

## **Economic and Employment Impact Assessment of Green Investment:**

A case study on Environmental Goods and Services Sector (EGSS) in Japan



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July 2015

Cover design by Xin Zhou.

## Summary

The Rio+20 United Nations Conference on Sustainable Development identified green economy as one of the important tools for achieving sustainable development, which can provide great opportunities to the transition to a new global paradigm of economic growth. Mobilising economy-wide investments in green sectors and to the greening of brown sectors is vital to green economy transition.

In Japan, green economy was defined by the Japanese Government as “an economic system which promotes sustainable growth while improving human welfare through pursuing economic growth and conserving the environment at the same time, as well as utilising natural resources and ecosystem services properly”. Technological innovation and the role of environmental industry as a new engine for economic growth are the centerpiece for achieving a green economy. The Environmental Goods and Services Sector (EGSS) has been considered as a key element for addressing these priorities. Assessing the economic and employment impacts of EGSS is one of the effective ways of measuring the progress in “greening” the economy.

The EGSS framework developed by the Eurostat which was embedded in the System of Environmental-Economic Accounting Central Framework provides descriptions and specifications on the activities which are classified as environmental activities. The document can be used as a guidance for estimating the share of green economic activities in national GDP and indicating their contributions to economic and social development in terms of revenue, value-added, employment and exports. The EGSS framework has been used in many EU countries as well as in several developing countries. In Japan, statistics on major indicators of environmental industry, started from 2000, followed the definition and methodology provided by the Organisation for Economic Co-operation and Development in 1999 which covers three broad categories of EGSS, i.e. pollution management, cleaner technologies and production and resource management. In 2012, classification of environmental industry was revised in Japan to reflect recent development in climate change mitigation and special characteristics of solid waste management, in particular the 3Rs (Reduce, Reuse and Recycling).

The purpose of this paper is to conduct quantitative assessment on the development trend of EGSS in Japan and its economic and employment impacts by using detailed environmental industry statistics and national input-output tables.

Results indicated that though originally aiming at reducing GHG emissions, enhancing energy security and attaining stricter environmental standards, EGSS generated an output of JPY 150 trillion and absorbed nearly 4 million workers directly and indirectly in 2012. With better multiplier effects than the national average in terms of both economic outputs and job creation, EGSS contributed substantially to achieving the 2020 goals set in the Japan's **2010 New Growth Strategy** and can be considered as a new engine for Japan's sustainable economic growth.

Specifically, among all EGSS in 2012, the building sector, in particular reform and repair, generated the largest economy-wide outputs, both directly from the sector itself and

indirectly from other sectors through inter-sectoral transactions. The building sector also had the largest employment impacts by absorbing one million workers both directly within the sector itself and indirectly through other sectors. On the other hand, eco-cars manufacturing sector had the largest output multiplier and the largest employment multiplier, indicating its superior payback from investment in terms of the expansion of economic scale and job creation when looking from broader economy-wide perspective.

## Acknowledgements

This study was conducted under the financial support from the Grants-in-Aid for Scientific Research provided by the Japan Society for the Promotion of Science (JSPS) (Project no. 25281073). An early version of this paper showing the preliminary results and analysis was presented as a full paper at the 23<sup>rd</sup> International Input-Output Conference held on 22-26 June 2015 in Mexico City. We would like to thank Sry Bopharath, an IGES intern from January to March, 2015, who assisted on data preparation work. We are grateful to our team assistant, Saeko Kadoshima, who assisted on logistics management. Thanks are also given to Yoshinobu Fujiwara who helped project management and financial accounting work. Last but not least, Emma Fushimi helped proofreading this paper.

## 1. Background

The 2011 earthquake and the ensuing tsunami and disaster at the Fukushima nuclear power plant has put Japan at a crossroads in choosing its future growth and development policies. The country has already been facing challenges relating to its economy, society and demography. Added to these are the new issues emerging from the 2011 disaster - reconstructing the affected areas, ensuring energy security, and at the same time achieving its commitment to reduce carbon emissions. Japan intends to address these challenges through an innovative and forward-thinking approach so as to stimulate and revitalise the economy (NPU, 2012).

Although Japan does not have any particular policy that explicitly focuses on green growth and green economy, several recently adopted policies and strategies incorporate various aspects of greening the economy. In 2007, Japan adopted its **Strategy for a Sustainable Society** (Government of Japan, 2007). Aiming at “Becoming A Leading Environmental Nation in the 21<sup>st</sup> Century”, the Strategy identified several priorities for Japan, including taking a leading role in combatting climate change, conserving biodiversity, creating sustainable material cycles, promoting international cooperation, putting environmental technologies at the centre of economic growth, promoting the proper utilisation of nature, fostering environment-related education, and creating a system to support Japan’s effort to become a leading environmental nation (Government of Japan, 2007). At the same time, it was felt that Japan should strengthen its policies for putting greater effort in emissions reduction. As a result, another strategy, “Toward a Low Carbon Society” was adopted in 2008, which puts emphasis on improving the **Kyoto Protocol Target Achievement Plan** and also on strengthening Japan’s domestic policies.

A major “green” focus occurred when Japan adopted the **New Growth Strategy** in June 2010 (GOJ, 2010). Unlike previous policies, this new Strategy focuses on demand-driven growth to revitalise the economy instead of stressing supply side measures to increase productivity (GOJ, 2010). It aims at fostering demand and creating job opportunities by turning Japan’s ensuing social, environmental, and demographic problems (e.g., aging society and climate change) into growth-enhancing opportunities. The New Growth Strategy identifies seven strategic/priority areas (OECD, 2011). Green Innovation is identified as one priority area, together with Live Innovation, Asian Economic Integration, Tourism and Local Revitalization, Science, Technology and IT, Employment and Human Resources and Financial Sector.

The New Growth Strategy aims at generating new demands amounting as much as JPY 50 trillion and 1.4 million new job opportunities by developing and diffusing green technologies (OECD, 2011). The Strategy also envisions achieving Japan’s greenhouse gas (GHG) emissions reduction target (25% by 2020 against 1990 levels). The initiatives under green innovation strategic area are: (i) introducing a feed-in-tariff system to expand the renewable energy market; (ii) using Future City Initiative to promote the use of eco-products and services; and (iii) revitalising forestry and raising the self-sufficiency ratio

to over 50% (GOJ, 2010).

Green innovation is the crux of Japan's concept of green economy. In the *Input to the Rio+20 Outcome Document*, Japan emphasised that for transitioning to a green economy, "various means and experiences including green innovation should be shared by each country" (GOJ, 2011). This is consistent with Japan's Ministerial Committee on the Global Warming Issue's introduction of a green innovation strategy, which aims at developing environmental technologies (OECD, 2011).

Following the Fukushima accident, Japan was forced to rethink its growth and development strategies. In 2012, the country adopted the *Innovative Strategy for Energy and Environment*. The Innovative Strategy is based on three pillars that reflect national debates that followed the 2011 nuclear accident. The second pillar emphasises the realisation of green energy revolution (Energy and Environment Council, 2012).<sup>1</sup> The Innovative Strategy also reinforces the *Comprehensive Strategy for the Rebirth of Japan*, adopted the same year (NPU, 2012). The Comprehensive Strategy builds upon four key policy areas: green (energy and environment); life (health); agriculture, forestry and fisheries; and small and medium enterprises. It provides the following policy package to realise innovative strategy and environment society (NPU, 2012): i) Chain of technological innovation (automobile/ transportation, housing, urban development etc.); ii) Smart community (distributed energy system, renewable energy, storage batteries, etc.); iii) Review of regulations and systems, tax incentives; and iv) Share with the world green technology, energy systems and possible solutions for energy issues.

The Comprehensive Strategy of 2012 also provides relevant strategies including 2020 goals for the identified priority areas. The strategies for the green (energy and the environment) area thus effectively stipulate Japan's green growth strategy. The 2020 goals set forth for this priority area includes next-generation vehicles, electric vehicles, storage batteries in the global market, zero-energy housing and commercial buildings, etc. (NPU, 2012). The strategies for this area include promoting "green" parts and materials as a driving force for Japan's green growth, enhancing the development of next generation vehicles, promoting widespread use of storage batteries, enhancing the development and use of marine and offshore resources (floating wind turbines, natural gas and algae for bioethanol), and enhancing the energy management systems (NPU, 2012).

