill disposal waste. This indicator is directly linked to the issue of securing final disposal (landfill) sites for waste.

[4] Society 5.0: The fifth stage of human society following (1) hunting society, (2) agricultural society, (3) industrial society, and (4) information society. New value and services are continuously created in order to bring wealth to the people who make up society. It is an attempt to solve various social issues by introducing advanced technologies to every industry and aspect of life in society to provide the necessary goods and services to the people who need them at the required time and in just the right amount.

[5] fourth industrial revolution: A technological revolution based on IoT, big data, AI, and other advanced core technologies following the first industrial revolution (mechanization of factories based on hydraulic and steam power at and after the end of the 18th century), the second industrial revolution (mass production made possible by electric power and division of labor at the beginning of the 20th century), and the third industrial revolution (more advanced automation based on electronics and information technology in and after the 1970s)

[6] lifecycle: All the stages of a material flow in the economy and society, including securing of resources, production, distribution, use, reuse, recycling, and disposal

[7] waste management and recycling industries: Industries involved in such operations as the reduction of generation of waste, etc., reuse, recycling, waste heat utilization, and proper waste treatment

[8] grade of mineral resources: The amount of metal content contained in mineral ores to be extracted, usually shown in terms of mass ratio. The degradation of mineral resources may lead to a rise in production costs, as well as to a higher environmental impact due to increased energy consumption in the process of refining and enhanced emission of impure substances.

[9] food loss: Food that is discarded despite still being edible

[10] microplastics: Tiny pieces of plastic waste with a diameter of 5 mm or less. Chemical substances contained/absorbed in microplastics may be transferred into the food chain and adversely affect ecosystems.

[11] 17 Sustainable Development Goals (SDGs) and 169 targets: A set of international development goals from 2016 to 2030 stated in the 2030 Agenda for Sustainable Development adopted at the United Nations Summit in September 2015 as the successor to the Millennium Development Goals (MDGs) set in 2001. A global-level goal is set for each of the 17 priority areas: (1) No poverty, (2) Zero hunger, (3) Good health and well-being, (4) Quality education, (5) Gender equality, (6) Clean water and sanitation, (7) Affordable and clean energy, (8) Decent work and economic growth, (9) Industry, innovation, infrastructure, (10) Reduced inequalities, (11) Sustainable cities and communities, (12) Responsible consumption and production, (13) Climate action, (14) Life below water, (15) Life on land, (16) Peace, justice and strong institutions, (17) Partnerships for the goals. The targets are more specific arrival points or midcourse points, including time frames and numerical targets, determined by each country's government in the light of their respective circumstances and in line with the global-level goals.

[12] the target of reducing food loss is....it is possible that they can be accomplished concurrently: Refer to the Annual Report on the Environment, the Sound Material-Cycle Society and Biodiversity in Japan 2017 (Part 1 Chapter 1 Section 2 1(2) Relationship between the goals and targets in the case of food loss, pages 10 and 11) for details.

[13] Strategic Approach to International Chemical Management (SAICM): An international strategy and action plan adopted at the First International Conference on Chemicals Management (ICCM1) in February 2006 in order to meet the goal set forth (WSSD 2020 Goal) at the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002, "aiming to achieve, by 2020, that chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and the environment." National governments, international organizations, industry, NGOs and other entities are working on a variety of efforts based on the SAICM.

[14] circulative resources: Waste, etc. that can be used. The Basic Act stipulates that circulative resources should be cyclically reused (reuse, recycle and heat recovery).

[15] biomass: A concept representing the quantity (mass) of biological resources (bio). Defined as biologically-derived

renewable organic resources excluding fossil resources, biomass has “carbon neutral” characteristics, meaning it does not add to CO_2 in the atmosphere.

[16] Internet of Things (IoT): A concept whereby automobiles, home appliances, robots, facilities, and others are connected to the Internet and communicate and interact with one another. Data is collected and exchanged to bring about automation and other convenience features and help create new value.

[17] big data: Sets of data that are so large in volume and so complex in structure that traditional technologies are not able to control or process them. Big data includes text data in social media, the user base of which is expanding rapidly, position information from the Global Positioning System (GPS) built into mobile and smart phones, and sensor data generated in real time.

