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The Japanese Industrial Waste Experience:

Lessons for rapidly industrializing countries

United Nations Environment Programme

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Acronyms and abbreviations

3Rs	Reduce, reuse, recycle
CO_2	Carbon dioxide
COP	Conference of the parties
DLCs	Dioxins and dioxin-like compounds
EPR	Extended producer responsibility
GDP	Gross domestic product
GHG	Greenhouse gas(es)
IETC	International Environmental Technology Centre
ISO	International Organization for Standardization
ITPO	Investment and Technology Promotion Office
Keidanren	Japanese Business Federation (formerly, Japan Federation of Economic Organizations)
MBIs	Market-based instruments
METI	Ministry of Economy, Trade and Industry of Japan
MHLW	Ministry of Health, Labour and Welfare of Japan
MHW	Ministry of Health and Welfare of Japan
MOE	Ministry of the Environment of Japan
NOx	Nitrogen oxide
OECD	Organisation for Economic Co-operation and Development
PCBs	Polychlorinated biphenyls
PDCA	Plan, Do, Check, Act
PET	Polyethylene terephthalate
POPs	Persistent organic pollutants
PPP	Polluter pays principle
PVC	Polyvinyl chloride
R&D	Research and development
RECP	Resource efficient and cleaner production
Rio+20	United Nations Conference on Sustainable Development
SO_3	Sulphur trioxide
SOx	Sulphur oxide
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization

LIST OF JAPANESE WASTE MANAGEMENT LAWS

Short title	Original title
Air Pollution Control Law	Air Pollution Control Law
Basic Act on Establishing a Sound Material-Cycle Society	Basic Act on Establishing a Sound Material-Cycle Society
Basic Environment Act	Basic Environment Act
Basic Law for Environmental Pollution Control	Basic Law for Environmental Pollution Control
Construction Material Recycling Law	Law on Recycling of Construction-related Materials
Containers and Packaging Recycling Law	Law for the Promotion of Selective Collection and Recycling of Containers and Packaging
End-of-Life Vehicle Recycling Law	Law for the Recycling of End-of-Life Vehicles
Factory Effluent Control Law	Factory Effluent Control Law
Food Waste Recycling Law	Law for Promotion of Recycling and Related Activities for the Treatment of Cyclical Food Resources
Home Appliance Recycling Law	Law for the Recycling of Specified Kinds of Home Appliances
Law Concerning Special Measures against Dioxins	Law Concerning Special Measures against Dioxins
Law for Promotion of Environmental Consideration	Law Concerning the Promotion of Business Activities with Environmental Consideration by Specified Corporations, etc. by Facilitating Access to Environmental Information, and Other Measures
Law for the Control of Export, Import and Others of Specified Hazardous Wastes and Other Wastes	Law for the Control of Export, Import and Others of Specified Hazardous Wastes and Other Wastes
Law for the Promotion of Effective Utilization of Resources	Law for the Promotion of Effective Utilization of Resources
Law on Promoting Green Purchasing	Law Concerning the Promotion of Procurement of Eco-friendly Goods and Services by the State and Other Entities
Law on Special Measures Concerning Removal of Environmental Problems Caused by Specified Industrial Wastes	Law on Special Measures Concerning Removal of Environmental Problems Caused by Specified Industrial Wastes
PCB Special Measures Law	Law Concerning Special Measures for Promotion of Proper Treatment of PCB Wastes
Public Cleansing Law	Public Cleansing Law
Sewage Disposal Law	Sewage Disposal Law
Small Waste Electrical and Electronic Equipment Recycling Law	Law on Promotion of Recycling of Small Waste Electrical and Electronic Equipment
Smoke and Soot Control Law	Law Concerning Controls on the Emission of Smoke and Soot
Waste Management Law	Waste Management and Public Cleansing Law

Foreword

Many developing countries are currently experiencing rapid industrial growth, the pace of which is unprecedented. While this growth has lifted millions out of poverty, it has also been accompanied by serious challenges linked to industrial pollution and, in particular, industrial waste.

But for some of these problems, we already know some of the solutions. This is because the challenges associated with industrial waste being faced by rapidly industrializing countries – air, soil, and water pollution and the resulting negative impacts on public health and economic development – are similar to those that countries such as the United States, Germany, Japan and others had to deal with in the second half of the 20th century.

By the 1960s, industrial waste in Japan had begun to have serious negative impacts on the national quality of life. A period of 'miracle growth' in the 1950s and 1960s and further intensive industrialization had led to a series of environmental crises, including poisonings from industrial discharges, such as those caused by mercury pollution in the city of Minamata. These challenges, and the increasing public concern, prompted the national government, cities and industry to adopt preventive and remedial measures. Increasingly, the economic impetus for more efficient use of resources through reduced waste, reuse and recycling (the "3Rs" approach), and a desire to minimize the impacts of industrial processes on climate change, became driving factors in improved waste management.

Japan's efforts to improve its management of industrial waste have been recognized internationally, and useful lessons can be drawn from them. *The Japanese industrial waste experience: Lessons for rapidly industrializing countries*, developed with the financial support of the Ministry of Foreign Affairs of Japan, reviews and analyses the Japanese case and highlights the potential relevance for sustainable development in rapidly industrializing countries.

The country's experience shows that a mix of policies helped it turn challenges into opportunities. Regulations to hold waste generators responsible, voluntary measures for industries, market-based instruments to subsidize city-level action, and awareness-raising programmes were all part of the mix that helped change attitudes and practices in industrial waste management. The results were soon apparent: between 1990 and 2010, landfill of industrial waste decreased by 84 per cent, while the resource productivity rate between 2000 and 2010 increased by 51 per cent. In sharing the Japanese experience, this publication aims to contribute to more effective policy responses to industrial waste issues around the world, and ultimately to assist in the transition to an inclusive Green Economy.

The future scale of environmental problems from industrialization in developing countries will depend greatly on actions taken today. If current patterns of consumption and production remain the norm, pollution, and in particular waste from industrial production, is likely to increase. The Japanese experience will be useful to rapidly industrializing countries, which now have an unparalleled opportunity to leapfrog unsustainable paths of industrial development, and in so doing, to provide models that other countries can follow.

Achim Steiner
UN Under Secretary General
Executive Director UNEP

Executive Summary

THE CHALLENGES AND OPPORTUNITIES PRESENTED BY INDUSTRIAL WASTE IN THE 21ST CENTURY

In the latter half of the 20th century, many OECD countries experienced rapid economic growth and industrial development. This led to an increase in waste from all sectors of society. In particular, the increased amount of both waste and pollution from industry seriously impacted human health, the environment and the economy. In many developed countries, a range of measures to control environmental pollution reduced the release of hazardous substances and the generation of waste from industry. However, as industries started relocating to developing countries, so did the pollution they cause.

While the problems that industrializing countries currently confront are similar to the ones OECD countries faced in the past, the scale and pace of industrial growth in industrializing countries present a major challenge. Coping with the increasing volume of waste is itself an arduous task, but the growing complexity and hazardousness of the waste is the most formidable difficulty. Industrializing countries have not yet developed appropriate systems to prevent, collect, segregate and further treat complex and increasing volumes of waste. Inappropriate waste treatment seriously harms the environment and public health and precipitates long-term economic impacts.

The biggest opportunity in dealing with industrial waste is found in integrated approaches that take both consumption and production into account and apply a life-cycle perspective. Managing waste from industrial production processes starts with preventing waste from being generated in the first place by rethinking the value chain from the perspective of product design. Where waste cannot be prevented completely, opportunities arise from treating it as a resource, by converting it to other uses or recycling it. As resources become scarcer, the waste market, including the market for recycled products, is emerging as an important part of the green economy. A preventive and integrated approach to industrial waste management can help rapidly industrializing countries to avoid the negative impacts of improperly treated industrial waste and reap significant environmental, economic and social benefits. This in turn will enable them to decouple economic growth from environmental damage and improve their businesses' competitiveness over the longer term.

This document analyses the translation of this preventive and integrated approach into concrete actions. It discusses a number of measures and policy instruments that could be useful by drawing upon Japan's successful industrial waste management measures from the late 20th century. Japan has dealt with industrial waste through different stakeholders taking measures cooperatively. This document analyses the Japanese policy mix and its effectiveness with a view to sharing lessons that can be learned from Japan's example. Significant attention is given to how Japan's policies were developed and implemented. This analysis is expected to stimulate more effective policy responses to industrial waste issues and expand the menu of potential policy options in other countries. The optimal mix of policy instruments is dependent on local and national conditions. Nonetheless, the Japanese experience is still expected to be instructive to other countries, particularly to those industrializing rapidly.

THE JAPANESE EXPERIENCE: JAPAN'S INDUSTRIAL WASTE SITUATION IN THE LATE 20TH CENTURY

Environmental policy instruments available to decision-makers can be divided into four categories: regulatory instruments, voluntary instruments, economic instruments and information-based instruments. The optimal type must be determined on a case-by-case basis. Solving complex industrial waste issues often requires the use of more than one of these types of policy instruments.

Japan improved its industrial waste management significantly by introducing different types of policies combined with appropriate implementation systems. Its transition to its current system can be better examined by looking at the transition that occurred across three phases historically.

The first phase includes the 1950s and the 1960s, which were characterized by increases in both pollution and waste generation. Although technological innovations by industry led to robust economic growth, environmental considerations were neglected. Industrial wastewater, soot and smoke caused pollution, affecting the environment and damaging the health of residents. The amount of waste generated by industry increased dramatically. Along with this, in an increasing number of cases, industrial waste was not treated appropriately, due to a shortage of space at landfill sites and other factors. Inappropriate treatment of industrial waste led to environmental pollution and posed major problems for society.

The second historical phase was the 1970s and the 1980s, when various problems arose, notably illegal dumping. Intense efforts were launched to treat industrial waste appropriately, and various environmental laws were formulated within a concentrated period of time. One of these was the Waste Management and Public Cleansing Law (Waste Management Law). Under the Waste Management Law, waste was separated into "industrial waste" and "municipal solid waste", and strict standards were applied to industrial waste in order to ensure appropriate treatment. Despite this, illegal dumping occurred on a large scale at this time. It became obvious that efforts to address the ever-increasing amounts of waste would not solve the problem unless the social structure based on mass production, mass consumption and mass disposal was changed.

The third phase is the 1990s and the 2000s, when efforts to implement the 3Rs (reduce, reuse, recycle) were made in order to establish a sound material-cycle society and reduce the amount of waste that was landfilled. Global environmental problems gained in prominence, and alongside this there was an increasing emphasis on cooperation between various parties. Japan began to focus more on the quality of its waste, as opposed to earlier emphasis mainly on the quantity of waste. Strict standards were established for dioxins and dioxin-like compounds (DLCs), polychlorinated biphenyl (PCB) waste and other toxic types. The Japanese government's policy on waste management changed course dramatically after legislation was enacted to work towards a sound material-cycle society through the promotion of the 3Rs. However, the creation of legal and regulatory frameworks has been only one part of Japan's overall endeavors. Other social actors have been actively engaged in establishing a sound material-cycle society, as can be seen in the voluntary actions of industry, in Eco-town projects, and in the activities of consumer and nonprofit organizations (NPOs) working on environmental issues.

Japanese legislation for waste management developed in accordance with the needs of the time. The Waste Management Law was enacted

during the second historical phase, the 1970s and 1980s. It stipulated the regulations and systems for treating the waste generated by households and business operators. In the Waste Management Law, 20 types of waste generated through business activities that could cause environmental pollution were defined as "industrial waste" for the first time. Based on the polluter pays principle (PPP), business operators in Japan are required to either treat industrial waste themselves or outsource treatment to appropriate contractors. The law stipulates the waste treatment responsibilities of business operators generating industrial waste. It also addresses the licensing of industrial waste treatment businesses, standards for the treatment of industrial waste and the licensing of industrial waste treatment facilities. The law also stipulates the collection of reports, on-site inspections, orders for improvement, orders to take measures and penal provisions.

The Basic Act on Establishing a Sound Material-Cycle Society was enacted later, during the third historical phase, the 1990s and the 2000s. This Basic Act establishes a hierarchy of methods to manage industrial waste, prioritized in the following order: reducing the generation of waste; reuse; recycling; heat recovery; and then disposal in an appropriate manner. It also clarifies the responsibility of waste generators, including business operators and citizens, and established the general principle of extended producer responsibility (EPR). The Law for Promotion of Effective Utilization of Resources was also enacted during the third phase with a view to promoting recycling. Individual laws governing the recycling of six categories of goods were also passed. Other systems were introduced to promote the development of industrial waste treatment facilities and to support technological development. Eco-town projects were launched with the aim of fostering the development of environmentally friendly towns.

THE WASTE SECTOR AND ECONOMIC ACTIVITIES IN JAPAN

In Japan, the basic system for industrial waste treatment businesses was created through the enforcement of the Waste Management Law. Private companies provide waste treatment services in exchange for monetary compensation. Under this system, business operators who generate waste only need to hand over their waste and their payment for waste treatment services. One consequence of the system was that waste generators typically focused on the treatment costs rather than the quality of treatment services. This situation enabled illegal dumping to proliferate, as some waste treatment businesses contracted for waste treatment services at low prices but then failed to treat the waste as stipulated by law. Such malpractice risked undermining the business model for the waste treatment industry as a whole, because it destroyed confidence in the entire industry and because the low pricing for improper treatment made it difficult for businesses conducting proper treatment to charge enough to make a profit. In response to this situation, the national government revised the law, tightening the regulations substantially. Local governments implemented the law rigorously and business operators who generate waste also started to consider their contractors carefully. Thus the revision of the law created a framework that facilitated appropriate competition.

In recent years, industrial waste has come to be viewed increasingly as a resource, leading to more recycling and less landfilling. Industrial waste generators, industrial waste treatment businesses and the government have been engaged in united efforts to promote recycling. Through these efforts, the percentage of industrial waste recycled out of the total amount generated increased from 37 per cent in fiscal 1996 to 53 per cent in fiscal 2010.

The percentage of waste landfilled during this period correspondingly declined, from 17 per cent to 4 per cent.

Effective treatment of industrial waste can be implemented by the government exclusively providing the treatment services or by the government granting licenses to particular companies that then exclusively provide services in specific areas. However, these non-competitive methods would be expected to inhibit the introduction of new recycling methods and also hamper recycling rate improvements. Although the optimal method depends on the particular circumstances of each individual country, if the Japanese method is to be used as a model, clear, transparent and appropriate regulations should be established and implemented as the minimum conditions for the model to work.

Another feature of the Japanese experience is the voluntary measures taken by Japanese industry. Keidanren (Japan Federation of Economic Organizations)[1], an organization comprised of leading Japanese companies, national organizations for individual industries and local business organizations, formulated the Keidanren Voluntary Action Plan on the Environment in 1997. In accordance with this plan, it promotes voluntary efforts by industry to work for a sound material-cycle society, including efforts to reduce the amount of industrial waste. Compared to regulatory instruments and economic instruments, voluntary instruments are typically efficient ways to tackle environmental problems, because each business can take measures after comprehensively assessing its own characteristics, trends in available technologies and the results of cost-benefit analyses. Under the Keidanren plan, each business category and each industrial organization set specific numerical targets for the amount of industrial waste to be landfilled, the recycling rate and so on. The results are disclosed later as a way of maintaining accountability to society. This method has proven to be successful, as reflected in the 86 per cent reduction in the amount of waste landfilled in fiscal 2010 compared with the amount landfilled in fiscal 1990.

WASTE MANAGEMENT BY LOCAL GOVERNMENTS IN JAPAN

Osaka City began treating industrial waste through public sector involvement from a relatively early stage. When the Waste Management Law was enacted in 1970, private sector treatment facilities were insufficient to deal with the city's waste, and there was concern that hazardous industrial waste would result in serious environmental impacts. Consequently the Osaka City government established a public corporation to set up facilities for neutralizing hazardous sludge. The city government was also actively involved in the development of facilities to treat PCB waste.

The experience from Osaka City shows that long-term public sector involvement prevents private waste treatment businesses from entering the market and it also prevents waste generators from having economic incentives to reduce the amount of waste they generate. Hence, the government needs to decide on the conditions under which it will withdraw from the waste treatment market before it enters the market. The government must also give appropriate guidance to waste generating business operators before withdrawing from the waste treatment market, in order to ensure a smooth transfer from public sector to private sector treatment.

1 Keidanren (Japan Federation of Economic Organizations) and Nikkeiren (Japan Federation of Employers' Associations) amalgamated in 2002 to become Keidanren (Japan Business Federation).

When deciding on public sector involvement in, or withdrawal from, the industrial waste treatment business, it is important to consider public benefits as well as economic viability. Governments should therefore consider a package of comprehensive industrial waste management measures that cover education and training as well as facility development. These measures would include regulatory guidance to relevant parties.

The cities of Kitakyushu and Kawasaki are leading manufacturing cities in Japan. They both experienced air, water and other pollution in the 1950s and the 1960s. However, through the development of environmentally friendly technologies and systems, these cities overcame these problems and they have become well known as local governments that succeeded in creating environmentally friendly cities through their Eco-town projects.

In Kitakyushu, a key element in the successful implementation of various environmental measures in recent years has been a partnership between industry, government, academia and citizens that has evolved through discussion. This partnership also played a critical role in the successful implementation of pollution control measures in the past. The Kitakyushu city government introduced into its industrial waste management the cleaner production approach proposed by the United Nations Environment Programme (UNEP). In fact, it had already used an extremely similar approach earlier during its struggle to overcome pollution. Through the cleaner production approach, the city succeeded in reducing the amount of industrial waste generated by encouraging industries to revise and improve entire production systems, including raw materials, production processes and manufacturing equipment. The city implements an Eco-town project by utilizing the resources accumulated through past experience, including technologies, human resources, industrial infrastructure and a network that links industry, government, academia and citizens. It also shares its experience and technologies for waste management and environmental improvement with Asian cities and other cities around the world through international inter-city environmental cooperation and utilizes the knowledge and technologies in cooperation projects.

Kawasaki was the first city in Japan that was approved to become an Eco-town project area. The city aims to achieve zero emissions. Accordingly, waste generated in urban districts is utilized as raw materials in the Eco-town project area situated in the coastal area of the city, and raw material residues and surplus energy released by factories and other facilities are shared amongst them and utilized efficiently. The city has worked to achieve zero emissions in four stages, namely, greening companies; greening the area through cooperation between companies; conducting research with the aim of creating an area which could develop sustainably through the utilization of environmental technologies; and sharing the results achieved by the area's companies and the community while also contributing to the sustainable development of developing countries and other societies.

When working to cultivate an eco-town in a developing country, as a first step it is important to identify the current priority issues in the area and then decide on the policies needed to resolve those issues. The necessary technologies must also be accumulated and the international community may assist in this area. It would be difficult to introduce eco-town projects at a large scale from the very beginning. It is recommended that projects start small, with the scope expanded later after trial projects are conducted in model areas.

THE INTERNATIONAL CONTEXT: THE POTENTIAL TO CONTRIBUTE TO GREEN ECONOMY OBJECTIVES

The increasing volume and complexity of waste pose threats to ecosystems and human health, but opportunities do exist to manage industrial waste in sustainable ways. Transitioning to sustainable industrial systems by decoupling economic growth from the use and consumption of natural resources and energy and providing more value with less environmental impact and better economic and ecological efficiency can offer significant opportunities for conventional, material-intensive and highly polluting industries. Prevention thus presents the greatest opportunity, but resource and energy recovery can also hold significant opportunities if waste cannot be completely avoided.

Applying sustainable waste management strategies to industrial processes can offer a number of opportunities in terms of avoided environmental pollution, reduced costs in managing industrial waste, profits from preventive approaches which reduce resource use and enhanced market opportunities for reusing and selling used products or scrap materials. In addition to this, there are many more benefits resulting from dealing with industrial waste in an integrated way, such as energy savings, creation of new businesses and jobs, energy production from waste, reduced greenhouse gas (GHG) emissions and contributions to equity and poverty eradication. Improved health, avoided health costs, avoided water contamination and the consequent cost of alternative water supply are also important streams of benefits. Rethinking industrial processes and applying approaches to prevent, reduce, reuse and recycle industrial waste can thus help in contributing to Green Economy objectives.

Each country will need to consider its appropriate policy mix to make the transition happen, mindful that the basic physical processes and damaging impacts associated with pollution and unsustainable resource use are universal.

As a sector strategy for achieving the overall goals of a Green Economy in the manufacturing and associated sectors, the UNIDO Green Industries Initiative promotes industrial production and development that does not come at the expense of the health of natural systems or lead to adverse human health outcomes. Green Industry is aimed at mainstreaming environmental, climate and social considerations into the operations of enterprises. It provides a platform for addressing global, interrelated challenges through a set of immediately actionable cross-cutting approaches and strategies that take advantage of emerging industry and market forces.

Promoting Green Industry is poised to create new jobs while protecting the environment, and assists developing countries move to clean technologies and implement environmental agreements, including initiatives and projects in waste management.

Specific programmes implemented by international organizations tackling waste management issues in developing countries and emerging economies include, for example: the joint UNIDO UNEP Resource Efficiency and Cleaner Production (RECP) Programme and the UNIDO Network of Investment and Technology Promotion Offices (ITPOs). These programmes contribute to cleaner and more competitive industrial development and help reduce pollution and reliance on unsustainable use of natural resources.

SHARING JAPAN'S EXPERIENCE GLOBALLY

Since the 1990s when government policy underwent a radical change, Japan has been working towards the establishment of a sound

material-cycle society, with a focus on preventive and integrated approaches. The formulation of government regulations and standards and the development of systems for society-wide involvement were key to Japan achieving significant positive results. One example of this participation by the society as a whole is the involvement of industry and local government in town development, tempered by citizen and NGO scrutiny and cooperation.

Japan's experience suggests that appropriate industrial waste management can be facilitated by developing systems that facilitate cooperation among various parties; by formulating and implementing a system that clarifies where responsibility for waste treatment lies and who must bear the costs; by establishing standards for recycling and treatment; by thoroughly enforcing regulations; by prioritizing the 3Rs and heat recovery in waste management; by providing government support for waste treatment system development; and by fostering human resources.

In Japan, business operators generating industrial waste made internal efforts to change their approach and took voluntary actions to improve waste management. This example of voluntary efforts by industry may prove instructive when other countries try to work towards a sound material-cycle society. Major forces that drove success in Japan include active efforts by industry itself to introduce ISO 14001 and other environmental management systems, combined with the use of supply chain management to assess the degree of environmental friendliness of business partners. The engagement of small- and medium-sized enterprises (SMEs) as well as local governments was another major factor in Japan's success. As of 2010, Japan had more then 20,000 ISO 14001-registered organizations and approximately 5,600 companies registered under Eco Action 21, a Japanese domestic environmental management system for SMEs modelled on ISO 14001. A substantial number of companies also formulate environmental reports and publicly release information on their environmental efforts, including efforts to reduce waste generation and carbon dioxide emissions.

In conclusion, it is likely that the efforts of a wide range of social actors to change their approach and take coordinated action contributed greatly to improving industrial waste management in Japan. Japan's experience and the lessons learned from the Japanese example have the potential to be useful for rapidly industrializing countries as they work to improve their management of industrial waste. This in turn will translate into enhanced sustainability in developing countries in Asia and around the world.

1 CHAPTER Background and Approach

1.0.1 THE CHALLENGES AND OPPORTUNITIES PRESENTED BY INDUSTRIAL WASTE IN THE 21ST CENTURY

In the latter half of the 20th century, many OECD countries experienced rapid economic growth and industrial development, leading to increasing levels of prosperity and consumption. This, in turn, set the stage for unprecedented increases in waste in all sectors of society. Most noticeable in many locations was the pollution, particularly the waste, generated by industries. In a number of countries, industrial waste generation reached alarming levels in the 1960s and 1970s. Air pollution, contaminated sites, tainted water, unrestrained use of space in landfills and the discarding of reusable resources were seriously affecting human health, the environment and the economy.

With environmental quality deteriorating, public awareness and concern escalating as a result of industrial accidents, and civil society movements on the rise in many countries, the need to take action became evident. Governments took a range of measures to control local environmental pollution, including waste generated by industries. Initial measures were typically reactive, end-of-pipe and focused primarily on a single pollutant or a specific site (UNEP, 2011a). In many countries, they helped in reducing the release of pollutants from industries. However, as production patterns changed, industries started migrating to developing countries, thus often mitigating pollution in one country by shifting it to another.

While the problems with industrial pollution – and waste, in particular – faced by many OECD countries in the latter half of the 20th century are similar to those confronting the majority of industrializing countries at the beginning of the 21st century, new challenges have also arisen. In particular, the scale and pace of industrial growth in rapidly industrializing countries present serious challenges.

Against a backdrop of global population growth, emerging economies are expanding and industrializing, lifestyles are rising and the associated consumption patterns demand the use of greater amounts of resources. In

this way, society is exceeding the capacity of natural systems to absorb and recycle waste products. While the increasing volume of waste constitutes a major challenge in itself, it is the growing complexity and hazardousness of the waste that is the most problematic. This is largely because highly polluting industries – primary industries dealing with the transformation of raw materials into industrial products such as steel, paper, and chemicals – account for a substantial portion of growth in rapidly industrializing countries.

Often, rapidly industrializing countries have not yet developed the appropriate systems and infrastructure to prevent, collect, segregate and treat the complex and increasing volumes of waste. Less stringent environmental legislation or enforcement and capacity gaps in dealing with waste products from industrial production processes result, for example, in industrial, often hazardous wastes being mixed with other wastes. In rapidly industrializing countries, densities in cities, where much of the industrial production is located, far exceed the densities found in developed countries, so the number of people exposed to pollutants is potentially much greater. Serious consequences to environmental quality and public health and long-term economic impacts ensue: local air, water and soil pollution can put the provision of basic necessities such as drinking water and food at risk; workers in the manufacturing sector suffer exposure to high levels of pollutants, as do adjacent communities and informal waste workers; greenhouse gas emissions from waste contribute to global climate change; and the loss of valuable resources further aggravates the depletion of virgin materials.

Challenging as the situation might seem, the management of industrial waste, if done properly, also holds some opportunities, which can mainly be attributed to a shift in approach in dealing with industrial pollution issues.

In comparison to the measures taken in the 1960s and 1970s, today, approaches tend to be preventive and precautionary. They are often more encompassing in that they take into account multiple pollutants and entire supply chains and material cycles. In addition, they typically address not only the production but also the consumption side, considering consumers as agents who can bring about changes in demand (UNEP, 2011a).

The biggest opportunity in dealing with industrial waste can be found in applying a preventive and integrated approach that addresses both consumption and production and applies a life-cycle perspective. This includes pursuing both supply and demand side strategies to use fewer resources and generate less waste and hazardous substances, and to ultimately close the resource use cycle in industrial production. The aim is thus to decouple economic growth and current consumption and production patterns from environmental pollution, in this case caused by industrial waste.

In other words, managing waste from industrial production processes begins with preventing waste from being generated by rethinking the value chain from the stage of product design. This will mitigate negative impacts of industrial waste on the environment while also reducing costs for end-of-pipe waste management. Where waste cannot be prevented completely, opportunities exist to treat it as a resource. Products and parts can be reused and scrap materials from industrial production processes can be recovered and converted to other uses or be recycled. Using waste as a resource can yield profits and at the same time save virgin materials. As resources become scarcer, the waste market, and, in particular, the market for recycled products, will grow, offering opportunities for businesses to sell and purchase recycled products (UNEP, 2013b).

In this way, proper waste management results in less environmental pollution, reduced costs in managing industrial waste, profits from reusing and selling used products or scrap materials, and savings of natural resources. Yet even more benefits can be derived from dealing with industrial waste in a preventive and integrated way, such as energy savings; creation of new businesses and jobs; energy production from waste; reduced greenhouse gas emissions; and contributions to equity and poverty alleviation. Improved health, health costs that are avoided, water contamination that is prevented, and the ensuing cost of alternative water supply are also important benefits (UNEP, 2010b).

By applying a preventive and integrated approach to industrial waste management, rapidly industrializing countries can avoid the negative impacts associated with industrial waste and reap significant environmental, economic and social benefits, which will enable them to decouple economic growth from environmental damage and improve their businesses' longer term competitiveness (UNEP, 2012).

This document will analyse how this integrated approach to industrial waste management can be translated into concrete actions and what kind of measures and policy instruments can be applied to turn the challenge of dealing with industrial waste into opportunities.

1.0.2 OBJECTIVES

The Japanese industrial waste experience: Lessons for rapidly industrializing countries, developed with the financial support of the Ministry of Foreign Affairs of Japan, reviews the development of the approach Japanese stakeholders took to deal with waste generated by industries. More precisely, *The Japanese industrial waste experience* analyses the policy mix that was applied and shares the lessons to be learned through the Japanese example.

The sharing of experiences and lessons learned from the Japanese case is intended to expand the menu of policy options for consideration by decision-makers in rapidly industrializing countries. The analysis in this document is intended to facilitate the development of more effective policy responses to industrial waste issues around the world and, ultimately, to promote more effective use of resources, reduced pollution and greenhouse gas emissions, improved public health and environmental quality, lower operational costs and enhanced corporate social responsibility. To assist rapidly industrializing developing countries in finding solutions to the environmental challenges associated with rapid economic growth is critical on the path to sustainable development.

There is, however, no universally applicable policy mix to address industrial waste management. The specific mix of policy instruments that worked in Japan might not necessarily apply in other countries. The optimal mix of policy instruments depends on local and national conditions. However, the Japanese experience is still expected to be instructive to other countries, particularly to those that are rapidly industrializing. The dissemination of Japan's multifaceted experience with industrial waste management will thus meet the need of developing countries faced with unprecedented rapid industrialization to find a mix of policy solutions that can best address the resulting environmental challenges.

1.0.3 APPROACH

The Japanese industrial waste experience provides a range of perspectives on the Japanese approach to deal with industrial waste. Several entities were invited to contribute chapters or expertise to review chapters. UNEP developed the analytical framework to guide collaborating entities in their analysis. Emphasis was placed on the analysis of policy developments taking a

particular view regarding the question of what could be learned from the Japanese experience.

The Japanese industrial waste experience is available in both English and Japanese. The document is structured into four main chapters.

Chapter 1: 'Background and Approach' outlines challenges and opportunities presented by industrial waste in the 21st century. It also presents the objectives of the document and depicts the approach used to develop it. In addition, it provides an overview of policy instruments to address industrial waste management. This establishes a basis for the analysis of the Japanese case that will follow in chapter 2.

Chapter 2: 'The Japanese experience' gives an overview of the industrial waste situation in Japan in the late 20th century. The sections that follow cover different perspectives on the Japanese approach towards dealing with industrial waste. They give insight into the historical developments and processes that led to the transition to dealing with industrial waste in a more sustainable way. The chapter overviews the triggers that started the debate, the main drivers, the policy instruments that were applied, and the changes that ensued.

Following the introductory section on the industrial waste situation in Japan, the Japanese policy framework is then covered in section **2.1**. In section **2.2**, the industrial waste management industry contributes its perspective as service providers. Section **2.3** examines waste generators and how they have taken voluntary actions to address industrial waste challenges. Finally, three success stories illustrate how industrial waste was dealt with in different cities. While Osaka City (**2.4**) shows a more conventional approach to industrial waste management, the cities of Kitakyushu (**2.5**) and Kawasaki (**2.6**) draw on their experience as eco-towns.

Chapter 3: 'The international context' provides information about initiatives at the international level that relate to industrial waste management. UNEP's Green Economy Initiative has shown that the waste sector can be an important contributor to green economy objectives (**3.1**). In turn, sustainable waste management also plays a role in UNIDO's Green Industry Initiative (**3.2**). Both sections provide linkages with the preceding chapters and show examples of how Japan's approaches to industrial waste management are echoed in these initiatives.

Chapter 4: 'Concluding observations' summarizes the Japanese experience and also reflects on the potential relevance of the lessons learned from the Japanese case for rapidly industrializing countries.

1.0.4 POLICY INSTRUMENTS TO ADDRESS INDUSTRIAL WASTE MANAGEMENT

To address the challenges and harness the opportunities presented by industrial waste in the 21st century, adequate policies need to be put into place. A number of different policy instruments are available that promote resource efficiency measures across the entire production and consumption system.

While traditional approaches in environmental policymaking mostly took the form of command-and control regulations, countries have expanded their menu of policy instruments in more recent times, including economic incentives and/or disincentives, information provision, and more flexible regulatory approaches.

A mix of different policy approaches, as will be shown in subsequent chapters of this publication, has led Japan to significantly improve its industrial waste management. As with other environmental problems,

instrument mixes, if well-designed, have been found to be effective to address "multi-aspect" environmental challenges (OECD, 2007b). Analysing the multifaceted Japanese experience in industrial waste management shows that it is critical to bring together a suitable mix of measures. To set the analytical background for the chapters to follow, an overview of common policy instruments used to address industrial waste management is provided below.

The spectrum of instruments available to decision-makers in environmental policy can be classified into four broad categories: regulatory, voluntary, economic and information-based (UNIDO, 2011). Monitoring and enforcement regimes are needed to make these instruments most effective.

Regulatory instruments

In developed and developing countries alike, regulatory instruments, also referred to as "command-and-control" approaches, usually constitute the basis of environmental policy frameworks. While they address a broad range of environmental problems, they were initially developed to regulate large industrial polluters, and are still useful in addressing point sources of pollution (UNEP, 2010b).

Regulatory instruments introduced in many countries since the 1970s have tended to be either technology-based or performance-based. While technology-based instruments require industries to use specific equipment and processes, performance-based standards establish levels of emissions allowed. For example, legislation with clearly defined standards of technology and/or performance can drive investments in environmentally sound technologies, encouraging industries to use natural resources more efficiently and create markets for sustainable products and production. Regulatory requirements can incorporate cleaner technology standards in the licensing of new industrial operations. Regulatory and control mechanisms can also promote principles such as the 3Rs (reduce, reuse, recycle), the Polluter Pays Principle and Extended Producer Responsibility (EPR) to encourage large industries with complicated supply chains to favour closed-cycle manufacturing and more efficient take-back systems for remanufacturing and recycling. Regulations on sustainable public procurement can enable governments to lead by example, as they stimulate demand for products that use fewer resources and support cleaner production processes (UNEP/CSCP, 2011).

Other regulatory instruments include bans. Most common are bans on particular toxic substances. Internationally, the Stockholm Convention, for example, focuses on eliminating or reducing the release of Persistent Organic Pollutants (POPs) into the environment. However, other types of bans also exist, such as, for example, bans on untreated waste going to landfill or bans on landfilling waste that can be incinerated.

The efficacy of regulatory instruments depends largely on their design. Well-designed regulations can effectively address industrial pollution, particularly when they are monitored and enforced adequately. However, whilst they might be easy to introduce, regulatory instruments can be costly to administer. Their traditional focus on end-of-pipe solutions has in the past often left limited incentive for industries to continually and fundamentally improve standards (dynamic efficiency). If poorly designed, regulations may even inhibit technological innovation, locking in certain technologies that are soon outperformed by new, more environmentally sound technologies.

Voluntary instruments

Voluntary instruments or agreements are initiatives, driven primarily by the private sector, that encourage businesses, industries

or sectors to improve their environmental performance beyond the minimum levels set forth under regulatory measures. Industries have been involved in a range of voluntary initiatives since the 1990s, often as a reaction to disturbing events such as industrial accidents during the 1980s. Voluntary agreements can take a variety of forms ranging from legally binding covenants to more informal expressions of intent. Depending on the form of agreement and the parties involved, voluntary agreements can either be seen as measures of private sector self-regulation or, when there is government involvement, as a measure of public policy.

Voluntary agreements may provide more flexible and more ambitious approaches in comparison to traditional regulatory approaches. They may thus lower administrative and enforcement costs. However, while these agreements can help to raise awareness and facilitate a shift towards more innovative and proactive behaviours in businesses, their environmental effectiveness needs to be assessed on a case-by-case basis. Free riding or poor performance can occur when monitoring and enforcement are weak. In the area of industrial waste, an example of a voluntary instrument can be an agreement with industry on waste prevention, on extended producer responsibility, e.g. through take-back obligations, or an initiative such as a cleaner production award (UNEP/CSCP, 2011).

Economic instruments

Economic or market-based instruments (MBIs) are policy approaches that, according to the OECD, "seek to address the market failure of 'environmental externalities' either by incorporating the external cost of production or consumption activities through taxes or charges on processes or products, or by creating property rights and facilitating the establishment of a proxy market for the use of environmental services" (OECD, 2007a).

MBIs, such as environmental taxes and charges, tradable permits and subsidies, are thus able to mitigate market failures in a cost-effective way. They can provide powerful incentives that alter the basic cost-benefit calculation of producers and consumers, thus driving changes in behaviour (UNEP, 2010b). In addition, MBIs provide incentives to use new, more efficient and environmentally sound technologies.

Environmental taxes force polluters to pay for emissions that are within the allowed emission limits set by regulation. Taxes thus ensure that prices account for the negative environmental impact the product is causing, particularly during the production process. While taxes can incite behavioural changes in polluters and encourage more efficient production methods over the long term, it is often difficult to forecast accurately the degree of pollution reduction that will result from a given tax. A critical challenge is thus determining the proper level of taxation. Closely linked to taxes are fees and charges for environmental services such as wastewater treatment and waste collection, water and energy supply. Taxes can also be raised on incineration or landfilling of waste.