Japan's green growth strategies are also supported by several market-based instruments such as taxes and subsidies that discourage carbon-intensive production and consumption patterns, and provide incentives for low-carbon or carbon-neutral patterns (METI, 2012; MOEJ, 2012a-e).

The review of Japanese policies and strategies related to green growth/economy makes it clear that technological innovation and the role of environmental industry as a new engine of growth have been stressed as priority areas. The Environmental Goods and Services Sector (EGSS) is thus a key element for addressing these priorities. This is

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<sup>1</sup> The other two pillars are "realization of a society not dependent on nuclear power in earliest possible future" and "stable supply of energy". For more information, see Energy and Environment Council (2012).

consistent with global initiatives on green economy. Assessing the economic and employment impacts of EGSS can be considered as an effective way of measuring the progress in “greening” the economy.

The EGSS framework developed by the Eurostat (2009) which is embedded in the System of Environmental-Economic Accounting (SEEA) Central Framework (UNEP, 2014) provides descriptions and specifications of the activities which are classified as environmental activities. The document can be used as a guide for estimating the share of green economic activities in national GDP and indicating their contributions to economic and social development in terms of revenue, value-added, employment and exports. The EGSS framework has been used in many EU countries as well as in several developing countries. In Japan, statistics on major indicators in the environmental industry, started from 2000, followed the definition and methodology provided by the Organisation for Economic Co-operation and Development (OECD) which covered three broad categories of EGSS, i.e. pollution management, cleaner technologies and production and resource management (OECD, 1999). In 2012, the classification of environmental industry was revised in Japan to reflect recent development in climate change mitigation and special characteristics of solid waste management, in particular the 3Rs (Reduce, Reuse and Recycling) (MOEJ, 2012f). Statistics were updated accordingly for the period from 2000 to 2012 in terms of market size, employment, value added, imports and exports (MOEJ, 2014).

The purpose of this study is to conduct quantitative assessment on the development trend of EGSS in Japan and its economic and employment impacts. We used detailed Japanese statistics on environmental industry (2000-2012) and Japan’s input-output (IO) tables (2000, 2005, 2009, 2010, 2011 and 2012, respectively). To use the statistics on environmental industry for input-output analysis (IOA), we developed a methodology to map the EGSS sectors (207 products & services/sectors) with IO sectors (104 sectors in the 2000 IO table, 108 sectors in the 2005 IO table and 80 sectors in the 2009-2012 IO tables). The economy-wide impacts (both directly from EGSS sectors and indirectly from other sectors through inter-sectoral transactions) in terms of economic outputs and employment were assessed based on multiplier analysis. Using the employment matrix in terms of sectoral occupation, we analysed skills and occupation distribution in Japan related to EGSS.

This paper is organised into four sections. Section 2 explains the methodology followed by the presentation of the results in Section 3. Section 4 concludes the paper.

## **2. Methodology**

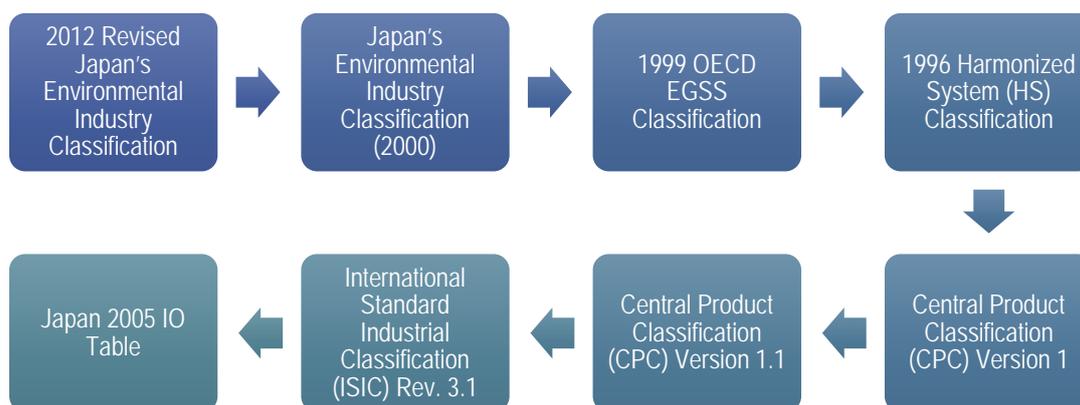
In this study, we used multiplier analysis based on Japanese IO tables for assessing the impacts on the economy and employment that generated from EGSS development. First, EGSS sectors based on the 2012 Revised Japan’s Environmental Industry Classification (MOEJ, 2012f) are mapped with the sectors defined in the Japanese IO tables. It is then possible to use environmental industry statistics on the market size and employment for

IOA. Then economic output multipliers and employment multipliers are calculated to assess the impacts of the investment in EGSS following an ex-post fashion of analysis based on historical statistics of EGSS (2000-2012). In addition, based on national employment and occupation distribution statistics, skills and occupation needs due to new employment or the changes in employment in all economic sectors induced by the development of EGSS are estimated.

### *2.1 Correspondence of EGSS sector classification and IO sector classification*

Sound green economy assessments must be underpinned by high-quality scientific environmental, social and economic data (UNEP, 2012). Several challenges prevail in applying environmental statistics to classic economic modelling exercise, e.g. input-output analysis, for quantitative policy assessment. First, deficiencies in scientifically credible data on the environment, in particular time series, are a major handicap in developing evidence-based policies (UNEP, 2012; OECD, 2011). Particularly, limited data are available on issues such as environmental expenditures, green investments, green gross domestic product accounting, trends in and effectiveness of payment for ecosystem service schemes, environmental crimes and environmental policy effectiveness (UNEP, 2012). Second, due to a lack of international standards for harmonised approaches for environmental statistics, including EGSS statistics, different countries often use different approaches to produce data on the same issue, making it difficult to compare or generate regional and global data. Third, due to the lack of consistent environment-economy accounting framework, while there is a substantive amount of economic and also environmental data, it is often difficult to combine them due to differences in classifications, terminology or timeliness (OECD, 2011).

Related to the above-mentioned last two challenges, in the first place, we could not directly use the statistics of Japanese environmental industry for IO analysis even though the statistics are rich in information with broad coverage and consistent time series data. This is because there is no direct correspondence between the classification of Japanese environmental industry and IO sectors. These two classification systems were developed separately. Therefore, we need to ensure correspondence between EGSS classification and IO sector classification. To do so, the following steps were followed through the bridges of the correspondence of different classification systems on products or industrial sectors. Figure 1 presents the linkages of different sector classification systems.



**Figure 1 Preparation of the correspondence table for EGSS and IO sectors**

Source: The authors.

The 2012 Revised Japan's Environmental Industry Classification has four categories: A -Pollution Prevention and Control, B - Measures Combating Climate Change, C - Solid Waste Management and D - Resource Effective Utilization and Conservation of the Natural Environment (See Appendix 1). The correspondence between the 2012 Revised Japan's Environmental Industry Classification and the Japan's Environmental Industry Classification (2000) is provided by the MOEJ (MOEJ, 2012f) (see Appendix 2). The Japan's Environmental Industry Classification (2000) is based on the 1999 OECD manual for data collection and analysis of the environmental goods and services industry (OECD, 1999), in which the correspondence between EGSS classification and the commodity codes in Harmonized Commodity Description and Coding System (HS) is provided. On the other hand, the correspondence between the Japanese 2005 IO table (190 sectors) and the International Standard Industrial Classification Revised Version 3.1 (ISIC Rev. 3.1) is provided by the Government of Japan (Ministry of General Affairs of Japan, 2002). ISIC Rev. 3.1 has correspondence with the Central Product Classification Version 1.1 (CPC V1.1) which links with CPC V1. Finally, CPC V1 links with the 1996 HS Classification. The correspondence table between the 2012 Revised Japan's Environmental Industry Classification 2012 and the 2005 IO sector classification (190 sectors) is then established. VBA programming is developed to help map different classifications.