[18] artificial intelligence (AI): The simulation of human intelligence by machines, especially computer systems

[19] sharing services: Services that allow individuals’ assets (including skills, time, and other intangible assets) to be made available for use by other individuals through an online matching platform.

[20] responsibility of waste-generating business operators: Responsibility owed by business operators to properly treat waste generated from their business activities. The responsibility cannot be absolved by merely outsourcing their waste management to others.

[21] extended producer responsibility (EPR): A concept where producers should bear a certain degree of responsibility for their products—not just in the resource input, production, and use stages but even after the products have been disposed of as waste, etc.

[22] design for environment (DfE): A technique to incorporate environmental considerations into product design, such as the ease of disassembly and the use of a single material for enhanced recyclability. Also called environmentally-conscious design and eco-design.

[23] PCBs: A group of chemicals used from their commercialization in 1929 for electric insulation oil, carbonless duplicating paper, and many other applications due to their stability, heat resistance, and insulation performance, but prohibited as a rule to be produced in and imported to Japan in 1974 because they were found hard to be degraded in the environment, bio-accumulative, and chronically toxic. PCBs are also prohibited as a rule to be produced and used internationally under the Stockholm Convention on Persistent Organic Pollutants, requiring the signatories to, among others, reduce emissions of unintentionally created substances, appropriately manage and dispose of stock and waste of products containing PCBs, and draw up plans to implement these measures within their borders.

[24] Stockholm Convention on Persistent Organic Pollutants (POP Convention): A convention which stipulates the elimination of production and use of, and reduction of release of, polychlorinated biphenyl (PCB) and other persistent organic pollutants (POPs), as well as proper treatment of waste containing such pollutants. POPs are persistent in the environment, bio-accumulative, and highly toxic to people and other living organisms, and therefore their long-distance migration is a concern. The signatories of the Convention are required to control such pollutants by enforcing national laws and regulations to ensure compliance with the Convention. With regards to the management of hazardous chemicals and waste, etc., measures have been taken not just under the Stockholm Convention but also under two other separate conventions—the Basel Convention and the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade—but because the three conventions share the same purpose of protecting health and the environment from hazardous chemicals and waste, the tighter cooperation and collaboration amongst the three conventions has been explored for more effective international control.

[25] persistent organic pollutants (POPs): Substances that are toxic, persistent, bio-accumulative and capable of long-distance movement. To eliminate and reduce POPs internationally, the POP Convention was adopted in May 2001 and came into effect in May 2004.

[26] an incident that severely damaged people’s trust in food occurred: An incident in which an industrial waste disposal business (also a food waste recycling contractor registered under the Food Recycling Act) in Aichi Prefecture to which the disposal of food waste had been outsourced by food manufacturers unlawfully resold the waste as food. (The offense was uncovered in January 2016, and all the food waste unlawfully stored by the firm was cleared by February 2017.)

[27] Interim Storage Facility: Facility for safely and intensively managing and storing decontaminated soil and waste from within Fukushima Prefecture

[28] Waste within management areas: Waste within contaminated waste management areas designated by the Environment Minister that is applicable to certain requirements

[29] designated waste: Waste such as incineration ash and sludge that contains more than 8,000 becquerels of radioactive cesium per kilogram and designated by the Environment Minister under the Act on Special Measures concerning the Handling of Pollution by Radioactive Materials

[30] Key Performance Indicators (KPIs): A performance measure used to effectively determine progress toward goals and objectives

[31] responsibility for the overall management of municipal waste: Responsibility held by municipalities to ensure proper treatment of all municipal waste generated within their jurisdiction including not just waste treated by municipalities themselves but also waste treated by others on behalf of municipalities

[32] the competitive environment of the industrial waste disposal industry in which "bad money drives out good": Waste generators desire to dispose of their waste, which is unnecessary for them anyway, at the lowest possible cost, while waste disposable businesses can earn money simply by collecting waste because the mere movement of waste generates money. Because of this structural problem, "cheap and nasty" waste management is prevailing in the market. There is a need to reform this structure to create an environment where high-quality waste disposal businesses can have an advantageous position in the market (i.e. preferentially chosen and hired by waste generators).