As with environmental taxes, tradable permits also use the price mechanism to internalize the cost of pollution. Under an emissions trading system, limits for emissions in an area or country are set (as caps) and permits representing shares of the total emissions target are allocated to each company participating. These permits can then be traded, allowing companies to sell surplus permits or buy more permits if they exceed their allowed emission targets. Trading schemes can combine a high degree of environmental certainty with a degree of flexibility that helps businesses to reduce the costs of reducing pollution. However, trading schemes can also be difficult to set up. In addition, the initial allocation of permits might prove challenging.

Subsidies are another type of economic instrument that are used primarily to stimulate investment in technologies. If ill-designed, subsidies can result in negative environmental impacts, such as locking in certain technologies or processes. An example of this would be charges for public services, such as water, waste or energy that are below actual cost. Subsidies can, however, be important instruments in expanding the adoption of cleaner industrial technologies and sustainable products and help promote waste prevention and recycling schemes, such as deposit and return systems (UNEP/CSCP, 2011).

Information-based instruments

A range of activities and initiatives can be termed information-based instruments, including audits, eco-labelling and certification schemes, information disclosure, education, and data collection and dissemination. These measures can help raise public awareness and thus complement and underpin other policy instruments. In particular, information sharing and disclosure, which is important at local, national and international levels, has become an increasingly recognized tool for encouraging environmental practices amongst businesses and for helping consumers make informed product choices (UNIDO, 2011). Public institutions can, for example, support the validation and harmonization of information mechanisms, such as eco-labelling schemes, and establish consumer awareness and education programmes to ensure consumers are able to make informed decisions and recognize newly introduced labelling and product information schemes (UNEP, 2010b). Other tools to raise awareness can be waste prevention campaigns, education on recycling and guides on waste separation (UNEP/CSCP, 2011).

Monitoring and enforcement

Monitoring and enforcement are needed to ensure that environmental policy goals are achieved. It is both complex and expensive to monitor compliance with regulations and take appropriate action to address cases of non-compliance. Successful execution also requires strong institutions that are capable of withstanding political pressure and corruption.

The right mix of instruments

Which instruments work best in a given context needs to be assessed on a case-by-case basis. Often, it is not a single instrument that resolves the complex challenge of dealing with industrial waste, but a mix. A mix of policy instruments has enabled Japan to realize an integrated approach to industrial waste management, as will be shown throughout this document.

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CHAPTER 2

The Japanese experience: Japan's industrial waste situation in the late 20th century

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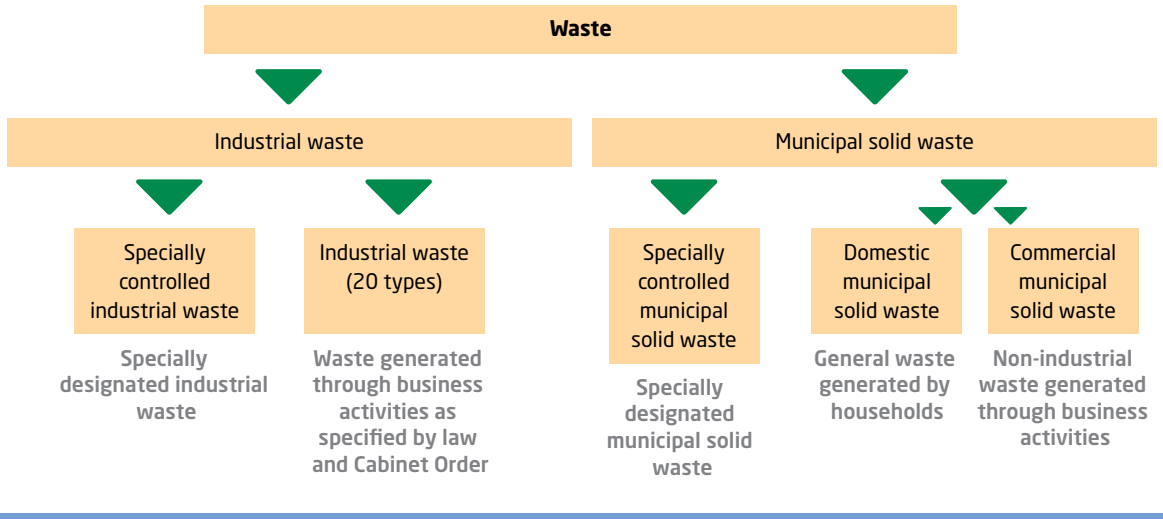
2.0.1 THE DEFINITION OF WASTE IN JAPAN

In Japan, waste is defined in the Waste Management and Public Cleansing Law (Waste Management Law) of 1970 as "refuse, bulky refuse, ash, sludge, excreta, waste oil, waste acid and alkali, carcasses and other unsanitary and unneeded matter, which are in a solid or liquid state (excluding radioactive waste and waste polluted by radioactivity)." Waste is classified as "industrial waste" or "municipal solid waste," with separate regulations and systems stipulated for the two categories in order to ensure appropriate treatment for each (see **Figure 2-0-1**).

Twenty types of waste that are generated through business activities and have the potential to cause environmental pollution are designated as "industrial waste". These are ash, sludge, waste oil, waste acid, waste alkali, waste plastics, waste rubber, metal scraps, waste glass and ceramics, animal and plant residue, paper scraps, wood chips, waste textiles, slag, debris, livestock excreta, livestock carcasses, dust, discarded solid matter derived from animals, and matter resulting from the treatment of the above-mentioned industrial waste before disposal. Industrial waste is subject to the polluter pays principle (PPP), under which the entity generating the waste has responsibility for treating it. The law stipulates that the business operators must either treat the waste themselves or outsource treatment to industrial waste treatment businesses licensed by the prefectural governor.

Waste other than industrial waste is defined as "municipal solid waste", which the law stipulates

Figure 2-0-1 Waste as Defined in Japan



Source: Based on the Waste Management Law (1970)

must be treated by municipal governments. Municipal solid waste includes waste not classified as industrial waste that is generated through business activities, and this is referred to as "commercial municipal solid waste". While this waste is also treated by municipal governments, the responsibility for treatment remains with the business operators who generated the waste, and thus they must assume the costs of treatment.

Industrial waste and municipal solid waste that is explosive, toxic, infectious or of a nature otherwise harmful to human health or the living environment is classified as "specially controlled industrial waste" and "specially controlled municipal solid waste", and is subject to stricter controls.

This chapter focuses on industrial waste and discusses how the national government, local governments, industry and waste treatment businesses in Japan manage industrial waste and what they have learned from their experience over the years. It then overviews lessons that can be utilized by developing countries.

2.0.2 JAPAN'S EXPERIENCE IN THE MANAGEMENT OF INDUSTRIAL WASTE

In this section, the latter half of the 20th century is divided into three phases, with the history of each phase explained in brief to promote understanding of Japan's industrial waste management experiences during this period.

In the 1950s and 1960s, while technological innovations by industry led to high economic growth, the environment was not taken into consideration until considerable damage had already been done. Pollution from industrial wastewater, soot and smoke degraded the environment and harmed human health. The pollution incidents that occurred in this period are characterized by the fact that both the companies causing the pollution and the victims of the pollution could be clearly identified. The amount of waste started to increase dramatically during this period and most waste was dumped untreated into landfill sites. Hazardous substances that were not appropriately treated negatively impacted the natural environment and posed major social problems.

In the 1970s and 1980s, the waste and environmental pollution generated by the affluent Japanese population became extremely problematic. For example, the amount of waste increased because of production systems and lifestyles based on mass production, mass consumption and mass disposal that had already become established in Japanese society. The rapidly increasing number of vehicles on the roads was also a factor in the nation's worsening air pollution.

In order to address the rapidly increasing amounts of waste, waste was separated into "industrial waste" and "municipal solid waste," and particularly strict standards were applied to industrial waste in order to ensure appropriate treatment.

Japan's limited land area made it difficult to secure new landfill sites where impacts on the natural environment and the living environment could be mitigated, while the space in existing landfill sites was decreasing. In addition, there arose a number of problems, including large-scale illegal dumping and air pollution, offensive odours and noise resulting from industrial waste treatment, which could not be solved solely through efforts to address the escalating volume of waste.

The manifestation of global environmental problems in the 1990s and 2000s set in motion efforts to mitigate climate change, establish a sound material-cycle society and protect biodiversity. These efforts were made through the participation and collaboration of all stakeholders in society, including the national government, industry, local governments, citizens and business operators. Japan's waste management strategy changed distinctly to focus on the creation of a sound material-cycle society. The government went beyond preparing waste treatment and disposal facilities and began efforts to utilize resources more effectively, reduce the amount of waste generated and promote recycling. It placed emphasis on the 3Rs of "reduce," "reuse" and "recycle," in that order of priority. Various public and private sector entities worked collaboratively to solve problems, and their activities steadily produced positive results. Their undertakings included legislation at the national level, voluntary efforts by industry, technological innovations for resource recycling, efforts made by local governments and efforts to raise the level of awareness and understanding among consumers and the general public.

The following section discusses Japan's experience in the latter half of the 20th century in greater detail. It identifies a first phase (the 1950s and 1960s), when pollution and the amount of waste increased; a second phase (the 1970s and 1980s), when various problems such as illegal dumping arose and efforts were made to treat waste appropriately; and a third phase (the 1990s and 2000s), when efforts to implement the 3Rs were made with the aim of establishing a sound material-cycle society and reducing the amount of landfilled waste to the greatest possible extent.

Phase 1: The 1950s and 1960s

Pollution and waste increase alongside rapid industrialization and high economic growth

a. The initial problem: Rapidly-increasing amounts of municipal waste (post-war reconstruction period)

After World War II ended in 1945, a devastated Japan began its economic reconstruction. The working population migrated from agricultural zones to cities, with the rapid rise in population causing major difficulties for cities in terms of treating waste. Most municipal waste was dumped on vacant land, creating breeding sites for mosquitos and flies, resulting in a health hazard.

This situation led to the enactment of the Public Cleansing Law in 1954, which stipulated that in urban areas, municipal governments must implement cleanup projects to improve public hygiene. The underlying principle, namely that household waste and human waste must be collected and treated by municipal governments in order to maintain public hygiene, was originally stipulated in the 1900 Sewage Disposal Law, Japan's first law on waste, which was enacted in the aftermath of plague epidemics.

In order to maintain public hygiene and deal with the increasing amount of waste, in 1963 the national government began providing subsidies for waste incineration plants. The first incineration plant in Japan to operate around the clock was also built in that year, and Japan introduced the method of incinerating combustible municipal waste, thereby reducing it to ash, before landfilling it.

b. Increasing amounts of industrial waste (high economic growth period)

In the mid-1950s, the post-war reconstruction period ended and Japan entered a period of high economic growth. From 1955 to around 1973, the Japanese economy experienced real growth of over 8 per cent per annum. The expanding economy resulted in Japan's gross national product (GNP) becoming the second largest in the world in 1968. People's lifestyles changed and an increasing number of home appliances came into popular use, including televisions, electric refrigerators and electric washing machines. These changes resulted in a considerable increase in bulky waste and waste plastics.

Japan faced another challenge in coping with the industrial waste generated through business operators' robust production activities. At the time, industrial waste was handled by individual companies, which would, for example, store waste both inside and outside their factories. Cases of inappropriate treatment arose with increasing frequency as the available space at landfill sites decreased and urbanization progressed. This led to such social problems as water pollution caused by the discharge of untreated waste oil. It soon became clear that the Public Cleansing Law was insufficient for dealing with a problem of this magnitude.

The amount of industrial waste generated in 1967 is estimated at 1,116,000 tons per day, a figure more than 20 times the roughly 50,000 tons per day of household waste generated that year (Japan, MHW, 1970).

c. Pollution resulting from the prioritization of industrial development

Although various technological innovations led to miraculous industrial growth, scant attention was typically paid to the treatment of waste, factory wastewater and flue gases, which required the investment of large sums of money. Priority was instead given to developing businesses.

Industrial development degraded local environments. For example, hazardous effluent from paper mills was discharged into rivers untreated. This in turn led to conflicts between fishermen and the paper mills. Thick soot and dust filled the skies above cities with heavy concentrations of industries, due to the burning of coal to power factories. In the 1950s and 1960s, four major pollution induced diseases seriously impacted the health of local residents and became major problems for society. These were Minamata disease, Niigata Minamata disease, itai-itai disease and Yokkaichi asthma (see **Box 1**).

Box 1: The four major pollution-induced diseases

- **Minamata disease (Japan, Environment Agency, 1973; Japan, MOE, 2006; Japan, MOE 2011a)**
  In April 1956, a girl in the city of Minamata in Kumamoto Prefecture was admitted to the hospital with serious symptoms that included paralysis of the limbs and the inability to talk or eat. Other patients presented identical symptoms and the situation developed into a major social problem. The symptoms were caused by methylmercury compounds contained in the effluent from a factory producing acetaldehyde, a raw material for plasticizers used to make plastics and other materials. The methylmercury compounds released into the sea bioaccumulated in fish and shellfish, and residents who ate the contaminated seafood developed nervous system disorders.

  The main symptoms include sensory disturbances, ataxia, concentric contraction of the visual field and hearing impairment. Some victims of fetal Minamata disease, contracted through exposure to methylmercury during the mother's pregnancy, experience symptoms different from those of adult victims.

  Some victims sued for damages against the company that caused the pollution. It was finally decided that those certified as having Minamata disease would be compensated in accordance with compensation agreements. There were 2,271 certified patients as of the end of July 2010.

- **Niigata Minamata disease (also referred to as "second Minamata disease") (Japan, Environment Agency, 1973; Japan, MOE, 2006; Japan, MOE, 2011a)**
  In 1965, people living around the Agano River area in Niigata Prefecture began to experience similar symptoms to Minamata disease, and this came to be called Niigata Minamata disease. This was again caused by methylmercury compounds contained in effluent discharged from a factory producing acetaldehyde.

  Similarly to the earlier instances of Minamata disease, those certified to be the victims of methylmercury poisoning are compensated based on compensation agreements. As of the end of July 2010, 698 people were certified (in Niigata Prefecture).

- **Itai-itai disease (Japan, Environment Agency, 1973)**
  In 1955, the outbreak of a disease of unknown cause was reported in the areas around the Jinzu River in Toyama Prefecture. It came to be called itai-itai disease because the patients cried out, "Itai! Itai!" meaning, "It hurts! It hurts!" Later, surveys revealed that, in the process of producing zinc from mined ores, water containing ore-derived cadmium and other heavy metals was discharged into the river, contaminating rice paddies and well water downstream. Residents who ingested the contaminated rice and water contracted the disease.

  Chronic cadmium poisoning affected the kidneys first, then caused osteomalacia, and further caused abnormalities in pregnancy, lactation and internal secretion while also accelerating aging and depleting calcium as a nutrient, which in turn caused the particular symptoms seen in itai-itai disease.

  Some patients filed lawsuits for damages against the company that caused the pollution and won damages. The company compensates those certified as itai-itai disease patients based on a written pledge. As of the end of 2011, there were 196 certified patients.

- **Yokkaichi asthma (Japan, Environment Agency, 1973)**
  Construction began on a large-scale petrochemical complex in the city of Yokkaichi in Mie Prefecture in 1956. The complex sold gasoline, paraffin oil and light oil, and it also sold the heavy oil that collected at the bottom of the tanks cheaply for industrial purposes. Factories that used this heavy oil emitted flue gases containing sulfur, heavy metals and nitrogen oxides (NOx), causing air pollution. The pollution caused asthma among local residents, which came to be known as Yokkaichi asthma.

  Some of the affected residents filed lawsuits in 1967 for damages against the six companies that caused the pollution. It was finally agreed that the companies would compensate the patients. Prompted by this incident and others, the Environment Agency radically revised the Law Concerning Controls on the Emission of Smoke and Soot (Smoke and Soot Control Law) to enact the Air Pollution Control Law in 1968.

  Similar health problems occurred in the area around the industrial zone in the city of Kawasaki in Kanagawa Prefecture and elsewhere.

Phase 2: The 1970s and 1980s

Faced with the consequences of mass production, mass consumption and mass disposal, Japan begins working towards the appropriate treatment of waste

a. The enactment of the Waste Management Law leads to appropriate waste treatment by emitters

In the 1970s, society came to realize the importance of the appropriate treatment of waste, wastewater, flue gases and hazardous substances, which had been overlooked as Japan started to enjoy the benefits of economic growth.

Various laws for environmental measures were enacted in the Diet session convened in 1970, which is still referred to as "the Pollution Diet" today. It was a major turning point for Japan's environmental policies. The Pollution Diet also resulted in the establishment of the Environment Agency in 1971 as the administrative agency responsible for planning and coordinating the implementation of environmental protection policies, including policies to prevent pollution and conserve the natural environment. It was also responsible for the comprehensive implementation of related measures.

In the Diet session, the Public Cleansing Law was also radically revised to enable an appropriate response to water area pollution caused by the illegal dumping of waste oil. The law was renamed the Waste Management and Public Cleansing Law (Waste Management Law). The basic framework for the current waste treatment system was created through this revision (see **2.1.3 (2)** for an outline).

The Waste Management Law clarified in its provisions that treatment shall have the aim of preserving the living environment, in contrast to the Public Cleansing Law, which focused on public hygiene. Waste was divided into "industrial waste" and "municipal solid waste", with both terms defined in the law. The results of the first nationwide survey conducted by the Water Supply and Environment Department in 1975 showed that about 236 million tons of industrial waste had been generated that year (Japan, MHW, 1979). This was five times the amount of municipal solid waste generated the same year (about 42 million tons).

b. Tightening the regulations for the treatment of hazardous waste and landfill sites

This 1970 Waste Management Law strictly regulated the treatment of hazardous waste from the standpoint of protecting human health. For example, it stipulated that sludge and slag containing hazardous substances such as mercury or cadmium must be solidified in cement before being landfilled. However, it was discovered in 1975 that a large volume of hexavalent chromium slag had been buried in the Edogawa and Koto wards of Tokyo (see **Box 2**). This major scandal led to a series of amendments to the standards in order to tighten the regulations. A 1977 amendment tightened regulations on landfill sites. It divided landfill sites for industrial waste into three types and stipulated the structure of each type of landfill site, thereby clarifying the standards governing them.

Various standards were developed through the enactment of the Waste Management Law in 1970 and its amendments, including standards for waste treatment, technical standards for treatment facilities and the criteria for hazardous industrial waste. Subsidy programmes, financing and preferential tax systems were also

implemented to help develop waste treatment facilities.

c. Illegal dumping

The oil crisis in 1973 caused an economic slowdown in Japan, with industrial waste generation decreasing somewhat as a consequence. The amount of waste later jumped during the bubble economy years from 1985 to 1990. About 395 million tons of industrial waste were generated in 1990. This amount exceeded 400 million tons in 1992 and it has remained at around that level since then (Japan, Environment Agency, 1994).

The enactment of the Waste Management Law and the tightening of standards and regulations began to improve the treatment of industrial waste, including hazardous waste. However, the Japanese population began to recognize that arranging a greater number of waste treatment and landfill facilities for ever-increasing volumes of waste would not solve the problem and that the social structure based on mass production, mass consumption and mass disposal would have to change.

The need for a change from the mass production, mass consumption and mass disposal system became more obvious after cases of large-scale illegal dumping came to light one after another, including on the island of Teshima in Kagawa Prefecture and in the city of Iwaki in Fukushima Prefecture, to name just two examples (see **Boxes 1** and **2** in **2.3**). Illegal dumping is a major social issue because taxpayers have to pay for the restoration of the original environment and the costs involved are multiple times the cost of treating the waste appropriately in the first place.

Box 2: Contamination of soil in Tokyo with hexavalent chromium

It was discovered that a large volume of hexavalent chromium slag was buried in land purchased by the Tokyo Metropolitan Government in 1973 for the development of a subway and the redevelopment of the urban district. In 1975, the Tokyo Metropolitan Government filed a lawsuit for damages against the chemical company which caused the pollution and the case was settled in 1986. For other pieces of contaminated private land, the company signed an "agreement on the treatment of slag-contaminated soil" in 1979 and carried out the permanent containment of slag under the supervision of the Tokyo Metropolitan Government. The treatment was paid for by the company.

The containment of the slag was completed for 86,000 m^3 based on the settlement and 347,000 m^3 based on the agreement. The pieces of land are currently used as parks and other such areas.

Source: Bureau of Environment, Tokyo Metropolitan Government (2012)

Phase 3: The 1990s and 2000s

Collaboration towards the establishment of a sound material-cycle society with a view to protecting the global environment

a. The Earth Summit in Rio de Janeiro and the enactment of the Basic Environment Act, facilitating participation by various parties

The United Nations Conference on Environment and Development (UNCED, or the Earth Summit) was held in Rio de Janeiro, Brazil in 1992. There, the importance of efforts by each country in solving global environmental problems was discussed and the rules for measures to curb global warming and for protecting biodiversity began to be developed.

Japanese industry also began taking environmental measures at this time. Companies which had expanded their businesses overseas were the first to take environmental measures, as they were more sensitive to global trends. Many energy efficient home appliances were developed and the words "environmentally friendly" were frequently used in TV

commercials. The message "think globally, act locally" sent by the Earth Summit took root in Japanese society.

The Japanese government enacted the Basic Environment Act in 1993. The government emphasized cooperation between various parties in society-wide efforts for the protection of the global environment, emphasizing the four key concepts of "material cycles", "symbiosis", "participation" and "international efforts". It was at this time that environmental considerations became an important element of social activities.

As part of the reorganization of central government ministries and agencies in 2001, the Waste Department of the Ministry of Health and Welfare (MHW) was merged into the Environment Agency and the Ministry of the Environment (MOE) was created. Administration of waste management was clearly defined as part of the national government's environmental administration system and was centrally controlled by the Ministry of the Environment.

b. Strengthening measures to control the quantity and quality of waste, including controls on waste generation and measures to control dioxins

Although there was increasing interest in global environmental problems, the annual generation of industrial waste remained at the high level of 400 million tons as vigorous economic activity continued, accompanied by the tremendous material flows associated with mass production, mass consumption and mass disposal. Various issues surfaced, including changes in the quality of waste, a lack of incineration plant capacity, diminishing space at landfill sites and large-scale illegal dumping. Reducing waste and recycling resources became more important than ever, and the Waste Management Law was significantly revised in 1991 to include provisions on reducing waste generation and on segregating and recycling waste. A "solid waste treatment centre system" (see **2.1.3 (3)** for an outline) was established, thereby creating a framework for local governments to become proactively involved in the part of the industrial waste management process that starts with reducing waste generated, then segregates and recycles waste and ultimately applies appropriate treatment to the remaining waste.

Japan exported industrial waste overseas, but these exports were restricted after Japan enacted the Basic Environment Act and ratified the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (the Basel Convention) in 1993. However, even before 1993, most industrial waste that was sent to other locations was moved within Japan from one prefecture to another, rather than from Japan to other countries.

Concerns began to intensify about the quality of waste in addition to the quantity of waste. For example, there were strong concerns about dioxins. In Japan, the incineration of waste before it was landfilled became the typical treatment method in order to ensure both hygienic management and a reduction in volume. Many plans to construct waste incineration plants near residential areas were announced, and protests against the construction of waste incineration plants intensified in various parts of Japan. There was an increasing concern among residents that the incineration of waste containing plastic, particularly vinyl chloride, would produce dioxins and the flue gases from plants would harm the health of nearby residents. This transformed into a problem recognized

by society as a whole when consumer organizations launched a boycott of vinyl chloride products.

Japanese society already had a deep distrust of waste treatment because of illegal dumping incidents from the 1980s and dioxin problems. Bold measures were introduced to respond to the situation in 1997 and 2000, including increasing the responsibility of business operators who generate waste, strengthening the waste manifest system, introducing penalties of up to 100 million yen (approximately US$1 million) for illegal dumping, and strengthening measures to control dioxins at incineration plants. As a result, illegal dumping started to decline after peaking in 1999. The Law Concerning Special Measures against Dioxins was enacted in 1999. This led to the introduction of comprehensive measures, including tightened regulations on flue gases from incineration plants, government support systems for technological development by business operators, and support for the improvement of incineration plants by local governments. Of particular note, the emissions of dioxins and dioxin-like compounds (DLCs) in Japan were successfully reduced from 5,000 grams in 1997 to 64 grams in 2004, a 98 per cent reduction (Japan, MOE, 2006).

The Law Concerning Special Measures for Promotion of Proper Treatment of PCB Wastes (PCB Special Measures Law) was enacted in 2001 for PCB waste, which until then had been handled by individual business operators even though it is a particularly hazardous and difficult-to-treat type of industrial waste. The law paved the way for the national government to develop five treatment centres nationwide and centrally treat PCB waste (see **2.4.4 (3)** for a specific example).

Box 3: Minamata today: Plentiful natural resources and a beautiful countryside

A family paddles a sea kayak with smiles on their faces. People visit this place for camping in the summer. In winter, people come to walk around the forest by the beach. The Minamata Nature School is a place where people gather to fully experience the reincarnated beach through their five senses.

The city of Minamata aims to revitalize the nature of the sea, once contaminated in the 1950s by industrial wastewater containing mercury, and create an "Environmental Model City" where responsible companies, businesses, citizens and government work cooperatively and energetically towards better urban planning.

The city is working to improve more than just the sea. The people here have taken into account the lessons learned from Minamata disease, including lessons about the appropriate management of household waste. They prioritize preservation of the environment and modify their behaviour accordingly.

Most cities in Japan dispose of household waste through either incineration or direct landfill disposal. In the early 1990s, the city of Minamata began segregating waste to use it as a resource. The Minamata city government achieved resource classification collection by creating base locations for collection in each community, and then collecting the sorted waste in containers, with the categories to be collected depending on the day of the week. Minamata is known for having cultivated an advanced system of 21 classifications from 1993 (24 classifications since 2000), using a structure based on cooperation by the citizens. But that was not all. There was a realization that unless waste was also reduced, they would continue to battle the issues of resource consumption and securing final disposal sites.

In 1997, the city office called on sixteen women's groups and created the Minamata Women's Council for Waste Reduction. Three thousand five hundred women in the city would reduce as much excessive potential waste as possible such as by carrying around reusable shopping bags and purchasing minimally packaged items. The stores would also cooperate by curbing the excessive use of food trays when putting food up for sale. In this way, the 3R (reduce, reuse and recycle) relationship would be established.

The city of Minamata, Kumamoto prefecture, with the beautiful sunset that falls on Shiranui bay, is known for its seafood, citrus growing in the woodlands, and abundant greenery and food, making it a city attractive to all. The citizens have cooperated in community building, but there should also be some focus on how environmental reclamation and the rebuilding of trust was not an easy road taken, and that these experiences should be avoided in other countries to the greatest extent possible.

c. Accelerating the creation of a sound material-cycle society based on the idea of extended producer responsibility

When light and easy-to-carry PET bottles became popular among consumers, there was a backlash from environmental organizations against the use of the disposable bottles. This increased the public's interest in the importance of the 3Rs (reduce, reuse and recycle), which take into consideration the reduction of waste generation in addition to recycling.

Against this social backdrop, the government created the Basic Act on Establishing a Sound Material-Cycle Society in 2000 (see **2.1.3 (1) b**. for an outline), which establishes the 3Rs as a foundation. Other recycling laws formulated before and after 2000 stipulate the roles of producers, consumers and government. These include the Law for the Promotion of Effective Utilization of Resources (1991); the Law for the Promotion of Sorted Collection and Recycling of Containers and Packaging (Container and Packaging Recycling Law; 1995); the Law for the Recycling of Specified Kinds of Home Appliances (Home Appliance Recycling Law; 1998); the Law on Recycling of Construction-Related Materials (Construction Material Recycling Law; 2000); the Law for Promotion of Recycling and Related Activities for the Treatment of Cyclical Food Resources (Food Waste Recycling Law; 2000); and the Law for the Recycling of End-of-Life Vehicles (End-of-Life Vehicle Recycling Law; 2002). In addition, the Law on Promotion of Recycling of Small Waste Electrical and Electronic Equipment (Small Waste Electrical and Electronic Equipment Recycling Law) was enacted in 2012.

Producers' responsibility for recycling and related activities was established in these recycling laws (see **2.1.3 (4)** for an outline), based on the idea of extended producer responsibility (EPR), in which producers take a certain level of responsibility for their products not only at the production stage but also at the utilization and post-consumer stages.

The Fundamental Plan for Establishing a Sound Material-Cycle Society, a plan for implementing relevant measures in a comprehensive and systematic manner, sets three targets for the "entrance", "material-cycle" and "exit" stages of the material flow in Japan (see **2.1.3 (1) c**. for an outline). These serve as indicators for achieving a sound material-cycle society when implementing the above-mentioned legislation as a whole. Japanese society is taking steady steps towards reducing natural resource consumption, using a greater amount of recycled materials and minimizing the amount of landfilled waste. As a result, the expected number of years before industrial waste landfill sites become full increased from 3.9 years in 2000 to more than 10 years in 2010.

d. Society-level efforts to create a sound material-cycle society

In addition to the implementation of legislation, initiatives by industry are important for transitioning to a sound material-cycle society. Keidanren (Japan Business Federation), which is comprised of leading Japanese companies, national organizations for individual industries and regional economic organizations, announced the Keidanren Global Environment Charter in 1991, when it was known as Keidanren (Japan Federation of Economic Organizations)[1]. Its aim was to

1 Keidanren (Japan Federation of Economic Organizations) and Nikkeiren (Japan Federation of Employers' Associations) amalgamated in 2002 to become Keidanren (Japan Business Federation).

express domestically and internationally the principles and specific guidelines for action that industry should use to tackle environmental problems. In order to put the principles into action, Keidanren formulated the Keidanren Voluntary Action Plan on the Environment in 1997 and it is now also working towards the development of a sound material-cycle society (see **2.2**).

With the aim of establishing a sound material-cycle society, the Ministry of the Environment and the Ministry of Economy, Trade and Industry (METI) institutionalized the "Eco-Town Project" initiative in 1997. Through this initiative, environmentally friendly cities are developed based on the concept of zero emissions (see **2.1.3 (5)** for an outline and **2.5.4** and **2.6.4** for specific examples). "Zero emissions" is a state in which all the waste generated by one industry is used by another industry as raw materials so that waste is reduced to zero.

These efforts of business operators, local governments and the national government to create a sound material-cycle society are motivated by an increasing awareness of residents about the environment. Currently, many consumer organizations and environmental NPOs are engaged in environmental activities. Women, more so than men, generally have standpoints rooted in the essentials of life, with strong concerns about pollution and the illegal dumping of industrial waste and hazardous substances such as dioxins and dioxin-like compounds from the standpoint of protecting the health of their families. Therefore, women play critical roles in scrutinizing the responses taken by business operators, local governments and the national government towards environmental problems. For many years, consumer organizations and local organizations nationwide have cooperated with each other through the National Liaison Committee of Consumer Organizations (Shodanren) established in 1956 and the National Liaison Council of Life-Focused Schools,[2] through which they conduct awareness-raising activities and advocacy activities. In 2010, nationwide networks of citizen organizations interested in the 3Rs jointly launched the Asia 3R Citizens Forum, through which they share among themselves and with others advanced examples of 3R activities in Japan while cooperating with organizations promoting the 3Rs in other parts of Asia.

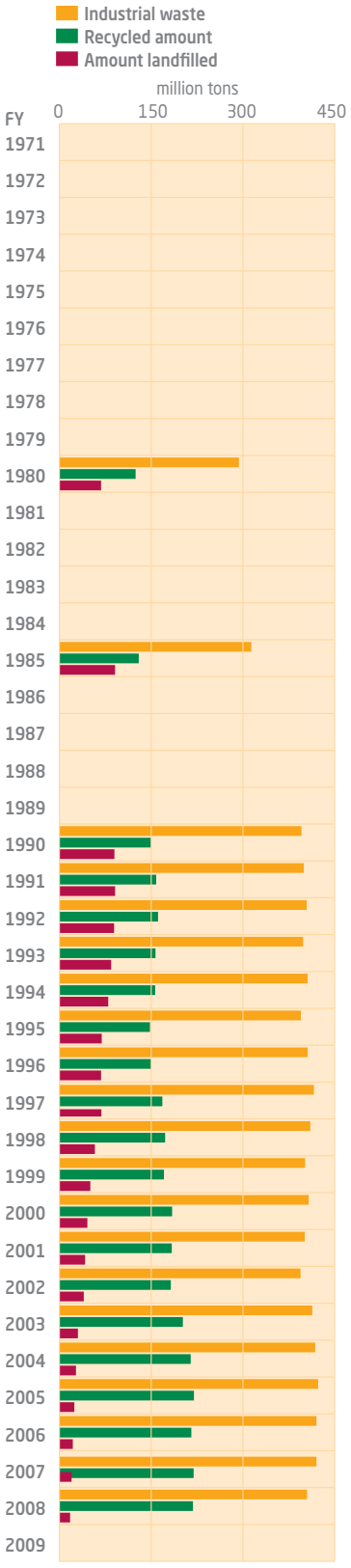
2.0.3 CONCLUSION

Table 2-0-1 summarizes in chronological order Japan's experiences regarding industrial waste. This chapter has so far discussed the challenges that arose in industrial waste management in the context of historical developments in Japan and the measures taken to tackle the challenges. Later sections will detail specific activities conducted by the national government, industry, local governments and others. They will also overview the results achieved through the activities and the lessons learned by each stakeholder group. An outline of national policies on waste management is given in **2.1**. The history of industrial waste treatment businesses in Japan is explained in **2.2**. The voluntary actions of industry are explained in **2.3**. The experiences and activities of Osaka City and the cities of Kitakyushu and Kawasaki are explained in **2.4**, **2.5** and **2.6**, as specific local government examples.

Since 2010, Japan has faced many new challenges that came one after another. As

2 *Zenkoku Seikatsu Gakko Renraku Kyougikai* in Japanese

Table 2-0-1 Japan's Experience regarding Industrial Waste in the Latter Half of the 20th Century

Years	Int'l (▲) and domestic (◆) events related to the environment and economy	Industrial waste emissions	Laws related to waste management and activities related to industrial waste management
1950s and 1960s	◆ **1955-1973: High economic growth period** ◆ 1955: Itai-itai disease ◆ 1956: Minamata disease ◆ 1958: Factory Effluent Control Law ◆ 1962: Smoke and Soot Control Law enacted ◆ 1964: Tokyo Olympics ◆ 1967: Basic Law for Environmental Pollution Control enacted		■ 1900: Sewage Disposal Law Municipal governments must treat household waste and human waste in order to maintain public hygiene. ■ 1954: Public Cleansing Law Municipal governments must implement cleaning projects in urban areas with the aim of improving public hygiene.
1970s and 1980s	◆ 1970: "Pollution Diet" ◆ 1970: Japan World Exposition in Osaka City ◆ 1971: Environment Agency of Japan established ▲ 1972: United Nations Conference on the Human Environment in Stockholm ◆ **1986-1991: Bubble economy**		■ 1970: Waste Management Law aims to preserve living environment and maintain public hygiene. Defines "municipal solid waste" as household waste to be treated by municipal governments, and "industrial waste", for which the responsibility for treatment lies with the business operators generating the waste. ▲ 1989: Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal
1990s, 2000s, and beyond	▲ 1992: United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro (Agenda 21 agreed; Framework Convention on Climate Change (UNFCCC) and Convention on Biological Diversity (CBD) opened for signature) ◆ 1993: Basic Environment Act enacted ◆ 1996: Keidanren Appeal on the Environment adopted; industry-wide Voluntary Action Plans developed in response ▲ 1997: Third session of the Conference of the Parties to the UNFCCC (COP3) held in Kyoto (Kyoto Protocol to the UNFCCC adopted) ◆ 2001: Environment Agency reorganized as Ministry of the Environment ◆ 2008-2012: First commitment period of Kyoto Protocol	All figures and tables refer to the Japanese fiscal year, running from 1 April of a given year to 31 March of the next year.	■ 1991: Law for the Promotion of Effective Utilization of Resources ■ 1995: Containers and Packaging Recycling Law ■ 1997: Eco-town system launched to foster environmentally friendly cities ■ 1998: Home Appliance Recycling Law ■ 1999: Law Concerning Special Measures against Dioxins ■ 2000: Basic Act on Establishing a Sound Material-Cycle Society ■ 2000: Construction Material Recycling Law ■ 2000: Food Waste Recycling Law ■ 2001: PCB Special Measures Law ■ 2002: End-of-Life Vehicle Recycling Law ■ 2012: Small Waste Electrical and Electronic Equipment Recycling Law

Source: Based on Japan, MOE (2011b)

industrialization progresses globally and the scarcity of resources such as rare earth elements increases their value, the 2Rs (reduce and reuse) are becoming increasingly important. Aggressive efforts are also needed to upgrade the quality of recycling technologies. The space in industrial waste landfill sites is declining and it is estimated that these sites will be full approximately 10 years from now. The focus has shifted to the recovery of energy as heat and electricity, with the aim of reducing the waste to be landfilled as much as possible. Therefore, Japan's efforts to develop a sound material-cycle society have entered a new stage.

Japan's experiences and the lessons it learned in the latter half of the 20th century can contribute to global efforts for the establishment of sound material-cycle societies. They can be particularly instructive as examples of the sustainable and effective use of resources, thorough implementation of the 3Rs and appropriate waste treatment and the recovery of heat and other forms of energy from waste.

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2.1 The national policy framework

Ministry of the Environment of Japan

2.1.1 INTRODUCTION

A study by the Research Institute of Solid Waste Management Engineering approximated waste generation worldwide at 10.47 billion tons in 2010. It also estimated future waste generation of about 14.87 billion tons in 2025 and 22.31 billion tons in 2050, representing increases of 45.0 per cent and 113.2 per cent respectively compared to the 2010 figure. As more waste is generated, waste management issues are expected to become increasingly acute all around the globe (RISWME, 2011).