Japanese IO tables that are used for the impact assessment of EGSS development in this study include the 2000 IO table (104 sectors), the 2005 IO table (108 sectors) and the annually extended IO tables (80 sectors) for 2009-2012. Due to different sector resolutions in the IO tables, the correspondence table for the classification of 188 sectors and 104 sector of the 2000 IO table (Economic Industry Investigation Committee, 2004) and the correspondence table for the classification of 190 sectors, 108 sectors and 80 sectors (Economic Industry Investigation Committee, 2009) are used to map different IO tables (80 sectors for the IO tables 2009-2012, 104 sectors for the 2000 IO table and 108 sectors for the 2005 IO table) with the EGSS and environmental industry statistics.

## 2.2 Data

Data used for the impact assessment is summarised in Table 1.

**Table 1 Data and sources**

No.	Data description	Source
1	Market size of EGSS (based on the 2012 Revised Japan's Environmental Industry Classification)	MOEJ, 2014
2	Employment in the EGSS (based on the 2012 Revised Japan's Environmental Industry Classification)	MOEJ, 2014
3	2000 IO table (104 sectors)	Ministry of General Affairs of Japan website
4	2005 IO table (108 sectors)	Ministry of General Affairs of Japan website
5	IO tables (2009-2012) (80 sectors)	Ministry of Economy, Trade and Industry ( METI ) website
6	Employment data for the 2000 IO table (104 sectors)	Ministry of General Affairs of Japan website
7	Employment data for the 2005 IO table (108 sectors)	Ministry of General Affairs of Japan website
8	2000 sectoral occupation matrix (104 sectors)	Ministry of General Affairs of Japan website
9	2005 sectoral occupation matrix (108 sectors)	Ministry of General Affairs of Japan website

## 2.3 Multiplier analysis

Multiplier analysis is used to assess the economic impacts (in terms of economic output) and employment impacts (in terms of number of workers) of per unit demand of (or investment in) EGSS on other sectors and on the economy as a whole. Japanese IO tables (2000, 2005, 2009-2012) are import non-competitive industry-by-industry type of IO models. In order to assess the domestic impacts generated by EGSS, we modify the IO models into import-competitive type (see Eqs. 1 - 2).

$$X = [I - (I - \hat{M})A]^{-1} F = BF \quad (1)$$

$$E = \hat{e}BF \quad (2)$$

In Eq.1,  $X$  is the vector of sectoral outputs;  $A$  is the technical coefficients;  $\hat{M}$  is the diagonal matrix of import ratios,  $m_i$ , defined as sectoral imports divided by sectoral outputs;  $(I - \hat{M})A$  is therefore domestic input coefficients;  $B$  is the Leontief multiplier matrix with each element  $b_{i,j}$  representing the required outputs from sector  $i$  to satisfy per unit final demand/investment of sector  $j$ ;  $F$  is the vector of sectoral final demand.

In Eq.2,  $\hat{e}$  is the diagonal of sectoral employment ratios,  $\hat{e}_i$ , defined as number of employees per unit sectoral output;  $\hat{e}B$  is therefore the employment multiplier matrix with each element  $\hat{e}_i b_{i,j}$  representing the number of employees working in sector  $i$  that induced by per unit final demand/investment of sector  $j$ ;  $E$  is the vector of the number of workers that induced by the final demand from all sectors,  $F$ .

For each EGSS sector,  $k$ , we used the output multiplier and the employment multiplier of its correspondence sector  $j-k$  in the IO tables, i.e.  $b_{i,j-k}$  and  $e_i b_{i,j-k}$  to estimate the output and employment impacts generated on sector  $i$  due to the final demand/investment of each EGSS sector  $j-k$ . See Eqs. 3 - 4.

$$x_i = b_{i,j-k} g_k \quad (3)$$

$$e_i = \hat{e}_i b_{i,j-k} g_k \quad (4)$$

$x_i$  and  $e_i$  are the outputs and number of employees of each economic sectors in the IO table generated from the final demand of each EGSS sector,  $g_k$ .

The statistical data on Japanese environmental industry (2000-2012) (see Appendix 3 for the statistics classification) are collected from supply side enterprises including the market size (turnover), employment, value-added, exports and imports. Demand side data is not available. To estimate the final demand of EGSS,  $g_k$ , we multiply the market size of each EGSS sector,  $Q_k$ , by the final demand ratio  $r_{j-k}$  calculated by dividing the sectoral final demand by the sectoral total output.

Data used to calculate the output multipliers, employment multipliers, and the final demand of EGSS sectors,  $g_k$ , for the years 2000-2012 is provided in Table 2.

**Table 2 Data used for multiplier analysis**

<b>Years</b>	<b>Output multipliers</b> ( $b_{i,j-k}$ )	<b>Employment ratios</b> ( $\hat{e}_i$ )	<b>Final demand ratios</b> ( $r_{i-k}$ )	<b>Market size of EGSS</b> ( $Q_k$ )	<b>Occupation distribution ratios</b> ( $o_{i,s}$ )
2000-2004	2000 IO table (104 sectors)	Employment data for the 2000 IO table (104 sectors)	2000 IO table (104 sectors)	Yearly environmental industry statistical data (2000-2004).	2000 sectoral occupation matrix (104 sectors)
2005-2008	2005 IO table (108 sectors)	Employment data for the 2005 IO table (108 sectors)	2005 IO table (108 sectors)	Yearly environmental industry statistical data (2005-2008).	2005 sectoral occupation matrix (108 sectors)
2009	2009 IO table (80 sectors)	Re-estimated for 80 sectors based on the employment data for the 2005 IO table (108 sectors)	2009 IO table (80 sectors)	Yearly environmental industry statistical data (2009).	Re-estimated for 80 sectors based on the 2005 occupation matrix (108 sectors)
2010	2010 IO table (80 sectors)	Re-estimated for 80 sectors based on the employment data for the 2005 IO table (108 sectors)	2010 IO table (80 sectors)	Yearly environmental industry statistical data (2010).	Re-estimated for 80 sectors based on the 2005 occupation matrix (108 sectors)
2011	2011 IO table (80 sectors)	Re-estimated for 80 sectors based on the employment data for the 2005 IO table (108 sectors)	2011 IO table (80 sectors)	Yearly environmental industry statistical data (2011).	Re-estimated for 80 sectors based on the 2005 occupation matrix (108 sectors)
2012	2012 IO table (80 sectors)	Re-estimated for 80 sectors based on the employment data for the 2005 IO table (108 sectors)	2012 IO table (80 sectors)	Yearly environmental industry statistical data (2012).	Re-estimated for 80 sectors based on the 2005 occupation matrix (108 sectors)

#### 2.4 Occupation need assessment

The sectoral occupation matrix is used to calculate sectoral occupation distribution ratios,

$o_{i,s}$ , by dividing the number of employees of each occupation category by the total number of sectoral employees.  $o_{i,s}$  is then used to calculate the total number of employees of each occupation category induced by the final demand/investment of EGSS.