[33] natural connections among forests, the countryside, rivers, and the sea: For example, forests and the sea are connected via rivers, and earth and sand carried down through rivers form tideland, sandy beaches, and the like and nutrient salts supplied from forests nurture fish and other living organisms in rivers and the sea and create rich oceans. Spring water from forests is channeled into paddy fields, irrigation ponds, and flumes in the countryside and flows into rivers to support people's lives in cities. The proper management of forests, the countryside, rivers, and the sea also helps reduce disasters. In this way, because forests, the countryside, rivers, and the sea are connected, it is important to look at a drainage basin in its entirety to fully bring out the wealth of the benefits of forests, the countryside, rivers, and the sea and their connection.

[34] biomass-derived plastics: Plastic materials made from renewable organic resources such as plant biomass

[35] biodegradable plastics: Plastics that are degraded—under certain conditions—by the action of microorganisms that are present in large numbers in nature into water and carbon dioxide, while retaining the functions and physical properties of plastics

[36] urban mining: The practice of extracting useful metals from waste products

[37] carbon fiber-reinforced plastics: Plastics combined with carbon fiber, a material having superior features, for enhanced properties. Carbon fiber-reinforced plastics can be given diverse features by changing the way plastics and carbon fiber are combined.

[38] electronic manifest: A system that enables waste-generators to manage the flow of their waste and ensure proper treatment of the waste when outsourcing waste treatment to a contractor. Under this system, the generator issues a document (manifest) to the contractor and, upon completion of the treatment, the contractor submits a copy of the document attesting to that fact to the generator. Electronic manifest is the replacement of paper manifest, enabling the participants to exchange data online. Not only does it increase paperwork efficiency and streamline information management for both generators and contractors, but it also has other benefits—because of the difficulty in falsifying manifests—such as improving prefectural governments' supervisory efficiency over waste treatment and accelerating their investigation on causes of improper waste treatment. The Waste Management Act, revised in 2017, makes it obligatory for generators of a large volume of specially-controlled industrial waste (excluding PCB waste) to use electronic manifests.

[39] traceability: The state in which waste generators and waste disposal businesses can check the progress of treatment of industrial waste swiftly by utilizing electronic manifests and application services related thereto. Application services providers (ASPs) have recently begun to offer services based on information technology that enable generators to check the proper treatment of their waste, which include services that utilize the Global Positioning System (GPS) to monitor the route by which waste is transported and that provide images of waste being treated.

[40] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention): A convention adopted in 1989 and that came into effect in 1992. Japan acceded to the convention in 1993. Its stipulations include the requirement for permission and advance notice for the export of hazardous waste and the obligation to re-import waste that has been unlawfully exported or disposed of.

[41] remanufacturing: Disassembly, cleansing, and repair of used products and parts, as well as other operations as needed (such as replacement of worn parts and quality inspection), conducted to manufacture products and parts with quality equivalent to brand-new ones

[42] servicizing: Providing product functionality rather than products. It is intended to, while adding value for customers, reduce the input and optimize the consumption of resources in the production of products to decrease environmental impact. Also called "product service system" (PSS) in Europe.

[43] 2Rs (Reduce, Reuse): An acronym for "Reduce" and "Reuse," separated from among the 3Rs (Reduce, Reuse, Recycle). The 2Rs are prioritized over "Recycle," yet are falling behind in terms of implementation. "Reduce" means reducing waste generation itself. All waste generated, whether recyclable or not, has an impact on the environment. Therefore, the most effective solution to reducing environmental impact derived from waste treatment is not to allow waste to be generated in the first place. "Reuse" means using used products, parts, containers, etc. again. As they are used without being reshaped, "Reuse" generally consumes less resources and generates less waste than "Recycle."

[44] bioplastics: A collective term for biomass-derived plastics and biodegradable plastics

[45] cyclical use rate at outlet = amount of cyclical use/generation of waste, etc.

Cyclical use rate at outlet represents the share of cyclical use (amount reused/recycled) to generation of waste, etc.