The state of waste generation and management varies according to the economic and social circumstances found in countries' local areas. Therefore, there is a need to tailor waste policies to each local area's particular set of circumstances. Nevertheless, this chapter introduces outlines of Japan's past industrial waste policies with the aim of providing a reference for policy making.

Section **2.1.2** overviews the industrial waste issue in Japan over time and the development of policies to address it. Section **2.1.3** highlights key elements of Japan's current industrial waste policies, namely the Basic Act on Establishing a Sound Material-Cycle Society, regulations based on the Waste Management Law, the construction of and improvements to industrial waste disposal facilities and support for technological development, recycling laws, and the Eco-town project. Section **2.1.4** discusses aspects of Japan's experience that are expected to be particularly relevant to developing countries.

2.1.2 INDUSTRIAL WASTE ISSUES IN JAPAN AND THE DEVELOPMENT OF POLICIES

Japan's legal framework for waste management began with the Sewage Disposal Law enacted in 1900. This law was wholly revised in 1954 with the enactment of the Public Cleansing Law, which aimed at maintaining cleanliness and improving public health. Based on the new law, municipalities disposed of most household and human waste generated in the daily lives of the general population. However, for waste from industry, although there was a provision that municipal mayors could order proper disposal of special wastes or wastes in massive amounts, as a matter of practice, it was the waste generators themselves who were tasked with the disposal of most industrial waste. How the waste was actually disposed of was usually unclear.

Japan achieved high economic growth from the mid-1950s through the early 1970s. This period saw a worsening of pollution problems, including air pollution and water contamination. No nationwide statistical data exist on the amount of industrial waste generated in Japan during this era, but there are estimates of about a million tons per day. This led to pollution problems attributable to the disposal methods for industrial waste, such as the contamination of water for public use as a result of the illegal dumping of such waste.

Because pollution had grown into a serious societal problem and because of mounting public opinion nationwide calling for pollution control, 14 pollution-related laws were newly enacted or revised in the Diet session that convened in November 1970 (called the "Pollution Diet"),

with the Public Cleansing Law wholly revised into the Waste Management Law.

This Waste Management Law established the basic frameworks of regulations and systems concerning industrial waste management that still exist today. The systems introduced were (1) classifying waste into industrial waste and municipal solid waste and establishing a system to manage each, (2) establishing the principle of industrial waste generators disposing of industrial waste appropriately on their own responsibility, (3) setting standards concerning the collection, transport and disposal of industrial waste, and (4) introducing a license system for industrial waste disposers.

However, after the Pollution Diet in 1970, such problems as air pollution and water contamination gradually came to be remedied, whereas the industrial waste issue was not solved by the enactment of the Waste Management Law. As economic growth continued, the generation of waste increased and greater diversity was seen in the types of waste generated. In the early 1990s, the industrial waste issue, including illegal dumping, a shortage of landfills and disputes between local communities over the establishment of landfills or incineration facilities became more acute.

Accordingly, the Law was revised significantly in 1991 and 1997. This revision considerably strengthened penalties for illegal dumping and enabled a transition into a permission system for the establishment of waste disposal facilities. This revision also introduced and expanded the system governing waste subject to special control and the system of industrial waste control manifests.

In addition, concerning cross-border movement of hazardous wastes, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention) was adopted in March 1989. In 1993 Japan ratified this law and brought into force the Law for the Control of Export, Import and Others of Specified Hazardous Wastes and Other Wastes to strictly control export and import of hazardous wastes specified in the Convention.

In the 1990s, Japan came to recognize structural changes in environmental issues. The existing pollution problems caused by industry had been remedied, but environmental pollution and increases in waste generation caused by economic and social activities rooted in "mass production, mass consumption, and mass disposal" came to be an issue. Global warming and other global environmental problems also received prominent attention. Against this backdrop, deliberations were held on the modalities of Japan's environmental policies based on the results of the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992 (UNCED, or the Earth Summit). This culminated in the enactment of the Basic Environment Act in 1993.

This law provides for the basic principles of environment conservation, the responsibilities of various entities, fundamental policies for environment conservation, and other such matters. As the responsibilities of business operators, the Basic Environment Act requires businesses to take necessary measures to ensure proper disposal when products and other items and materials related to business activities become waste. It also requires businesses to make efforts to reduce the environmental burden during the stages of product use and disposal and to make efforts to use recycled resources.

In the First Basic Environment Plan, based on the Act and formulated in 1994, an "environmentally sound material cycle" was the first of four long-term objectives. It advocated

"minimizing the environmental burden and realizing a socioeconomic system based on an environmentally sound material cycle. These will be achieved through reducing the occurrence of waste, conducting proper disposal, and other means, thereby securing to the greatest extent possible sound material cycles in social and economic systems."

Thus, for solving serious waste problems, just the conventional approach of properly disposing of waste through incineration or landfilling was inadequate. Japan recognized the importance of reducing the amount of waste generated in the first place and of recycling any waste that still ended up being generated. Concrete policies for both gradually came to be introduced. When the Waste Management Law was revised in 1991, the purpose of the law was amended to include reducing the amount of waste generated and also recycling waste. In 1995, the Law for Promotion of Selective Collection and Recycling of Containers and Packaging (Containers and Packaging Recycling Law) was enacted, and in 1998, the Law for the Recycling of Specified Kinds of Home Appliances (Home Appliance Recycling Law) was enacted. Various measures were promoted under laws addressing individual categories of waste, yet waste discharge still increased. Therefore, comprehensive and systematic waste controls were deliberated at the Central Environmental Council[1] and other meetings.

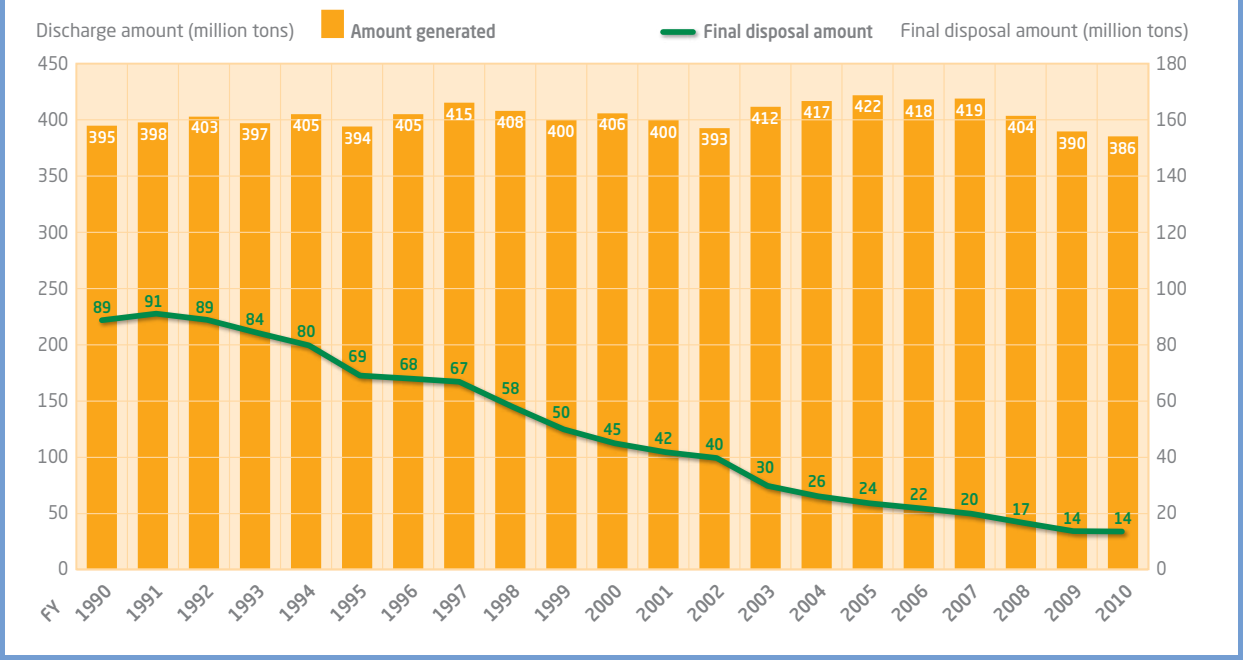
In the late 1990s, dioxin emissions from waste incineration facilities became a major issue. In 1999, the Law Concerning Special Measures against Dioxins was enacted, and the council of ministers for dioxin countermeasures set forth further measures for waste disposal and recycling. These included reducing the amount of waste generated, promoting recycling, and setting waste reduction targets.

Against this backdrop, the three ruling parties reached a policy agreement in October 1999 that "fiscal 2000 should be positioned as the year to launch a sound material-cycle society, and that the legislation that will serve as the basic framework will be formulated" (Japan, MOE, 2000). After this policy agreement, the parties and government departments held deliberations on and then enacted the Basic Act on Establishing a Sound Material-Cycle Society in 2000. That same year, the Diet also newly enacted the Law on Recycling of Construction-Related Materials (Construction Material Recycling Law), the Law for Promotion of Recycling and Related Activities for the Treatment of Cyclical Food Resources (Food Waste Recycling Law), and the Law Concerning the Promotion of Procurement of Eco-Friendly Goods and Services by the State and Other Entities (Law on Promoting Green Purchasing) and revised the Waste Management Law and the Law for the Promotion of Effective Utilization of Resources. In this way, the legal framework advanced in a way that makes it entirely fitting to call the year 2000 the year in which Japan's sound material-cycle society began. Japan then reorganized its ministries and agencies in 2001. The Environment Agency was promoted in status to become the Ministry of the Environment and waste management, which had historically been administered by the Ministry of Health and Welfare, was transferred to the remit of the Ministry of the Environment.

After that, multiple recycling-related laws came to be enacted, including the Law for the Recycling of End-of-life Vehicles (End-of-life Vehicle Recycling Law) in 2002 and the Law on Promotion of Recycling of Small Waste Electrical and Electronic Equipment (Small Waste Electrical and Electronic Equipment Recycling Law) in 2012.

1 The Central Environmental Council is tasked with examining environmental issues and providing its views to the Prime Minister, the Environment Minister and other relevant ministers.

Figure 2-1-1 Changes in the amount of industrial waste generated and final disposal amount



Source: Ministry of the Environment

Meanwhile, improvements were made to the legal framework to ensure proper disposal of industrial wastes. The Law Concerning Special Measures for Promotion of Proper Treatment of PCB Wastes (PCB Special Measures Law) was enacted in 2001 to promote processing of PCB wastes, an area of waste management which for many years had seen hardly any progress. In addition, the Law on Special Measures Cconcerning Removal of Environmental Problems Caused by Specified Industrial Wastes Law was enacted in 2003 to eliminate obstacles to environmental conservation caused by illegal dumping.

The Waste Management Law was revised repeatedly in 2003, 2004, 2005, 2006 and 2010 to further strengthen regulations for proper disposal of industrial waste while introducing systems to promote recycling and heat recovery.

In parallel with these changes introduced by the national government, local governments strengthened their enforcement of regulations and systems. Measures to advance the 3Rs (reduce, reuse, recycle) and proper disposal by industrial waste generators and disposal companies were promoted. As a result, although the amount of industrial waste generated remained unchanged, the landfill amount was reduced dramatically, from 89 million tons in fiscal 1990 to 14 million tons in fiscal 2010 (see **Figure 2-1-1**). This reflected progress in both recycling and proper disposal. Illegal dumping has been also decreasing in terms of both the number of cases and the total amount of waste.

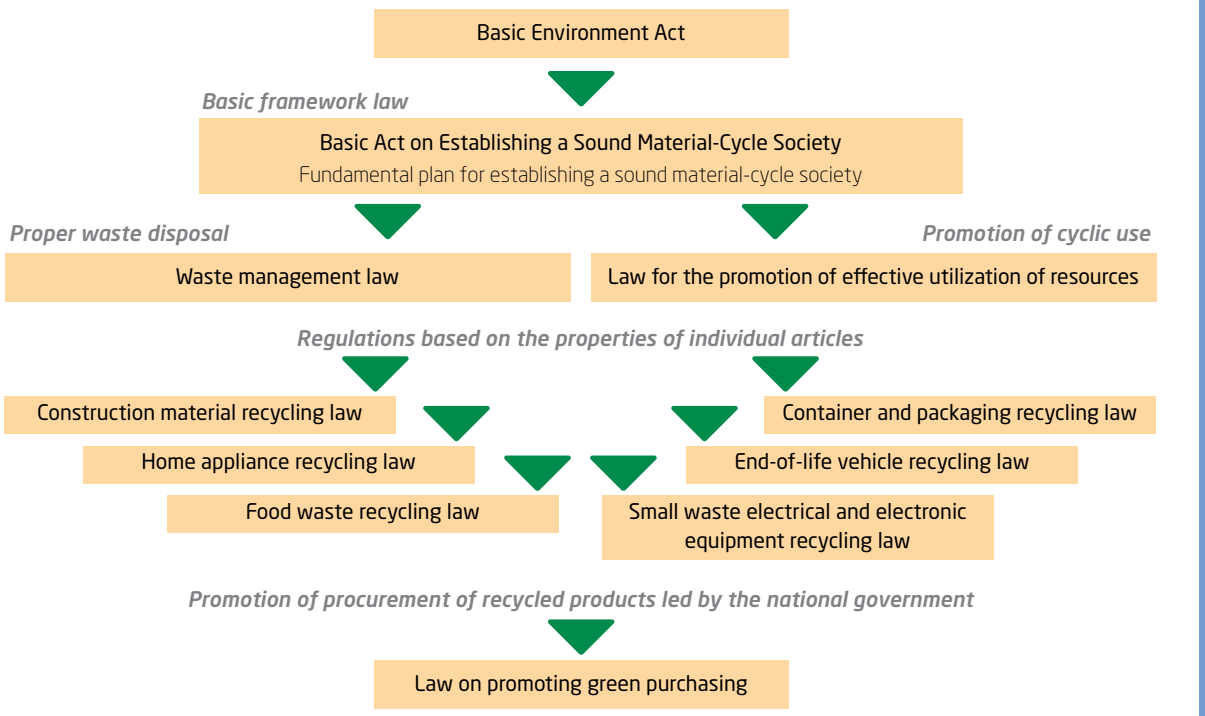
2.1.3 POLICIES RELATED TO INDUSTRIAL WASTE MANAGEMENT IN JAPAN

(1) Establishing a sound material-cycle society

a. Legal structure of waste policies in Japan

Japan's legal system governing waste is shown in **Figure 2-1-2**. The Basic Environment Act provides for the basic principles underlying not only waste policies but also environmental policies in general. It also lays out the modalities of fundamental policies and measures. The Basic Act on Establishing a Sound Material-Cycle Society was enacted in 2000.

Figure 2-1-2 Legal structure for establishing a sound material-cycle society



Source: Ministry of the Environment

More concrete regulations and systems are specified by individual laws. The Waste Management Law stipulates regulations and systems for the disposal of waste from households and those from businesses.

In order to promote recycling, Japan also enacted the Law for Promotion of Effective Utilization of Resources. Moreover, there are six individual laws that prescribe the recycling systems for six categories of articles, namely containers and packaging, home appliances, food, construction materials, automobiles and small appliances.

b. Outline of the Basic Act on Establishing a Sound Material-Cycle Society

This law first defines "a sound material-cycle society" as a society where the consumption of natural resources can be reduced so as to lower burdens on the environment as far as possible by securing reduction in generation of waste and cyclic use and proper disposal of recyclable resources.

The Act also establishes a hierarchy for waste management. The order of priority in managing waste begins with reducing the amount generated. This is followed by reuse, then recycling, then heat recovery. Proper disposal is the final option for waste that is unable to undergo any of these.

The Act also specifies the responsibilities of individual entities such as the national government, local governments, business operators and citizens. Notably, it clarifies the "responsibility of the waste generator" for both businesses and citizens, and it establishes the general principle of extended producer responsibility (EPR), whereby producers take unambiguous responsibility for their products and other such articles until after they are used and become waste.

In addition, the Act sets forth the modalities for the fundamental policies and measures related to establishing a sound material-cycle society. It also stipulates that

the national government shall formulate a Fundamental Plan for Establishing a Sound Material-Cycle Society.

c. Fundamental Plan for Establishing a Sound Material-Cycle Society

The First Fundamental Plan for Establishing a Sound Material-Cycle Society was formulated in 2003, grounded in the Basic Act on Establishing a Sound Material-Cycle Society. This plan analysed the status quo and the challenges for establishing such a society and presented a vision for an ideal sound material-cycle society. It set forth the indicators and numerical targets involved in establishing such a society and outlined the efforts that the government should advance and the roles that citizens, NGOs, business operators and local governments should play. In order to ensure effective implementation of the plan, it prescribed that the progress of the plan shall be evaluated and reviewed by the Central Environment Council, which serves in an advisory capacity to the Minister of the Environment. The Second Plan was formulated in 2008 and the Third Plan was formulated in 2013. Both of these follow the basic organization of the First Plan.

With regard to the indicators in the Fundamental Plan, the methods for calculating the flow of materials within economic activities are established on the basis of various types of statistical data. These material flows are calculated on a continuing basis for each fiscal year.

In addition, as the indicators for the "entry", "material cycle" and "exit" of the material flows in economic activities, their numerical targets are set. In the base year (FY2000), the resource productivity was 248,000 yen/ton, the recycling ratio was 10.0 per cent, and the final disposal amount was 56 million tons. In fiscal 2010, however, the resource productivity was 374,000 yen/ton (+51%), the recycling ratio was 15.3 per cent, and the final disposal amount was 19 million tons (-67%), as shown in **Table 2-1-1**. Every indicator shows a trend toward improvement. In particular, a marked improvement has been evident since the enactment of the Basic Act on Establishing a Sound Material-Cycle Society in 2000.

"Entry" indicator: Resource productivity
Resource productivity = GDP/Natural resources input
Indicator representing comprehensively how effectively materials are used by industry or in people's lives (the amount of wealth created by using smaller amounts of resources)

"Material cycle" indicator: Recycling ratio
Recycling ratio = Recycling amount/(Natural resources input + Recycling amount)

Table 2-1-1 Degree of achievement of numerical targets in the Fundamental Plan for Establishing a Sound Material-Cycle Society

	FY2000 (Base year)	FY2010 (Compared to FY2000)	FY2015 (Target year for Second Plan)
Resource productivity (yen/ton)	248,000	374,000 (+51%)	420,000
Recycling ratio (%)	10.0	15.3 (+5.3 points)	14-15
Final disposal amount (million tons)	56	19 (-67%)	23

Source: Ministry of the Environment

Indicator representing the extent to which much cyclical resources (reused or recycled) resources have been utilized, as a percentage of the total amount of resources input into society

"Exit" indicator: Final disposal amount
Amount of waste landfilled (total of municipal solid waste and industrial waste) and indicator directly linked to the issue of shortages of final disposal sites for waste

The Fundamental Plan establishes other types of indicators beyond these three material flow indicators, with numerical targets set for some of them. First, the Fundamental Plan establishes supporting indicators related to material flows. Among these are indicators with relevance to establishing both a low carbon society and a sound material-cycle society. Examples of these indicators are the "resource productivity of fossil resources" and the "greenhouse gas emissions originating in the waste management sector". Second, the Fundamental Plan contains indicators for efforts underway. These measure the degree of progress in efforts being undertaken to establish a sound material-cycle society.

The Sound Material-Cycle Society Panel within the Central Environment Council is charged with evaluating and reviewing the progress of the Fundamental Plan. Every fiscal year, a report compiling the results of the Panel's review is published. The report provides an update on the indicators set forth in the Plan, assesses efforts by the national government and other entities and overviews the challenges still being faced, and indicates the direction of future policy development.

This process of evaluation and review at the Central Environment Council is considered an effective system because it reviews the degree of progress on a continual basis and the results can be reflected in policymaking swiftly. It is also a way to inform society broadly about these matters and encourage the private sector to make efforts.

(2) Regulations concerning industrial waste management, based on the Waste Management Law

a. Purpose of the Waste Management Law

The Waste Management Law is intended to maintain people's living environment and improve public health through reductions in waste generation and through proper waste disposal. It establishes regulations and systems concerning the disposal of waste in general from households and businesses. Although the regulations and systems based on the Waste Management Law are stipulated by the national government, most of them are enforced by local governments, such as prefectural governments and municipalities.

b. Definition and classification of waste

The Waste Management Law defines 20 types of waste generated by business activities as "industrial waste" and other types of waste as "municipal solid waste". Waste that does not fall under the definition of industrial waste falls into the category of municipal solid waste, even if that waste is generated through business activities (more specifically, such waste would be classified as 'municipal solid waste from business activities'). In addition, waste with properties that may harm human health or damage the living environment is classified as "specially controlled industrial waste" and "specially controlled municipal solid waste". This separate classification enables the government to regulate them more strictly (see chapter 2).

c. Responsibilities of business operators and responsibility for industrial waste disposal

The Waste Management Law sets forth the responsibilities of business operators. Specifically, it says that businesses shall appropriately manage the waste left as a result of their business activities. The law also specifies other responsibilities of business operators. These include making efforts to reduce waste generated through recycling and other means; ensuring that, for all products manufactured, processed or sold by a company, at the time of disposal of the products and the products' packaging, proper disposal will not be a burden, by giving consideration to such matters at the time of product development and by providing information on appropriate disposal methods; and cooperating with policies and measures by the national government and local public authorities for reducing the volume of waste and conducting proper disposal.

To make such provisions more concrete, this law says "Businesses shall be required to manage their industrial waste by themselves." clarifying that the responsibility for disposing of industrial waste is to be taken by the waste generators. It should be noted that such responsibility may be carried out by commissioning the waste properly to third parties.

The law specifies that for municipal solid waste, including waste from people's daily lives, municipalities shall provide disposal service. For municipal solid waste from business activities, in light of the above-mentioned provisions for the responsibility of business operators, the law states that business operators are to make efforts to dispose of such waste on their own as much as possible, and that they are to cooperate in disposal undertaken by municipalities. Under these provisions, municipalities may require that waste be commissioned to disposers. Alternatively, if the municipality itself conducts the disposal, it may collect fees for this. The system in use varies with the content of the local ordinances addressing municipal solid waste from business activities.

d. Licensing for industrial waste handling businesses

An entity that will provide industrial waste handling (collection, transport and disposal) as a business service must be licensed by the governor of the prefecture (or the mayor of the government ordinance-designated city) where the entity will conduct the business. However, this license is not required when waste generators dispose of wastes on their own and for other entities designated by ordinance of the Ministry of the Environment. There are four types of licenses, categorized by the waste's classification as either industrial waste or industrial waste subject to special control, and also by the type of services to be provided, either collection and transport services or disposal services. In principle, this license needs to be renewed every five years. In addition, the license designates the scope of services able to be performed, specifying the disposal processes and the types of industrial wastes able to be handled. This designation is determined based on the contents of the application submitted and the results of a screening.

The law stipulates that prefectural governors must not grant a license when the applicant's competence (knowledge, expertise and basic skills in accounting) cannot be confirmed or when the facility used for the business fails to meet the established standards. Furthermore, the applicant must not fall under conditions for disqualification (cases in which the entity was subject to disciplinary action for certain

types of unlawful behaviour, regarding this law or any other laws and regulations, cases in which less than five full years have passed since the entity had its license for waste handling revoked, and other such cases). The licensing requirements for this business have been made stricter in stages in order to remove disposers who engage in illegal dumping or otherwise engage in the improper disposal of waste.

In addition, disposers that had no adverse dispositions, including no orders for improvement, during the validity period of the previous licensing timeframe and that also satisfy requirements in the areas of information disclosure, environmental friendliness, and so on can now be certified as industrial waste disposers of excellence. These disposers are granted licenses that are valid for seven years, and the government promotes information disclosure about such businesses in order to assist waste generators in selecting industrial waste disposers of excellence.

In addition, there are some exceptions for which a license for engaging in an industrial waste disposal business is not required. The main ones, for which the Environment Minister authorizes businesses handling wastes, are permits for entities that recycle specific industrial wastes (recycling permit), permits for entities that are manufacturers and conduct waste management over a wide area for industrial waste resulting from their products (national permit system) and permits for those who render industrial wastes including PCBs and asbestos harmless (detoxification permit). The requirements for r eceiving such authorization have been established separately for each category. Businesses having such authorization are not required to have the regular license for engaging in an industrial waste disposal business.

e. **Disposal standards for industrial waste**
Whether waste generators dispose of their industrial wastes on their own or commission third parties to do it, disposal must be in accordance with the standards established.

During the stages of collection and transport, intermediate processing, and landfill, the disposal standards require prevention of scatters and spills, strong odours, noise or vibration and the labelling of the vehicles used in collection and transport and of the storage facilities. They also stipulate the processes to be used when incinerating or landfilling the waste.

There are stricter disposal standards that have been established separately for industrial wastes subject to special control.

f. **Permission for industrial waste disposal facilities**
Prior permission from the prefectural government is required to establish certain types of disposal facilities for industrial waste, as the living environment in surrounding areas must be maintained and surrounding facilities must also be taken into consideration. Facilities requiring this prior permission include incineration facilities and landfills. This provision is applicable regardless of what entity is conducting the disposal (the waste generator or a commissioned entity).

To apply for this permission, the entity seeking to establish such a facility must conduct a survey on the impacts on the surrounding living environment and attach the results to the application form. In addition, for some facilities requiring permission, the procedure is designed to ensure transparency in the permission process. The process includes giving public notice and allowing public inspection of the

application. The process also includes the opportunity for the municipalities concerned and relevant parties to submit their views.

It is required that the structure and maintenance plan of the facility as well as the competence of the applicant meet the standards and that the applicant does not fall under conditions for disqualification. After permission is granted for a facility, the entity establishing the facility must perform maintenance in accordance with the maintenance standards and also the maintenance plan submitted as part of the application.

In addition, final disposal sites for wastes are designated as sites having underground waste even after removal of the facility. If earthwork or other changes are to be made to the configuration of a site, the facility must confirm that these changes will not negatively impact the living environment.

g. Regulations concerning waste generators' responsibility for disposal

As mentioned above, the Waste Management Law states that "Businesses shall be required to manage their industrial waste by themselves", with the provision that such responsibility may be carried out by commissioning the waste properly to third parties.

The Waste Management Law has been revised repeatedly to reinforce waste generators' responsibility for industrial waste disposal. The regulations below have been established to ensure proper disposal whether disposal is undertaken by the waste generator or commissioned to a third party.

g-1. Regulations on commissioning disposal

When waste generators commission the collection, transport or disposal of industrial wastes to disposers, they may commission only licensed disposers or others that are able to dispose of the industrial wastes in accordance with the Waste Management Law.

When doing so, the standards for commissioning must be followed. These standards specify that commission contracts must be made in writing and itemize what must be included in the contracts as well as the documents to be attached to the contracts. It prescribes that waste generators shall include the properties of their industrial waste and handling precautions within the contracts.

Those who are entrusted with disposal of industrial waste are in principle prohibited from recommissioning it, excluding cases that satisfy established standards, which include the prior approval of the waste generators. Moreover, additional recommissioning is prohibited without exception. This is because recommissioning may lead to improper disposal by making it unclear where responsibility for the disposal lies.

g-2. Manifest

When waste generators commission disposal to third parties, they must provide a manifest upon transferral of their industrial wastes. The manifest is a collection of slips containing information such as the names of the waste generator and disposal company, the mode of packing the industrial waste and the addresses of the waste generator and the sites for intermediate processing and final disposal. The waste generators provide this manifest while handing over their industrial wastes to collectors, transporters or disposers.

The contractors receiving the waste send one slip of the manifest back to the waste generator upon completion of disposal. In this way, the waste generators can understand how the disposal progressed.

In addition, when waste generators commission industrial waste disposal, they are obliged to make efforts to take required measures for proper disposal after checking the status of disposal, by conducting site investigations or utilizing information disclosed by the disposer.

Japan also operates a system of "electronic manifests" in addition to the paper manifest system. This system electronically delivers, returns, and stores manifest information through a single information processing centre. This enables waste generators to understand or check the disposal status quickly and reduce the amount of work associated with manifest management. It has been becoming increasingly popular, with electronic manifests accounting for about 30% of manifests in fiscal 2012.

g-3. Addition of waste generators as the subject of administrative orders
When disposers illegally dump or improperly dispose of wastes, waste generators are also the subject of administrative orders, including an order of "removal of … the difficulty [for conservation of the living environment]" (Japan, Waste Management and Public Cleansing Law, 1970, Article 19). A waste generator is subject to receiving such an order when it commissions disposal in violation of commissioning standards. It is also subject to receiving such an order even when there are no violations of the commissioning standards, either in the case that the disposal company is lacking in sufficient funds and the waste generators did not pay a proper disposal charge, or in the case that the waste generator knew that disposal would be conducted improperly.

h. Collection of reports, on-site inspection, orders to improve operations, administrative orders and penalties
In order to ensure the effectiveness of regulations based on the Waste Management Law, provisions for collecting reports, on-site inspections, orders to improve operations, administrative orders and penalties have been established. These provisions stipulate that waste generators are also subject to administrative orders as mentioned above in specific cases. With regard to penalties, they also established rules on corporate exposure. For the most serious infractions of the law, such as in cases of illegal dumping, penalties of up to 300 million yen (approximately US$3 million) are imposed on corporations involved.

(3) Promotion of maintenance of disposal facilities for industrial waste and support for technology development
Since disposal of industrial wastes in Japan must be done either by the waste generators themselves or by commissioned licensed disposers, in principle, private businesses should maintain disposal facilities on their own.

However, in the early 1990s, there was an increase in the amount of industrial wastes that were difficult to dispose of, and simultaneously it was becoming more difficult to develop disposal facilities. As a result, the need arose for local governments

to be involved and exercise the faith placed in them by the public while utilizing the technologies and know-how of the private sector to construct and improve disposal facilities. Accordingly, local governments invest or contribute funds and designate corporations engaging in industrial waste disposal as "waste disposal centres". The Ministry of the Environment subsidizes a portion of such corporations' expenses (up to one-fourth) for constructing and maintaining disposal facilities.

In terms of countermeasures for climate change, the Ministry of the Environment also subsidizes part (up to one-third) of the expense of waste disposers that construct or maintain facilities recovering electric or thermal energy (generation through waste incineration) in the course of waste disposal.

Other measures to promote the maintenance of such facilities have been introduced, including a low-interest loan system by the Japan Finance Corporation and a debt guarantee system by the Japan Industrial Waste Management Foundation.

There is also a system for providing assistance for the research and development of waste disposal technologies. The Ministry of the Environment has created a competitive research fund called the "comprehensive promotion fund for environmental research". This fund publicly invites research institutions and private companies to submit applications for research and development topics. Research expenses are subsidized based on the results of a screening.

In addition, Japanese companies have developed a variety of technologies for the 3Rs (reduce, reuse, recycle), heat recovery, and proper disposal in waste management and have offered equipment and services in which such technologies are utilized.[2]

(4) Recycling laws

As mentioned in section **2.1.3 (1) a.**, Japan has enacted the Law for Promotion of Effective Utilization of Resources as well as six recycling laws addressing certain categories of articles.[3]

The Law for Promotion of Effective Utilization of Resources is designed to promote efforts by product manufacturers to implement the 3Rs (reduce, reuse, recycle). The law designates target industries and products. Within these voluntary efforts, the law states that 3R measures should be used during the stages of product design and manufacturing, that companies should use identification labeling to enable the classification of waste for collection, and that business operators should voluntarily formulate collection and recycling systems.

The six individual recycling laws target articles for which there is a particular need for recycling. They were designed in a way that promotes recycling according to the articles' properties or state of waste generation. The details of these systems vary with the individual laws.

These laws clarify the role sharing, obligations, and cost burdens of relevant

2 For more information on these technologies, see "The Project for Supporting the Incubation of Firms in the Field of Venous Industry and Promoting the Spread of Japanese Waste Management and Recycling Technologies Overseas". Information is available in Japanese, English and Chinese at http://www.env.go.jp/recycle/circul/venous_industry/en/index.html

3 These are the Containers and Packaging Recycling Law, Home Appliance Recycling Law, Construction Material Recycling Law, Food Waste Recycling Law, End-of-Life Vehicle Recycling Law, and Small Waste Electrical and Electronic Equipment Recycling Law.

parties, such as the manufacturers, retailers, consumers, waste generators, disposers and local governments. They also set targets for recycling. The laws include special exceptions for those who dispose of wastes in accordance with the Waste Management Law.

The enactment and enforcement of these laws has significantly increased the rate of recycling of the articles they target.

(5) Eco-town project

The Eco-town project was launched in fiscal 1997. It aims to promote advanced environmentally conscious community development, based on a "zero emission vision" (a vision aiming at zero emissions of waste by utilizing all waste from any given industry as materials in other fields).

Specifically, Japan's Ministry of the Environment (MOE) and Ministry of Economy, Trade and Industry (METI) jointly approve plans formulated by local governments according to the characteristics of their communities. Based on these plans, they support programmes for facility improvement and construction that are implemented by local governments and private organizations.

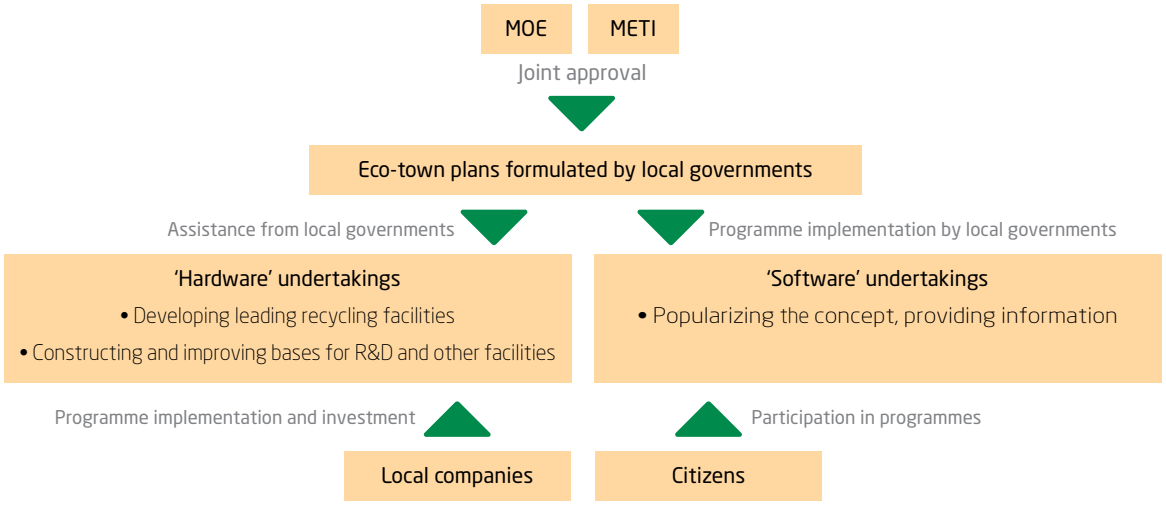
Eco-town plans have been approved for 26 communities in Japan. Efforts are now underway to develop communities with integrated recycling facilities (examples will be introduced in sections **2.5** and **2.6**).

2.1.4 KEY MESSAGES ARISING FROM JAPAN'S EXPERIENCE

Various points are expected to be useful for developing countries and others in the world as they address industrial waste, taking into account Japan's experience with the industrial waste issue and policies to address this issue.

Firstly, the degree of priority of the industrial waste issue should be raised within the government and this issue should be addressed through cooperation among various entities such as the government, local governments, industry, academia and citizens. Changing the way of thinking by these stakeholders is expected to be

Figure 2-1-3 Scheme of the Eco-town project



Source: Based on eco-town project materials

particularly important in bringing about tangible changes. That said, engendering changes in people's way of thinking is in fact quite difficult, and it happens over the course of time.

Japan has a limited amount of land. This meant that illegal dumping, improper disposal, and the shortage of disposal facilities became quite prominent as social problems, particularly from the 1990s onward. There was also a striking need for policies that included the 3Rs (reduce, reuse, recycle) and proper disposal of industrial waste. In light of this, dialogue between stakeholders was promoted at various councils within the national and local governments, and these functioned as opportunities for deliberating the merits and the modalities of such policies.

In parallel with this, industry, academia, and citizens became increasingly active in making policy recommendations, pursuing technology development and pioneering practical activities. These came to be reflected in policies. As a result, the industrial waste issue has been remedied to reach the current state of affairs.

On the basis of Japan's experience, it seems that the most fitting path forward for other countries as well is to raise the priority of industrial waste policies and change people's way of thinking by repeating the process in which first the industrial waste issue is shared through dialogue between stakeholders, and then concrete policies and actions to solve the issue are agreed upon and implemented.

Secondly, an appropriate system clarifying disposal responsibility and cost burden for industrial waste management should be formulated and implemented. This tends to be taken for granted but in fact the process is quite difficult. Wastes including industrial wastes involve costs both for recycling and for proper disposal. If recycled resources and recovered electricity or heat can be sold in a way in which economic rationality exceeds the costs, then a certain amount of recycling and heat recovery will take place even in a market economy. In actuality, most industrial wastes have homogenous and stable properties and are generated continuously. Consequently, most of this waste becomes recycled under a market economy. However, if there is a cost burden on waste generators or disposers for recycling or for proper disposal, the inducement to improperly dispose of wastes, such as through illegal dumping, in an effort to avoid the cost burden can arise in a market economy where regulations are not in place. Improving this situation requires clarifying which entity holds the responsibility for disposal and the cost burden of waste. In terms of the polluter-pays principle, the system should incorporate the responsibility of waste generators and the extended producer responsibility for products that became waste.