### 3. Results

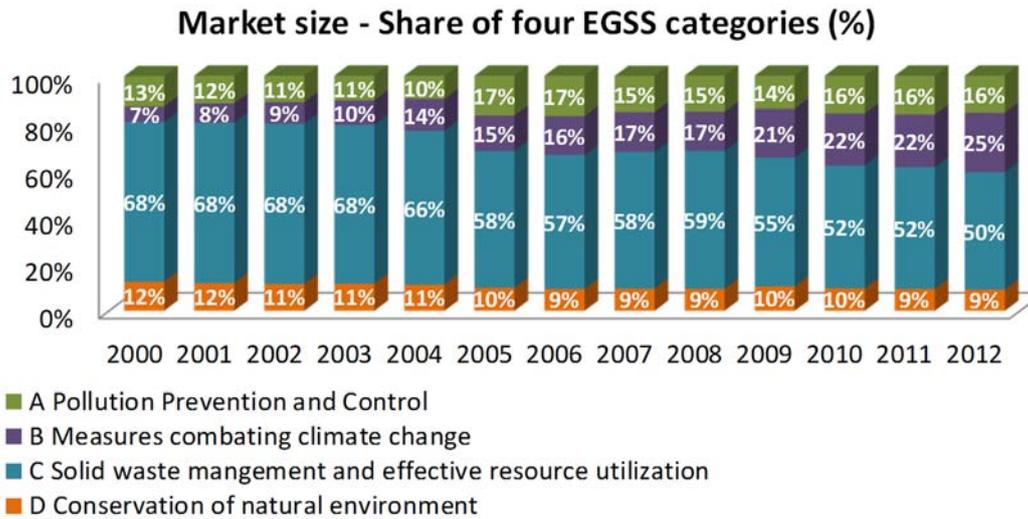
#### 3.1 Development trend of EGSS

The historical trend of EGSS development from 2000 to 2012 in term of market size is presented in Figure 2 and Figure 3. The market size of EGSS underwent some fluctuations by growing slowly from 2000 to 2003, reaching JPY 60 trillion in 2004, then increasing drastically from 2005 and steadily and reaching JPY 80 trillion in 2007. After peaked in 2008, it dropped dramatically down to less than JPY 75 trillion in 2009 due to the economic downturn but recovered steadily from 2010 and reached JPY 86 trillion again. In 2012, the market size of environmental industries in Japan valued at JPY 86 trillion, equivalent to 17% of GDP, attributing to the increase in Category B, Measures Combating Climate Change, and in C, Solid Waste Management and Effective Resource Utilization. Estimated value-added was about JPY 37 trillion, accounting for 7.8% of nominal GDP 2012. Imports were estimated as JPY 2 trillion and exports were estimated as JPY 9 trillion.



**Figure 2 Market size of EGSS (2000-2012)**

Source: Compiled by the authors based on the statistical data of MOEJ (2014).

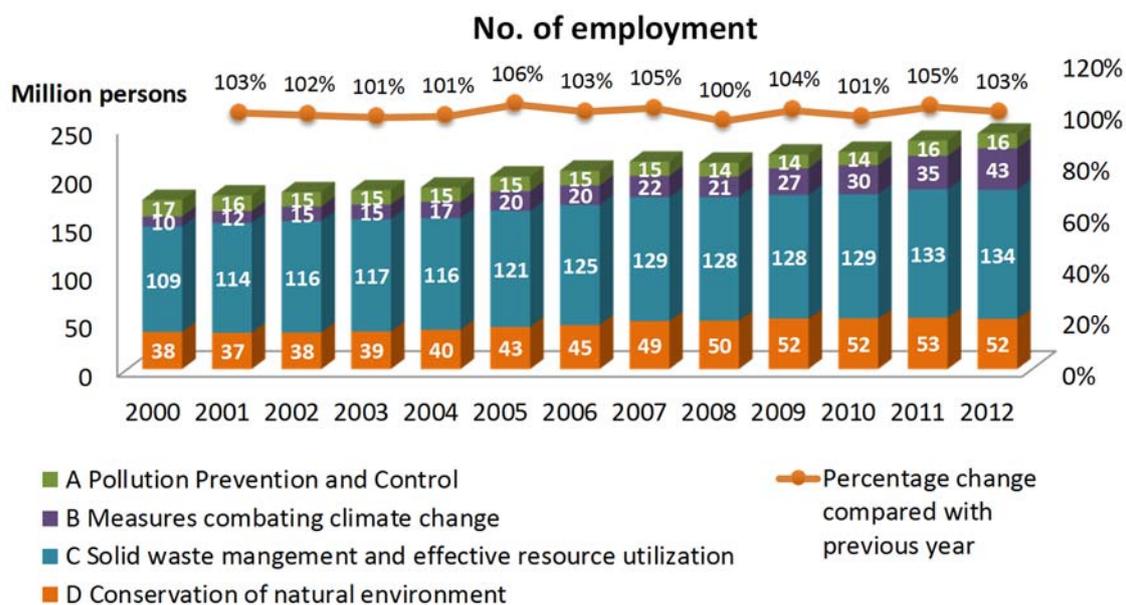


**Figure 3 Share of four categories in the market size of EGSS (2000-2012)**

Source: Compiled by the authors based on the statistical data of MOEJ (2014).

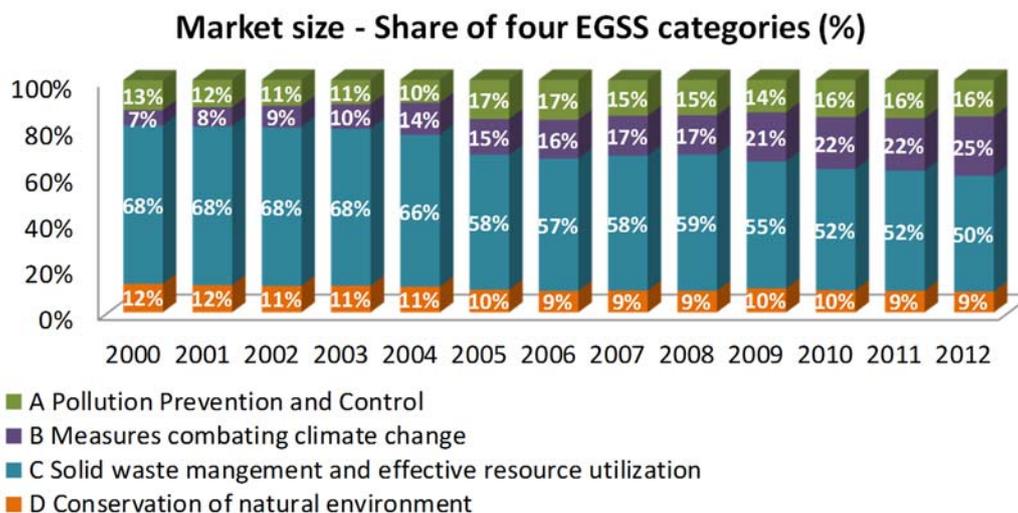
From structural change viewpoint, Category A, Pollution Prevention and Control, grew dramatically in 2005 mainly due to the start of sulphur-free gasoline and diesel supply in the same year. Category B, Measures Combating Climate Change, grew steadily from 7% in 2000 to 25% in 2012. In contrast, Category C, Solid Waste Management and Effective Resource Utilization, and Category D, Conservation of the Natural Environment, decreased in terms of percentage share.

Employment numbers in EGSS and the share of each category are presented in Figure 4 and Figure 5. From 2000 to 2012, employment grew steadily from 1.8 million people in 2000 to 2.4 million in 2012. The employment in Category C was the largest among four EGSS categories but its share in the total employment in EGSS had been decreasing. In contrast, employment in Category B, Measures Combating Climate Change, increased by four times from 0.1 million in 2010 to 0.4 million in 2012.



**Figure 4 Employment in EGSS (2000-2012)**

Source: Compiled by the authors based on the statistical data of MOEJ (2014).



**Figure 5 Share of four categories in EGSS employment (2000-2012)**

Source: The authors compiled based on the statistical data of MOEJ (2014).