[46] reduction of greenhouse gas emissions from other sectors through the utilization of waste as raw materials and fuels as well as sources for power generation: Reduction of fossil fuel-derived greenhouse gas emissions generated by the discharge of waste through utilizing waste as raw materials and fuels as well as sources for power generation in sectors other than the waste sector

[47] average power generation efficiency of garbage incineration facilities constructed or improved during the specified period:

Average power generation efficiency of garbage incineration facilities with power generation capability constructed or improved during the five-year period of the Waste Treatment Facility Preparation Plan (FY2018 to FY2022). The five-year average is calculated for such facilities from their annual average of each fiscal year.

[48] ratio of domestically-produced biomass resources to total natural resources input = domestically-produced biomass resources/total natural resources input

[49] per-capita waste generation per day = waste generation (amount of municipal waste (including that from businesses) collected through planned collection, direct collection, and group collection)/population/365 days

[50] per-capita household waste generation per day = household waste generation (amount of municipal waste collected from households excluding waste from group collection and recyclable waste)/population/365 days

[51] business waste generation: Since there is a large fluctuation in the number of businesses and a significant variance in the amount of waste generation depending on the size of businesses, the total amount of waste generation is set as an indicator, rather than waste generation per business.

[52] number of local governments working on the formation of regional circulating and ecological sphere: The number of prefectural governments and municipalities that answered that they are working on the formation of local recycling networks

[53] Basic Waste Management Policy: A basic policy for "promoting measures comprehensively and systematically on restrain of the waste discharge, waste reduction by recycling and other proper management of waste" established under Article 5-2 of the Waste Management Act, which sets forth similar indicators to those in this Fourth Fundamental Plan. When the basic policy is revised in the future, its targets will be set in a way to be aligned with those of this Fourth Fundamental Plan.

[54] per-capita consumption of natural resources in terms of primary resources converted = (input of natural resources in terms of primary resources converted－export volume in terms of primary resources converted)/population

This is calculated by dividing the amount of natural resources consumed for economic activities in Japan or raw material consumption (RMC) (the input of natural resources in terms of primary resources converted less the export volume in terms of primary resources converted) by the population. Although the estimation method for the material footprint per capita, one of the SDG indicators, is not determined, discussions are currently underway regarding the method of estimating material footprint as RMC. If this is the case, per-capita consumption of natural resources in terms of primary resources converted and material footprint per capita will be considered to be the same indicator.

[55] Car sharing: A system particularly suitable for urban areas with well-developed public transportation in which, instead of owning their own vehicles, people can rent and use vehicles that are considered most convenient for their purpose for short periods of time whenever as the need arises like their own vehicles. This concept was invented in Switzerland in the late 1980s to resolve traffic problems and as part of environmental conversation activities. It became popular across Europe in the 1990s and has recently been spreading in Japan as well.

[56] four types of resources: Metal, non-metallic minerals, fossil, and biomass resources

[57] number of remaining sustainable years of municipal waste final disposal sites: The number of years before landfill sites reach full capacity, calculated based on the available capacity of a certain fiscal year and the final disposal amount of that fiscal year

[58] green purchasing: Purchasing only necessary products and services and giving priority to and selecting products and services with less environmental impact from among those available in the market

[59] the results of the poll executed in FY2012: The percentages of citizens taking major specific actions for the 3Rs as found in the poll on environmental issues conducted by the Cabinet Office in June 2012 are as follows:

- Refrain from using plastic shopping bags (carrying my own bags) or ask for less packaging: 59.1%
- Use refill products: 59.2%
- Do not purchase disposable products: 28.1%
- Use rental/lease services in order not to buy unnecessary products: 20.1%
- Try not to throw away foodstuff by refraining from leaving food uneaten or buying or cooking too much food: 55.8%
- Buy products that use reusable containers such as beer and milk bottles: 23.4%
- Cooperate in collection at shops of small waste electronic equipment such as mobile phones: 26.2%
- Buy recycled products made of recycled materials: 20.7%

[60] mixed metal scrap: Miscellaneous scrap materials including iron, non-ferrous metals, and plastics, as found in mixed waste of used electric and electronic equipment and metal scrap