Thirdly, standards for proper recycling and disposal should be set. Lower disposal costs are always better from the vantage point of waste generators and disposers of industrial wastes. Therefore, even if the disposal responsibility and the cost burden are clarified, a failure to establish standards for proper disposal will result in some businesses opting for low-cost, improper disposal regardless of any potential harm to society. This in turn may cause problems in maintaining the living environment. Preventing such a situation requires setting standards for proper recycling and disposal and then enforcing them. Nevertheless, considering that industrial waste is diverse and that disposal technologies will improve, it is desirable to require that disposal meet a certain standard while ensuring flexibility with regard to disposal processes.

A fourth key point is that regulations should be thoroughly implemented to eliminate illegal dumping and improper disposal. Even if the regulatory system and standards mentioned earlier are established, it will all be meaningless

if they are not followed. Also, Japan's experience demonstrates that supervision and control to prevent improper disposal, including illegal dumping, are quite difficult and cost-consuming. At the same time, it should be recognized that a tremendous cost will be incurred to resolve any environmental pollution that results from improper disposal, such as illegal dumping. In addition, if businesses that improperly dispose of wastes through illegal dumping or other means are not controlled, these businesses will ultimately prevail in the market, as they are the cheapest for waste generators to use. High quality businesses that properly dispose of wastes cannot easily succeed under such conditions and they will be forced to withdraw from the market, resulting in increasingly severe circumstances. In light of this, the cost for supervision and control by the government and the police can be regarded as the smaller ultimate cost burden under the two scenarios, and therefore the costs of supervision and control should be readily borne.

The fifth item of note is that the 3Rs (reduce, reuse, recycle) and heat recovery should receive priority in industrial waste policies. In Japan, incineration facilities were introduced early on and the 3Rs have been promoted from the 1990s onward. However, in developing countries where the amount of waste generated is expected to increase dramatically in the future, it is possible to create a system that introduces the 3Rs and heat recovery preferentially. Through effective resource utilization and efficient production activities, both the 3Rs and heat recovery can be incorporated in a manner that is consistent with economic development.

A sixth important point is that consideration should be given to developing a management framework. This is because even if policies, laws and regulations on industrial waste management are all in place, proper recycling and disposal cannot take place without a management framework. Because of the diversity of industrial wastes, it is difficult to dispose of them uniformly through services provided by the public sector. Once the standards for proper disposal are set, it will be critical to foster private businesses so that the ingenuity of the private sector can be fully utilized.

The importance of human resource development can be offered as a seventh critical point. Even though addressing the issue of industrial waste is a difficult but important matter, desirable disposal technologies, know-how and policies are not always organized systematically. Also, Japan arrived at its responses through the accumulation of various types of experience in response to numerous problems. Therefore, it will be desirable for academia, industry and the national and local governments to each establish an organization or department for handling the issue of industrial waste management and cultivating personnel who are well-versed in this field.

An eighth point is that it is possible that industrial waste problems may not be addressed in a timely way if the diverse processes of policy formulation and implementation, framework development, and human resource development are implemented while countries accumulate experience from scratch. Given this, there is a pressing need to implement these processes through international cooperation, thereby accelerating the process. The role for Japan and other developed countries is expected to be large. Japan has assisted developing countries based upon its experience through bilateral cooperation and also through the Regional 3R Forum in Asia, a strategic/knowledge platform launched in 2009 for sharing and disseminating best practices, policy instruments, tools and technologies.[4]

4 For further information on the Regional 3R Forum in Asia, see http://www.uncrd.or.jp/env/spc/regional_3r_forum.htm

2.1.5 CONCLUSION

In the context of many pressing environmental issues, it is difficult to take policy measures for the industrial waste issue. Although about 40 years have passed since the Waste Management Law was enacted, Japan has faced various problems and it has improved its policies through repeated revisions to its legal framework and other means. However, it can be expected that there is still plenty of room for Japan to develop its policies still further.

Meanwhile, the industrial waste issue in developing countries is quite serious, and it must be solved in less time than Japan required during its own journey. For that reason, it is necessary to build consensus among various stakeholders and work out effective policies. However, this consensus-building process often takes time. This is true in Japan as well.

Improper disposal of industrial wastes contributes to other environmental problems such as climate change and water contamination and wastes valuable resources. Conversely, the promotion of proper recycling and disposal of industrial wastes can create opportunities to solve both the industrial waste issue and other environmental or resource problems. The formulation of good policies will facilitate early consensus-building by stakeholders and early policy implementation. It is desirable to take an approach that also integrates other environmental or societal problems.

In light of the highly localized nature of waste issues, Japan's policies are not necessarily applicable to other countries. Nevertheless, Japan hopes that a study of its policies and experiences will assist other countries as they work to formulate and implement effective industrial waste policies in their journey to create a sustainable society.

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2.2 The Japanese industrial waste management industry

National Federation of Industrial Waste Management Associations

2.2.1 THE HISTORY OF THE JAPANESE INDUSTRIAL WASTE MANAGEMENT INDUSTRY

(1) Before the Waste Management Law

Japanese industrial waste management businesses began in 1971 when the Waste Management Law came into force (see **chapters 2** and **2.1** for outlines), because this law legally defined the category "industrial waste" for the first time. The law established the basic principle that business operators who generate industrial waste are responsible for the treatment of that waste, and therefore they are required to treat the waste themselves or outsource the treatment to licensed waste treatment businesses. In this way, the law clearly indicates that in principle, industrial waste should be treated as a private sector business activity.

Before the enactment of the Waste Management Law, waste-related legislation was grounded in the Public Cleansing Law. The "unsanitary matter" mentioned in the Public Cleansing Law included waste that is currently categorized as either "general waste" (municipal solid waste) or "industrial waste" as a single classification, but the basic scope of the law was, for practical purposes, the management of municipal solid waste. Municipal governments were responsible for the treatment of unsanitary matter and the basic principle was that municipal governments should provide "cleansing" (cleanup) services directly for citizens or use contractors to provide the services. Licensed businesses existed as supplemental cleansing service providers.

Therefore, each municipal government—the fundamental local governmental authority—was responsible for waste treatment in principle, rather than the entity that generated the waste. The Waste Management Law inherited the principle of municipal government responsibility for treating municipal solid waste. In the Public Cleansing Law era, unsanitary matter was treated in accordance with detailed standards with which both municipal governments and treatment businesses alike were obliged to comply. However, the scope of these standards was limited essentially to household waste and human waste generated by households. There were virtually no frameworks or standards for the treatment of waste generated in large quantities through business and industrial activities (the waste now classified as "industrial waste"). Therefore, the treatment of industrial waste was left essentially uncontrolled.

At the time, Japan was in the midst of its high economic growth period and various types of industrial waste were being generated in large quantities. In spite of this situation, industrial waste was left to private businesses specializing in "cleaning up" waste, rather than being treated by municipal cleaning services stipulated in the Public Cleansing Law. However, industrial waste is a negative asset, and with virtually no regulation or treatment standards, "cleaning services" only removed the waste from areas where daily activities took place or simply "got rid of it". No businesses conducted specialized treatment of industrial waste.

(2) After the Waste Management Law

The Waste Management Law established the principle that responsibility for the treatment of industrial waste lies with the business operators who generate the waste. Business operators generating industrial waste have the options of either treating the waste appropriately themselves or outsourcing the treatment to businesses specializing in industrial waste treatment. The law requires those in the treatment business to obtain a license from the relevant authority. The applicant's capacity to handle industrial waste is confirmed before the license is issued. The law also stipulates that treatment should comply with specific treatment standards for each type of industrial waste. This created for the first time an institutional framework for private businesses to provide treatment services through the market, in contrast to the handling of municipal solid waste, a service which the public sector provides.

The Japan Standard Industrial Classification published in 1972 had a "health and public cleaning business" category, with a "public cleaning business" sub-category and a "garbage disposal business" as a further sub-category under that. This indicates that services to treat industrial waste had not yet been recognized as an industrial sector. It was only in the 1976 version that industrial waste treatment services were included in the classification. This version had "health and waste disposal business" as a category, under which there appeared a sub-category of "industrial waste disposal business". Under that, there was a further breakdown into "industrial waste collection and transport" and "industrial waste disposal (other than collection and transport)". This demonstrates that industrial waste treatment businesses had become recognized as an industrial sector in government statistics. Currently, "industrial waste disposal business" is an independent category, signifying that industrial waste treatment businesses have become a more important industry in the waste sector.

Although the category of "industrial waste" was first defined in the Waste Management Law, which entered into force as the Public Cleansing Law was repealed, the government's administration of waste management initially tended to focus on municipal solid waste, largely as a carry-over from the days of the Public Cleansing Law. Another major reason for the emphasis on the treatment of municipal solid waste may have been that Japan was dealing with many important challenges concerning municipal solid waste at the time. There was a need to deal with pollution problems that had rapidly become the focus of public attention (such as the introduction of pollution mitigation equipment at municipal garbage incineration plants) as well as the new problem of hydrogen chloride released from garbage incineration plants. There were also difficulties in finding new sites for municipal waste treatment plants.

With regard to the industrial waste sector, as the Waste Management Law began to be implemented, various standards were also developed and consensus began to form concerning how the law should be interpreted. Support measures were introduced for industrial waste treatment businesses and for industrial waste treatment facilities. However, these were limited to government-backed financing and preferential tax measures for the development of facilities, and many of these measures were in fact aimed at mitigating pollution. It can therefore be said that these support measures were not designed to support the development of industrial waste treatment businesses *per se*.

The lack of measures for industrial waste management at the time is likely to be because government agencies still relied on the mindset that existed under the Public Cleansing Law, which focused on municipal solid waste, rather than because the government had deliberately decided to focus on municipal solid waste. In fact, the development of industrial waste treatment facilities through public-sector involvement was a major political issue at the time. The business community, as the generator of industrial waste, was also continually asking for public-sector involvement in the development of industrial waste treatment facilities. Despite these circumstances, emphasis appears to have been too heavily weighted towards establishing smooth and appropriate treatment systems for municipal solid waste.

In the case of municipal solid waste, which is treated by the public sector, many problems can likely be solved once the facilities for the appropriate treatment of the waste have been put in place. In contrast to this, treatment systems for industrial waste work only when private companies provide treatment services and receive compensation from their customers. Even if appropriate facilities are in place, a profitable treatment business cannot be established unless waste generating businesses choose treatment methods that make use of those facilities. That is to say, incentivizing the development of appropriate waste treatment facilities is important. However, such incentives lead nowhere unless they also facilitate the establishment of profitable businesses. Without the ability to confirm the feasibility of a line of business, most entrepreneurs would hesitate to invest in the development of related facilities. During the initial implementation stage of the Waste Management Law, government agencies did not seem to have fully grasped what private companies needed in order to establish profitable waste treatment businesses.

(3) The growth of the industrial waste management industry

The Waste Management Law established the basic institutional framework for the industrial waste management industry when it came into force in 1971. However, the system for operating industrial waste treatment businesses took some time to develop. When the Waste Management Law came into force, the two categories of "municipal solid waste" and "industrial waste" were created within the waste sector, with totally different waste treatment principles applied to the two categories. As mentioned above, municipal governments were responsible for municipal solid waste treatment, and treatment services were undertaken using public money in principle. For industrial waste, the business operators generating the waste were responsible for waste treatment, and treatment services were provided by the private sector in principle. While the principles underlying the treatment of municipal solid waste remained unchanged from the Public Cleansing Law era, industrial waste treatment was a totally new area to be considered. Both the public and the private sector individually began to develop systems that corresponded to the new institutional framework.

Industrial waste management was a new industry, and business operators from various existing industries entered the market. Relatively large numbers of businesses entered the market from industries already experienced at handling unsanitary matter, including from the municipal solid waste treatment industry, the construction industry, the resource collection industry and the freight industry.

Table 2-2-1 Changes in the number of licenses issued for industrial waste treatment businesses

	Collection and transport	Intermediate processing	Landfilling	Collection, transport and intermediate processing	Collection, transport and landfilling	Intermediate processing and landfilling	Collection, transport, intermediate processing and landfilling	Total
August 1973	1,709	35	60	142	254	11	70	2,281
March 1974	2,731	53	73	221	358	18	71	3,525
February 1976	9,113	122	101	548	626	28	144	10,682
May 1978	17,752	188	142	1,052	839	34	228	20,235
April 1979	20,526	232	169	1,209	873	34	238	23,281
April 1980	23,226	264	171	1,393	843	41	250	26,188
April 1982	28,012	353	228	1,701	1,069	30	286	31,679
April 1983	32,106	393	254	1,846	1,173	33	301	36,106
April 1984	36,150	420	275	1,971	1,238	36	327	40,417
April 1985	42,665	473	294	2,165	1,383	38	370	47,388

Source: Japan, MHW (1974-1986)

Organizational structures were also gradually developed within the relevant authorities. Licenses were issued for industrial waste treatment businesses under the new system. Education and training programmes were launched in 1974 for those who wished to be licensed as industrial waste treatment businesses. Those applying for a license as an industrial waste treatment business were in effect required to take courses on waste treatment legislation, industrial waste treatment technologies, standards for industrial waste treatment and other such matters.

The Annual Report on Health and Welfare[1] 1973 published by the Ministry of Health and Welfare states that there were 873 licensed industrial waste treatment businesses as of 1 December 1972, of which nearly 80 per cent only provided collection and transportation services. **Table 2-2-1** summarizes the changes in the number of licenses issued for industrial waste treatment businesses since then.

The table shows that a considerable number of new businesses obtained licenses. As the number of licensed businesses increased, licensed waste treatment businesses started to organize themselves into groups in order to attain recognition in society and to gain social status as experts on waste treatment. In 1978, the National Federation of Industrial Waste Management Associations was established as a voluntary association and it launched its activities to organize industrial waste treatment businesses nationwide. The federation became an incorporated association in 1985 after obtaining permission from the Minister for Health and Welfare. It is a national organization with prefectural organizations with industrial waste treatment businesses as members. At the time of its establishment, the federation covered 35 of Japan's 47 prefectures with a membership of 35 organizations (4 incorporated associations, 13 business cooperatives and

1 Waste management was under the remit of the Ministry of Health and Welfare until the January 2001 reorganization of Japan's ministries and agencies. As part of that reorganization, waste management came to be under the remit of the newly-formed Ministry of the Environment (previously the Environment Agency).

18 voluntary associations). By 1991, it became a truly nation-wide organization in the sense that it had members in all 47 prefectures. All the member organizations have become incorporated associations.

In this way, systems to implement industrial waste treatment had been established while industrial waste treatment businesses had increased in number and become organized into associations. However, in reality the quality of the industrial treatment businesses varied significantly. Some businesses made efforts to conduct appropriate treatment while others did not, and illegal dumping and inappropriate treatment were widespread. This reflected not only the low quality of some industrial treatment businesses, but also the low degree of awareness of the business operators generating the industrial waste concerning their responsibilities.

The standards applied at the time were considerably more lax than the current regulations. Differing interpretations of the standards also resulted in difficulties when trying to determine whether or not a business satisfied the standards. Adding to this was the fact that government monitoring was less rigorous than it is currently, allowing waste generating business operators and waste treatment businesses to choose cheaper options. The fact that waste is a negative asset was not accounted for within the legislation, nor was it factored into the way the legislation was implemented. The low level of awareness among waste generating business operators and waste treatment businesses about their responsibilities was perhaps a reflection of these insufficient regulations and their inadequate implementation.

Allowing illegal dumping to continue unchecked has negative impacts in two major senses. The first is that illegal dumping degrades the environment and threatens human health. The other is that it undermines the business environment for waste treatment companies conducting appropriate treatment. It negatively impacts the entire industrial waste management industry because illegal dumping destroys confidence in the industry. It also makes it impossible for businesses engaged in proper treatment to set profitable prices because businesses that inappropriately treat waste undermine market prices by setting prices lower than what is necessary to treat the waste properly. It is also possible that waste treatment businesses which unknowingly transact with companies that illegally dump waste could lose some business contracts with waste generators after the illegal dumping comes to light.

Outsourcing waste treatment is the trading of a negative asset. In normal transactions, money flows in the opposite direction from the flow of goods and services. However, in the case of waste treatment contracts, money flows in the same direction as the flow of goods (waste). Therefore, nothing is left in the hands of entity paying for the service. This tends to result in waste generators concentrating on the differences in the cost of treatment rather than the quality of the treatment services provided. Due to these characteristics, appropriate treatment levels cannot be maintained if quality control is left to private companies, unlike in typical business transactions. Both waste generating businesses and waste treatment businesses may find it more tempting to reduce costs than to treat the waste appropriately. In addition, under lax regulations, inappropriate treatment damages public goods including the natural environment and the living environment of nearby residents, while those who caused the

situation do not suffer any negative effects. Therefore, adequate control standards and appropriate enforcement of the standards are preconditions for appropriate waste treatment businesses to function.

(4) The tightening of regulations and revision of the law

After the Waste Management Law entered into force in 1971, it underwent revisions in 1976 and 1991 in order to meet the needs of the times. However, when large-scale illegal dumping incidents were revealed in various parts of Japan (see **Boxes 1** and **2**), it became clear that government agencies had not been able to control illegal dumping and deep concerns and distrust of the industrial waste treatment system immediately became widespread nationwide. It was in this context that the law underwent a major revision in 1997 in order to tighten regulations for industrial waste treatment in particular.

Under the 1997 revision, before establishing an industrial waste treatment facility such as a landfill site, an impact assessment on the living environment became compulsory and the assessment process began to require the opportunity for other stakeholders to voice their views. The conditions for obtaining a license became stricter and a waste manifest system became compulsory for all contracts for treating industrial waste. Alongside the revision of the law, various standards having their grounding in the law were also revised. It became necessary to obtain permission to construct any landfill, regardless of size. The standards became more detailed, and ambiguous standards were revised into numerical standards wherever possible to enable objective judgments. Measures to control dioxins, which had been the focal point of public attention at the time, were also included within the standards for incineration plants, and waste treatment

Box 1: Illegal dumping on the island of Teshima, Kagawa Prefecture

In November 1990, the police uncovered a case of illegal dumping of industrial waste on the island of Teshima (20 km in circumference, with a population of 1,300) in Kagawa Prefecture, as a result of a compulsory investigation on a charge of violation of the Waste Management Law. An industrial waste treatment business based on the island had accumulated about 622,000 m3 of industrial waste including shredder dust (such as waste plastics), waste oil and sludge since around 1983. The company brought a large volume of waste onto its business premises and repeatedly burned it in the open. The company called the shredder dust "valuables" and attempted to have it composted using earthworms in order to turn it into a soil improvement agent.

The company's business license for industrial waste treatment was revoked and an order to remove the industrial waste was issued. However, the company effectively discontinued its business and Teshima residents were left with an enormous quantity of industrial waste. The residents took the case to mediation and a mediation plan was agreed upon in June 2000. The plan was that the Kagawa Prefectural Government would conduct intermediate processing of the industrial waste, with the industrial waste to be neutralized by melting it down into slag.

Source: Kagawa (2003)

Box 2: Illegal dumping in the city of Iwaki, Fukushima Prefecture

In areas around an industrial waste treatment facility in the city of Iwaki in Fukushima Prefecture, a total of about 55,000 drums of waste oil had been brought in and kept since around 1985. After many years of exposure to the elements, the content dispersed or spilled as a result of damaged and corroded drums, and there was a concern that the spilled oil may impact on the local residents' living environment. The problem was caused by an industrial waste treatment business operator based in the city that signed a contract to treat large volumes of waste oil. The company stored the waste oil that it could not treat out in the open. Similar illegal dumping problems also occurred in other areas because the above-mentioned business outsourced the treatment of some of this waste oil to unlicensed businesses.

An order to restore the area to its original state was issued in June 1998, but it was confirmed that there was no prospect of the business operator in question carrying out the order. Therefore, the Fukushima Prefectural Government began executing the necessary restoration measures as a substitute for the company that caused the situation. These measures included the removal of the drums and the contaminated soil as well as the purification of contaminated water, at a total cost of 3.6 billion yen (approximately US$36 million).

Source: Fukushima (n.d.)

facilities that did not meet the criteria were forced to close down.

In addition to the revision of laws and regulations, there were changes in the attitudes of the local governments, which are responsible for implementing the laws and regulations. They began to enforce the laws and regulations more rigorously since it became clear that removing illegally dumped waste and contamination and restoring the living environment is costly for local governments that fail to prevent illegal dumping or other illegal acts. The attitudes of business operators generating waste also changed significantly and it became common practice for business operators to consider their contractors carefully based on the quality of their services. Thus a framework which facilitated appropriate competition among private companies was finally established for the industrial waste management industry.

Up to the end of the 1980s, the focus had been on treating waste appropriately, but recycling efforts began gaining momentum from the beginning of the 1990s. The revision of the Waste Management Law in 1991 added the restriction of waste discharge as a purpose of the law and "recycling" was added to the treatment methods. With recycling now being specified in the law, recycling laws for individual items came to be formulated one after another (see section **2.1.3 (4)** for an outline).

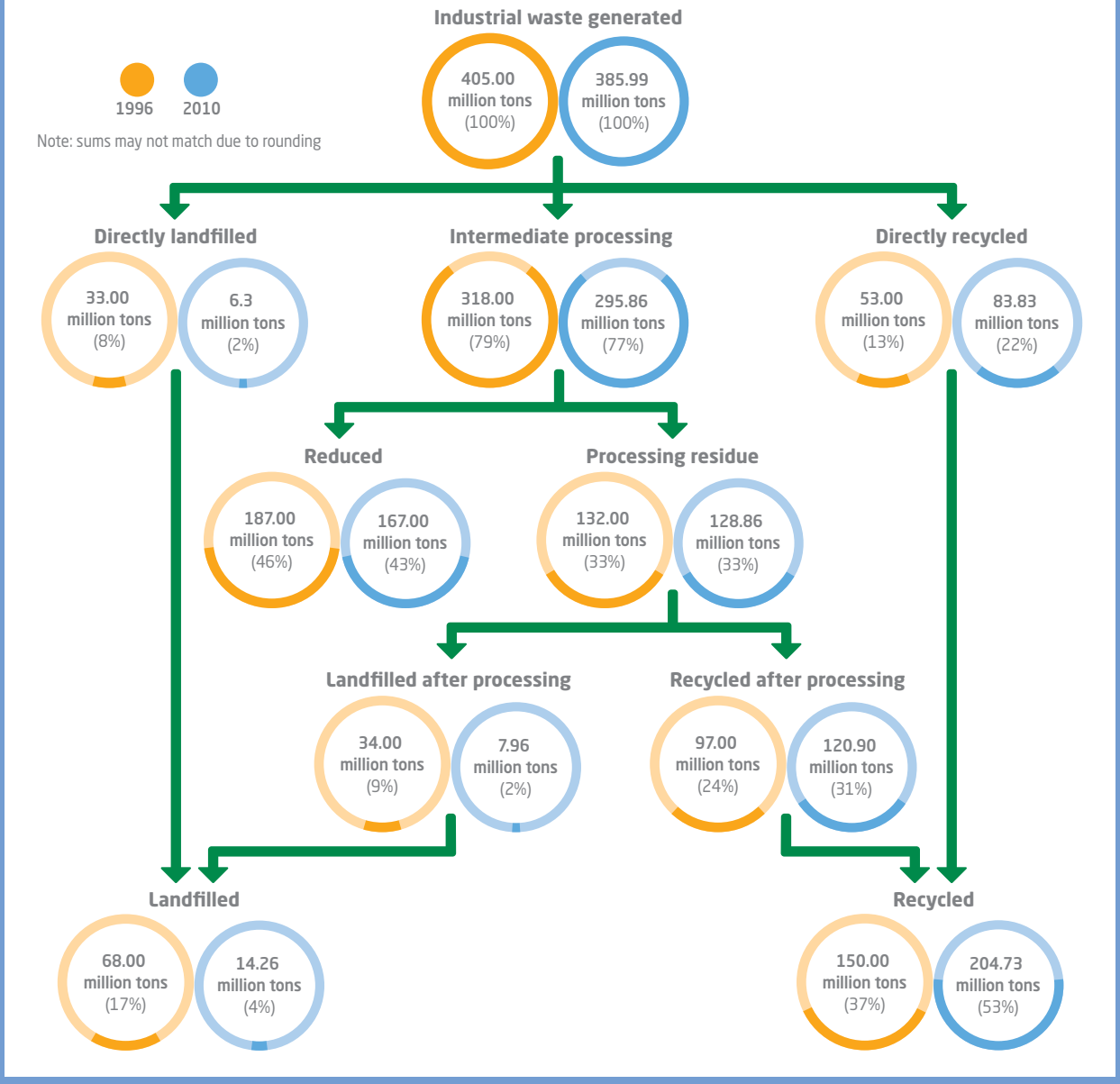
Although the main scope of many of these laws was municipal solid waste, the laws became the driving force for promoting the recycling of waste in general by creating a recycling trend in society. Compared to municipal solid waste, industrial waste is generated in large volumes at each emission source and the quality of the waste from each emission source is relatively homogeneous. Therefore, the recycling rate for industrial waste had been relatively high from the start. The recycling rate for industrial waste further increased as recycling became a social trend. In addition, the standards for the establishment of landfill sites were tightened in the revision of the Waste Management Law in 1997 and the diminishing space in landfill sites became a well-known problem. This further accelerated the recycling trend and reduced the amount of waste to be landfilled.

Figure 2-2-1 shows the estimated flow of industrial waste treatment nationwide in 1996 and 2010. There was no dramatic change in the total amount of waste generated between 1996 and 2010 (405 million tons in 1996 and 386 million tons in 2010).

By 2010, the amount of waste landfilled had been reduced dramatically to about one-fifth of the 1996 level, from 68 million tons in 1996 to about 14 million tons in 2010. The amount recycled increased by more than 30 per cent, from 150 million tons in 1996 to 200 million tons in 2010. This contributed to a reduction in the amount of waste landfilled. In 1996, 37 per cent of the industrial waste generated was already being recycled because much of industrial waste is easier to recycle than municipal solid waste. The recycling rate had further increased to 53 per cent by 2010.

The numbers in the above flowchart also indicate a major change in the intermediate processing trend. Some of the figures related to intermediate processing did not change significantly. The amount of waste that underwent intermediate processing was 310 million tons in 1996 and 300 million tons in 2010. The amount reduced by intermediate processing and the amount of processing residue also remained at

Figure 2-2-1 The estimated flow of industrial waste treatment nationwide in 1996 and 2010



Source: Based on Japan, MHW (1999); Japan, MOE (2012)

similar levels between 1996 and 2010. However, the recycling rate for processing residue increased significantly. A quarter of processing residue was landfilled in 1996 (34 million tons landfilled out of 132 million tons of processing residue), but only 6 per cent was landfilled in 2010 (7.96 million tons landfilled out of 128.86 million tons of processing residue) and 94 per cent was recycled. This indicates that intermediate processing methods had changed from processing for appropriate disposal to processing for recycling. The major changes occurring over this 14-year period are likely to be the results of concerted efforts to promote recycling that have been conducted by business operators generating waste, industrial waste treatment businesses and government agencies.

(5) Future challenges

While the framework for fair business competition has been established and recycling has progressed since industrial waste treatment began in Japan, there are still many challenges for the treatment of

industrial waste and for the industrial waste management industry.

Unfortunately, the problems of illegal dumping and the inappropriate treatment of waste still persist, although the number and the scale of such incidents have significantly decreased. Japan is approaching the limits of further regulation tightening, having already revised its laws and regulations repeatedly. Many collateral effects arising from regulations have also come to be felt by the industrial waste management industry. Therefore, further improvements should be made through raising awareness among waste generators, providing support to industrial waste treatment businesses of excellence and providing training in order to improve the quality of industrial waste treatment businesses and ensuring that government agencies enforce laws and regulations properly.

The fact that the implementation of laws related to industrial waste is left to each local government contributes to inefficient implementation of laws. The ways that the laws are implemented vary slightly among areas, and individual local governments have also established their own regulations. The ways that these regulations are implemented are not always transparent. In order to increase the recycling rate, it is necessary to collect large amounts of the same types of waste, and this generally requires the establishment of a regional recycling system.

The existence of different regulations in different areas could inhibit the establishment of a regional system. Therefore, benefits can be expected to arise through streamlining the rules now existing at different levels by identifying the minimum regulations needed at the local area level and the regulations that can be applied at the regional level, as well as by identifying unneeded regulations.

From the standpoint of businesses engaged in industrial waste treatment, undertaking a review of the waste management system found within the Waste Management Law—specifically, the classification of waste into "general waste" (municipal solid waste) and "industrial waste"—may also be a positive change that would promote appropriate treatment and recycling.

For these businesses, a major challenge will lie in maintaining or increasing the vitality of the industrial waste management industry even though the industries generating large volumes of industrial waste, such as the manufacturing industry and the construction industry, are expected to see little growth in Japan in the future.

2.2.2 CONCLUSION

Japan's industrial waste treatment system was launched in 1971. Within the system, private-sector business operators who generate industrial waste are responsible for treating the waste and private-sector waste treatment businesses treat most industrial waste through business competition. After about 40 years, although some inappropriate treatment cases have been seen, the system seems to have taken hold in Japanese society.

The most important thing in this sort of system is that appropriate regulations be formulated and properly implemented in order to ensure that the trading of waste, which is a negative asset, is viable as a profitable business. If regulations are unclear or enforcement is lax, waste generating businesses will try to outsource the treatment of the waste as cheaply as possible and contractors will try to reduce costs by providing inappropriate treatment.

This makes it impossible for the market to establish an appropriate price and businesses conducting appropriately rigorous and more costly treatment will not be profitable.

As an alternative to Japan's private sector-based system, it would also have been possible to have a system in which the government exclusively provided industrial waste treatment services, or in which the government granted licenses to specific companies that would then exclusively provide services in specific areas. However, such non-competitive methods would not have resulted in the diverse new methods of recycling or the improvement in the recycling rate that has in fact come about.

It is difficult to determine exactly what type of system is most suitable for rapidly industrializing countries. If the Japanese system in which private companies provide treatment services through competition is to be used as a model, it should be emphasized that clear, transparent and appropriate regulations should be formulated and implemented as the minimum and essential conditions for success. To ensure regulatory compliance, the government in each local area should establish administrative frameworks and secure adequate human resources. In addition, the technological infrastructure must be developed in order to enable appropriate treatment.

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2.3 Japanese industry's voluntary action plan on the environment

Keidanren (Japan Business Federation)

2.3.1 INTRODUCTION

Keidanren, also known as the Japan Business Federation[1], is an economic organization with a membership comprised of 1,300 leading Japanese companies, 121 national associations of manufacturing industries, service industries and other major industries and 47 regional economic organizations (as of July 2013). Keidanren's mission as a general economic organization is to draw upon the vitality of corporations, individuals and local communities in order to support corporate activities that contribute to the self-sustaining development of the Japanese economy and enhance the quality of life for the Japanese people. For this purpose, Keidanren builds consensus within the industrial community on a variety of important domestic and international issues and communicates with a wide range of stakeholders including political leaders, administrators, labour unions and citizens in order to achieve steady and prompt resolution of problems. Keidanren also strives to establish and maintain public confidence in the business community while working to resolve international issues and foster closer economic relations with various countries through policy dialogues with governments, the economic associations of various countries and international organizations.

In particular, Keidanren promotes efforts to solve environmental problems grounded in the view that solving environmental problems is a common challenge for humanity and that the resolution of such problems is essential for the existence of companies and for their activities. This section gives an outline of the Keidanren Voluntary Action Plan on the Environment, a voluntary effort by the business community to solve environmental problems.

2.3.2 KEIDANREN VOLUNTARY ACTION PLAN ON THE ENVIRONMENT

(1) Developing the plan

a. Formulating the Keidanren Global Environment Charter (1991)

Recent efforts by Keidanren to solve environmental problems are based on the Keidanren Global Environment Charter formulated in April 1991, which preceded the United Nations Conference on Environment and Development (UNCED), also known as the Earth Summit, held in June 1992. In the run-up to the Earth Summit when public awareness about global environmental issues was increasing both within Japan and overseas, this charter was compiled with the aim of expressing domestically and internationally the principles and specific guidelines for actions which Japanese industry should take to address environmental problems.

Japan found itself facing major waste management challenges at the time. Industrial waste was increasing in volume and becoming increasingly diverse even as space in landfill sites was decreasing. Documents compiled by the Environment Agency of Japan at that time estimated that Japan's landfills would be full after about

1 Prior to its 2002 amalgamation with Nikkeiren (Japan Federation of Employers' Associations), Keidanren was known in English as the Japan Federation of Economic Organizations.

two years. The commitment of all members of society would be needed to solve these problems at their core.

The charter outlined Keidanren's basic philosophy that working to solve environmental problems is essential to the existence of companies and to their activities. It also stated that Keidanren would promote companies' voluntary and proactive efforts to protect the environment. More specifically, it set 11 guidelines for the actions of companies as shown in **Figure 2-3-1** and adopted the position that companies should always follow the guidelines. For example, in item 3, "Concern for the environment", the charter stipulates that companies should "endeavor to use resources efficiently and reduce waste products through recycling". In item 7, "Public relations and education", it states that companies should "provide users with information on the appropriate use and disposal, including recycling, of their products".

Figure 2-3-1 Outline of the Keidanren Global Environment Charter

Basic philosophy

- In carrying on its activities, each company must maintain respect for human dignity, and strive toward a future society where the global environment is protected. Each company must recognize that grappling with environmental problems is essential to its own existence and its activities.

Guidelines for corporate action

1. The establishment and thorough implementation of general management policies

   Companies should always consult the guidelines below when carrying out their activities. They must work to protect the global environment and improve the local living environment, take care to protect ecosystems and conserve resources, ensure the environmental soundness of products and protect the health and safety of employees and citizens.
2. Development of the corporate organization
3. Concern for the environment

   Care shall be taken in the research, design, and development stages of making a product to lessen the possible burden on the environment at each stage of its production, distribution, appropriate use, and disposal.
4. Promoting technology development
5. Active technology transfers
6. Emergency measures
7. Public relations and education
8. Community relations
9. Environmental considerations for overseas operations
10. Contribution to public policies (the government, political parties, etc.)
11. Response to global problems

Ten-Point Environmental Guidelines for Japanese Enterprises Operating Abroad

(1) Establish a constructive attitude toward environmental protection.

(2) Abide by the environmental standards of the host country and make further environmental conservation efforts.

(3) Conduct an environmental assessment and also take measures based on an assessment conducted after the activities have started.

(4) Facilitate the transfer of environment-related technologies and know-how.

(5) Establish an environmental management system.

(6) Provide information on environmental measures.

(7) Deal with environment-related issues in an appropriate manner.

(8) Cooperate in the promotion of the host country's scientific and rational environmental measures.

(9) Actively publicize the activities of overseas businesses regarding environmental considerations.

(10) Ensure that head office understands the importance of environmental measures and establishes a support system.

Source: Keidanren (1991)

b. Formulating the Keidanren Voluntary Action Plan on the Environment (1997)

In 1991, Keidanren began surveying the waste management efforts taken by industry with the cooperation of 15 industries. It publishes the results of each survey. In order to put the principles of the Keidanren Global Environment Charter into action, in June 1997, Keidanren formulated the "Keidanren Voluntary Action Plan on the Environment (Section on Waste Disposal Measures)" with the cooperation of 36 industries. The scope has since then expanded to 41 industries and the section has been renamed the "Section on the Establishment of a Sound Material-Cycle Society". The plan encourages voluntary actions by industry towards the establishment of a sound material-cycle society, including the reduction of industrial waste. It also states that each industry should implement the PDCA (Plan, Do, Check, Act) cycle.

Keidanren also strongly promotes measures to mitigate climate change based on the Keidanren Voluntary Action Plan on the Environment (Section on Measures to Combat Global Warming) (see **Box 1**) and Keidanren's Commitment to a Low Carbon Society (see **Box 2**).

(2) Characteristics of the Keidanren Voluntary Action Plan on the Environment

The Keidanren Voluntary Action Plan on the Environment is characterized by the following three points:

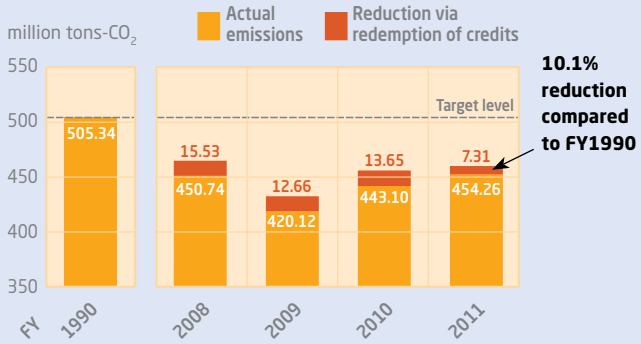
Firstly, the Plan is a voluntary instrument. Encouraging the voluntary efforts of industry is a very effective way of promoting environmental solutions because business operators, who best understand their operations, can formulate and take measures by comprehensively taking into consideration the trends in available

Box 1: Keidanren Voluntary Action Plan on the Environment (Section on Measures to Combat Global Warming)

(1) Keidanren formulated the Voluntary Action Plan on the Environment (Section on Measures to Combat Global Warming] in June 1997, before the Kyoto Protocol was adopted at COP3. Currently, companies and organizations from 61 business categories participate in the plan (the industrial and energy-conversion sectors account for 34 of these business categories).