### 3.2 Economic and employment impacts of EGSS development in Japan

#### 3.2.1 Economy-wide output impacts of EGSS development

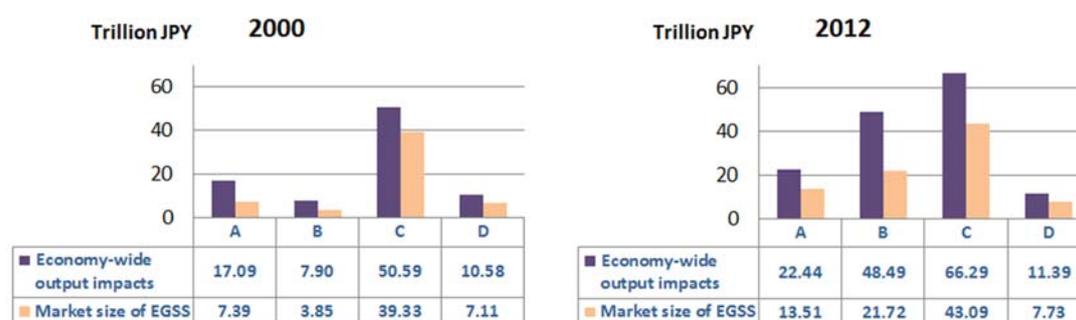
Output multipliers of four EGSS categories are presented in Table 3 (2000 vs. 2012). Among four EGSS categories, B - Measures Combating Climate Change has the largest output multiplier (2.28 in 2012), followed by C - Solid Waste Management and Effective Resource Utilization (1.78 in 2012). Among all EGSS sectors, eco-cars, including highly

efficient and low-emission vehicles, electric vehicles, hybrid vehicles, LNG vehicles and fuel cell vehicles, had the highest sectoral output multipliers (3.05) in 2012, followed by eco-driving related facilities (2.91). The building sector (reform and repair) had the largest economy-wide total output impacts generating about JPY 12 trillion in 2012. In addition, the average multiplier of EGSS was 1.86 in 2000 and 1.91 in 2012, both higher than those of an average economic sector.

**Table 3 Average output multipliers of four EGSS categories**

Output Multipliers	A	B	C	D	EGSS average	Economy-wide average
2000	1.97	2.12	1.72	1.84	1.86	1.70
2012	1.52	2.28	1.78	1.71	1.91	1.65

Figure 6 presents the direct and indirect output impacts of four EGSS categories in a comparative way for 2000 and 2012. The total economic impacts in terms of economic outputs, including both generated directly from EGSS and indirectly generated from other sectors induced by the development of EGSS, were JPY 86 trillion in 2000 and nearly JPY 150 trillion in 2012. Among four categories, Category C, Solid Waste Management and Effective Resource Utilization, contributed to almost 45% to the total impacts in 2012, followed by Category B, Measures Combating Climate Change (32%).



**Fig. 6 Comparison of direct and economy-wide output impacts of EGSS**

### 3.2.2 Employment impacts of EGSS development in Japan

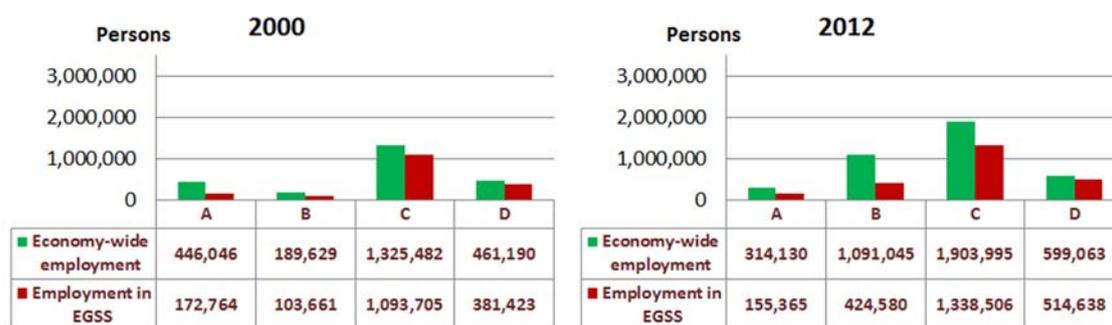
Employment multipliers of four EGSS categories are presented in Table 4 (2000 vs. 2012). The average employment multiplier of EGSS was 1.68 in 2000 and 1.84 in 2012, both higher than those of an average economic sector, similar to the case of output multipliers. Among four categories, Category B, Measures Combating Climate Change (2.36), had the highest employment multiplier in 2012, followed by Category A, Pollution Prevention and Control (1.84). Among all EGSS sectors, eco-cars (9.3) had the highest employment multiplier in 2012 followed by sulphur-free petroleum (6.5). The building sector (reform and repair) had the largest total economy-wide employment impacts,

engaging about 1 million workers in total, including workers in the sector itself and those working in other sectors induced by the demand from the building sector.

**Table 4 Average employment multipliers of four EGSS categories**

Employment multipliers	A	B	C	D	EGSS average	Economy-wide average
2000	1.81	2.50	1.45	2.05	1.68	1.561
2012	1.84	2.36	1.59	1.76	1.84	1.558

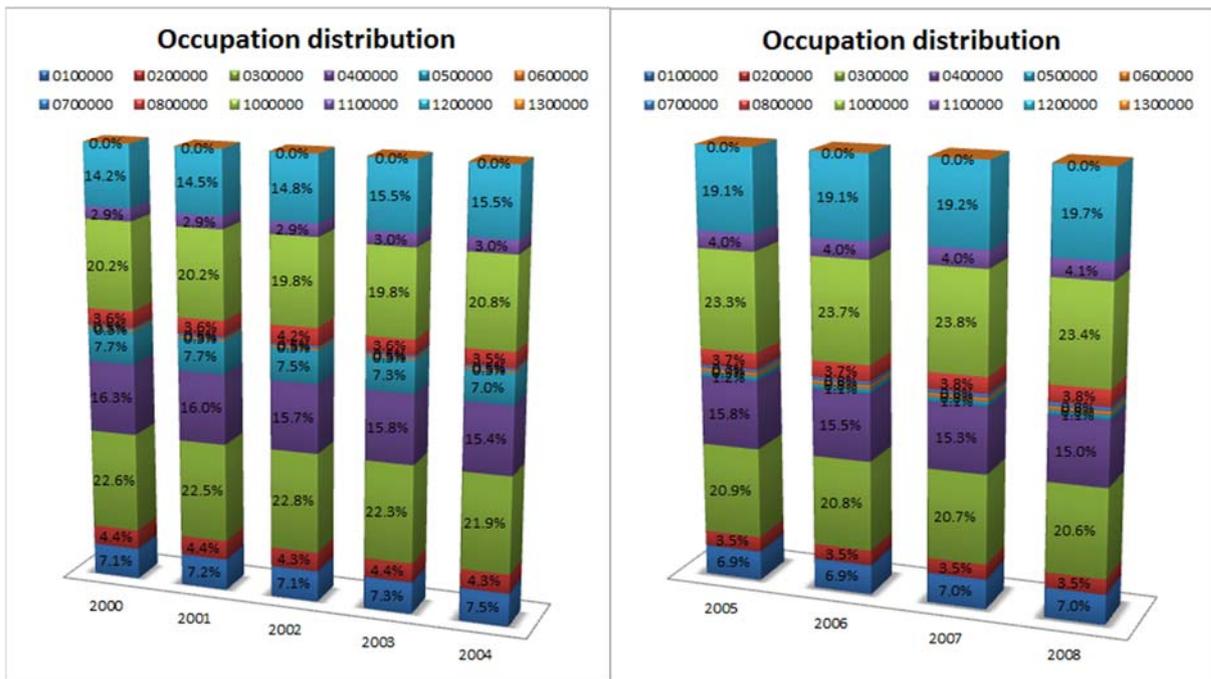
Figure 7 presents the direct and indirect employment impacts of four EGSS categories (2000 vs. 2012). The economy-wide employment impact, include both direct and indirect impacts, of EGSS development was 2.4 million people in 2000 and 3.9 million in 2012. Among four categories, Category C, Solid Waste Management and Effective Resource Utilization, absorbed nearly 49% of the total employment generated directly or indirectly from EGSS in 2012, followed by Category B, Measures Combating Climate Change (28%).



**Fig. 7 Comparison of direct and indirect employment impacts of EGSS**

### 3.2.3 Occupation distribution induced by the employment impacts of EGSS development

Figure 8 presents the economy-wide occupation distribution due to EGSS development over the years based on 13 occupation classification (Digit-1). In 2012, workers for extraction and construction (Code 120) accounted for the largest share (23%), followed by machine operators (Code 100), which was 21%. From structural change viewpoint, more workers were in the extraction and construction in 2012 compared with 2000, but fewer workers were in the sales (Code 040) and service sector (Code 050).