[61] food bank: An activity in which substandard products identified in food production processes or food loss products generated in distribution processes are collected and provided free of charge to welfare institutions and other establishments

[62] food drive: An activity in which food donations are collected from households, etc. and provided free of charge to welfare

institutions and other establishments

[63] sea bottom hollows: Large-scale sites from which earth, sand, and gravel used to be extracted for use as fill materials for land reclamation and concrete aggregates. Some of the sites are found to be having an adverse effect on habitat environments of living organisms because they are deteriorating the quality of water and bottom sediments by causing the stagnation of tidal exchange and decomposition of organic matter, among others, to generate hypoxic waters (waters that are depleted of dissolved oxygen), as well as the elution of dissolved hydrogen sulfide from bottom sediments which can result in blue tides.

[64] risk communication: Sharing of information and exchange of opinions among citizens, the state, local governments, NPOs, NGOs, business operators, and all other relevant actors regarding how they perceive and think about the level of environmental risks of chemical substances, etc. and what measures should be taken against such environmental risks to develop dialogue for mutual trust and understanding

[65] environmental report: A report prepared and published by each of companies and other business operators to communicate messages from their top management and provide such information as their policies, targets and action plans concerning environmental conservation, the status of their environmental management (environmental management system, environmental accounting, legal compliance and design for environment, etc.), and their efforts for reduction of environmental impact

[66] International Resource Panel (IRP): A panel of world-renowned scientists and experts established by the United Nations Environment Programme (UNEP) in November 2007 to address the sustainable use of natural resources, an international issue that is becoming increasingly important along with the global expansion of economic activities. The goals of the panel are to develop a coherent approach towards the management of worldwide resources and to become a driving force for decoupling.

[67] International Environmental Technology Centre (IETC)： A UNEP organization established in 1992 for the purpose of transferring environmentally-sound technologies to developing nations. Headquartered in Osaka, the organization works mainly to enhance waste management in developing nations by promoting, among others, the improvement of environmental issues, the dissemination of environmentally-sound technologies, and integrated waste management.

[68] Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC) : An international partnership founded in February 2012 by the United States, Canada, Sweden, Mexico, Ghana, and Bangladesh to reduce emissions of short-lived climate pollutants (SLCPs). Japan also joined the partnership in April 2012. SLCPs are short-lived greenhouse gases and the like, such as black carbon (soot-like particles), methane, and chlorofluorocarbon. The reduction of SLCPs emissions is thought to be effective for both short-term mitigation of climate change and for the prevention of air pollution, and is receiving international attention.

[69] non-metallic mineral resources: Mineral resources excluding metallic minerals and fossil fuels, such as earth and rocks, gravel, and limestone. The resources were simply called “earth and rocks” in the previous fundamental plans.

[70] resource productivity in terms of primary resources converted: Although the estimated weight of imported products themselves is calculated into the total input of natural resources (which is used as the denominator in the calculation of resource productivity), the input of natural resources used in their production overseas is not included in this calculation. Accordingly, to more accurately grasp the total amount of resources consumed in Japan’s economic activities, it has been decided that the estimated weight of all raw materials (primary resources) required for the production of imported products will be figured in to calculate the raw material input (RMI) and that resource productivity based on RMI will be monitored.

[71] consumption of natural resources: The total amount of domestic and imported natural resources and imported products consumed for economic activities in Japan (the input of natural resources less the quantity exported or direct material consumption (DMC))

[72] cyclical use rate at outlet for municipal waste = amount of cyclical use of municipal waste/generation of municipal waste

[73] cyclical use rate at outlet for industrial waste = amount of cyclical use of industrial waste/generation of industrial waste

The amount of animal waste used on agricultural land without processing is classified as the amount of resources consumed in nature in the fundamental plans and is not included in the amount of cyclical use of industrial waste.