(2) The uniform target for the industrial and energy-conversion sectors is to "strive to reduce the annual average amount of CO_2 emissions in the period between the 2008 and 2012 fiscal years to the 1990 fiscal year level or less".

Results from implementing the Voluntary Action Plan on the Environment



Factors that contributed to changes in CO_2 emissions from the industrial and energy-conversion sectors in the period between FY1990 and FY2011

	Comparison with FY1990
Change in amount of factory output	+1.1%
Change in CO_2 emission coefficient	+1.7%
Change in CO_2 emissions per unit of output	-13.0%
Total	-10.1%

Reductions in the CO_2 emissions per unit of output were the driving force for emissions reductions

Source: Keidanren (2012)

technologies, cost-benefit analysis results, and other relevant factors. This, as well as the fact that it does not require the government to bear any administrative costs, makes it possible for society as a whole to tackle environmental problems more efficiently than through regulatory instruments or economic instruments such as environmental taxes.

Secondly, the plan sets numerical targets. The reduction target for the amount of industrial waste to be landfilled was set as a target for industry as a whole. As shown in **Figure 2-3-2**, the targets have been revised twice because previously-set targets had already been achieved by industry. When individual industries have set their own targets in light of their business characteristics and other circumstances, those targets are also set as targets within the plan. Examples of this include a higher recycling rate for industrial waste, greater amounts of waste collected from other industries, or reductions in commercial municipal solid waste.

Thirdly, follow-up surveys for the plan are conducted every fiscal year and their results are disclosed to the public to demonstrate accountability to society. This also enables industry to review its activities periodically and improve efforts being made towards environmental solutions.

(3) Specific efforts by individual industries

As shown in **Table 2-3-1**, companies

Box 2: Implementation of Keidanren's Commitment to a Low Carbon Society

The time span for the Keidanren Voluntary Action Plan on the Environment (Section on Measures to Combat Global Warming) ended in fiscal 2012 when the first commitment period of the Kyoto Protocol (2008-2012) ended. However, Keidanren will continue its efforts from fiscal 2013 onwards and it is implementing a plan called Keidanren's Commitment to a Low Carbon Society, which contains four key pillars. As of August 2013, 39 business categories are participating in the plan and 8 more have expressed their intention to participate. The four key pillars are:

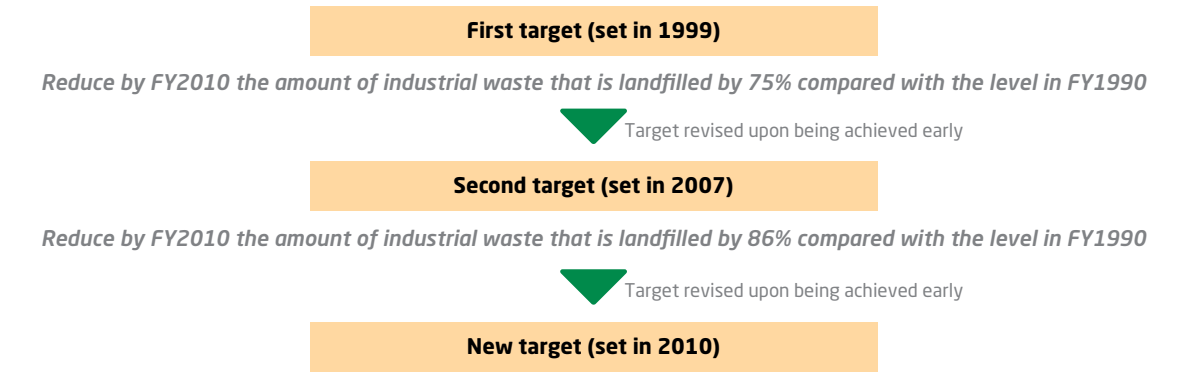
(1) The establishment of CO_2 reduction targets for domestic business operations for the year 2020;

(2) Strengthened cooperation with consumers, customers, and other interested groups (the reduction of CO_2 throughout product lifecycles);

(3) Contributions on the international level, including the promotion of technology transfers to developing countries; and

(4) The development of innovative technologies.

Figure 2-3-2 Targets for industry as a whole set out in the Keidanren Voluntary Action Plan on the Environment



Source: Keidanren

Table 2-3-1 Specific efforts within individual industries

- Thoroughly segregating waste
- Turning waste and by-products into products through technology development and through finding new uses
- Reducing waste volume through intermediate processing
- Maintaining or improving thermal power plant efficiency
- Recycling parts for manufacturing equipment, etc.
- Identifying recycling businesses with superior services
- Reducing the number of returned goods through strict demand management
- Accepting and utilizing waste from other industries
- Thermal recycling
- Developing and marketing products with environmentally conscious designs
- Recovering useful metals from post-consumer home appliances, etc.
- Reducing the amount of commercial municipal solid waste
- Composting food scraps
- Conducting recycling projects overseas
- Implementing the 3Rs in overseas factories
- Other efforts

Source: Keidanren (2013b)

also work to achieve industry-specific targets in addition to the target set for industry as a whole. Even if something is merely "waste" if left in its current form, companies are actively working to develop new technologies and find new uses in order to utilize that waste as a resource. One example of this is the cement industry accepting and utilizing waste generated by other industries into its operations.

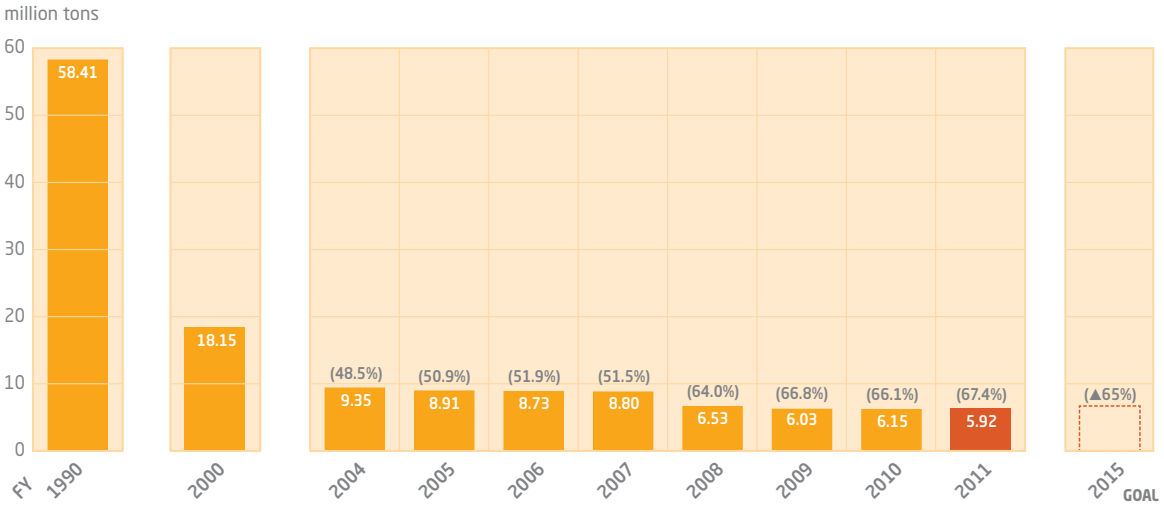
(4) Progress in the achievement of numerical targets

Through the industry-specific efforts outlined above, industry has been working to achieve the numerical targets set out in the Keidanren Voluntary Action Plan on the Environment. The progress is overviewed below.

a. Targets for industry as a whole (see **Figure 2-3-3**)

In fiscal 2011, the amount of industrial

Figure 2-3-3 The amount of industrial waste landfilled by industry as a whole



The numbers in brackets indicate the percentage reduction in the amount of industrial waste landfilled compared to the base year (FY2000).

Industries participating in the Keidanren Voluntary Action Plan on the Environment (Section on the Establishment of a Sound Material-Cycle Society) (41 industries): Power, gas, petroleum, iron and steel, nonferrous metal manufacturing, aluminum, copper and brass, electric wire, rubber, flat glass, cement, chemicals, pharmaceuticals, papermaking, electric and electronic equipment, industrial machinery, bearings, automobiles, auto parts, auto-bodies, industrial vehicles, rolling stock, shipbuilding, flour milling, sugar refining, dairy products, soft drinks, beer, construction, airlines, communications, printing (the 32 industries listed above are included in the calculation for the amount of industrial waste landfilled by industry as a whole), housing (the housing industry overlaps the construction industry and its waste is already included in the figures from the construction industry; therefore, the waste from the housing industry is not included in the calculation), real estate, machine tools, trade, department stores, railways, maritime transport, banks, general insurance.

The amount of landfilled industrial waste that is covered in the follow-up surveys by Keidanren account for about 40 per cent of the total amount of Japan's landfilled industrial waste, as calculated by the Ministry of the Environment (as of FY2010).

Source: Keidanren (2013b)

waste landfilled was about 5.92 million tons, in marked contrast to the roughly 58.41 million tons landfilled in fiscal 1990. Therefore, the amount of landfilled industrial waste was reduced to about one-tenth over approximately 20 years. This is a significant achievement for the Keidanren Voluntary Action Plan on the Environment, although the reduction from fiscal 2008 onwards has resulted partly from the economic slump and other factors. Through these efforts, the estimated number of years before landfill sites nationwide become full increased from about two years at the beginning of the 1990s to about 14 years recently, according to estimates released by the Ministry of the Environment.

With regard to Keidanren's new target, which is to reduce by fiscal 2015 the amount of industrial waste to be landfilled by about 65 per cent compared with the fiscal 2000 level, the amount for fiscal 2011 already showed a reduction of about 67.4 per cent compared to the amount that had been landfilled in the fiscal 2000 base year (about 18.15 million tons). The target has therefore already been surpassed.

b. Individual industries' own targets
(see Table 2-3-2)
Currently, 35 out of the 41 industries participating in the Keidanren Voluntary Action Plan on the Environment establish their own targets. Setting targets for individual industries helps to accelerate the speed at which a sound material-cycle society can take root. This is because individual industries have their own particular sets of circumstances, and the industries themselves are most adept at creating targets suitable for those circumstances. In addition, this arrangement makes it possible for the individual efforts of industries to be highlighted.

2.3.3 CONCLUSION

Japan is a country poor in natural resources. Japan needs to establish a sound material-cycle society as a strategy to ensure adequate resources. It will also serve as a strategy to resolve the issues of diminishing space in landfill sites for industrial waste and the need to treat waste appropriately. Therefore, industry will continue to promote the 3Rs (reduce, reuse, recycle), including working to reduce the amount of industrial waste to be landfilled.

In order to move further towards a sound material-cycle society, it is important for individual parties in society, including the national government, local governments, citizens and industry, each to play its part while also cooperating with other parties. Keidanren will continue to promote the 3Rs, provide information and conduct awareness-raising activities for consumers.

The Keidanren Voluntary Action Plan on the Environment can serve as a reference when industries in rapidly industrializing countries work to curb environmental problems. Keidanren actively cooperates with developing countries to the greatest possible extent by sharing its know-how on utilizing resources effectively and reducing industrial waste.

Table 2-3-2 Targets established by individual industries

Business category (organization name)	**Target indicators**	**Level of achievement as of FY2011**	**Target year (FY)**	**Target set**
Power (Federation of Electric Power Companies of Japan)	Recycling rate	97%	2015	Work to achieve about 95%.
Gas (Japan Gas Association)	(1) Amount of waste generated (2) Recycling rate for municipal solid waste (3) Amount of new soil brought in, as a per cent of expected amount of soil excavated	(1) 1,000 tons (2) 75.8% (3) 16.2%	2015	(1) Reduce to 1,000 tons or less (about 79% reduction from the FY2000 level). (2) Achieve 82% or more. (3) Reduce to 17%.
Petroleum (Petroleum Association of Japan)	Percentage of waste landfilled	0.4%	2015	Achieve a landfilled waste rate of 1% or less.
Iron and steel (Japan Iron and Steel Federation)	(1) Steel can recycling rate (2) Amount of waste plastic, etc. used	(1) 90.4% (2) 400,000 tons	(1)-(2) 2020	(1) Achieve 85% or more. (2) Use 1 million tons per year.* * Assumes preconditions such as legislation for further promoting the establishment of a sound material-cycle society and a material collection system are in place.
Aluminium (Japan Aluminium Association)	Aluminium dross recycling rate	99.8%	2015	Maintain 99% or above.
Copper and brass (Japan Copper and Brass Association)	Amount of waste landfilled per unit of production	9.0%	2015	Reduce by 8.4% or more from the FY1990 level.
Rubber (Japan Rubber Manufacturers Association)	Amount of waste landfilled per unit of production	60 tons/ 10,000 tons	2015	Strive to maintain 40 tons/10,000 tons or below.
Flat glass (Flat Glass Manufacturers Association of Japan)	Recycling rate	94.5%	2015	Achieve 95% or more.
Electric and electronic equipment (Four electric and electronic organizations)	Percentage of waste landfilled	1.0%	2015	Achieve 2% or less.
Industrial machinery (Japan Society of Industrial Machinery Manufacturers)	Recycling rate	90.6%	2015	Achieve 84% or more.
Bearings (Japan Bearing Industry Association)	Recycling rate	97.0%	2015	Strive to achieve 95%.
Automobiles (Japan Automobile Manufacturers Association, Inc.)	Recycling rate	99.9%	2015	Maintain 99% or above.
Auto parts (Japan Auto Parts Industries Association)	Recycling rate	86.1%	2015	Achieve 85% or more.
Auto-bodies (Japan Auto-Body Industries Association Inc.)	Coverage ratio of sales volume	98.2%	2015	Achieve 95% or more.

Table 2-3-2 Targets established by individual industries *continued*

Business category (organization name)	**Target indicators**	**Level of achievement as of FY2011**	**Target year (FY)**	**Target set**
Industrial vehicles (Japan Industrial Vehicles Association)	Recycling rate	99.6%	2015	Work to maintain 90% or above.
Rolling stock (Japan Association of Rolling Stock Industries)	Recycling rate	99.4%	2015	Achieve 99% or more.
Shipbuilding (Shipbuilders' Association of Japan)	Recycling rate	88.0%	2015	Achieve about 86%.
Flour milling (Flour Millers Association of Japan)	Recycling rate	94.3%	2015	Achieve 90% or more.
Sugar refining (Japan Sugar Refiners' Association)	Recycling rate	90.9%	2015	Achieve 90% or more.
Dairy products (Japan Dairy Industry Association)	Recycling rate	95.8%	2015	Achieve 96% or more.
Soft drinks (Japan Soft Drink Association)	Recycling rate	99.1%	2015	Maintain 99% or above.
Beer (Brewers Association of Japan)	Recycling rate	100%	2015	Maintain 100%.
Construction (Japan Federation of Construction Contractors)	(1) Recycling rate for construction sludge (2) Amount of mixed waste generated through construction work	(1) 93.7% (estimated) (2) 1.62 million tons (estimated)	2015	(1) Achieve 85%. (2) Reduce to 1.75 million tons or less (reduce by 64% compared to the FY2000 level).
Airlines (Scheduled Airlines Association of Japan)	Percentage of waste landfilled	4.5%	2015	Aim to achieve 3.6% or less.
Communications (NTT Group)	(1) Percentage of waste landfilled for all types of waste (2) Percentage of communications equipment waste that is landfilled	(1) 1.8% (2) 0.04%	2020	(1) Achieve 2% or less. (2) Continue zero emissions (1% or less).
Printing (Japan Federation of Printing Industries)	Recycling rate	96.6%	2015	Maintain 90% or more.
Housing (Japan Federation of Housing Organizations)	Recycling rate	86.1%	2015	Achieve 90.4% (96% for concrete, 70% for timber, 92% for iron).
Real estate (Real Estate Companies Association of Japan)	Recycling rate	Paper: 82.6% Glass bottles and jars: 99.4% Cans: 99.8%	2015	(1) Aim to achieve 85% for paper. Work to maintain 100% for glass bottles and jars, cans and PET bottles. (2) Increase the percentage of recycled paper purchased. (3) Increase the percentage of green procurement.

Table 2-3-2 Targets established by individual industries *continued*

Business category (organization name)	**Target indicators**	**Level of achievement as of FY2011**	**Target year (FY)**	**Target set**
Machine tools (Japan Machine Tool Builders' Association)	Recycling rates for the main types of waste	Paper: 77.9% Lubricants and cutting oil: 83.4% Iron: 97.8% Copper: 95.0% Aluminium: 96.6%	2010	Reduce the non-recycling rate by 10% from the FY1997 level. Achieve the following recycling rates: 32.7% for paper, 33.7% for lubricants and cutting oil, 86.7% for iron, 83.1% for copper and 86.6% for aluminium.
Trade (Japan Foreign Trade Council, Inc.)	(1) Amount of commercial municipal solid waste disposed of (2) Recycling rate for commercial municipal solid waste	(1) 1,150 tons (2) 80%	2015	(1) Reduce by 67% from the FY2000 level (reduce to 1,128 tons or less). (2) Achieve 80%.
Department stores (Japan Department Stores Association)	(1) Percentage of waste landfilled out of the waste generated at shops (per 1 m^2) (2) Amount of paper containers and packaging (wrapping paper, paper tote bags, paper bags and cartons) used per unit of sales (3) Amount of plastic containers and packaging used (4) Rate of recycling, etc. for commercial food waste generated at shops	(1) 39.6% (2) 40.7%	(1) 2020 (2) 2020 (4) 2012	(1) Aim for 50% reduction from the FY2000 level. (2) Aim for 45% reduction from the FY2000 level. (3) Minimize. (4) Achieve 45%.
Railways (East Japan Railway Company Group)	(1) Recycling rate for waste collected from stations and trains (2) Recycling rate for waste generated at general rolling stock centres, etc. (3) Recycling rate for waste generated through equipment installation	(1) 93% (2) 95% (3) 95%	2013	(1) 90% (2) 95% (3) 95%
Maritime transport (Japanese Shipowners' Association)	-	-	-	Continue to conduct appropriate waste disposal in accordance with international standards and work to control the generation of waste.
Banks (Japanese Bankers Association)	Percentage of recycled or environmentally friendly paper purchased	69.9%	2015	Achieve 75% or more.
General insurance (General Insurance Association of Japan)	(1) Amount of waste landfilled and the recycling rate for commercial municipal solid waste (2) Percentage of environmentally friendly products used (3) Amount of photocopy and printer paper used (4) Utilization of recycled auto parts	-	-	Each insurance company should develop improvement systems and work to improve each indicator through its business operations.

Source: Keidanren (2013b)

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2.4 Osaka City's experience and initiatives

2.4.1 OVERVIEW OF OSAKA CITY

Location: See **Figure 2-4-1**.

Population: 2,683,417 (as of August 1, 2013)

Gross municipal product: About 19.65 trillion yen (approximately US$196.5 billion) (FY 2009)

Key industries: Wholesaling, retailing, and services. Wholesaling and retailing account for 30% of its economy.

Sources: Osaka City (2013a), Osaka City (2013b), Osaka City Economic Bureau (2013).

Figure 2-4-1

2.4.2 HISTORY OF WASTE MEASURES IN OSAKA CITY

Beginning in the early Meiji period (1868-1912), Osaka City maintained a cleaning system under which firefighting organizations undertook waste disposal on a contract basis, but in 1889, it placed cleaning services under its direct control.

In the early 19th century, waste was disposed of by returning it to agricultural land or dumping it on reclaimed land or into the sea. But in 1900, because of various problems such as the outbreak of contagious diseases, decreasing amounts of reclaimed land, and the floating of waste on the sea surface, the city government started research into reasonable waste disposal methods and built an incinerator in Nezumijima, a small island located within the city, on a trial basis for experiments. At that time, the amount of waste generated annually was about 110,000 tons, or about 350 grams of garbage discarded per person per day. Later, population growth increased the amount of waste generated, so the government built a large incinerator and began waste disposal through incineration. In 1919, it gathered information on waste disposal in Western countries and conducted research on sorted collection, the use of waste for fertilizers and fuel, and power generation through the incineration of waste. By 1934, the city was capable of burning up to 800 tons of waste daily, but the amount of waste generated exceeded the city's capabilities. Later, with no additional incinerators constructed, the government made all-out efforts to sort out waste when collecting it and made efforts to reuse the waste collected.

After World War II, the city government resumed waste collection in 1946. However, the incineration plants had been heavily damaged during the war, so the waste collected was landfilled in areas that had become sunken hollows as a result of damage during the war. In 1948, incineration plants began to be restored, with the plants gradually recovering their functions by 1957. This enabled part of the collected waste to be incinerated. However, the amount of waste generated continued to increase each year, making it difficult to secure tracts of land that could be used for landfills. In 1959, pressed by the need to reinforce its incineration capabilities, the city government built an incineration plant (a batch-type

furnace[1]) with four times the treatment capacity of the previous plants.

Smoke from chimneys had also become a serious issue for the city government to address. As a result there were urgent calls for other incineration plants built to actively include pollution countermeasures. In 1956, the government started to consider introducing an L. de Roll furnace[2]—the latest model in Europe—from Switzerland, and completed its construction in 1965.

2.4.3 OSAKA CITY'S INITIATIVES FOR COMMERCIAL MUNICIPAL SOLID WASTE

In 1970, the Waste Management Law was established to require business operators to take responsibility for disposing of industrial waste generated from their business activities, but particular types of business waste such as paper scraps and wood chips were considered commercial municipal solid waste and disposed of in the city's disposal facilities (as outlined in **2.1.3 (2) c.**).

After the 1970s, the amount of waste needing disposal continued to grow significantly, reflecting citizens' brisk consumption and companies' lively business activities. In fiscal 1991, the amount of waste requiring disposal reached 2.176 million tons, a record high. As part of its measures for increasing commercial municipal solid waste disposal capabilities, the city government had concentrated its efforts on developing facilities, such as constructing incineration plants, but as the lack of capacity at incineration plants and landfills had become critically serious, the top priority issue to be addressed became how to promote measures to reduce the amount of waste generated.

One regional characteristic of Osaka City was that the number of business sites, the number of business sites per unit of population, and the daytime population (the rate of rise in the daytime population) were all the highest among the ordinance-designated cities[3] in Japan and as a result, commercial municipal solid waste accounted for about 60 per cent of the total disposal amount for the city, far exceeding the national average of about 40 per cent. Reducing commercial municipal solid waste was therefore a major issue to be addressed in improving the city's waste administration. In particular, after 1985, as copiers and personal computers spread because of office automation, wastepaper from offices increased rapidly, exceeding 40 per cent of total waste disposal volume.

Therefore, the city government set up an Osaka waste reduction council to rouse the interest of citizens and private enterprises in waste problems and encourage citizens, businesses, and administrative agencies to work together and rack their brains to reduce waste in the city. In 1993, it proposed initiatives for offices to implement to reduce scrap paper.

In addition, the city worked to provide guidance in reducing business waste to business operators discharging large amounts of commercial municipal solid waste such as office wastepaper. In 1993, the government revised the Osaka City Ordinance Concerning Promotion of Waste Reduction, Appropriate Disposal of Waste, and Maintenance of Clean Living Environments. This ordinance requiring the owners and administrators of buildings of a certain size or larger to appoint waste managers and submit a plan for promoting waste reduction. The city

1 A heat-treatment furnace
2 A mechanical furnace with a continuous feed

3 A city with a population greater than 500,000 that has been designated by government ordinance. Such cities perform many of the administrative functions normally performed by prefectural governments. Also known as "designated cities" or "government ordinance cities".

also began providing on-site guidance and giving advice and consultation on how to promote waste reduction. Initially, such guidance was provided to offices, stores and other structures with a total floor area of 3,000 m^2 or more, but the range of guidance given was expanded later, and today, it includes buildings with offices having a total floor area of 1,000 m^2 and those with manufacturing plants and warehouses having a total floor area of 3,000 m^2. While the city government provides business operators with guidance in waste reduction, it has established a system to officially commend the owners and administrators of buildings with excellent performance in initiatives for waste reduction and appropriate disposal. In this way, the city encourages business operators to undertake efforts for waste reduction.

As a result of these initiatives, the amount of commercial municipal solid waste for disposal was reduced to about 690,000 tons in fiscal 2011 from its peak of approximately 1.3 million tons in fiscal 1991.

2.4.4 DISPOSAL OF INDUSTRIAL WASTE

(1) From pollution control measures to industrial waste disposal measures

Osaka City's response to industrial waste started with countermeasures against environmental pollution. After the Meiji period (1868-1912), the city saw commerce and industry develop dramatically, playing a role in the modernization of the country. However, the economic development was underpinned by the use of large amounts of groundwater and fuel such as coal, and its negative aspects such as land subsidence and air pollution became major problems. The smoke problem with spinning mills led to the introduction of an Osaka Prefectural ordinance to regulate the construction of plants emitting smoke and rules to control manufacturing sites, and in subsequent years, various initiatives were carried out to take countermeasures against environmental pollution.

After the post-war reconstruction, Osaka City started to achieve rapid economic growth around 1955. At the same time, lively industrial production brought air pollution, water contamination and increased waste along with it, posing serious environmental problems. The city government took measures to cope with pollution issues, but in those days, industrial pollution was typically air pollution and water contamination, and the measures taken to cope with these problems gave rise to new problems.

The installation of dust collectors as a measure to tackle air pollution and also wastewater treatment equipment as a measure to prevent water contamination caused business operators to become stumped regarding how to dispose of the dust, soot and particulate matter that had been within the smoke and captured by the collectors and the sludge resulting from the treatment of wastewater. These residual substances were not accepted by the municipal cleaning bureau's waste treatment plants, and there was no established method of disposing of them. They consequently filled factories, affecting their continuous operation. Working out countermeasures against them became an urgent issue, because failure to dispose of them appropriately would cause secondary pollution, but no existing law had any provisions for their disposal, making it a prickly question to consider a counterplan for disposal.

In 1967, before the establishment of the Waste Management Law, Osaka Prefecture and Osaka City worked together to set up a liaison meeting to discuss a wide range of measures for pollution administration. As

a result, the two governments decided to separate waste generated in the course of industrial activities from "general waste" (municipal solid waste) as stipulated in the Public Cleansing Law in effect at the time. The former was labelled "industrial waste" and its appropriate disposal came to be handled as part of their measures to cope with environmental pollution.

In order to push forward measures for appropriate disposal of industrial waste, it was necessary first to grasp the amount of industrial waste generated and related data. The city government conducted its first survey of industrial waste in 1968. The city government came to realize that some of the dust, soot and particulate matter caught by dust collectors contained iron and valuable metals such as zinc. Therefore, industrial waste, a byproduct of production activities, held the potential to be a valuable resource that could be recycled, even though it was useless to the factories that discharged it. In fact, the collected dust, soot and particulate matter were mixed and kneaded using a mixer and turned into pellets of waste. Nearby casters purchased these as items of value, thereby providing a precedent for resource recycling. Meanwhile, the city government carried out a survey of businesses in the city to find what they thought of public involvement in the disposal of industrial waste, and the results of the survey indicated that many of the businesses wanted the city government to dispose of all industrial waste together and that the feasibility of disposing of industrial waste through business to business cooperation was extremely low.

(2) Establishment of Osaka Industrial Waste Disposal Corporation

In the Waste Management Law enacted in 1970, the national government stated expressly that the responsibility for disposing of industrial waste lies with the business operators that generate it. This legislation therefore anticipated the Polluter Pays Principle (PPP), which was put forward in the OECD's 1972 Recommendation on Guiding Principles Concerning International Economic Aspects of Environmental Policies. However, Osaka City had a considerable number of small and medium enterprises in its small area. Thus, leaving the disposal of industrial waste to individual business operators in accordance with the principle of "polluters' responsibility" might detract from a favorable living environment, and the city government decided that public involvement, particularly in securing final disposal sites, was necessary from a long-term perspective.

In this way, the government determined that unless it used a system in which a public corporation disposed of industrial waste with the cooperation of businesses, as a practical matter, the feasibility of disposal was low. Thus, it examined providing industrial waste disposal service through public involvement. In February 1971, in order to ensure appropriate disposal of industrial waste, maintain a comfortable living environment, and contribute to the maintenance and facilitation of urban functions, Osaka City worked with Osaka Prefecture to found the Osaka Industrial Waste Disposal Corporation, after which it developed landfills and intermediate treatment facilities for industrial waste. Specifically, it implemented the projects described below, which were difficult for private enterprises to implement on their own in those days.

[1] Coastal reclamation using industrial waste

Earth from construction sites, debris, harmless sludge, dust, cinders and other types of industrial waste were buried in the Sakai 7-3 area

[2] Intermediate treatment of industrial waste
Incineration of waste oil, oil sediments and organic sludge as a way of intermediate treatment prior to coastal reclamation in the Sakai 7-3 area

[3] Other projects
Received dredged earth and sand, as well as earth and sand generated in the course of Osaka City's public works concerning reclaimed land in the city's port and harbor area

The Osakafu Mekki Industrial Association, a union of platers, and other organizations in the city strongly urged the city government to build waste disposal facilities. The government obtained a project site and dispatched personnel. It built the Clean Osaka Center, a facility that rendered waste harmless and disposed of it through concrete solidification, and launched operations. Thus, this Center provided the service of rendering hazardous sludge, slag, dust, and cinders harmless and disposed of them.

In this way, through public involvement, Osaka City developed final disposal sites and intermediate treatment facilities for industrial waste earlier than any other municipality in the country, thereby playing a major role in preventing inappropriate disposal such as large-scale illegal dumping of industrial waste, which would constitute a serious obstacle to the maintenance of a comfortable living environment.

Subsequently, while various laws were enacted to ensure appropriate disposal of industrial waste, the private sector made progress in developing industrial waste disposal facilities on its own. For this reason, Osaka Industrial Waste Disposal Corporation, which determined that it had fulfilled its original mission, dissolved itself at the end of March 2006, terminating its industrial waste treatment and disposal services.

When it closed the Clean Osaka Center, the Corporation gathered and organized information on disposers, both in Osaka Prefecture and in neighboring prefectures, that were capable of disposing of hazardous sludge and other types of industrial waste. This is because it was necessary to guide its clients to private industrial waste disposers. It then provided such information to the Osakafu Mekki Industrial Association and other organizations and gave them advice on how to gather and transport industrial waste efficiently in order to reduce disposal costs. Thus, the Corporation tried to take carefully thought-out measures in order to ensure a smooth transition.

(3) Initiatives for ensuring early and appropriate disposal of waste PCBs

Because of its characteristics that include incombustibility, a high degree of electrical insulation and thermal stability, polychlorinated biphenyls (PCBs) used to be used in a wide range of applications such as thermal media and insulating oil for transformers and condensers. In Japan, however, the Kanemi rice bran oil disease incident (see **Box 1**) led to the discontinuation of PCB use in 1972, and the national government required its users to store them appropriately. By 1974, their import, manufacture, and use had been prohibited. On the other hand, the revised Waste Management Law, which came into force in 1976, allowed holders of PCBs to dispose of them through high-temperature incineration, and a portion of the waste PCBs and similar substances was incinerated at high temperatures from 1987 to 1989. Later, however, waste PCBs were left untreated, because the general

public failed to reach an agreement on whether they should be disposed of through incineration, and business operators holding waste PCBs were obliged to keep them for about 30 years. Since they were kept for long periods, it was confirmed on a nationwide scale that some waste PCBs were unable to be accounted for, and there arose grave concern about growing environmental risks such as air pollution and soil and river contamination. Under these circumstances, the revised Waste Management Law of 1997 authorized a new method of disposing of PCBs using chemical degradation.

There was a great quantity of waste PCBs in Osaka City, because about one-fourth of waste PCBs in the six prefectures of the Kinki region[4] in PCB oil equivalent was stored there. The Osaka City Office, a large storer of waste PCBs, kept about half of the waste PCBs present in the city. Since modern industry developed in Osaka from early on, waste PCBs kept in the city are often found in transformers and condensers used in factories, fluorescent lamps and stabilizers from office buildings and factories, as well as large transformers employed for railway and other services (see **Table 2-4-1**).

Disposing of waste PCBs in Osaka early and appropriately was an urgent issue to be addressed by the city, which was aiming to become an environmentally advanced city. The city government aimed to complete the disposal of all waste PCBs there by 2007, in part because it had made a bid to host the Olympic Games in 2008. Therefore, in 2000, it established a committee to examine the appropriate disposal of its PCBs.

Box 1: Kanemi rice bran oil disease incident

In 1968, in western Japan, particularly in and around the city of Kitakyushu, a rapidly increasing number of people complained about various symptoms such as serious rashes and purulent swellings, deformed or discolored nails, large amounts of eye mucus, paralysis of the hands and feet, and the tendency to become easily tired.

This incident occurred because PCBs and other hazardous substances used as thermal media during deodorization within the rice bran oil production process had leaked through holes in eroded piping to contaminate rice bran oil produced by the Kanemi Company in Kyushu. People using this oil for cooking suffered from acute poisoning and developed these symptoms. Some 14,000 people reported harm to their health, with just over 1,900 of them becoming certified as victims in the Kanemi rice bran oil disease incident.

Source: Japan, Environment Agency (1972); City of Goto (n.d.)

Table 2-4-1 Storage of Waste PCBs (as of March 1999)

	Number of business sites storing waste PCBs	Quantities of devices containing PCBs
Electric equipment	1,927	
High-voltage condensers		7,313 units
High-voltage transformers		760 units
Other high-voltage equipment		758 units
Low-voltage equipment	8	About 220,000 units
Waste pressure-sensitive copy paper	8	About 171 tons

Source: Osaka City

Initially, the discussions at the committee covered only waste PCBs in Osaka City, but the national government enacted the new Law Concerning Special Measures for Promotion of Proper Treatment of PCB Wastes (PCB Special Measures Law), which came into force in July 2001, and this prompted moves to promote wide-area disposal at key bases of operation and develop disposal facilities via the Japan Environment Corporation. The city government decided to cooperate with the national government in locating these key

4 The Kinki region is in west-central Honshu and is comprised of Osaka, Kyoto, Hyogo, Nara, Wakayama, and Shiga prefectures.

wide-area disposal facilities in the city (such as the dispatch of personnel to the Japan Environment Corporation and the provision of information related to the selection of a project site) on the assumption that these facilities would dispose of the city's waste PCBs first (see **Box 2**). It also decided to use this wide-area disposal scheme using key bases to ensure early and appropriate disposal of waste PCBs in the city (Osaka City's basic waste PCB disposal plan of June 2001).

After Osaka City's basic plan was publicly announced, some people around the site where disposal facilities were planned to be built voiced their opposition to the construction plan, but starting from the phase of site selection, the city, the national government and the corporation worked together to explain the plan to various local organizations such as district associations carefully and persistently at important points such as the announcement of the basic designs of the facilities and the implementation of environmental assessments.

2.4.5 SUMMARY

Japan has long taken the stance that waste should be disposed of by the public sector in order to ensure public health. Against this background, local governments have incinerated waste and sent incinerated waste to landfills in a sanitary way. However, rapid economic development was accompanied by an increasing volume and diversity of waste, making it impossible for local governments to dispose of it in the same way as before.

The Waste Management Law enacted in 1970 was groundbreaking. It clarified that the responsibility for the disposal of waste generated through business activities lies with the businesses that generate the waste. This legislation precisely met the demand of the times when industrial pollution was a major societal issue.

At first, immediately after the law came into force, however, there were not sufficient industrial waste disposal facilities run by private enterprises, and in addition, the system allowed businesses to outsource the disposal

Box 2: Regional wide-area facilities that dispose of waste PCBs in Osaka City

Project name: Osaka Waste PCB Disposal Service
Project promoter: Japan Environmental Safety Corporation (JESCO) (which took over the project from the Japan Environment Corporation)
Location of the disposal facilities: Konohana Ward, Osaka City (waterfront area)
Items disposed of: High-voltage transformers, high-voltage condensers, waste PCBs, etc. (Excluding fluorescent lamp stabilizers and contaminated items such as waste cloth)
Areas covered: The six prefectures of the Kinki region (Osaka, Kyoto, Hyogo, Nara, Wakayama), in which Osaka City is located

Method of disposal: Chemical degradation
Completion of the project: March 2016

Around March 2002: Select a project site
Within fiscal 2003: Conduct environmental fact-finding surveys
January 2005: Start construction work
March 2006: Start trial operation
October 2006: Start full-scale operation
The facilities started by disposing of waste PCBs in Osaka City and they are still in operation even today.

Table 2-4-2 Disposal of Waste PCBs in Osaka City (as of March 2013)

Types of items disposed of	Disposal amount	Progress rate
High-voltage transformers	994 units	76%
High-voltage condensers	10,820 units	87%
Waste PCBs, etc.	392 drums	80%

Source: Osaka City (2013)

of industrial waste to external disposers, even though the entities that generated the industrial waste retained primarily responsibility for its disposal. Some businesses did not pay attention to how their industrial waste was actually disposed of once it was consigned to external disposers, allowing inappropriate disposal to become widespread. Some industrial waste disposal companies, for example, contracted for waste disposal at prices lower than the actual cost of appropriate disposal and simply burned it in fields or dumped it illegally.

In the early stages after the legislation, partly because the private sector did not make much progress in developing disposal facilities, and partly because hazardous industrial waste was disposed of inappropriately, imparting serious effects on the environment, the public sector had to involve itself in the development of model industrial waste disposal facilities in order to ensure the safe and reliable disposal of industrial waste.

There have been several cases that required public involvement in waste disposal. One example was that the Osaka City government took leadership in developing facilities to dispose of hazardous sludge and other types of industrial waste after rendering them harmless. Another is recent projects such as waste PCB disposal, for which the national government had to take responsibility for implementation; holders of waste PCBs were forced to keep them for more than 30 years, as business operators did not make progress in developing disposal facilities because it was extremely difficult to do so on their own.