**Figure 8 Occupation distribution induced by the employment impacts of EGSS development**

Note: 0100000: Professional/technical position; 0200000: Management position; 0300000: Administrative staff; 0400000: Sales-related workers; 0500000: Services; 0600000: Services; 0700000: Agr/Forest/Fishery Farmers; 0800000: Transportation/communication workers; 0900000: engineers; 1000000: Manufacturing workers; 1100000: Operator for specific machineries; 1200000: Mining and construction workers; 1300000: Others.

## 4. Conclusions

Preliminary conclusions have been drawn up as follows:

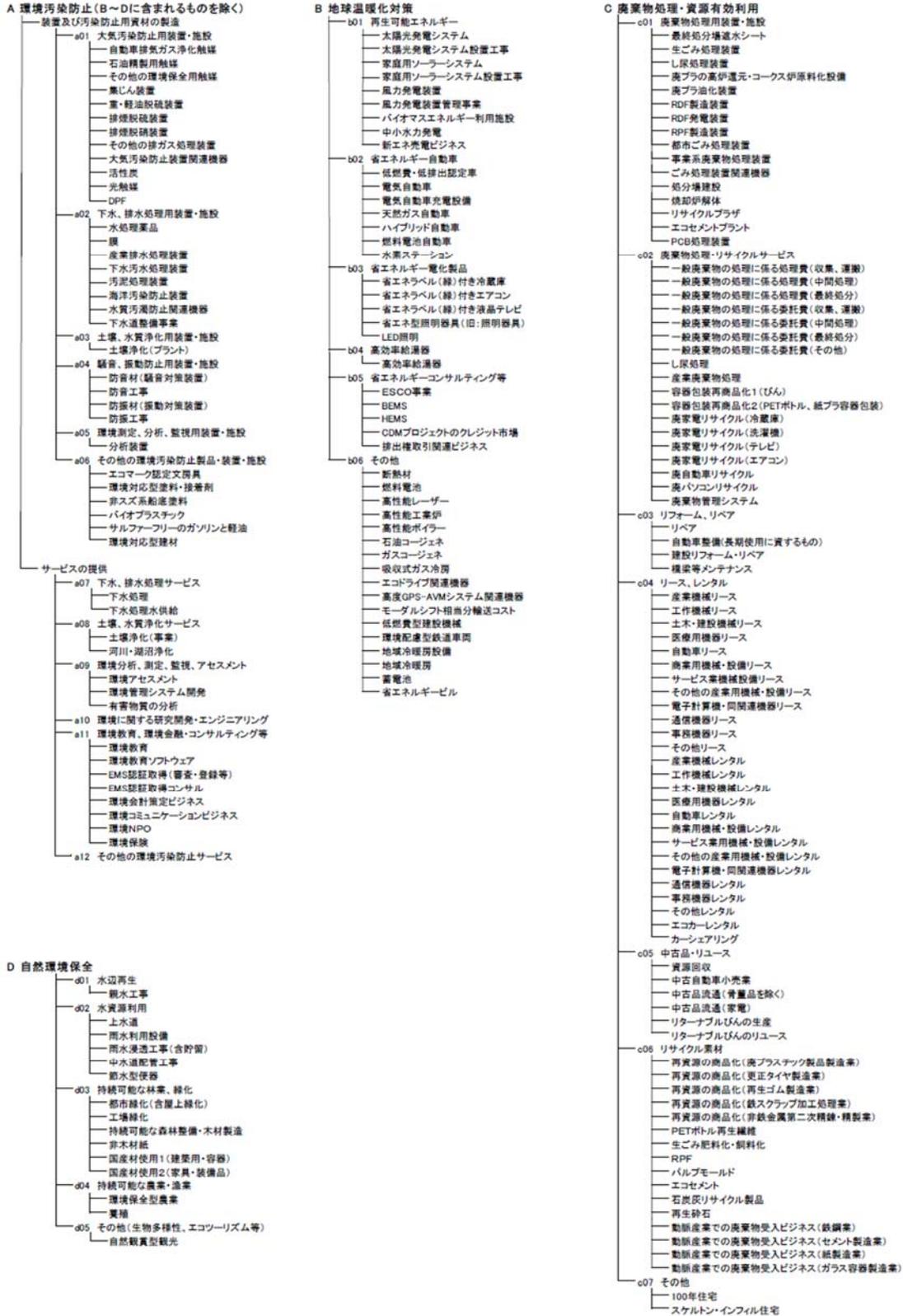
- EGSS in Japan, accounting for 10% of total national output and 8% of total value-added and providing 2.4 million jobs in 2012, is a key and potential industry contributing not only to solving environmental issues but also contributing to economic growth. EGSS can be considered a win-win solution helping countries in decoupling their economic growth from environmental degradation and depletion of natural resources.
- From an economy-wide impact perspective, EGSS generated total economic outputs of JPY 150 trillion and absorbed nearly 4 million workers directly and indirectly in 2012, which in some sense helped achieve the 2020 goals set by the Japan's **2010 New Growth Strategy**.
- The higher multipliers of EGSS sectors, in terms of both output multipliers and the employment multipliers, compared to the national average levels of all sectors, indicated that EGSS can be considered as a new engine and competitive edge of Japan's sustainable economic growth.

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# Appendix 1 2012 Japan's Revised Environmental Industry Classification (in Japanese)



## Appendix 2 Correspondence table between the Revised EGSS Sector Classification 2012 and the EGSS Sector Classification 2000