[74] resource productivity based on the consumption of natural resources in terms of primary resources converted = GDP/(input of natural resources in terms of primary resources converted－quantity exported in terms of primary resources converted)

[75] resource productivity of fossil resources = GDP/input of fossil natural resources

[76] Certification regarding sustainable use of resources acquired: e.g. the area of Forest Stewardship Council (FSC)-certified forests

[77] rate of materials added to stock = total stock/total input of materials

[78] Eco-Action 21: An integrated system that enables a wide range of organizations including small and medium-sized enterprises, educational institutions, and local governments to carry out the following environment management activities with ease: implementation of an environmental management system, environmental performance evaluation, and environment reporting

[79] targets for the control of food waste generation: Values calculated by dividing the amount of food waste generated from food businesses by values closely associated with the generation of food waste (e.g. sales for the fiscal year in question)

[80] cyclical use rate of metal resources at inlet based on the TMR indicator, which includes hidden flows =

$\sum i$ {(amount of recycled materials used in the process of domestic product production for Metal i × TMR coefficient for Metal i) /

$\sum i$ （amount of raw materials used in the process of crude metal and metal production and amount of imported materials used for products for Metal i × TMR coefficient for Metal i）

TMR or total material requirement represents the total amount of materials—including "hidden flows," such as mineral ores, earth and sand—that are generated in association with the extraction and mining of certain resources. However, when using the TMR indicator for metal resources, the following need to be noted: a) although it is necessary to gain accurate information on the grade and type of mineral ores at mines where metal resources are extracted, it is difficult to obtain such information from overseas mines and therefore there is a need to rely on estimates to some extent; b) such information does not necessarily indicate the magnitude of the impact on the environment; and c) it is currently difficult to accurately figure out the recycling rate for each type of mineral and therefore there is still a need to rely on estimates.

[81] recycling rate of specified construction waste: At least 99% recycling rate for asphalt concrete blocks and concrete blocks; at least 95% recycling and reduction rate for construction wood waste; at least 90% recycling and reduction rate for construction sludge; at least 60% recycling and reduction rate for mixed construction waste; no more than 33.5% generation rate for mixed construction waste; at least 96% recycling and reduction rate for total construction waste; and at least 80% effective utilization rate for soil from construction work. The generation rate of mixed construction waste means the percentage of the amount of mixed construction waste generated relative to the total amount of construction waste generated. The effective utilization rate of soil from construction work means the percentage of the amount of soil from construction work utilized effectively (e.g. reuse within the same construction site or at other construction sites, for the restoration of former quarries where proper embankment work has been done, and for agricultural land) relative to the total amount of soil generated from construction work.

[82] ratio of local governments with a disaster waste management plan in place = number of local governments that have formulated a disaster waste management plan/total number of local governments

[83] ratio of facilities whose operations can be resumed in the event of a disaster = number of garbage incineration facilities owned by core or larger cities whose operations can be resumed in the event of a disaster/total number of garbage incineration facilities owned by core or larger cities

Because core and larger cities are planning to incorporate anti-disaster measures into their facilities when the facilities are renewed, the achievement of the numerical target became difficult. For this reason, the target year has been postponed to 2025.

[84] ratio of waste incineration facilities taking measures against deterioration = number of garbage incineration facilities owned by core or larger cities that are not deteriorated/ total number of garbage incineration facilities owned by core or larger cities

Although the numerical target has been achieved, the target year has been extended to 2025 to maintain the current situation.

[85] rate of progress in the construction of temporary disaster waste storage facilities = number of municipalities working to secure temporary disaster waste storage facilities or looking for candidate sites/ total number of municipalities

Because the delay in the formulation of disaster waste management plans, among other reasons, made it difficult to achieve the numerical target, the target year has been postponed to 2025.

[86] implementation rate of training regarding disaster waste = number of prefectural governments that conduct training regarding disaster waste/total number of prefectural governments

implementation rate of training regarding disaster waste = number of municipalities that conduct training regarding disaster waste/ total number of municipalities

Because the lack of knowledge, among other reasons, made it difficult to achieve the numerical target, the target year has been postponed to 2025.

[87] ratio of major cities discussing measures for the management of hazardous waste in the event of a disaster = number of core or larger cities that are discussing measures for the management of hazardous waste in the event of a disaster/ total number of core or larger cities

Because the lack of knowledge, among other reasons, made it difficult to achieve the numerical target, the target year has been postponed to 2025.