While public involvement plays an important part in waste disposal, if public involvement continues for a long time, it fails to give private enterprises an incentive for initiatives to prevent or reduce the generation of industrial waste. Therefore, it is necessary to set the conditions in advance for public organizations to withdraw from waste disposal projects. When they withdraw from such projects, it is important to take carefully thought-out measures. Such measures would include giving appropriate guidance to dischargers at an appropriate timing to ensure a smooth transition to disposal by private industrial waste disposers.

In Japan, both the national and local governments have recently discontinued or reviewed various public works in an effort to put their finances on a sound footing. However, when they consider whether they should enter or withdraw from industrial waste disposal service, important factors to consider include not only economic viability but also the public interest, such as protecting local environments and preventing inappropriate disposal. It is necessary to work out comprehensive measures to cope with industrial waste, including methods of regulation and guidance.

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2.5 Kitakyushu's experience and initiatives

2.5.1 OVERVIEW OF KITAKYUSHU

Location: See **Figure 2-5-1**.

Population: 968,544 (as of August 1, 2013)

Gross municipal product: Approximately 3.43 trillion yen (approximately US$34.3 billion) (FY 2010)

Key industries: Services, manufacturing (iron and steel, general machinery and tools, metal products, and chemicals)

Sources: City of Kitakyushu (2013a, 2013b).

Figure 2-5-1

2.5.2 OVERCOMING ENVIRONMENTAL POLLUTION

Kitakyushu has developed as an industrial city while supporting the economic growth of Japan. At the same time, the city experienced air pollution and other types of serious environmental pollution. It was widely known that Kitakyushu suffered from the largest amount of dust, soot and particulate matter falling anywhere in Japan. Its water contamination was so severe that even coliform bacteria[1] were unable to grow in the sea. However, through the efforts of its citizens and other parties concerned, the city regained its blue sky from what had been known as the "smoke of seven colors", and it restored a blue sea, vibrant with life, from what had been called the "sea of death". Kitakyushu overcame its environmental pollution so successfully that it was even praised around the world as transforming "from a gray city to a green city" (OECD, 1985). It was through the tireless efforts of a great many people that made today's Kitakyushu possible.

Kitakyushu suffered from severe environmental pollution as its industries developed. The first to rise up against environmental problems were its ordinary citizens. A group of women called the Tobata Women's Association had realized through their daily lives that the environment was being degraded, because their laundry had become terribly dirty. This Women's Association undertook investigations on its own initiative while receiving guidance from university professors. Based on the results of its investigations, the Association asked the city hall (the local government) to take measures to address environmental pollution.

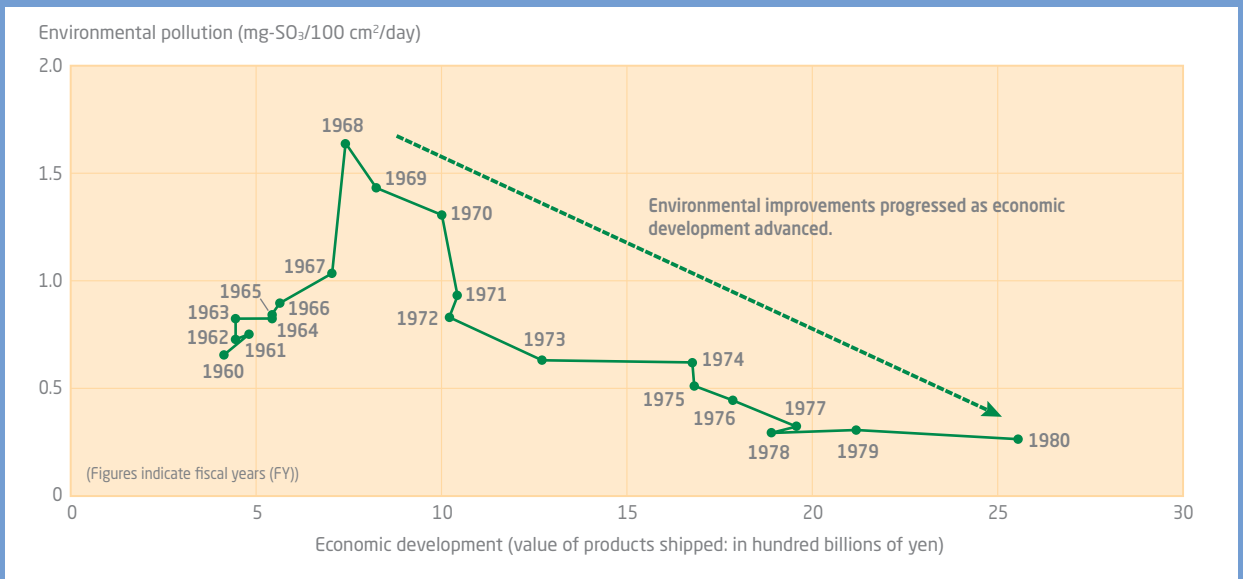
In order to protect the health and lives of its citizens, the local government requested businesses causing pollution to take appropriate environmental measures. It also established regulations, gave instructions to companies and provided support. For their part, private enterprises introduced cleaner production, including energy conservation, resource recycling, and pollution reduction through technological innovation and capital investment. Through their efforts they aimed to reduce substantially the pollutants discharged into the environment.

1 Coliform bacteria are a commonly used indicator of sanitary quality of foods and water.

Photos 2-5-1 The sky over Kitakyushu in 1960 (inset) and today (above)

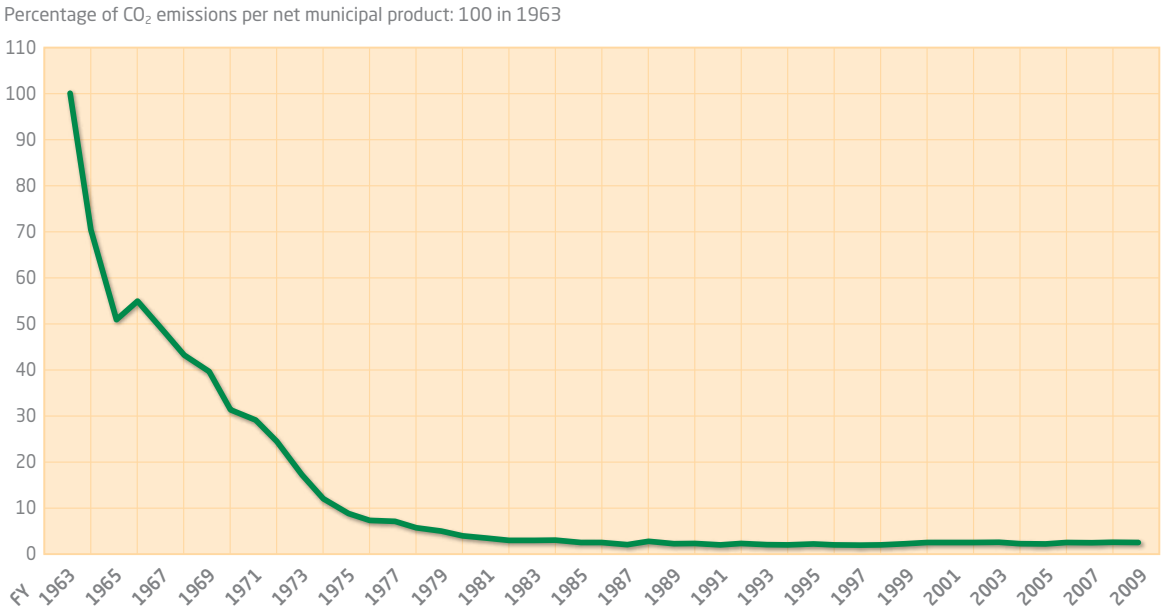
As a result, the city was able to improve its environment even as it enjoyed economic development. In 1968, the value of manufactured goods shipped was about 750 billion yen (approximately US$7.5 billion) and the sulfur oxide concentration in the atmosphere was about 1.7 mg-SO_3 per 100 cm^2 per day, but by 1980, the value had risen to about 2.55 trillion yen while the sulfur oxide concentration fell to about 0.25 mg-SO_3 per 100 cm^2 per day. These figures clearly indicate the environment was improving even as the economy grew (see **Figure 2-5-2**) (World Bank, 1996). In addition, looking at greenhouse gas emissions, CO_2 emissions per unit net municipal product in 2009 had

Figure 2-5-2 Simultaneous achievement of economic development and environmental improvement



Source: World Bank (1996)

Figure 2-5-3 Changes in CO_2 emissions per unit net municipal product in Kitakyushu



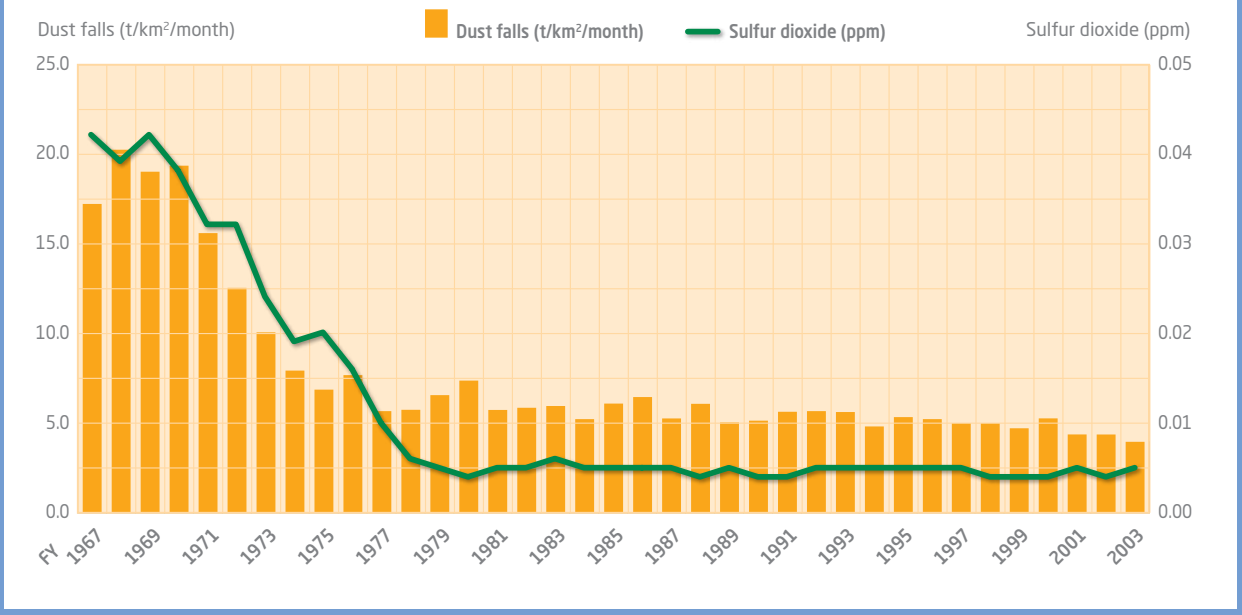
Source: City of Kitakyushu (2011)

been reduced to about 2 per cent of the 1963 level through businesses' all-out efforts to conserve energy (see **Figure 2-5-3**) (City of Kitakyushu, 2012).

Kitakyushu succeeded in improving the environment through the initiatives of local residents and cooperation among the parties concerned, environmental technology and investments, education and participation by citizens, and effective environmental governance (UNESCAP, 2000). In particular, citizens, businesses, universities and the local government were not antagonistic to each other. Instead, they successfully established a dialogue-based partnership among themselves. This was used effectively to take measures to address environmental pollution during the initial years of their efforts, and this partnership has continued to assist as the city undertakes diverse environmental measures today.

Fuel conversion played a major role within the city's efforts to mitigate air pollution. The city advanced from coal to petroleum, from petroleum to petroleum fuel with low sulfur content and more refined burners, and from petroleum to gas. As part of the city's cleaner production systems, scrubber-based desulfurization facilities were installed as a measure that addressed sulfur oxides by removing the pollutants in the exhaust gas emitted as the final effluent. Electric dust collectors were also installed as a means of removing dust, soot and particulate matter. These were later replaced by high-efficient bag filters. In addition, exhaust gas facilities were consolidated to make disposal highly efficient and collective chimneys were built, among other necessary measures taken. The amount of dust, soot and particulate matter that fell over the city in 1967 was about 17 tons per km^2 per month, while the sulfur dioxide concentration in the atmosphere was about 0.042 ppm. However, as a result of the city's measures, by 2003 these figures had fallen to about 2.5 tons per km^2 per month and about 0.008 ppm, respectively. In this way, air quality improved dramatically (see **Figure 2-5-4**) (City of Kitakyushu, various years).

Figure 2-5-4 Changes in the amount of dust, soot and particulate matter falling over the city and changes in sulfur dioxide concentrations



Source: City of Kitakyushu (various years)

Measures to address water contamination consist mainly of three methods: control of plant wastewater, development of public sewerage (for domestic wastewater), and dredging and removal of bottom sediments containing hazardous substances (City of Kitakyushu, 1998). These measures result in sludge—a type of industrial waste— being generated at wastewater treatment facilities. In Kitakyushu, as a fundamental principle, the city's industrial waste is treated and disposed of within the city, while this sludge is sent to landfills after it is dehydrated, although part of this sludge is able to find use.

Photos 2-5-2 The sea in Kitakyushu: The "sea of death" in the 1960s (inset) and today (above)

2.5.3 MANAGEMENT OF INDUSTRIAL WASTE

Industrial waste is generated in each industrial process, including manufacturing, processing, and the disposal of exhaust gases and wastewater, and it will continue to be generated so long as there are industrial activities. This fact notwithstanding, the amount of industrial waste can be reduced by reviewing and improving the production system as a whole. Improvements would therefore be made through changes in raw materials, production processes and production equipment. This is known as "cleaner production". The concept of cleaner production was first put forward by the United Nations Environment Programme (UNEP) in 1992.

Kitakyushu had essentially been incorporating the idea of, and initiatives for, cleaner production ever since it launched its efforts to overcome environmental pollution in the 1960s. It also integrated cleaner production into its approach to industrial waste management.

One notable point is that although large amounts of industrial waste are generated in Kitakyushu, an extremely high percentage of it is effectively used or recycled.

By type, the amount of industrial waste generated in Kitakyushu in fiscal 2010 was 2.46 million tons of slag (38 per cent), the largest category of all, followed by 1.98 million tons of sludge (30 per cent), 670,000 tons of scrap metal (10 per cent), 470,000 tons of dust (7 per cent), 390,000 tons of debris (6 per cent), and 230,000 tons of refuse glass (4 per cent). These six types of waste account for about 90 per cent of the total amount of industrial waste generated (City of Kitakyushu, 2011). While the difference between the generated amount and discharged amount (that is, the difference between the generated amount and the total of the valuable amount and the stored amount) is small for sludge and debris, it is large for slag, scrap metal and dust (City of Kitakyushu, 2011). This is a result of effective use and recycling. Blast furnace slag, which accounts for a large percentage of total slag, is directly sold as raw materials for cement and roadbed materials, while scrap metal is sold as raw materials for iron making. Furthermore, almost all of the dust, generated primarily in the steel industry, is directly returned to steelmakers' own production lines for reuse. The amount of slag generated is the largest category within Kitakyushu's industrial waste, but almost all of it is sold, making the amount discharged much smaller than the amount generated.

Ultimately, it is the amount of sludge discharged that is the largest, representing over 60 per cent of the total amount of industrial waste discharged. A comparison of Kitakyushu with the national average in terms of the amount of industrial waste discharged by type shows that in Kitakyushu, it is the amount of sludge discharged that is the largest, a situation similar to other cities nationwide. However, in Kitakyushu, slag comes next, whereas livestock excretions come next in other cities. This is probably because Kitakyushu has fewer breeders of domesticated animals.

Figure 2-5-5 indicates the final disposal of industrial waste generated in the city (City of Kitakyushu, 2011). In fiscal 2000, the final disposal volume declined remarkably, while from fiscal 2003 to fiscal 2006, it remained at more or less the same level, at about 650,000 tons. However, in recent years, it has continued to decrease. In fiscal 2009, the final disposal volume was about 300,000 tons, although in fiscal 2010, it rose somewhat, to 360,000 tons.

The conspicuous decrease in final disposal volume from 2000 to 2001 is perhaps explained by the enactment of the Construction Material Recycling Law in 2000 (see **2.1.3 (4)** for an outline). Up until fiscal 2000, large amounts of

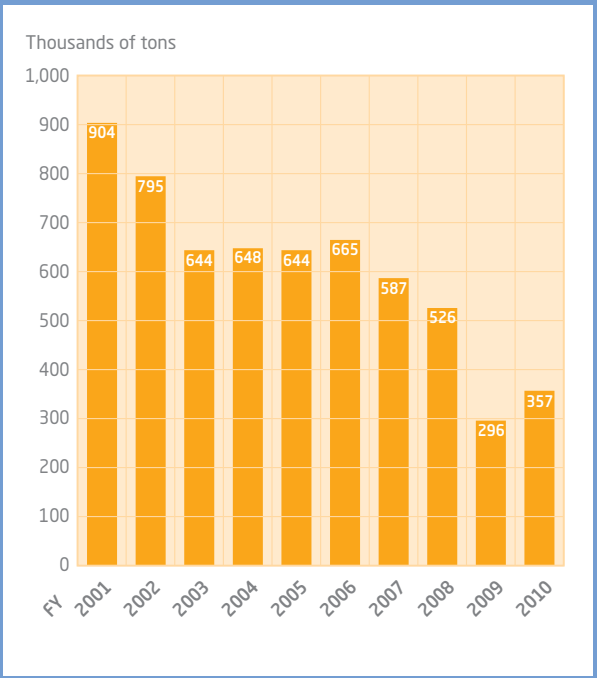
earth and sand were sent to landfills together with debris, but starting in fiscal 2001, the classifications of debris and of earth and sand were legally clarified, and earth and sand was no longer sent to landfills. In addition, starting in fiscal 2001, large-scale dischargers have been required to submit disposal plans under the Waste Management Law, and efforts are underway to reduce final disposal volumes in accordance with these disposal plans. This too may have contributed to the decrease in final disposal amount.

In addition, in 2003, the city government introduced an "environmental future tax" as an object tax not stipulated in the local tax law. The purpose was to establish a continuous and stable source of revenue in order to push forward with environmental measures actively, including appropriate waste disposal and eco-town measures. Currently, 1,000 yen (approximately US$10) is assessed in taxes for each ton of industrial waste sent to landfills within the city. This environmental future tax helps curb the amount of industrial waste sent to landfills and supports future measures, such as a system for subsidizing the development of future environmental technology.

2.5.4 KITAKYUSHU ECO-TOWN AND INTERNATIONAL COOPERATION

Kitakyushu is implementing the Kitakyushu Eco-Town project as a unique regional policy that combines industrial promotion and environmental protection measures. It has been designed to make the most of Kitakyushu's particular characteristics, such as the technological capabilities it accumulated as a major manufacturing city over the past century; its human resource and industrial infrastructures, which enjoy a broad foundation; and the networks of people in industry, academia and government that came to be established in the process of overcoming environmental pollution (see **2.1.3 (5)** for an outline of the Kitakyushu Eco-town project).

Figure 2-5-5 Final disposal amount of industrial waste generated in the city



Source: Kitakyushu City

Kitakyushu Eco-town contributes to regional development by industrializing environmental activities in the form of waste recycling. Its economic effects include reducing CO_2 emissions by about 380,000 tons annually, generating investments worth 66 billion yen (approximately US$ 660 million), and creating more than 1,300 jobs (**Figure 2-5-6**) (City of Kitakyushu, 2012).

Through inter-city international environmental cooperation, Kitakyushu shares its experience in, and technology for, waste management and environmental improvement with other cities worldwide, particularly those in Asia, so that they can be put to effective use there. Regarding measures to mitigate environmental pollution, the city has cooperated with its friendship city, Dalian, China, in formulating an environmental model district development plan and in taking measures to make it successful. Meanwhile, regarding cooperation in waste management,

Kitakyushu succeeded in reducing waste sent to landfills by 30 per cent in its environmental sister city, Surabaya, Indonesia, by introducing a compost system into Surabaya's communities (see **Figure 2-5-7**). In addition, the experience and knowledge gained in Kitakyushu Eco-Town is being used effectively to construct eco-towns in the Chinese cities of Qingdao, Tianjin, and Dalian. Furthermore, the recovery of rare metals is gaining importance, and Kitakyushu

Figure 2-5-6 Life cycle assessment (LCA) associated with Kitakyushu Eco-Town and reductions in environmental impacts

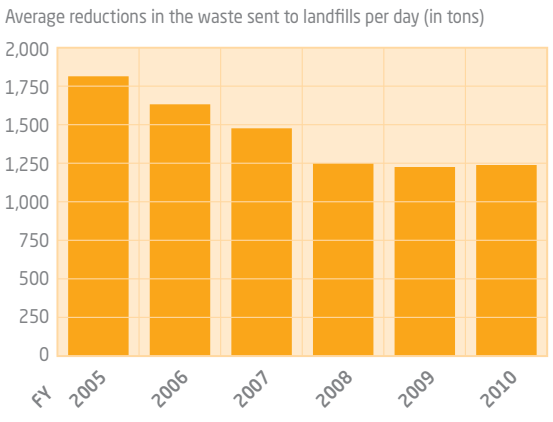
Demonstrative research area
Number of research facilities: 16
Number of research projects: 56

Comprehensive Environmental Complex and the Hibiki Recycling Complex
Number of business facilities: 29

Project results
Environmental: Reduction in CO_2 emissions of 380,000 tons/year, as well as resource and energy conservation
Economic: Investments total approximately 66 billion yen (approximately US$ 660 million) (71.7% by the private sector, 18.2% by the national government and others, and 10.1% by the City of Kitakyushu)
The number of employees is about 1,340 (including part-time workers).
The cumulative number of visitors from 1998 to December 2011 is one million.

Source: City of Kitakyushu (2011)

Figure 2-5-7 Producing compost; reductions in the waste sent to landfills in Surabaya, Indonesia



Source: Kitakyushu City

is currently implementing a programme aimed at importing waste electronic substrates from India and disposing of them together with those collected in Japan.

2.5.5 SUMMARY

In 2011, Kitakyushu was chosen by the Organization for Economic Cooperation and Development (OECD) under its green city programme as a "green growth city", together with Paris, Chicago, and Stockholm. Recently, the OECD issued a report on Kitakyushu that includes its analysis and evaluation of the city's green growth (OECD, 2013). The report presents advanced examples of environmental initiatives such as Kitakyushu Eco-Town and the city's engagement in international environmental cooperation. As Kitakyushu works towards green growth into the future, it is also making proposals for, among other things, more active participation by citizens, utilization of local assets such as green innovation technology, and contributions to green growth through closer international cooperation with Asia and other regions.

Environmental problems such as industrial waste management should now be solved not only by each country and region but also, from the perspective of resource recycling and conservation, at a global scale. Kitakyushu will further bring its environmental policy into service at both the local and global levels.

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2.6 Kawasaki's experience and initiatives

2.6.1 OVERVIEW OF KAWASAKI

Location: See **Figure 2-6-1**.

Population: 1,446,579 (as of August 1, 2013)

Gross municipal product: Approximately 4.83 trillion yen (approximately US$48.3 billion) (FY 2009)

Key industries: Manufacturing (steel, electronics, communications, precision machinery, petroleum, chemicals), information and services

Growing industries: New manufacturing technology, information and communications, environment, welfare and life sciences, lifestyles and culture

Special note: Manufacturing accounts for a larger portion of Kawasaki's economic base than it does in any other major city in Japan.
Leading information and communications firms have core research facilities there. Large corporations developing business globally have also located key operational bases there. Small- and medium-sized enterprises with a high level of platform technological strength are concentrated there.

Figure 2-6-1

2.6.2 TECHNOLOGY AND KNOW-HOW DEVELOPED THROUGH MEASURES TO MITIGATE ENVIRONMENTAL POLLUTION

The Kawasaki waterfront area developed through building what is known as the Keihin industrial zone, which was created through land reclamation and by locating plants and other industrial facilities there. After the 1950s, large factories were increasingly concentrated there as exemplified by the establishment of petrochemical complexes, and prominent companies in all industries including steel, electric machinery, food and petrochemicals located their headquarters in the area. Thus, Kawasaki became one of the major production bases that supported, and indeed drove, Japan's rapid economic growth. One negative aspect of the city's development, however, was the rapid deterioration of the environment, characterized by serious environmental pollution such as air pollution and water contamination (see **Photo 2-6-1**).

In order to solve these pollution problems, around the year 1970 Kawasaki instituted a system to relieve pollution victims and also entered into agreements with 39 factories to mitigate air pollution, thereby taking stronger measures to address the problem at its source. At around this same time, the city government enacted an ordinance to mitigate pollution, urging all factories to take stricter environmental measures and establishing a monitoring system, primarily by installing pollution monitoring centres and by founding pollution research institutes.

In response to these measures taken by the government, businesses actively made investments to mitigate pollution. These

Photos 2-6-1 The sky over Kawasaki (inset photo: 1960s; centre photo: 2013)

investments have allowed them to develop various technologies and know-how to prevent pollution and meet rigorous emission standards.

In addition, the oil crisis, which arose at the same time, provided an acute stimulus for businesses to conserve energy, and these efforts gave rise to a substantial amount of environmental technologies and know-how that Japan can pride itself on internationally. Examples include dust collection, desulfurization, and denitrification equipment for exhaust gas; equipment to remove nitrogen, phosphorus, and hazardous substances from wastewater; reduction of sulfur in heavy oil; improvement of fuel used such as conversion to liquefied natural gas; improvement of manufacturing processes; and energy conservation technology. The sizeable quantity of innovations and the depth of experience in Kawasaki are among the city's strengths today.

2.6.3 THE HOLLOWING OUT OF INDUSTRY AND THE DECLARATION OF A STATE OF EMERGENCY REGARDING WASTE

With the two oil crises in the 1970s, the collapse of the bubble economy in the 1990s, the changes in industrial structure spurred by the shift of the economy to information and services, and the emergence of Asian countries, Kawasaki saw manufacturers, mainly those in its waterfront area, lose their competitiveness rapidly and relocate their factories overseas. As the hollowing out of industry progressed, the amount of idle land increased in the city's waterfront industrial district.

In years past, Kawasaki had been praised as a city with an advanced waste disposal system because it had established a system for daily waste collection and complete waste incineration. However, the amount of waste collected started

to grow by nearly 5 per cent annually because of population growth and the ongoing bubble economy, putting strain on the city's landfills. In 1990, the city government declared a state of emergency for waste. In order to promote waste reduction and recycling, it took various measures such as expanding the range of items subject to sorted collection, supporting group-based collection of resources, creating a waste reduction instructor system and providing environmental education with the cooperation of citizens and businesses. In 1993, it formulated the Kawasaki New Era 2010 Plan, which led to the Kawasaki Eco-Town Plan later on.

The city government also decided to further develop these initiatives and push forward with the 3Rs (reduce, reuse, recycle) programme to deal with waste, thus helping build a recycling-oriented, environmentally friendly, and sustainable society.

2.6.4 KAWASAKI ECO-TOWN

(1) Formulating the Eco-Town Plan

The Ministry of Economy, Trade and Industry and the Ministry of the Environment are promoting eco-town projects. These projects aim at promoting environmental industries, utilizing the industries and other assets already existing in local communities and building a recycling-oriented society by reducing the amount of waste generated based on regional characteristics as well as by moving forward assertively with resource recycling (see **2.1.3 (5)** for more information about eco-town projects).

In the Kawasaki New Era 2010 Plan, a comprehensive programme developed in 1993, the city government decided to work to create a recycling-oriented society, and in 1997, it formulated the Basic Concept for the Project to Make Kawasaki City Environmentally Harmonious (Kawasaki Eco-Town Plan), which aims at forming a recycling-oriented society and reconstructing the city's waterfront area actively utilizing the characteristics of the waterfront area and the experience it had gained through its past measures to mitigate pollution. One notable characteristic of the area is that a wide range of businesses with manufacturing technologies exist in places adjacent to existing urban districts and that they established close cooperation amongst themselves as they developed into a major industrial complex. In July 1997, Kawasaki was recognized by the national government as Japan's first Eco-Town area.

(2) Overview of Kawasaki Eco-Town

The Kawasaki Eco-Town Plan covers the entire industrial zone of about 2,800 hectares in the city's waterfront area, where industry has prospered throughout the city's history (see **Figure 2-6-2**). It aims at shifting all production by businesses located in this area to a resource recycling type while encouraging the construction of advanced recycling facilities that have new production processes built in. Furthermore, it hopes to combine the two to transform the city's entire waterfront area into an area boasting the greatest amount of energy saving and resource recycling that also maintains lively industrial activities.

The ultimate goal of this plan is zero emissions, whereby waste generated in urban districts will be effectively used as raw materials for production at the waterfront eco-town area and residual raw materials and excess energy from facilities or factories will be circulated to others for effective utilization. The plan envisages four phases of development to achieve the goal.

The first step is to promote businesses' efforts to enable them to become more

environmentally conscious. The plan will help businesses make their factories environmentally friendly, mainly by establishing environmental management systems, reducing plant waste to zero, and building environmentally friendly transport systems.

The second step is to make the waterfront area more environmentally conscious through inter-company cooperation. Businesses aiming to be more environmentally friendly will work together to make the area more compatible with the environment.

The third step involves conducting research to realize a waterfront area that develops continuously while focusing on environmental initiatives. In order to further develop the eco-town, research to better enable sustainable development will be advanced, along with efforts to promote the cascading utilization of waste factory heat as an effective use of energy, efforts to recycle residual materials in the area, and endeavors to establish product recycling systems to develop such efforts into viable businesses.

The fourth step is communicating information on the results obtained by businesses and the waterfront area to the rest of the world and contributing to society in general and to developing countries. This means compiling into a collection the results of ongoing research aimed at making businesses and the area environmentally friendly and then communicating those results throughout Japan as well as overseas. It also means transferring the environmental protection and pollution prevention technologies developed in Kawasaki to developing countries worldwide, particularly those in Asia.

Figure 2-6-2 Waterfront area participating in the Kawasaki Eco-Town Plan

Kawasaki Zero-Emission Industrial Complex

Source: City of Kawasaki

The resource recycling facilities built in the project area based on the Kawasaki Eco-Town Plan are facilities to turn waste plastics into raw materials for blast furnaces (2000), household electric appliance recycling facilities (2001), facilities to produce concrete frame panels from waste plastics (2002), facilities to recycle difficult-to-recycle used paper (2002), facilities to turn waste plastics into raw materials for ammonia (2003), and PET-to-PET recycling facilities (2004).

Many of these facilities were constructed using subsidies, which in each case amounted to no more than half the cost. These helped to cover the recycling facility development costs for private operators in the area certified as an eco-town. Such subsidies have been on the list of the national government's support measures.

In addition to these facilities, which have been positioned as part of the Kawasaki Eco-

Town Plan, the area has facilities to produce recycled cement and facilities to recycle non-ferrous metal products. With these facilities as its core, the Kawasaki Eco-Town is promoting recycling and the effective use of resources on a town-wide scale while establishing organic cooperation between these facilities and neighboring ones.

In the Eco-Town area, Kawasaki brought the first phase of the Kawasaki Zero-Emission Industrial Complex into service in October 2001 as a pioneering model of its Eco-Town Plan. At this time it launched its initiatives for reducing environmental impacts through inter-company cooperation as the second step of the Plan. In this industrial complex, companies aim to reduce waste materials from their individual factories and other business sites. They also reuse one another's waste materials as raw materials through cross-industrial cooperation (including nearby factories), thereby achieving zero waste emissions. In March 2005, the entire industrial park acquired ISO 14001 certification. These companies held aloft the banner of their environmental goals in their business activities, with these goals shared by all members of the Industrial Complex.

(3) Specific initiatives in the Kawasaki Eco-Town

One characteristic of resource recycling in the Kawasaki waterfront area is that it is directly connected to existing materials and the production processes of energy-related companies. For example, the core business areas of the JFE Group are steelmaking and engineering. Within the Kawasaki Eco-Town, the JFE Group operates facilities to turn waste materials into raw materials for blast furnaces and facilities to produce concrete frame panels from waste plastics. Similarly, the core business of Showa Denko is the manufacture of chemical products, and it runs facilities to turn waste plastics into raw materials for ammonia. Likewise, San-Ei Regulator, a manufacturer whose core business is papermaking, operates facilities to recycle difficult-to-recycle used paper. Also indispensable in promoting resource recycling are cement companies, which recycle considerable amounts of waste resources into raw materials for cement. Steel, cement, and chemicals give the impression that they are old industries, but these manufacturing industries are essential when forming a recycling-oriented society in the 21st century. The following section introduces some of the resource recycling businesses within the Kawasaki Zero-Emission Industrial Complex.

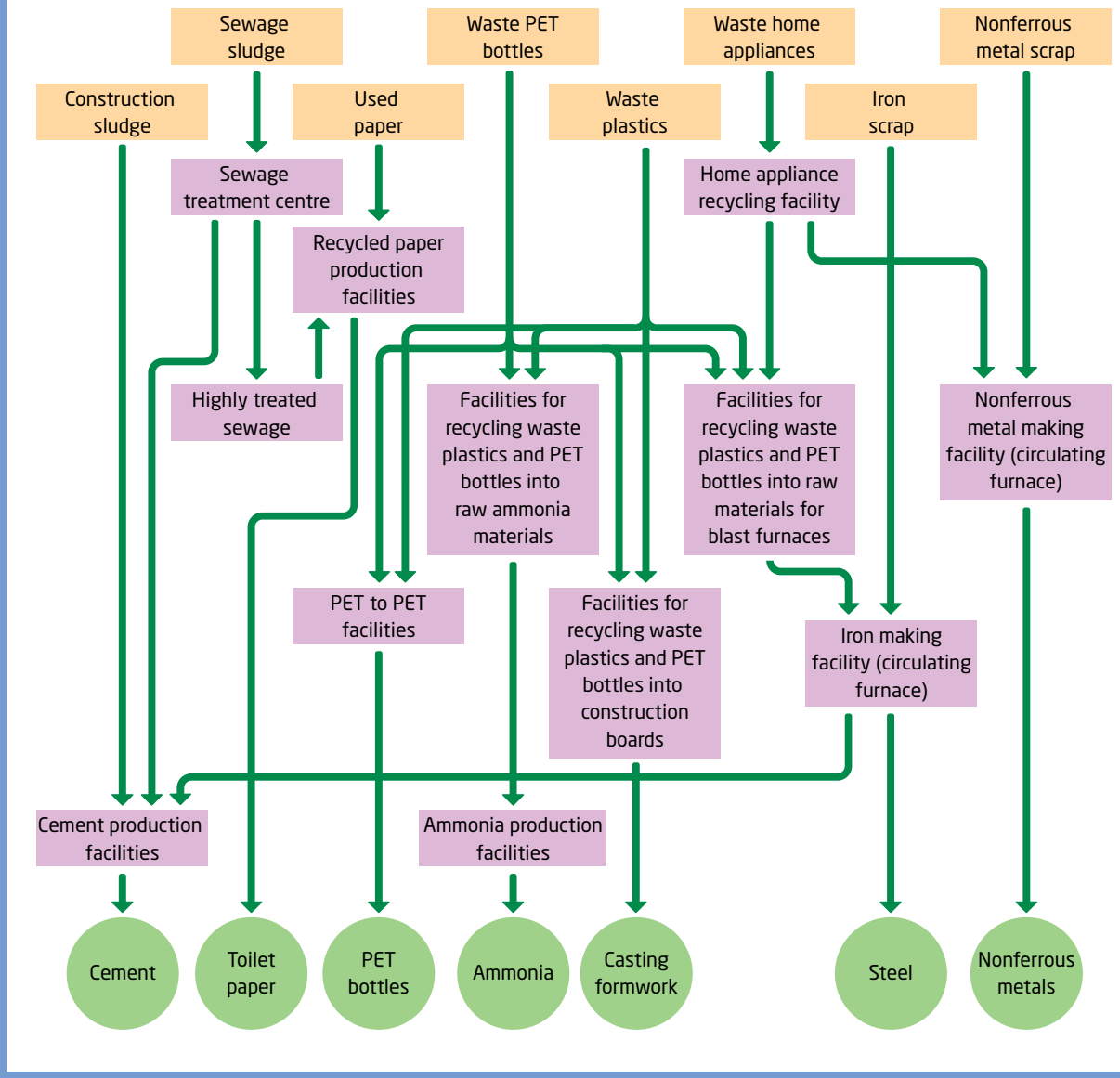
a. Turning end-of-life plastics into raw materials for blast furnaces

The JFE Group (JFE Kankyo Corp. and JFE Plastic Resource Corp.) molds end-of-life plastics discharged by consumers into boards. These boards are then sold as forming panels for concrete under the product name "NF boards". NF boards can be used about 20 times, which is twice as many times as wooden boards. End-of-life NF boards are collected and completely recycled into reducing agents for iron making.

b. Turning waste plastics into raw materials for ammonia

Showa Denko K.K. collects and decomposes waste plastics and also uses decomposed plastics as a raw material for producing ammonia. The company produces 175 tons of chemical products from 195 tons of plastics. The ammonia thus produced is sold as the environmental brand "Eco-Am". In addition, this ammonia is used as a denitrifying agent at local governments' clean centres and other facilities. Part of the ammonia gas thus produced is supplied

Figure 2-6-3 Resource recycling flow in the Kawasaki Eco-Town area



Source: City of Kawasaki

through pipelines to neighboring companies as industrial ammonia.

c. Recycling used paper

San-Ei Regulator Co., Ltd. produces toilet paper using 100 per cent used paper as raw materials. Its used paper recycling system is characterized by its ability to recycle special printing products and those laminated with resin or similar material, which are normally quite difficult to recycle. The Kawasaki city government collects mixed paper discharged from general households and then sorts it and supplies it to San-Ei Regulator's factory. This makes it an example of recycling undertaken through cooperation between government and business. Papermaking uses large amounts of water in its production process, but the factory effectively uses water that has undergone advanced wastewater treatment at the city's sewage treatment plant.

d. PET bottle recycling

In general, PET bottle recycling involves cleaning and then crushing bottles, removing impurities from the crushed bottles, and then using them as raw materials for

fleece and other products. PET Refining Technology Co., Ltd. chemically decomposes end-of-life PET bottles and recycles the decomposed material into PET bottles that are comparable in quality to those made from virgin materials. It is one of the few PET bottle recyclers that can execute the high-level technology and quality control required for PET-to-PET recycling.

e. **Recycling in cement production**
If primarily limestone or clay is blended to attain a certain chemical composition, firing that raw material at a high temperature will change it to a mineral whose nature is to solidify in reaction to water. If the mineral is finely crushed and mixed with gypsum, that mixture is cement.