旧分類(平成22年12月調査迄)		▶	新分類の対応項目 (平成23年6月以降)
具体的な事業の例			
<b>A. 環境汚染防止装置及び資材の製造</b>			
A-1	大気汚染防止用	自動車排気ガス浄化触媒/石油精製用触媒(重油脱硫用を含む水素化処理触媒)/集じん装置/重・軽油脱硫装置/排煙脱硫装置/排煙脱硝装置/大気汚染防止装置関連機器/光触媒 等	A-1 大気汚染防止用装置・施設
A-2	排水処理用	水処理薬品/膜/水処理装置 等	A-2 下水、排水処理用装置・施設
A-3	廃棄物処理用	最終処分場遮水シート/生ごみ処理装置/高圧の高圧還元・コーストイ原料化設備/RDF製造装置/RDF発電装置/中間処理装置(破砕・選別・焼却・溶融)/リサイクルプラザ/PCB処理装置 等	O-1 廃棄物処理用装置・施設
A-4	土壌、水質浄化用(地下水を含む)	土壌浄化(プラント製造) 等	A-3 土壌、水質浄化用装置・施設(地下水浄化を含む)
A-5	騒音、振動防止用	防音材(騒音対策装置)/防振材(振動対策装置) 等	A-4 騒音、振動防止用装置・施設
A-6	環境測定、分析、アセスメント用	分析装置 等	A-5 環境分析、測定、監視用装置
A-7	その他	A-1~A-6に含まれない環境汚染防止装置/汚染防止用資材の製造 等	A-6 その他の環境汚染防止製品・装置・施設
<b>サービスの提供</b>			
A-8	大気汚染防止	大気汚染モニタリング/アセスメント-評価・計画 等	A-9 環境分析、測定、監視、アセスメント
A-9	排水処理	下水処理 等	A-7 下水、排水処理サービス
A-10	廃棄物処理・リサイクル	収集・運搬/中間処理/最終処分/一般廃棄物の処理に係る委託費/産業廃棄物処理/廃棄物発電/資源包装再商品化(びん、PETボトル、紙容器包装)/廃家電リサイクル(冷蔵庫、洗濯機、テレビ、エアコン)/廃自動車リサイクル/廃パソコンリサイクル/廃OA機器リサイクル 等	O-2 廃棄物処理・リサイクルサービス
A-11	土壌、水質浄化(地下水を含む)	土壌浄化(事業)/河川・湖沼浄化 等	A-8 土壌、水質浄化サービス(地下水浄化を含む)
A-12	騒音、振動防止	騒音、振動のアセスメント/モニタリング 等	A-9 環境分析、測定、監視、アセスメント
A-13	分析、データ収集、測定、アセスメント	環境アセスメント/有害物質の分析 等	A-5 環境分析、測定、監視用装置
A-14	環境に関する研究開発	クリーン製造プロセス/汚染管理手法の研究開発 等	A-9 環境分析、測定、監視、アセスメント
A-15	環境に関するエンジニアリング	エンジニアリング/デザイン/プロジェクト管理/環境計画/監査/法律サービス 等	A-11 環境教育、環境活動・コンサルティング等
A-16	教育、訓練、情報提供	環境教育/環境教育ソフトウェア/環境監査/ISO14000 取得コンサル/環境コミュニケーションビジネス 等	A-11 環境教育、環境活動・コンサルティング等
A-17	その他	環境保護 等	O-2 廃棄物処理・リサイクルサービス
<b>施設及び機器の据え付け</b>			
A-18	大気汚染防止設備	ダイオキシン除去プラント 等	A-1 大気汚染防止用装置・施設
A-19	水処理設備	下水処理場 等	A-2 下水、排水処理用装置・施設
A-20	廃棄物処理施設	処分場/焼却炉/焼却炉解体 等	O-1 廃棄物処理用装置・施設
A-21	土壌、水質浄化設備	土壌浄化関連建設工事 等	A-3 土壌、水質浄化用装置・施設(地下水浄化を含む)
A-22	騒音、振動防止設備	防音工事/防振工事 等	A-4 騒音、振動防止用装置・施設
A-23	環境測定、分析、アセスメント設備	分析装置の建設 等	A-5 環境分析、測定、監視用装置
A-24	その他	A-18~A-24に含まれない施設の建設 等	A-6 その他の環境汚染防止製品・装置・施設
<b>B. 環境負荷低減技術及び製品(装置製造、技術、素材、サービスの提供)</b>			
B-1	環境負荷低減及び省資源型技術、プロセス	BEMS/HEMS/CDM/プロジェクト/排出権取引関連ビジネス 等	B-5 省エネルギーコンサルティング等
B-2	省エネルギーコンサルティング	省エネルギー設計/ESCO事業	B-6 その他地球温暖化対策
B-3	環境負荷低減及び省資源型製品	DPF/環境対応塗料・接着剤/バイオマスプラスチック/サルファーリコーティング/軽油/エコマーク製品 等	B-5 省エネルギーコンサルティング等
B-4	環境配慮型自動車	電気自動車/天然ガス自動車/メタノール自動車/ハイブリッド自動車/燃料電池自動車/低燃費かつ低排出自動車(エコカー減税対象車(平成17年基準準率75%以上低燃費(9.9L/4km)かつ燃費基準+15%以上)などの低公害車)	A-1 大気汚染防止用装置・施設
B-5	リース・レンタル	省資源減圧リース・レンタル/輸送機器リース・レンタル/通信機器リース・レンタル/産業用機械設備リース・レンタル/医療用機器リース・レンタル/電子計算機・同関連機器リース・レンタル/土木・建設機械リース・レンタル 等	A-6 その他の環境汚染防止製品・装置・施設
B-6	その他	カーシェアリング 等	O-7 その他の資源有効利用
<b>C. 資源有効利用(装置製造、技術、素材、サービス提供、施設、機器の据え付け)</b>			
C-1	室内空気汚染防止	環境対応塗料 等	A-6 その他の環境汚染防止製品・装置・施設
C-2	水供給	雨水利用設備/雨水浸透工事(倉貯留)/中水運配工事/下水処理水供給 等	D-2 水資源利用
C-3	再生素材	資源回収/中古品流通/リターナブルびんの生産・リユース	O-5 中古品・リユース
C-4	再生可能エネルギー施設	再生資源の廃品化(高プラスチック製品製造業、鉄スクラップ加工処理業、非鉄金属二次精錬・精製業 等)/PETボトル再生繊維化および利用/生ごみ肥料化/再生紙/エコセメント/自動車業での廃棄物処分ビジネス(鉄鋼業、セメント製造業、紙製造業 等) 等	O-6 リサイクル素材
C-5	太陽光発電システム	風力発電装置/水力発電装置/バイオガス発電/バイオガス発電装置/下水汚泥/バイオガス発電装置 等	B-1 再生可能エネルギー
C-6	スマートグリッド	太陽電池/家庭用ソーラーシステム	B-1 再生可能エネルギー
C-7	省エネルギー及びエネルギー管理	スマートグリッド事業	B-1 再生可能エネルギー
C-8	高効率給湯器	給湯効率向上/LED等省エネルギー型照明器具	B-1 再生可能エネルギー
C-9	省エネルギー型家電製品(エコポイント対象)	(リチウムイオン電池/ニッケル水素電池 等)	D-2 省エネルギー自動車
C-10	持続可能な農業、漁業	燃料電池/高性能ボイラー/ガスコージェネ/エコドライブ関連機器モデルシフト 等	B-3 省エネルギー電化製品
C-11	持続可能な林業	次世代省エネルギー住宅/節熱材/節熱施工 等	B-6 その他地球温暖化対策
C-12	自然災害防止	家庭用燃料電池(エコキュート/エコフレ/エネファーム)	B-6 その他地球温暖化対策
C-13	エコツーリズム	エコポイント対象のテレビ、エアコン、冷蔵庫	B-4 高効率給湯器
C-14	エコファンド	エコポイント対象のテレビ、エアコン、冷蔵庫	B-3 省エネルギー電化製品
C-15	その他(自然保護、生態環境、生物多様性等)	山崩れ等の自然災害対策、津波対策 等	D-4 持続可能な農業、漁業、林業
		自然観賞型観光 等	D-5 その他の自然環境保全
		エコファンド 等	A-11 環境教育、環境活動・コンサルティング等
		NGO活動	O-3 リフォーム、リペア
		リペア/建設リフォーム	D-3 持続可能な林業、緑化
		緑化/医薬材使用	D-5 その他の自然環境保全
		(その他)	

### Appendix 3 Revised Classification of Japan's Environmental Industry Statistics

Classification of Environmental Industry Statistics							
A Pollution prevention and control							
Level 2	Level 3		Level 4				
a1	Air pollution control	a11	Air pollution control equipment and facilities	a11-1	Automobile exhaust gas catalytic converters		
				a11-2	Oil refinery catalysts		
				a11-3	Other catalysts for pollution control		
				a11-4	Dust collectors		
				a11-5	Heavy/light oil desulfurization equipment		
				a11-6	Flue gas desulfurization equipment		
				a11-7	Flue gas denitrification equipment		
				a11-8	Other exhaust gas-handling equipment		
				a11-9	Devices for air pollution control		
				a11-10	Activated carbon		
				a11-11	Photo-catalyst		
				a11-12	DPF		
a2	Wastewater management	a21	Wastewater management equipment and facilities	a21-1	Wastewater treatment chemicals		
				a21-2	Screens, strainers		
				a21-3	Industrial wastewater treatment facilities		
				a21-4	Sewage water treatment facilities		
				a21-5	Sludge treatment facilities		
				a21-6	Seawater pollution prevention facilities		
				a21-7	Water pollution control devices		
				a21-8	Construction work of sewage systems		
		a22		Wastewater management services	a22-1	Sewage water treatment	
		a22-2		Sewage water treatment for water supply			
a3	Remediation and clean-up of soil and water	a31	Equipment and facilities for the remediation and cleaning-up of soil and water	a31-1	Soil purification (plant)		
				a32	Services for the remediation and cleaning-up of soil and water		
		a32-1		Water purification (business)			
				a32-2	River and lake water purification		
a4	Noise and vibration abatement	a41	Noise and vibration abatement equipment and facilities	a41-1	Soundproofing materials (noise prevention devices)		
				a41-2	Soundproofing works		
				a41-3	Vibration-proofing materials (vibration prevention devices)		
				a41-4	Vibration-proofing works		
a5	Environmental management	a51	Environmental measuring, analysis and monitoring equipment	a51-1	Environmental analysis equipment		
		a52		a52-1	Environmental impact assessment		
				a52-2	Development of environmental management system		
				a52-3	Analysis of hazardous substances		
				a61-1	Stationaries for eco-mark certification		
a6	Other	a61	Other pollution management products, equipment and facilities	a61-2	Environmentally friendly paints and adhesives		
				a61-3	Non-tin ship bottom paints		
				a61-4	Bioplastics		
				a61-5	Sulfur-free gasoline and diesel		
				a61-6	Environmentally friendly building materials		
				a62	Environmental education and consulting services	a62-1	Environmental Management System (EMS) certification (review and registration, etc.)
						a62-2	Consultant services for EMS certification
						a62-3	Environmental education
		a62-4				Environmental education software	
		a62-5				Environmental accounting business	
		a62-6				Environmental communication business	
		a62-7				Environmental NPOs	
		a62-8				Environmental insurance	