As materials for recycling, DC Co., Ltd. uses soil supplied from construction sites and ashes obtained from incinerated sewage sludge instead of natural materials such as limestone, clay and iron raw materials. Ordinary incinerators generate incinerated ash in the form of cinders through their operations. Typically, this ash is sent to landfills. However, when it is recycled into cement, it becomes incorporated into the mineral as part of the raw materials for cement. Therefore, one distinctive feature of this recycling is no generation of secondary waste.

In the resource recycling flow in the Kawasaki Eco-Town area (see **Figure 2-6-3**), manufacturers incorporate what would otherwise be discarded into the manufacturing process as raw materials and form a network of recycling through cooperation with government. As described above, Kawasaki Eco-Town is steadily carrying out concrete initiatives to attain its vision of zero emissions.

2.6.5 SUMMARY

Since the national government launched its Eco-Town Project in 1997, Kawasaki's eco-town initiatives have attracted attention both within Japan and overseas, with many visiting the city each year to observe and learn from its example. Many visitors come from Asian countries in particular. Their purpose in visiting is often to investigate potential responses to environmental problems that have arisen as their countries industrialize, or to find inspiration for new business models.

In order for a country or city to create a recycling-oriented society, it is essential to devise the model most suitable for the particular characteristics of that country or city. The model must take into account the policies in place; collaboration and division of roles among citizens, businesses, and governments; and the introduction of environmental technology appropriate for the country or city comprehensively. Even if a country or city introduces excellent technology, this may be ultimately meaningless if it ends as a one-off project. The country or city has to continue its initiatives to create a recycling-oriented society—and ultimately, a sustainable community—using the technology introduced.

The example of the Kawasaki Eco-Town initiative shows that not only the mere concentration of technology but also long years of environmental efforts and technological accumulation, administrative policy (by both the national and municipal governments), corporate efforts, cooperation from the general public, and the locational advantage of the city have combined to bring the initiative to success.

In light of this fortuitous amalgamation of circumstances, rapidly industrializing developing countries will not be able to successfully imitate the Kawasaki Eco-Town initiative in its entirety, and in fact such attempts may not even generate

very positive results. It is important for such countries first to analyse their present situation to identify critical issues, formulate policies to resolve those issues, and accumulate the technologies needed for implementing those policies. It is difficult to implement policies extensively right from the beginning. It can be expected that a shortcut to success will be implementing policies on a trial basis. This will involve formulating models suitable for that particular country and then expanding them across wider areas.

Kawasaki will make use of these initiatives to communicate relevant information both within Japan and overseas. It will also transfer environmental technologies that will improve the environment in recipient communities, thereby contributing to the international community. Kawasaki's initiatives are expected to help other countries and cities as they take steps to become recycling-oriented, sustainable communities.

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3 CHAPTER The international context

Japan's efforts to improve industrial waste management have been recognized internationally. Best practices and lessons learned have been drawn from the Japanese experience and echoed in international initiatives, including UNEP's Green Economy Initiative and UNIDO's Green Industry Initiative. For example, UNEP's Green Economy Initiative points to the waste sector as an important contributor to green economy objectives. Sustainable waste management is also instrumental in UNIDO's Green Industry Initiative.

3.1 The waste sector as a contributor to Green Economy objectives

United Nations Environment Programme

3.1.1 INTRODUCTION

In 2011, UNEP launched its report "Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication", commonly referred to as the Green Economy Report (UNEP, 2011b). The report confirmed that an investment of 2 per cent of global GDP across 10 key sectors is what is required to transition to a green economy.

Two of the 10 sectors analysed in the report – waste and manufacturing – are closely linked to the topic of this publication. This chapter takes a closer look at opportunities for the industrial sector in managing waste more sustainably, and thus in facilitating the transition to a green economy. The Japanese experience, as analysed in the previous chapters, serves as an example of how the shift

to a green economy is already underway in some countries.

3.1.2 WHAT IS A GREEN ECONOMY?

UNEP defines a green economy as one that results in "improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities". Put another way, a green economy is low-carbon, resource efficient, and socially inclusive. In a green economy, growth in both income and employment is driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services (UNEP, 2011b).

Rising ecological scarcity associated with unsustainable use and overexploitation of biological resources and ecosystems is usually not reflected in market prices. This leads to further depletion of natural resources resulting in irrevocable loss of ecosystems and biodiversity. In addition, the design of policies and institutions fails to adequately incorporate costs associated with worsening ecological scarcity globally. Moreover, policy distortions and failures often further aggravate resource scarcity by encouraging wasteful use of natural resources and environmental degradation. To face this challenge, society needs to overcome these market, policy and institutional failures that prevent recognition of the economic significance of environmental degradation.

Three steps are suggested in the Green Economy Report to reverse this progression towards unsustainable development. First, environmental valuation and policy analysis must be improved to ensure that markets and policies take the full costs and benefits of environmental impacts into account. Second, policy must play a major role in mitigating environmental degradation. This requires utilization of effective and appropriate information and the implementation of incentives, institutions, investments and infrastructure. Third, there must be interdisciplinary research on the potential long-term impacts of environmental degradation. Increasing collaboration among environmental scientists, ecologists and economists will be necessary in assessing and monitoring these impacts. Interdisciplinary research is also needed to help identify solutions during the transition to a green economy, particularly research related to setting thresholds of how much natural capital can be used within the carrying capacity of the earth and research related to new technologies that reduce the amount of natural capital used.

Measures – research, policies and investments – aimed at reducing environmental risks and scarcities also need to be compatible with alleviating global poverty and remediating social inequality. As the majority of the population in developing countries directly depends on natural resources, an important challenge in the transition to a green economy lies in identifying ways to protect global ecosystems while simultaneously improving the livelihoods of the poor.

Transitioning to a green economy will vary among countries, depending on each country's specific preconditions with regard to natural and human capital as well as the country's relative level of development. Countries with a high level of industrial development have often achieved that level at the expense of their natural resource base. The challenge for these countries is to reduce their per capita ecological footprint without diminishing their quality of life. For other countries with lower ecological footprints, the challenge will be to deliver improved levels of services and material well-being to their

citizens without drastically increasing the burden on their natural resource base.

A successful transition to a green economy will require specific enabling conditions – conditions that do not, as currently prevailing, encourage a brown economy. These consist of legislative and regulatory infrastructure, policies, subsidies and incentives, as well as international market and legal infrastructure, trade and technical assistance. At the national level, examples of such enabling conditions are: changes to fiscal policy, reform and reduction of environmentally harmful subsidies; employing new market-based instruments; targeting public investments to green key sectors; greening public procurement; and improving environmental rules and regulations and enhancing their enforcement (see **1.4** Policy approaches to address industrial waste). At an international level, there are also opportunities to add to market infrastructure, improve flows of trade and aid and foster greater international cooperation. These interventions also need to take into account the broader context of policies to address innovation, which will, as the histories of many economies such as Japan confirm, foster resource efficiency, long-term competitiveness and social welfare.

Strong environmental policies that include resource pricing help drive inefficiencies out of the economy by removing those firms and industries that only exist because of implicit subsidies in under-priced resources. Resource pricing drives investment into research and development (R&D) and innovation, as it provides incentives to avoid costly resources and to find new production methods. Investments in R&D may then generate innovation rents and strong environmental policies may anticipate future resource scarcities, thus addressing market failures and ecological scarcities (UNEP, 2011b).

3.1.3 THE WASTE SECTOR'S CONTRIBUTION TO GREEN ECONOMY OBJECTIVES

Challenges

Population growth, urbanization and economic development have resulted in changing resource consumption patterns and have led to a rapid increase in waste volumes and types of wastes. Increases in the quantity and complexity of wastes accompanying economic growth pose risks to ecosystems and human health. While the increasing volume of waste generated is one challenge for controlling the impact on human health and ecosystems, it is the growing hazardous component of all waste streams that is most problematic. Unless action is taken to properly prevent, collect and segregate waste materials, many developing countries face the challenge of mixed and growing waste streams that exceed their capacities. This holds true for all kinds of waste streams. The case of industrial waste presents particular challenges, as countries undergoing rapid industrialization typically have not yet developed appropriate systems to deal with hazardous and special wastes.

Industries have a large material impact on the economy, environment and human health. Industrial processes leave polluted and sometimes toxic waste streams that need treatment and whose costs in many instances are not reflected in the cost of production. Most industrial processes cause, to varying degrees, air, water and soil pollution – costs to society and the environment that need to be accounted for, internalized and reduced. The impacts from hazardous substances and waste constitute a significant environmental externality at a global scale.

While releases of toxic emissions from industries in developed countries have decreased as a result of substitution, emission reducing measures and changes in production patterns, these releases have increased in developing

countries. In many cases this can be attributed to the fact that heavily polluting industries have been migrating to developing countries, where regulatory frameworks are lacking and where costs for the sound management of industrial (hazardous) waste are rarely internalized. More generally, this transition process has resulted in significant capacity gaps in developing and transition economies in managing the structural transformation of their economy on a more sustainable basis.

In addition to posing significant risks to ecosystems and human health, current consumption and production patterns significantly impact the economy as they can lead to further depletion of virgin materials and thus might cause supply risks. Metals are a case in point (UNEP, 2013a). Resource scarcities will thus affect industrial production, unless the full value chain is reconsidered and more sustainable consumption and production patterns are pursued.

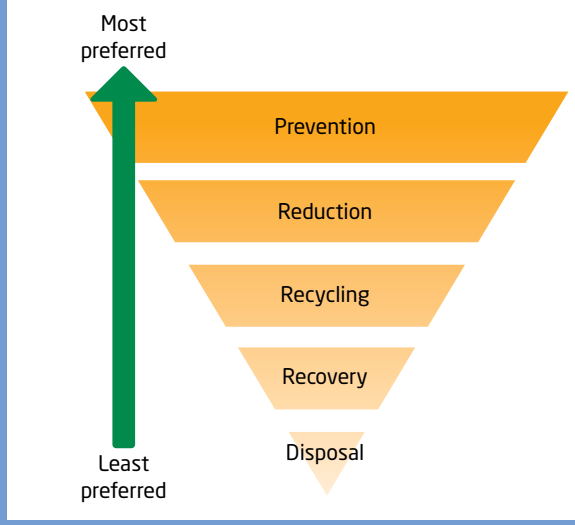
Opportunities

Despite the challenges, the management of industrial waste can also present opportunities as described in previous chapters.

Generally speaking, transitioning to sustainable industrial systems by decoupling economic growth from the use and consumption of natural resources and energy and providing more value with less environmental impact and better economic and ecological efficiency can offer significant opportunities for conventional, material-intensive and highly polluting industries. In other words, if industries use their potential to prevent waste and reduce the material, energy and pollution intensity per unit of industrial output, they can reduce their overall ecological footprint (in terms of carbon, water, etc.) while at the same time improving productivity and competitiveness. In the area of waste, applying the waste management hierarchy is paramount in realizing these opportunities. The waste management hierarchy emphasizes 1) prevention of waste in the first place; 2) minimization in the generation of waste; where waste is inevitable, 3) recycling waste into usable products and 4) recovery of materials and energy from waste and remanufacturing; and 5) treating and disposing of any remaining unusable waste in an environmentally friendly or in the least damaging way.

In the area of prevention, several strategies can be applied. Resource efficient and cleaner production (RECP) (see **3.2**), for example, can help mitigate negative impacts of industrial waste on the environment while reducing costs for end-of-pipe waste management. Resource efficiency achieves environmental management through the minimization of waste and pollution. Production efficiency makes good business sense as it foregoes the use of unnecessary materials and reduces energy use in producing goods and services. Lastly, humans benefit from the efficient and cleaner processes because of the more judicious use of resources. Measures include adopting environmentally sound technologies, introducing process modification and substituting raw materials.

Figure 3-1-1 Waste management hierarchy



Source: UNEP (2011b)

There is also growing evidence that systemic innovation offers a historic opportunity to put decoupling into practice. Innovation is a recognized driver of sustainable development. It addresses the three pillars of sustainable development (environmental, economic and social pillars) on a national (macro) level and serves as a driver for business success and competitive advantage at the firm (micro) level. Such innovation – namely eco-innovation[1] – allows for new ways of addressing current and future environmental problems and decreasing energy and resource consumption, while promoting sustainable economic activity. Eco-innovation in companies involves creating and implementing novel solutions to engender significant improvement of a combination of the product (throughout its value chain[2]), production process, organization[3] and business model[4] of a company. This improvement enhances the company's sustainability performance.

Where waste cannot be avoided completely, it can at least be minimized. Life-cycle approaches, resource efficiency and productivity improvements can provide opportunities for industries and reduce the environmental burden of industrial processes. This requires supply- and demand-side approaches, ranging from resource efficient and cleaner production, sustainable product innovation and the re-design of products to cleaner technologies and closed-cycle manufacturing. The costs of end-of-pipe pollution control can be reduced by cleaner production approaches in management, cleaner raw material selection, and cleaner technologies that reduce emissions and integrate by-products into the production value chain (UNEP, 2011b). Substituting virgin materials with recovered resources from waste streams also contributes to resource and energy conservation. Energy savings in turn bring reductions in greenhouse gas emissions.

When prevention and minimization efforts result in residual waste, then opportunities are to be found in treating industrial waste as a resource by reusing products, recycling waste and recovering materials and energy. Using waste as a resource can be profitable for industries, while at the same time easing the pressure on virgin materials. With resource scarcity increasing, the market for recycled products will grow, offering opportunities for industries to sell waste materials and purchase recycled products (UNEP, 2013a).

Residual waste can also be used for energy recovery purposes. This can have significant climate benefits as it helps reducing greenhouse gas emissions from landfills. Waste to energy, using either renewable (biomass residues) or non-renewable (municipal waste, plastics) sources, is of particular importance to industrial waste management. By avoiding emissions, waste to energy projects can also earn carbon credits under the Clean Development Mechanism (CDM) created under the Kyoto Protocol.

1 Eco-innovation is the development and application of a new business strategy that entails a combination of a new or significantly improved product (good/service), production process, organization and business model that will lead to better sustainability performance.

2 The value chain describes the full range of activities required to bring a product or service from conception through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use. The value chain therefore refers to activities within a company as well as those involving its supply chain. The supply chain refers to a set of entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances and/or information, from a source to a customer.

3 An organization model refers to company services beyond those related to production, such as human resources (number, skills and responsibilities/structure), procurement processes, marketing and communication.

4 A business model describes the rationale of how an organization creates, delivers and captures value (economic, social, cultural or other forms of value). The process of business model construction is part of the business strategy.

Similarly, using organic waste generated by industrial processes to produce compost can also help to mitigate greenhouse gas emissions. In addition, compost can be used as a fertilizer and soil conditioner, which can bring economic benefits to small-scale farmers and reduce nutrient run-off and nitrogen leaching. It can also increase carbon management properties of the soil and enhance crop yields.

In addition to their economic and environmental benefits, recycling and recovery of industrial waste also has great potential to create decent jobs that offer training, health protection and fair compensation (UNEP, 2011b).

Finally, for residual waste that is unusable in any manner, industries should ensure it undergoes proper treatment to make it least damaging to the environment and human health.

Applying the waste management hierarchy to industrial processes can result in a number of benefits in terms of environmental pollution that is avoided, reduced costs in managing industrial waste, increased profitability through reductions in resource use, enhanced market opportunities to reuse and sell second-hand products or scrap materials, and conservation of natural resources. Numerous other benefits can also be expected from dealing with industrial waste in a preventive and integrated way, such as energy savings, creation of new businesses and jobs, energy production from waste, reduced greenhouse gas emissions, and contributions to equity and poverty alleviation. Improved health, health costs that are avoided, water contamination that is prevented, and the consequent costs of an alternative water supply are also among the many other types of benefits that can be expected (UNEP, 2010b). Some concrete options for the industrial sector in dealing with industrial waste, along with anticipated benefits, are discussed below.

Strategic options for the industrial sector

Consideration of the full value chain and a rethinking of industrial systems can identify a range of areas for eco-innovation and green investment in industries and contribute meaningfully to the ultimate aim of enhancing resource efficiency while preventing, reducing, and recycling industrial waste and treating it in an environmentally friendly way. At each stage of the waste management hierarchy, there are opportunities to improve resource efficiency within industrial processes. Approaches can include systemic, long-term strategies, product design and development (PD), material and energy substitution (MES), process modification and control (PM) and new, cleaner technologies and processes (CT).

More concretely, approaches may include the following:

- Developing and applying eco-innovation approaches, e.g. new business strategies that entail a combination of a new or significantly improved product (good/service), production process, organization and business model that will lead to better sustainability performance;
- Changing the composition of demand within both industry and the final consumption stage, including strategies that promote sustainable procurement by major consumers such as the public sector;
- Introducing resource efficient and cleaner production and new, cleaner technologies to improve the efficiency of existing processes to leapfrog and establish new modes of production having fundamentally higher material and energy efficiencies. In manufacturing, major savings potential can result from improving the resource efficiency of existing processes;
- Re-designing products and/or business models so that the same functionality can be delivered with fundamentally less use

Box 1: Japanese companies pursuing zero waste goals

To pursue reductions in industrial waste, many Japanese companies have been using the "zero emissions" concept, a concept originally introduced as an approach for creating sustainable economies through the clustering of industries. In 1994, the United Nations University launched the Zero Emissions Research Initiative (ZERI), which promoted and further developed the concept. A number of companies and municipalities later developed a series of efforts in line with the concept. Japan's increasing shortage of space within landfills, especially for industrial waste, and growing waste disposal costs prompted many Japanese companies to focus on zero waste emissions in particular. For example, Panasonic has continuously improved its recycling rate to over 99 per cent in 2012. This has been achieved by introducing resource-saving product designs and production processes. In order to also enhance recycling rates in its factories outside Japan, Panasonic also conducts reviews to identify tailored solutions in line with the local recycling and waste management infrastructure. In addition, regular professional training on waste management is held to enhance the capacity of the company's employees.

Source: Based on http://panasonic.net/sustainability/en/eco/resources_recycling/zero_emission/

of materials and energy. This also requires extending the effective lifetime of complex products and improving quality, by incorporating repair and remanufacturing into a closed-loop system;

- Substituting green inputs for brown inputs wherever possible. For example, biomass can be introduced as a source of chemical feedstocks, and companies can emphasize process integration and the upgrading of process auxiliaries such as lighting, boilers, electric motors, compressors and pumps, while practicing good housekeeping and employing professional management;
- Recycling internal process wastes, including wastewater, high temperature heat and back pressure. Companies can introduce combined heat and power (CHP) if there is a local market for surplus electric power and use materials and energy that have less environmental impact, such as by using renewables or waste as inputs for production processes. Companies can also choose materials with a higher level of recyclability and find or create markets for process wastes such as organics; and
- Redesigning systems, especially transportation systems and urban infrastructure downstream, to utilize less resource-intensive inputs. The first target must be to reduce the need for and use of automotive vehicles requiring liquid fuels in comparison to rail-based mass transportation, bus rapid transit and bicycles.

Closed-loop industrial systems

Drawing on the principles of industrial ecology, closed-cycle manufacturing is a particularly ambitious approach. This concept refers to an ideal manufacturing system that maximizes the useful life of products and minimizes the waste and loss of valuable and scarce metals. At a broader systems level, another version of closed-cycle manufacturing is industrial symbiosis or eco-industrial parks. They are modeled on the Kalundborg (Denmark) example, within which wastes from certain manufacturing operations can be used as raw materials for others. As the success stories of Kitakyushu and Kawasaki illustrate, similar approaches have been applied in Japan (see **2.5** and **2.6**).

It is not easy to reproduce these synergies elsewhere, as some specific conditions need to be met: an eco-park needs to grow around a fairly large basic industry that generates predictable wastes, with usable elements or components that smaller operations nearby can utilize. At the product level, closed-cycle manufacturing achieves life-cycle efficiency by facilitating maintenance and repair, reconditioning and remanufacturing, with dismantling and

recycling at the end, in contrast to today's linear throw-away paradigm. The usual one-way flow of products from the factory to the salesroom is changed to a two-way flow. However, the lifetime extension of a product through repair, recycling and innovation may lead to inabilities to make the best possible use of technological progress, which, in turn, might result in higher energy consumption for some products. Life cycle assessments are needed to determine which phase of the life cycle causes the most environmental pressure.

Remanufacturing is also becoming increasingly important, particularly in areas such as motor vehicle components, aircraft parts, compressors and electrical and data communications equipment. Japanese companies like Canon, which began remanufacturing photocopiers in 1992, are among the companies that have advanced this concept.

The major obstacle to re-manufacturing is that the strategies for extending the useful life of manufactured products depend upon active cooperation from original equipment manufacturers (OEM). Many manufacturers have resisted this approach historically and even taken steps in the opposite direction by intentionally making their products increasingly difficult to repair. Unless legislation is enacted or pricing differentials are introduced, consumer product companies will tend to view repaired, renovated or remanufactured products as being in direct competition with their new products.

Following repair and remanufacturing to enable the reuse of products, recycling is a key step within the closed manufacturing system. This can facilitate the use of the by-products of production processes whilst also providing solutions in the substitution of inputs in manufacturing, e.g. the use of scrap metals in place of ore.

Significant job creation opportunities are expected from the use and recycling of valuable by-products and scraps. Remanufacturing and recycling of scarce metals provide primary opportunities in the manufacturing sector. Significant opportunities may also lie in the area of industrial symbiosis (new products from old processes), which also highlights the importance of broader systemic (cross-sectoral) impacts.

One important (and under-exploited) near-term opportunity for improving energy efficiency in industrial processes lies in recycling high-temperature waste heat from processes such as coke ovens, blast furnaces, electric furnaces and cement kilns, especially for electric power generation using combined heat and power (decentralized CHP). Virtually all of these examples are technically suitable for small combined heat and power plants with paybacks of approximately four years, providing that the power can be utilized locally. The pulp and paper industry has reported heavy investment in CHP technology to reduce energy consumption, noting that CHP installations allow savings of 30 to 35 per cent of primary energy. Where CHP is not an option, the next example of input substitution is the use of waste as fuel, such as biomass or municipal waste.

Numerous measures can also be taken to reduce absolute water use through efficiency and recycling measures. Recycling wastewater from a variety of industrial processes is increasingly important because of the scarcity of fresh water alongside a growing demand for water in many parts of the developing world, such as northern China and India (UNEP, 2011b).

The economic case for investing in managing industrial waste

In the past, environmental and health-related reasons have motivated investments in managing waste from industrial processes, based on costs that can be avoided through proper

collection and disposal. While these arguments continue to be important for policy actions, the economic case needs to be emphasized more prominently in order for policy-makers to channel significant resources towards decoupling current production and consumption patterns and managing resource efficiency in, and waste from, industrial processes.

There are no established international targets for managing waste from industrial processes, apart from the control of specific hazardous substances as governed by international conventions, such as the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. Most goals are established nationally or even locally, as seen in section 2.1 of this publication dealing with the Japanese national policy framework. It is therefore difficult to have universally applicable goals for making industrial processes more resource efficient and industrial waste management more sustainable. As outlined before, however, all countries should follow the waste management hierarchy in this regard.

Increased investment is necessary for managing resource efficiency in and waste from industrial processes. Preventing and minimizing industrial waste generation requires innovation and changes to system and product design and production processes upstream. Downstream recovering, remanufacturing, recycling, and final treatment require either new facilities or the upgrading of existing facilities. Investment is also needed to train the labour force in the industrial and waste management sectors as well as to formalize the informal sector. It is important to note that the appropriateness of different approaches and technologies in enhancing resource efficiency in and waste management from industrial processes is mainly determined by local conditions (UNEP, 2011b).

3.1.4 CONCLUSION

Real opportunities for industries to manage waste in a more sustainable way lie in taking a preventive approach. Such an approach can enable rapidly industrializing economies to decouple environmental damage from economic growth and improve their longer-term competitiveness.

Preventive efforts to promote resource efficiency and cleaner production at the product, production process and company level need to be complemented by improvements at the industrial cluster and systems level. At the company level, this starts with approaches such as eco-innovation, including novel solutions to bring about significant improvement in a combination of the product (throughout its value chain), production process, organization and business model, which will in turn lead to better sustainability performance. At the industry and systems level, this implies the greening of supply chains and clustering of industries in a given economic zone to become a platform for resource efficiency through optimized resource flows between industries.

The industrial parks of the future could be eco-parks that maximize industrial symbiosis and secure decent jobs. The move toward closed-cycle manufacturing through remanufacturing and reprocessing of post-consumption products and materials that are currently thrown away as waste represents an important opportunity for transitioning to a green economy. Resource scarcities and the growth of the waste market will generate demand for recycled products, offering opportunities for industries to sell waste materials and purchase recycled products (UNEP, 2013a).

Public policies, such as extended producer responsibility or returnable deposits, can help to promote closed cycle manufacturing and extend product life cycles, thereby saving resources

and creating more jobs in maintenance, repair, remanufacturing and recycling. New areas of employment might include the collecting and sorting of used or end-of-life products (reverse logistics). Shifting taxes away from labour on to waste emissions and/or materials extraction could also be an effective way of creating more jobs by reducing labour costs vis-à-vis direct energy costs or capital costs.

Indeed, there are multiple benefits from enhancing resource efficiency in industrial processes and managing industrial waste in a more sustainable way, such as waste prevention, resources recovered from waste and the consequent extraction of fewer raw materials, new products such as compost and energy derived from waste, lower costs associated with reducing greenhouse gas emissions, carbon credits, health costs that are avoided, and job creation.

Each country will need to examine its own appropriate policy mix in order to transition to more sustainable industrial systems, mindful that the basic physical processes and damaging impacts associated with pollution and unsustainable resource use are universal. As major point sources of pollution, industries have traditionally been easy targets of command-and-control regulations. In some cases these regulations need reform, while in others, new regulations will be required to facilitate the transition to sustainability. Command-and-control regulations need however to be better combined with market-based approaches, allowing appropriately structured markets to reflect the real price of energy and other resources and allowing industries to innovate and compete on a fair basis. Recent history shows that the introduction of taxes can be a strong driver for technology innovation, with petrol taxes and vehicle engine technology as examples. The use of economic instruments can also reduce monitoring costs for regulators, but there needs to be the willingness to undertake a thorough economic analysis on their likely costs, benefits and effectiveness in order to design them correctly (UNEP, 2011b).

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3.2 Sustainable waste management in the context of Green Industry

United Nations Industrial Development Organization

3.2.1 SUSTAINABLE WASTE MANAGEMENT APPROACHES AS PART OF UNIDO'S GREEN INDUSTRY INITIATIVE

What is the Green Industry Initiative?

Conscious of the industrial, environmental and energy policy challenges developing and emerging countries face, UNIDO launched its Green Industry Initiative in 2009. Its objective is the mainstreaming of social and environmental considerations into the operations of enterprises in all countries and regions through the more efficient use of energy and raw materials, innovative practices and applications of new green technologies. The Green Industries Initiative can be seen as a sector strategy for achieving the overall goals of green growth and green economy in the manufacturing and associated sectors. In other words, UNIDO promotes Green Industry for a sustainable and economically viable future with an aim to ensure that industry does not harm the environment in developing and emerging countries. Specifically, UNIDO helps developing countries to secure resource-efficient, low-carbon growth. Promoting Green Industry is poised to create new jobs while protecting the environment, and assists developing countries move to clean technologies and implement environmental agreements, including initiatives and projects in waste management. Green Industry involves a two-pronged strategy to create an industrial system that does not require the ever-growing use of natural resources and pollution for growth and expansion. These two components are the greening of industries and creating green industries.

The greening of industries is a method to attain sustainable economic growth and promote sustainable economies. It will enable and support all industries regardless of their sector, size or location, to green their operations, processes and products by using resources more efficiently; transforming industrial energy systems towards greater sustainability by expanding renewable energy sources; phasing out toxic substances; and improving occupational health and safety at the industrial level.

Creating green industries involves establishing and expanding (new) green industries that deliver environmental goods and services. Green industry is a rapidly expanding and diverse sector that covers all types of services and technologies that help to reduce negative environmental impacts and resource consumption. This includes material recovery, recycling, waste treatment and management, as well as the provision of environmental and energy consulting and services, such as energy service companies and companies that provide monitoring, measuring and analysis services.

Benefits of Green Industry

There are multiple benefits from pursuing a Green Industry approach. These may include reduced raw material (i.e. commodity) costs, increased security of supply, reduced pollution risks and costs, lower cost of capital, increased employee appeal and engagement, increased awareness of emerging smart technologies, enhanced innovation capacity and skills, and improved brand recognition and competitive

position in markets. At enterprise, national and global public policy levels, Green Industry offers a practical pathway to long-term economic growth and sustainable development.

Waste management approaches

Approaches to sustainable waste management are covered under both components of the Green Industry Initiative.

Greening of industries involves preventing and minimizing the generation of wastes and emissions through such approaches as improvements in process operation, monitoring and maintenance, application of advanced process technologies with higher efficiency and specificity, and recycling, reuse and recovery of process wastes. In addition, minimizing the risks associated with chemicals and (hazardous) wastes through sound management of chemicals, phasing out of toxic and other environmentally harmful substances (including those contributing to ozone layer depletion and/or climate change), application of Best Environmental Practices and Best Available Techniques to prevent unintended formation and emissions of POPs and other hazardous pollutants, replacement of chemical processes by non-chemical processes (biological, physical, etc.), and substitution of chemicals with safer, more specific and/or more effective alternative ones.

Waste management approaches are also part of creating green industries. Industries are encouraged to develop and deliver advanced integrated waste management, to use recycling and resource recovery technologies, services and systems for municipal, commercial, industrial, construction, demolition and other specific waste streams, and to produce reliable supplies of recycled materials and products. Industries are also supported in their efforts to collect, manage and dispose of (hazardous) wastes and/or emissions in environmentally sound ways. They are also assisted in developing and delivering technologies, equipment, products, management systems, know-how and/or services that collect, manage and dispose of (hazardous) wastes and/or emissions in environmentally sound ways, including, for example chemical and medical wastes, electronic waste, etc.

3.2.2 JAPAN'S PROVEN TRACK RECORD AND TECHNOLOGIES IN SUSTAINABLE WASTE MANAGEMENT

Japan has a proven track record in sustainable waste management and a number of advanced waste management technologies have been developed in Japan. While the previous section highlighted the importance of sustainable waste management approaches as part of the Green Industry Initiative, this section will focus on transfers of Japanese technologies in the field of waste management.

UNIDO's Investment and Technology Promotion Office (ITPO) in Tokyo, Japan is promoting direct investment and technology transfers from Japan to developing countries through foreign direct investment, joint ventures, licensing of technologies, and other efforts. As part of its vital role in transferring environmentally-friendly technologies to developing countries and economies in transition, UNIDO ITPO Tokyo gathers information on environmental technologies developed by Japanese companies. It processes and edits the technical information and feeds it into an easily navigable database. UNIDO ITPO Tokyo disseminates this information to support its mandate to promote these technologies in developing countries.

Japanese technologies that have received considerable interest in developing countries are water-related technologies, such as for

Box 1: Transfer of Japanese technologies for Green Industries

The transfer of technologies to developing countries needs to take into account local conditions, such as the technological potential within a particular country and infrastructure-related conditions, such as the availability and steadiness of power supply, water and sewage infrastructure, and the ease with which parts for the technology can be procured. UNIDO ITPO Tokyo reliably takes these and other local conditions into account when selecting and promoting Japanese technologies. The technologies in its database are usually low-cost, low in electricity consumption, and do not require special training.

For example, in the field of waste prevention and emissions from industries, Japanese companies have technologies that can help in recovering fluorocarbons for either reuse or destruction. These technologies can help in preventing releases of ozone-depleting substances (ODS) into the atmosphere. The Japanese company Asada Corporation uses, for example, electrostatic and plasma technologies to recover and destroy refrigerants from air conditioners and other appliances. Technologies are easy to transport and easy to maintain.

In the area of water technologies, Japanese companies developed technologies to treat wastewater and to store and purify rainwater. For example, the Japanese company Aquatech Inc. uses clumps of gravel bound together by resin, which are called "jarikkos". These can purify water contaminated with organic matter, such as organic waste or sludge. Jarikkos are used to purify water bodies such as rivers and lakes and to treat industrial wastewater contaminated with organic matter. The technology is low cost in comparison to other purification methods and has no maintenance cost accompanying it.

In the area of rainwater harvesting, the Japanese company Totetsu Mfg. Co., Ltd has developed a rainwater storage and usage system that collects, purifies and stores the rainwater in specifically designated underground plastic storage tanks. The purified water is suitable for daily life needs, agriculture, and industry, but needs to undergo additional filtration and sterilization to attain drinking water quality.

Source: UNIDO ITPO Tokyo

piping, pumping water after floods and water-proofing. Developing countries have also shown interest in technologies for metal processing and waste management.

3.2.3 APPROACHES, POLICIES AND/OR TECHNOLOGIES APPLICABLE IN INDUSTRIALIZING COUNTRIES

In order to disseminate know-how, best practices and technology transfer on industrial waste management in developing countries and countries with economies in transition, UNIDO promotes several approaches.

To promote an enabling environment, UNIDO encourages businesses individually and collectively to adapt and adopt Green Industry. It assists businesses in mainstreaming and embedding Green Industry in industrial and related policies and strategies, fostering access to appropriate and affordable technologies, enabling access to affordable financing and creating human and institutional capacity. In addition, UNIDO supports knowledge transfer, including know-how, good practices and technology information through multilateral environmental agreements, such as the Montreal Protocol and the Stockholm Convention.

The UNIDO Montreal Protocol-related activities include the phasing-out of methyl-bromide, conversion of technologies used by refrigerator manufacturers, identification and application of non-ODS production technologies, assistance to local authorities in institutional strengthening for the preparation of regulations, codes of good production and maintenance practices, and provision of capacity building services to strengthen SMEs. With regard to the Stockholm Convention, UNIDO cooperates with technology providers to promote technologies that can mitigate persistent organic pollutants in developing countries.

Through a number of programmes, UNIDO is promoting Green Industry and sustainable industrial waste management.

Green Industry Platform

The Green Industry Platform is a global high-level, multi-stakeholder partnership intended to act as a forum to catalyse, mobilize and mainstream action on Green Industry around the world. It is jointly convened by UNEP and UNIDO and provides a framework to bring together governmental, business and civil society leaders to secure concrete commitments and mobilize action in support of the Green Industry agenda. By encouraging the more efficient use of energy and raw materials in manufacturing processes and services, the Platform will contribute both to cleaner and more competitive industrial development, and will help reduce pollution and reliance on unsustainable use of natural resources.[1]

National Cleaner Production Centres (NCPCs)

To support mainstreaming of resource efficiency and cleaner production (RECP), the joint UNIDO UNEP RECP Programme has supported national capacity building through NCPCs and other qualified institutions since the 1990s. NCPCs are professional centres that deliver and coordinate services in regard to cleaner production methods, policies, practices and technologies. The RECP Programme works through its 55 RECP network (RECPnet) members from almost 40 countries with like-minded institutions, the private sector (particularly small- and medium-sized enterprises), policy makers and other stakeholders at the national level to promote a more resource efficient and Green Economy.

Investment and Technology Promotion Offices

UNIDO's network of investment and technology promotion offices (ITPOs) was established to broker investment and technology agreements between developed, developing countries and countries with economies in transition. UNIDO ITPO Tokyo's mandate is to promote Japanese technologies. In the field of waste management, recent cooperation focused on e-waste technology promotion in the Russian Federation and the promotion of waste tracking systems in India.

1 More information on the Green Industry Platform can be found at: http://www.greenindustryplatform.org/

4 CHAPTER

Concluding observations on the potential relevance of Japan's experience for rapidly industrializing countries

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4.0.1 INTRODUCTION

The world's waste discharge has been increasing along with population growth and also economic growth in developing countries. In rapidly industrializing countries in particular, waste discharged through industrial activities has shown a sharp increase and its impacts on the environment are a concern. If the increase continues at the present rate, the world's waste discharge in 2050 is estimated to grow to more than twice the 2010 amount. Making effective use of limited resources while dealing properly with waste is one of the most important issues globally in the path to sustainable development.

Two types of decoupling will be key: realizing economic growth while reducing resource consumption and using resources effectively while minimizing environmental burdens. Japan's experiences in the late 20th century in industrial waste treatment and disposal are expected to be useful for rapidly industrializing countries as they seek to decouple in these areas. Since waste disposal systems or methods vary according to countries or regions, it is i mportant to consider what aspects of the Japanese experience can be useful in light of each country's individual situation and local conditions.

There were three notable changes in Japan's way of thinking as a result of its experiences in the late 20th century. The roles of the entities promoting these changes have also evolved. The following sections highlight these transitions.

4.0.2 THREE CHANGES IN JAPAN'S WAY OF THINKING DERIVED FROM ITS EXPERIENCES IN THE LATE 20TH CENTURY

a. **Quality and quantity: Efforts to conserve the environment are essential for sustainable development**

During its rapid growth in the 1950s and 1960s, Japan focused on economic development and took the environment into consideration only afterward, leading to pollution problems. Delays in controlling industrial effluent and smoke gave rise to water contamination and air pollution. Heavy metals flowed into rivers and became concentrated in various types of food, resulting in health issues for the people who ate them. During the Diet session that convened in 1970, laws to address environmental issues were formulated all in one burst, as were systems for medical care and compensation for people suffering from pollution-related health problems. However, lawsuits demanding certification of pollution-related health impacts have continued until recently. Despite a half century, society still bears a number of deep scars.

The experience showed that end-of-pipe measures focusing on cleaning up environmental pollution results in many more costs than preventive measures. As the Japanese experience showed, the measures needed to recover from pollution included not only environmental recovery, but also medical care and compensation for harm inflicted on people's health.

In light of this experience, in creating a safe and secure society moving towards sustainable development, it is important to specify "environmental conservation" within the philosophies or basic principles adopted by the national government, companies and local governments. This represents a change in the conventional way of thinking.

b. **The 3Rs: Transitioning to a recycling society in which resources are effectively utilized and recycled, departing from just waste disposal**

In the 1970s and 1980s, Japan established laws, regulations and disposal standards for hazardous substances to ensure proper disposal of industrial waste, grounded in the responsibility held by the entity generating the waste, that is Extended Producer Responsibility (EPR). However, as the generation of industrial waste discharge increased, there was no end to the number of businesses that improperly disposed of it by contracting for disposal at low prices with companies that illegally dumped the waste in remote areas. The costs associated with cleaning up and restoring the severely polluted environment were much greater than the costs that would have been incurred by properly disposing of the waste.

In light of this, Japan concluded that in response to increases in industrial waste generation, it is important to depart from the focus on just disposing of waste. Japan has been working to change society's way of thinking so as to switch over to a recycling society in which resources are effectively utilized and recycled. Doing so requires that the priority order of the 3Rs be followed conscientiously. This 3R hierarchy has "reduce", or effective use of limited resources and reduction in generated waste, as the highest priority. This is followed by "reuse", by which things are used multiple times, and finally by "recycle", or cyclic use. It is also essential to create systems for this recycling society that incorporate heat recovery and proper disposal.

c. **Coordination: Society-wide efforts through cooperation among the national government, local governments, industry, disposal companies and citizens**

Since it is possible to point to a source company in many cases of pollution, pollution tends to be blamed on companies rather than on society as a whole. However, in the case of automobile fumes polluting the air, society as a whole is both victimizer and victim. In the same way, improper industrial waste management, such as chlorofluorocarbons not recovered from refrigerators or air conditioners at the time of disposal, can develop into a global environmental issue.

It is therefore important to have a change in the way of thinking in which all social actors, including the national government, local governments, industry, disposal companies and citizens, take responsibility for their own roles and work collaboratively to manage industrial waste. It is primarily major companies with consistent performance that are able to shoulder the costs and advance environmental measures and the 3Rs. Society as a whole must create an environment that effectively incentivizes companies that undertake environmental efforts or the 3Rs. A better reputation for the company in society and higher enterprise value are among the incentives that companies generally respond to.

4.0.3 ROLES OF SOCIAL ACTORS; PERSPECTIVES THAT FACILITATE COORDINATION AND COLLABORATION

a. **Establishing appropriate regulations and standards by the national government to stimulate changes in society's way of thinking and foster business operators**

In creating a recycling society that appropriately manages industrial waste, the most important roles of the government are to raise the degree of priority given by the government to relevant policies; to improve the legislative framework; to encourage changes in how stakeholders, including the national government, local governments, industry, academia, and citizens, think about the issue; and to develop frameworks under which these entities can work in cooperation. In Japan, after the illegal dumping and improper disposal of industrial waste and the shortage of disposal facilities became social problems, policies on the 3Rs and on proper disposal of industrial waste were rapidly formulated, beginning in the 1990s. Since 2000, the basic laws for creating a recycling society and various legal systems concerning recycling have also been established.

Specifically in the case of industrial waste disposal, it is necessary to formulate and implement systems clarifying the responsibility for disposal and for costs. When considering environmental conservation measures, it is important to incorporate the responsibility of waste dischargers and extended producer responsibility, under the polluter pays principle. On that basis, it is necessary to set standards for proper recycling and disposal as well as provide administrative supervision to investigate whether or not these standards are in fact followed. Regulations must also be thoroughly enforced.

The 3Rs and heat recovery should receive high priority within industrial waste policies. In Japan, incineration was introduced early on because of hygiene considerations. However, in countries that will be creating improved industrial waste disposal systems in the future in response to rapid increases in waste, the 3Rs and heat recovery should be included on a priority basis when devising the system. In light of the highly diversified types of industrial waste that must be addressed, it is difficult to manage industrial waste under a uniform approach through public services. It is therefore essential that policies be created in ways that foster private businesses so that

the originality and ingenuity of the private sector can be utilized.

In addition, Japan has conceived of ways to address industrial waste problems through many years of responding to a variety of problems. To replicate this expertise that comes with experience, it would be beneficial to establish an organization or a department to handle industrial waste disposal issues and then cultivate relevant personnel.

Although these processes, including policy planning and implementation, improvements to various systems and human resource development, have been communicated to other countries proactively through the Regional 3R Forum in Asia and on other occasions, in order to address increasingly serious industrial waste problems, there is a tremendous need to make use of international cooperation when moving into implementation.

b. Responsibilities of businesses generating industrial waste and voluntary efforts by industry

The Voluntary Action Plan on the Environment set forth by Keidanren in 1997 is worthy of special mention, as it led to accelerated involvement by industry in environmental conservation as well as in earnest efforts at industrial waste management.

A notable characteristic of the Keidanren plan is voluntary efforts conducted by businesses. If industries devise measures that comprehensively take account of both technology trends and cost-effectiveness while working towards the national government's overarching direction for creating a recycling society, then society as a whole will be able to address environmental issues more efficiently than if businesses are regulated in detail through a regulatory approach.

Industrial circles as a whole adopted a quantitative approach, setting a numerical reduction target for the final disposal volume of industrial waste. Their joint efforts resulted in a final disposal amount in FY2010 that was 86 per cent less than the amount in FY1990. In addition, individual targets were set by various industrial sectors. Industries have been enhancing the atmosphere of trust afforded to them by society by carrying out their responsibilities to society, namely by conducting follow-ups annually on what they actually achieved, implementing the PDCA cycle and then publishing the results for the public to see.

Industry contributes to the creation of a recycling society not only by making such voluntary efforts but also by providing information and conducting educational activities for consumers.

c. Strengthening the industrial waste disposal industry's integrated performance in proper disposal and recycling

Industrial waste disposal in Japan makes good business sense, with businesses receiving value from the disposal companies that provide disposal services. However, unlike in ordinary commercial transactions, nothing remains with the businesses that generated the waste after their waste and the money for services are handed over to disposal companies. Therefore, waste generators tend to pay attention to the cost of disposal rather than the quality of disposal. As a result, disposal companies emerge that contract for disposal at a low price and then improperly dispose of the waste, such as through illegal dumping. They may even deprive legitimate disposal companies

of their economic base. Accordingly, when a national government establishes appropriate regulatory standards and local governments enforce them properly, together they set the foundation for improving the quality of disposal and also for the sound operation of legitimate industrial waste disposal businesses.

Recently, the establishment of various legal systems for recycling and the difficulties in constructing new final disposal sites have further accelerated the trend towards recycling industrial waste as a resource rather than landfilling it. The industrial waste disposal industry has also shown a trend towards recycling through cooperative efforts with waste-generating businesses, giving birth to new industries. As a result of waste-generating businesses, industrial waste disposal companies and the government promoting recycling in a united manner, the final disposal amount of industrial waste residues after intermediate processing has decreased in Japan to about a quarter of the previous amount.

Industrial waste disposal processes could also include such options as a public sector monopoly on disposal services or the provision of disposal services only by regional exclusive companies that have been specially authorized by the public sector. However, such anticompetitive processes would not be expected to result in a diversified range of devices for recycling or higher rates of recycling. Although the most appropriate path forward will vary with national circumstances and local conditions, developing and implementing clear, transparent, and appropriate regulations would be a minimum requirement if the Japanese process is taken as a base.

d. Creating a virtuous cycle between the environment and the economy as a step towards sustainable production and consumption

When businesses take an interest in the quality of disposal as generators of industrial waste and come to engage in recycling assiduously in cooperation with disposal businesses, their cost burden for environmental measures increases. In order to have businesses establish environmental measures, it is important for society as a whole to take an interest in such business activities and for consumers to select green companies' products or services as well as environmentally friendly products, such as plainly wrapped products. Moreover, when financial institutions decide on investments or loans for companies, it is desirable for them to evaluate highly those companies that have demonstrated their interest in creating a recycling society. It is also important for the government, companies and citizens to cooperate in order to cultivate a society in which environmental friendliness is highly evaluated by the consumer and financial markets.

Through cooperation with the private sector, the Japanese national government developed an eco-label to affix on environmentally friendly products to assist consumers in decision-making. The Law Concerning the Promotion of Procurement of Eco-friendly Goods and Services by the State and Other Entities (Law on Promoting Green Purchasing) was enacted as well to promote the procurement of eco-friendly goods and services by the national and local governments.

There has also been an increase in the number of companies that have adopted an environmental management system to check their business activities. They communicate the status of their activities

to the public on a regular basis through environmental reports. In order to encourage such behaviour by industry, the Law Concerning the Promotion of Business Activities with Environmental Consideration by Specified Corporations, etc. by Facilitating Access to Environmental Information, and Other Measures (Law for Promotion of Environmental Consideration) was enacted to serve as the strategy for communicating companies' environmental information to society as a whole and for raising the level of public interest.

Consumer groups and NGOs have also been enthusiastically engaged in efforts to support sustainable production and consumption. They are also active in community-based environmental learning in cooperation with businesses and local governments.

e. **Coordination by local governments; motivation to create communities taking an environmental perspective**

Osaka City is a community that introduced industrial waste disposal through public sector involvement. Under the Waste Management and Public Cleansing Law enacted in 1970, businesses generating industrial waste dispose of it by consigning it to industrial waste disposal companies. However, as the private sector did not move forward in improving and constructing disposal-related facilities, there was concern that serious environmental impacts on the environment would arise should there be cases of improper disposal of hazardous industrial waste. Against this backdrop, the Osaka City government set up the Osaka Industrial Waste Disposal Corporation jointly with the Osaka prefectural government to improve and construct landfills and intermediate processing facilities.

While public sector involvement plays a key role, its involvement over the long term inhibits the development of private businesses and impedes waste reduction. Accordingly, it is necessary to set in advance the conditions under which the public sector will withdraw its involvement. In addition, when the government's withdrawal takes place, it is important to provide appropriate guidance to the businesses that generate waste in order to smooth the transition to disposal by the private sector.

When the public sector decides to initiate or withdraw from involvement in industrial waste disposal services, not only economic viability but also public utility are important. Public sector involvement should therefore be comprehensive, including regulations and guidance strategies rather than merely the systems for collecting, transporting and processing waste.

The cities of Kitakyushu and Kawasaki are both leading manufacturing areas in Japan. They also are known historically as cities that suffered from pollution, including air pollution and water contamination. However, the two cities have overcome this pollution by developing environmentally friendly technologies and systems to the point where they are now well respected as communities with successful urban development that takes an environmental perspective. Parts of Asia have areas with significant environment deterioration caused by rapid industrialization. The experience and efforts of Kitakyushu and Kawasaki are expected to be instructive for such communities. It can also be said that a mentality has been fostered in both of these cities whereby society welcomes spending money on environmental measures.

Kitakyushu has succeeded in creating industry-government-academia cooperation

in the process of overcoming pollution. As a result, research institutions including universities join measures proactively to help improve the quality of this collaboration. In concrete terms, one characteristic of Kitakyushu's efforts is its adoption of methods to reduce the environmental burden during each production process, in a way highly similar to the cleaner production approach advocated by UNEP.

In addition, in order to secure the financial resources for proactively promoting environmental measures including proper waste disposal and the Eco-town project, an "environmental future tax" has been imposed, whereby a tax of 1,000 yen (approximately US$10) is collected for each ton of industrial waste that is landfilled. This tax has resulted in reductions in the amount of landfilled industrial waste and has been utilized as a financial resource that support new measures, such as a grant-in-aid programme for technology being developed for the 'environmental future'.

Kawasaki has been working to achieve community-wide zero emissions not only through the introduction of new technologies for recycling and waste disposal but also through cooperation across the entire area and cooperation within local neighborhoods by industry. Under this system, one factory's waste is used as a resource in another nearby factory. Kawasaki is the first city in Japan to formulate and implement a plan for environmentally friendly urban development as an "Eco-town".

The first step in creating an Eco-town is to increase the eco-friendliness of companies by encouraging a switchover to factories that are in harmony with the environment. The second step is to increase the eco-friendliness of the area by aiming to achieve an eco-friendly area through cooperation among companies that are already working to be environmentally friendly. The third step is to undertake research to bring about a district that can develop sustainably with the environment as the cornerstone. The city encourages research for sustainable development, promotes cascading utilization of waste heat and fosters recycling efforts. The fourth step is to communicate information on the achievements of companies and districts to others. Under this step, accomplishments are publicized both domestically and overseas and technologies to conserve the environment and mitigate pollution are transferred to developing countries.

When launching efforts to create an Eco-town, it is important first to understand the major challenges in the area and decide upon policies to solve those challenges, as well as to accumulate the technologies that will be required. In addition, it is difficult to implement these efforts at a wide scale from the beginning. It is desirable to expand the efforts across a broader area after completing a trial implementation in a model area.

4.0.4 SUGGESTIONS FOR INDUSTRIAL WASTE MANAGEMENT IN DEVELOPING COUNTRIES, BASED ON JAPAN'S EXPERIENCE AND LESSONS LEARNED

Various suggestions on industrial waste management in developing countries can be made based on Japan's experience with such management and the lessons it has derived from its experiences. Developing countries could work to:

(1) formulate frameworks to address waste problems overall through cooperation among stakeholders, including the national

government, local governments, industry, academia, and citizens;

(2) establish systems that clarify the sharing of responsibility and costs for waste disposal;

(3) consider public sector involvement in waste disposal in situations in which the private sector industrial waste management system is inadequate;

(4) establish standards for proper recycling and disposal;

(5) enforce regulations on illegal dumping and improper disposal thoroughly;

(6) place priority on the 3Rs and heat recovery within industrial waste policies;

(7) develop frameworks for industrial waste disposal in accordance with policies, laws and regulations;

(8) develop the human resources that will be engaged in waste management;

(9) understand the problems in the country or city and develop and accumulate policies and technologies that will solve those problems;

(10) receive transfers of experience and technology in waste management or environment improvement from developed countries through international cooperation;

(11) foster voluntary environmental efforts by businesses generating waste and create a social environment that encourages such efforts; and/or

(12) promote measures to create a recycling society, such as the Eco-town project in Japan

4.0.5 CONCLUSION

Since the 1990s in particular, Japan has steered itself towards the creation of a recycling society in part by raising the priority of waste- and recycling-related policies within the national government. However, Japan's tremendous results were achieved not only through the national government establishing regulations and standards but also through the development of frameworks to be undertaken by society as a whole, including community creation by local governments and industrial circles and checking and cooperation by citizens and NGOs.

Thinking back about the transition to a recycling society, it appears to have been particularly valuable to achieve a change in society's way of thinking, as this factor led industrial waste-generating businesses to make voluntary efforts. It seems that such social change was largely influenced by three factors, namely, the assertive introduction of environmental management systems including ISO 14001 by industry; the use of supply chain management, under which companies critically examined their business partners' environment-related policies; and the engagement of even SMEs and local governments in environmental efforts. In 2010, the number of organizations registered for ISO 14001 screening in Japan surpassed 20,000, while the number of businesses certified under Eco Action 21, an ISO 14001-like certification system within Japan that targets SMEs, reached 5,600. In addition, according to a survey by Japan's Ministry of the Environment, the ratio of companies preparing "environmental reports" and publishing their environmental efforts to reduce waste or CO_2 in 2011 reached 55 per cent of listed companies and 25 per cent of unlisted companies.

Thus, it can be concluded that the changes in the way of thinking and cooperative efforts by individual entities have contributed significantly to the improvement of industrial waste management in Japan. It is hoped that Japan's experience and lessons can serve as a useful reference in industrial waste management conducted through the cooperation of many stakeholders. Japan's experience and lessons have the potential to be instructive for the creation of sustainable societies in Asian or other developing countries around the world, taking into consideration their individual situations and local conditions.

Glossary

Best available techniques (BAT): The latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting environmental and social impacts (UNEP, 2010a).

Best environmental practices (BEP): Practices that apply the most appropriate combination of environmental control measures and strategies.

Biodiversity: Biological diversity or biodiversity means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (CBD, 1992).

Brown economy: See green economy.

Bubble economy: A boom in Japan from the latter half of the 1980s through the early 1990s notable for soaring asset prices.

Carbon credit: Under the Clean Development Mechanism (CDM), defined in Article 12 of the Kyoto Protocol, a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) is allowed to implement an emission-reduction project in developing countries. Such projects can earn saleable certified emission reduction (CER) credits – or carbon credits, each equivalent to one ton of CO_2, which can be counted towards meeting Kyoto targets (UNFCCC, n.d.). See also **emissions trading** and **Clean Development Mechanism**.

Central Environmental Council: A council established within the Ministry of the Environment in accordance with Article 41 of the Basic Environment Law. It examines environmental rules and regulations in Japan and provides its views on environmental issues to the Prime Minister, the Environmental Minister and other relevant ministers. The council consists of both specialists and members representing local governments, business organizations, and labour unions, non-governmental organizations, and other civil society groups.

Clean Development Mechanism (CDM): Defined in Article 12 of the Kyoto Protocol, the CDM is intended to meet two objectives: (1) to assist parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the convention; and (2) to assist parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments. Certified Emission Reduction Units from CDM projects undertaken in Non-Annex I countries that limit or reduce GHG emis¬sions, when certified by operational entities designated by Conference of the Parties/Meeting of the Parties, can be accrued to the investor (government or industry) from parties in Annex B. A share of the proceeds from certified project activities is used to cover administrative expenses as well as to assist developing country parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation (UNEP, 2013c).

Cleaner production: The continuous application of an integrated preventive environmental strategy to processes, goods, and services to increase overall efficiency, and reduce risks to humans and the environment. Cleaner Production can be applied to the processes used in any industry, to goods themselves, and to various services provided in society. See also **resource efficient and cleaner production** (UNEP, 2010a).

Combined heat and power (CHP)/ decentralized combined heat and power (decentralized CHP): A system that generates power using fuel such as petroleum or natural gas and then uses the resulting waste heat for hot water service and heating/air-conditioning. Decentralized systems generate heat and power near to where they are used (Japan Waste Management & 3R Research Foundation, 2006).

Commercial municipal solid waste: Waste generated through business activities that is not designated as industrial waste under Japan's Waste Management Law (Japan Waste Management & 3R Research Foundation, 2006).

Decent jobs: Jobs that involve opportunities for work that is productive and delivers a fair income, security in the workplace, social protection for families, better prospects for personal development and social integration, freedom for people to express their concerns, organize and participate in the decisions that affect their lives and equality of opportunity and treatment for all women and men.

Dioxins and dioxin-like compounds (DLCs): Persistent environmental pollutants that are primarily by-products of industrial processes, including incineration, smelting, chlorine bleaching of paper pulp, and some types of chemical manufacturing, but may also result from certain natural processes, such as volcanic eruptions and forest fires. The term includes polychlorinated dibenzo-para-dioxins (PCDDs) and compounds with dioxin-like properties such as polychlorinated dibenzofurans (PCDFs) and polychlorinated biphenyls (PCBs). In Japan, they are regulated under the Law Concerning Special Measures against Dioxins (WHO, 2010).

Eco Action 21: A set of guidelines in Japan based on the ISO 14001 standards of the International Organization for Standardization. Eco Action 21 was formulated by the Ministry of the Environment of Japan to encourage environmental activities by small- and medium-sized enterprises, which often find certification under ISO 14001 standards to be a heavy burden. These guidelines set forth methods for business operators to adopt effective and efficient systems for environmental activities, then implement those activities, evaluate, and continually improve upon them, and finally report on the results to the public. Companies completing all the steps can apply for Eco Action 21 certification (Japan, MOE, 2004). See also **ISO 14001**.

Eco-industrial parks: See **industrial symbiosis**.

Eco-innovation: Eco-innovation is the development and application of a new business strategy that entails a combination of a new or significantly improved product (good/service), production process, organization and business model that will lead to better sustainability performance.

Eco-town project: Eco-towns in Japan originated in 1997 through a subsidy system established by the Ministry of International Trade and Industry and the Environment Agency of Japan (predecessors to Japan's current Ministry of Economy, Trade and Industry and the Ministry of the Environment). The project facilitates the development of an urban planning and environmental management approach for cities with industrial clusters based on the Zero Emissions Concept (METI, n.d.).

Ecodesign: Ecodesign aims at reducing the environmental impact of products (including energy consumption) throughout their entire life cycle (UNEP, 2010a).

Eco-labelling: A system in which products are required to be labelled with information about their impacts on health and the environment.

Ecological footprint: A measure of how much biologically productive land and water an individual, population or activity requires to produce all the resources it consumes and to absorb the waste it generates using prevailing technology and resource management practices. The ecological footprint is usually measured in global hectares (a common unit that encompasses the average productivity of all the biologically productive land and sea area in the world in a given year). Because trade is global, an individual or country's footprint includes land or sea from all over the world (UNEP, 2010a).

Economic instruments: A monetary incentive or disincen¬tive to act in a manner supportive of policy objectives (UNEP, 2010a).

Emissions trading: A market-based approach to achieving environmental objectives that allows those reducing greenhouse gas emissions below what is required, to use or trade the excess reductions to offset emissions at another source inside or outside the country. In general, trading can occur at the intra-company, domestic and international levels (IPCC, 2007). See also **carbon credit**.

Environment Agency of Japan: See **Ministry of the Environment of Japan**.

Environmental assessment: An assessment of the possible impacts that a proposed project may have on the environment, consisting of the environmental, social and economic aspects.

Environmental management system: An environmental management system (EMS) is part of an organisation's management system used to develop and implement its environmental policy and manage its interactions with the environment. A management system is a set of interrelated requirements used to establish policy and objectives, and to achieve those objectives it includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources (UNEP, 2010a). Guidelines and standards for EMSs include Eco Action 21 created by the Ministry of the Environment of Japan and ISO 14001. See also **Eco Action 21** and **ISO 14001**.

Extended producer responsibility (EPR): An environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle (UNEP, 2013c).

Green Cities Programme: A programme of the OECD to assess how urban green growth and sustainability policies can contribute to economic performance and environmental quality of metropolitan areas and thus enhance the contribution of urban areas to national growth, quality of life and competitiveness (OECD, n.d.).

Green economy; brown economy: A "green economy" is defined within UNEP's Green Economy Initiative as an economy that results in improved human well-being and social equity while significantly reducing environmental risks and ecological scarcities. In contrast, the conventional type of economy which is based on fossil fuels and results in resource depletion and a large amount of carbon emissions is referred to as a "brown economy" (UNEP, 2011b). See also **Green Economy Initiative**.

Green Economy Initiative: An initiative led by UNEP having three key components: promoting the Green Economy Report and related research to analyse the implications of green investment, providing advisory services on how to transition to a green economy, and engaging a wide range of stakeholders, including researchers, non-governmental organizations, and businesses, in implementing the Initiative (UNEP, n.d.). See also **green economy**.

Green growth: Green Growth is environmentally sustainable economic progress that fosters low-carbon, socially inclusive development. It articulates concise and clear entry points and policy approaches for making real gains in transferring to low-carbon development, synergizing climate action with development goals (UNEP, 2010a).

Heat recovery: Collecting and using thermal energy generated when waste is incinerated instead of using incineration solely as a means of disposing of waste.

High economic growth period: Period of dramatic economic growth in Japan from the mid-1950s to the beginning of the 1970s. Consumption rapidly increased and a social structure based on mass production, mass consumption and mass disposal emerged.

Impact assessment on the living environment: An assessment conducted under the Waste Management Law of Japan for forecasting and analysing the impacts of a planned waste treatment facility on the surrounding living environment, after identifying the current state of the living environment of the surrounding area. The results are used to consider measures to protect the living environment that are suitable in light of the current situation. The assessment is conducted for the atmospheric environment, the aquatic environment, noise, vibration and offensive odours (Japan, MOE Waste Management and Recycling Department, 2006).

Industrial symbiosis: The sharing and recycling of materials and energy between different industries in an integrated industrial complex or park, often referred to as an "eco-industrial park", in order to minimize waste and pollution. The symbiotic relationship also optimizes the activities of each individual industry. A well-known example of industrial symbiosis is Kalundborg Eco-Industrial Park in Denmark, the first such network in the world (Onishi and Fujita, 2005).

ISO 14001: A set of standards formulated by the International Organization for Standardization (ISO) that establish specifications for environmental management systems. The standards include items which must be complied with when trying to establish environmental management systems that are in line with ISO standards.

Itai-itai disease: A pollution-caused disease which occurred in areas around the Jinzu River in Toyama Prefecture, Japan in 1955. In the process of producing zinc from mined ores, water containing cadmium and other heavy metals was discharged into the river, contaminating rice paddies and well water in downstream areas. Residents who ingested the contaminated rice and water contracted the disease.

Japan Standard Industrial Classification (JSIC): A statistical standard in Japan that includes statistics broken down by industry and categorizes all economic activities related to the production or provision of goods and services (Japan, Ministry of Internal Affairs and Communications, 2008).

Kanemi rice bran oil disease incident: An incident which occurred in 1968 in Kitakyushu and other areas of western Japan. In the deodorization process for manufacturing rice bran oil by Kanemi Company in Kyushu, PCBs used as a heating medium leaked through corroded pipes and contaminated the oil, causing acute poisoning to those who ingested the contaminated oil. See also **polychlorinated biphenyl (PCB)**.

Life cycle: A product's passage through distinct stages from extraction of raw materials, manufacture, packaging, transport, distribution,

sale, use to end-of-life, when it enters into the waste management system and the later phases of the waste hierarchy.

Life cycle assessment (LCA): A tool to evaluate the environmental and social performance of products or services along their life cycle. See also **life cycle**.

Minamata disease: A pollution-caused disease that occurred in and around the city of Minamata in Kumamoto Prefecture, Japan in 1956. Methylmercury compounds contaminated wastewater from a plant that produced acetaldehyde, a raw material for plastics. These compounds accumulated in fish and shellfish, and local residents who ate such fish and shellfish developed nervous system diseases.

Ministry of Economy, Trade and Industry of Japan (METI): Japanese ministry whose areas of responsibility include economic and industrial development, particularly the improvement of economic vitality in the private sector and the smooth development of foreign economic relationships, as well as ensuring the efficient and stable supply of mineral resources and energy. The ministry was reorganized in 2001 from the Ministry of International Trade and Industry (MITI).

Ministry of the Environment of Japan (MOE, MOEJ): The Environment Agency of Japan was established in 1971 and upgraded in 2001 to become the Ministry of the Environment. Its areas of responsibility include the protection of the global environment, pollution prevention, the conservation and improvement of the natural environment and other types of environmental protection. The ministry's areas of responsibility also include ensuring the safety of nuclear energy research, development and utilization.

Ministry of Health, Labour and Welfare of Japan (MHLW): Japanese ministry responsible for waste management until the reorganization of Japan's ministries in 2001, at which time its waste management responsibilities were transferred to the Ministry of the Environment. The ministry of Health and Welfare merged with the Ministry of Labour in 2001 to form the Ministry of Health, Labour and Welfare.

Niigata Minamata disease: A pollution-caused disease similar to Minamata disease which occurred in the basin of Agano River in Niigata Prefecture in 1965, also referred to as "second Minamata disease".

Original equipment manufacturer (OEM): A company that designs, develops and manufactures products or components on behalf of another company, which then sells the items under its own brand name.

PDCA cycle: A management method where operational improvement activities are continually conducted by repeating a cycle of (1) making policies and plans ("plan"), (2) implementing ("do"), (3) checking ("check") and (4) correcting and revising ("act").

Persistent organic pollutants (POPs): Chemical substances that persist in the environment, bioaccumulate through the food web, and pose a risk of causing adverse effects to human health and the environment. It is a collective name for organic compounds including PCBs, dichlorodiphenyltrichloroethane (DDT), dioxins and dioxin-like compounds (DLCs). The Stockholm Convention on POPs (adopted in May 2001) aims to protect human health and the environment from persistent organic pollutants (Stockholm Convention, 2001).

Polluter pays principle (PPP): An environmental policy principle stating that those who cause or gen¬erate pollution should bear the cost of it. In the waste management context, the principle means that those who

generate waste should bear the cost of managing it so that it does not pose risks to human health and the environment. It is the basic principle for the pollution control measures in Japan's Basic Environment Act. The concept originated in a recommendation adopted by OECD in 1972 and is also found in the 1992 Rio Declaration on Environment and Development (UNEP, 2002; OECD, 1972).

Polychlorinated biphenyl (PCB): A man-made organic chemical formerly used for insulating and lubricating oil and other purposes due to its electric insulation and chemical and thermal stability. It became the focus of attention as a pollutant thought to damage human health and living environments because it remains intact in the environment for long periods, becomes widely distributed geographically, bioaccumulate in in the fatty tissue of humans and wildlife. In Japan, its use and import was discontinued in 1972. Its holders are required to store it appropriately and dispose of it appropriately at an early time (Japan Waste Management & 3R Research Foundation, 2006).

Reduce-reuse-recycle (3Rs): The 3R Initiative aims to promote the "3Rs" (reduce, reuse and recycle) globally so as to build a sound-material-cycle society through the effective use of resources and materials. Agreed upon at the G8 Sea Island Summit in June 2004, it was formally launched at a ministerial meeting in Japan in the spring of 2005. Reducing means choosing to use things with care to reduce the amount of waste generated. Reusing involves the repeated use of items or parts of items which still have usable aspects. Recycling means the use of waste itself as resources. Waste minimization can be achieved in an efficient way by focusing primarily on the first of the 3Rs, "reduce," followed by "reuse" and then "recycle" (UNEP, 2010a).

Resource efficiency: The goal of resource efficiency is to rethink the life-cycle of a product from the perspective of the resources that go into each stage, since losing resources as waste is inefficient. That may include rethinking the entire design and asking whether the functions that the product provides to the consumer can be delivered in some other way.

Resource efficient and cleaner production (RECP): RECP reduces environmental impact and pollution by minimizing the use of resources to lessen waste within the production system. These strategies attempt to exemplify a preventive stance towards environmental management, choosing pollution prevention rather than end-of-pipe treatments. Measures include adoption of environmentally sound technologies, introduction of process modification and substitution of raw materials.

Sulfur oxides: The collective name for sulfur an oxygen containing compounds, notably sulfur dioxide (SO_2) and sulfur trioxide (SO_3), generated by the combustion of the sulfur content in fuels. Sulfur oxides are abbreviated as SOx. Sulfur dioxide is a common pollutant that can injure the respiratory system and is a major precursor to acid rain. Most of the sulfur oxides contained in combustion gases are SO_2, but part of the SO_2 is oxidized in the air and becomes SO_3 (Japan Waste Management & 3R Research Foundation, 2006).

Smart city: A city or an area which has social infrastructure that has been streamlined and upgraded using information and communications technologies (ICT), environmental technologies and other advanced technologies.

Sound material-cycle society: A society where consumption of resources is reduced and environmental impacts are minimized, through preventing or reducing the generation of waste by promoting cyclical use as circulative resources and ensuring the appropriate

disposal of what cannot be put into cyclical use (Japan, Basic Act, 2000).

Supply chain: The process from the raw material stage to the point where products or services are delivered to consumers.

Value chain: A tool for analysis and strategic planning in which business activities are classified into processes. The processes are analysed to find where value is added, determine which aspects of the activities have strengths and weaknesses, examine the effectiveness of business strategies, and look for means of improvement.

Waste (general waste; industrial waste): In Japan, the Waste Management and Public Cleansing Law, enacted in 1970, defines waste as "garbage, bulky trash, [and] ...other unclean or unnecessary things that are solid or liquid." The Law also designates 20 types of waste discharged as a result of business activities that may pollute the environment (cinders, sludge, waste oil, waste acid, waste alkali, waste plastics, rubber scraps, metal scraps, refuse glass and ceramics, animal and plant residue, waste paper, wood chips, waste textiles, slag, debris, excretions from livestock, corpses of domestic animals, dust, unnecessary animal solids, and what is left by disposing of the industrial waste listed above) as "industrial waste" and other types of waste as "general waste" (commercial municipal solid waste).

Waste-to-energy: Recovering energy in the form of electricity or heat from waste.

Yokkaichi asthma: A pollution-caused disease that occurred in the city of Yokkaichi in Mie Prefecture, Japan from the early 1960s into the early 1970s. Sulfur, heavy metals, and nitrogen oxide contained in soot and smoke discharged from the city's petrochemical complex polluted the air, causing local residents to develop asthma.

Zero emissions: A concept put forward by the United Nations University in 1994 that all industrial inputs can be completely converted into a final product and that waste products can be converted into value added inputs for another chain of production. Manufacturing is therefore viewed as a series of production cycles and recycling systems. The aim is to transition from societies based on mass production, mass consumption and mass disposal to sustainable, recycling-based societies. Although it is difficult for a single company to eliminate waste, society as a whole can achieve zero waste emissions through different industries utilizing waste generated by other industries as raw materials (UNU-IAS, 2013).

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About the UNEP Division of Technology, Industry and Economics

Set up in 1975, three years after UNEP was created, the Division of Technology, Industry and Economics (DTIE) provides solutions to policy-makers and helps change the business environment by offering platforms for dialogue and co-operation, innovative policy options, pilot projects and creative market mechanisms.

DTIE plays a leading role in three of the six UNEP strategic priorities: **climate change, chemicals and waste, resource efficiency**.

DTIE is also actively contributing to the **Green Economy Initiative** launched by UNEP in 2008. This aims to shift national and world economies on to a new path, in which jobs and output growth are driven by increased investment in green sectors, and by a switch of consumers' preferences towards environmentally friendly goods and services.

Moreover, DTIE is responsible for **fulfilling UNEP's mandate as an implementing agency for the Montreal Protocol Multilateral Fund** and plays an executing role for a number of UNEP projects financed by the Global Environment Facility.

The Office of the Director, located in Paris, coordinates activities through:

> **The International Environmental Technology Centre** – IETC (Osaka), which promotes the collection and dissemination of knowledge on Environmentally Sound Technologies with a focus on waste management. The broad objective is to enhance the understanding of converting waste into a resource and thus reduce impacts on human health and the environment (land, water and air).
> **Sustainable Consumption and Production** (Paris), which promotes sustainable consumption and production patterns as a contribution to human development through global markets.
> **Chemicals** (Geneva), which catalyses global actions to bring about the sound management of chemicals and the improvement of chemical safety worldwide.
> **Energy** (Paris and Nairobi), which fosters energy and transport policies for sustainable development and encourages investment in renewable energy and energy efficiency.
> **OzonAction** (Paris), which supports the phase-out of ozone depleting substances in developing countries and countries with economies in transition to ensure implementation of the Montreal Protocol.
> **Economics and Trade** (Geneva), which helps countries to integrate environmental considerations into economic and trade policies, and works with the finance sector to incorporate sustainable development policies. This branch is also charged with producing green economy reports.

DTIE works with many partners (other UN agencies and programmes, international organizations, governments, non-governmental organizations, business, industry, the media and the public) to raise awareness, improve the transfer of knowledge and information, foster technological cooperation and implement international conventions and agreements.

For more information,
www.unep.org/dtie

The Japanese industrial waste experience: Lessons for rapidly industrializing countries, ***developed with the financial support of the Ministry of Foreign Affairs of Japan, analyses the Japanese case and highlights the potential relevance of Japan's experience in industrial waste management for sustainable development in rapidly industrializing countries.***

The Japanese industrial waste experience ***gives an overview of the industrial waste situation in Japan in the late 20th century. Concrete examples of how the industrial waste challenge has been tackled in Japan are provided by the national government, local government entities, and the private sector. They give an insight into the historical developments and processes that led to the change in dealing with industrial waste in a more sustainable way. Some of the approaches applied in Japan have already been echoed in international initiatives.***

The sharing of experiences and lessons learned from the Japanese case is intended to expand the menu of policy options for consideration by decision-makers in rapidly industrializing countries. Assisting these countries in finding solutions to the environmental challenges associated with rapid economic growth is critical on the path to sustainable development.

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