### Appendix 3 Revised Classification of Japan's Environmental Industry Statistics (continued)

Classification of Environmental Industry Statistics						
B Measures combating climate change						
Level 2	Level 3	Level 4				
b1	Renewable energy use	b11	Renewable energy power generation systems	b11-1	Solar PV power system	
			b11-2	Installation of solar PV power system		
			b11-3	Residential solar PV system		
			b11-4	Installation of residential solar PV system		
			b11-5	Wind power generation facilities		
			b11-6	Biomass energy utilization facilities		
			b11-7	Small and medium hydro power		
			b11-8	Geothermal power generation		
			b11-9	Measures for power system stability		
			b11-10	Wood stove		
	b12	Renewable energy electricity sales	b12-1	New energy power generation business		
	b13	Operation and maintenance of renewable energy power generation facilities	b13-1	Operation and maintenance of wind power generation facilities		
b13-2			Operation and maintenance of non-residential solar PV power generation system			
b3	Energy saving and management	b30	Energy-saving buildings	b30-1	Heat insulating materials	
				b30-2	Energy-saving buildings	
				b30-3	Next generation energy-saving buildings	
				b30-4	Double glazing	
				b30-5	Heat insulating sash windows	
				b30-6	Heat-proof paints	
			b31	Energy-saving electric appliances	b31-1	Smart meters
		b31-2			BEMS	
		b31-3			HEMS	
		b31-4			Energy-saving labelling refrigerators	
		b31-5			Energy-saving labelling air conditioners	
		b31-6			Energy-saving labelling Liquid crystal televisions	
		b31-7			Energy-saving lighting appliances (conventional appliances)	
		b31-8			LED	
		b31-9			MEMS	
			b32	High-efficient combustion facilities	b32-1	Highly efficient hot water heaters
		b32-2			High performance industrial boilers	
		b32-3			High performance boilers	
		b32-4			Oil cogeneration	
			b32-5	Gas cogeneration		
			b32-6	Gas absorption type cooling system		
			b32-7	Construction of district heating and cooling system		
b4	Fuel-efficient automobiles	b41	Eco-cars	b41-1	Certified highly efficient and low emissions vehicles	
				b41-2	Electric vehicles	
				b41-3	Natural gas vehicles	
				b41-4	Hybrid vehicles	
				b41-5	Fuel cell vehicles	
				b41-6	Electricity charge facilities for EVs	
				b41-7	Hydrogen station	
			b42	Equipment supporting eco-driving	b42-1	Eco-driving management system
		b42-2			Advanced GPS-AVM systems	
b5	Other	b50	Emissions trading system	b50-1	Credit markets of CDM projects	
				b50-2	Business for emissions trading	
			b51	Other products against climate change	b51-1	Fuel cell batteries
		b51-2			Storage batteries	
		b51-3			Highly fuel efficient building machines	
		b51-4			Environmentally friendly railway vehicles	
		b51-5			Eco-ship projects	
			b52	Other services against climate change	b52-1	ESCO business
		b52-2			District heating and cooling system	
		b52-3			Transport costs related to model shift	

### Appendix 3 Revised Classification of Japan's Environmental Industry Statistics (continued)

Classification of Environmental Industry Statistics					
C Solid waste management and effective resource utilization					
Level 2	Level 3	Level 4			
c1	Solid waste treatment and utilization	c11	c11-1	Leakage isolation sheets for solid waste landfilling	
			c11-2	Kitchen waste disposal facilities	
			c11-3	Human waste treatment facilities	
			c11-4	Blast furnace reduction and coke oven using waste plastics as raw materials	
			c11-5	RDF manufacturing facilities	
			c11-6	RDF electricity generation facilities	
			c11-7	RPF manufacturing facilities	
			c11-8	Municipal solid waste treatment facilities	
			c11-9	Commercial solid waste treatment facilities	
			c11-10	Solid waste treatment facilities	
			c11-11	Construction of landfills	
			c11-12	Dismantling of incinerators	
			c11-13	Recycling plaza	
			c11-14	Eco-cement plants	
			c11-15	PCB treatment facilities	
	c12	Solid waste treatment and recycling services	c12	c12-1	Collection and transportation of general solid wastes (public)
				c12-2	Intermediate treatment of general solid wastes (public)
				c12-3	Landfilling of general solid wastes (public)
				c12-4	Collection and transportation of general solid wastes (commissioned works)
				c12-5	Intermediate treatment of general solid wastes (commissioned work)
				c12-6	Landfilling of general solid wastes (commissioned work)
				c12-7	Other solid waste treatment (commissioned work)
				c12-8	Human waste treatment
				c12-9	Industrial solid waste treatment
				c12-10	Reuse of packaging materials 1
				c12-11	Reuse of packaging materials 2
				c12-12	Recycling of home electronic wastes (refrigerators)
				c12-13	Recycling of home electronic wastes (washing machines)
				c12-14	Recycling of home electronic wastes (TVs)
				c12-15	Recycling of home electronic wastes (air conditioners)
				c12-16	Recycling of waste cars
c12-17				Recycling of waste computers	
c12-18				Solid waste management system	
c12-19				Recycling of small home electronic wastes	
c2	Re-utilization of recyclable resources and equipment	c21	Recyclable materials	c21-1	Recycling of recyclable materials (waste plastics)
				c21-2	Recycling of recyclable materials (waste tyre)
				c21-3	Recycling of recyclable materials (waste rubbers)
				c21-4	Recycling of recyclable materials (iron and steel scraps)
				c21-5	Recycling of recyclable materials (secondary refinery of non-ferrous metals)
				c21-6	Recycling of PET bottles
				c21-7	Kitchen waste composting
				c21-8	RPF manufacturing
				c21-9	Moulded pulp
				c21-10	Recycled coal ash products
				c21-11	Recycled crashed stones
				c21-12	Waste inputs to the primary sector (iron and steel industry)
				c21-13	Waste inputs to the primary sector (cement industry)
				c21-14	Waste inputs to the primary sector (paper industry)
				c21-15	Waste inputs to the primary sector (glass containers manufacturing)
				c21-16	Recycling of rare metals

**Appendix 3 Revised Classification of Japan's Environmental Industry Statistics  
(continued)**

Classification of Environmental Industry Statistics					
C Solid waste management and effective resource utilization					
Level 2	Level 3		Level 4		
	c22	Reuse of secondary products	c22-1	Collection of recyclables	
			c22-2	Retail of used cars	
			c22-3	Distribution of used products (except for antiques)	
			c22-4	Distribution of used products (home electronic appliances)	
			c22-5	Manufacturing of returnable cans	
			c22-6	Reuse of returnable cans	
			c22-7	Distribution of used buildings	
	c23	Reform and repair	c23-1	Repair	
			c23-2	Vehicle repair (for long-time use)	
			c23-3	Reform & repair of buildings	
			c23-4	Infrastructure maintenance	
	c24	Lease and rental	c24-1	Lease of industrial machineries	
			c24-2	Lease of working machineries	
			c24-3	Lease of civil engineering and construction machineries	
			c24-4	Lease of medical appliances	
			c24-5	Lease of vehicles	
			c24-6	Lease of commercial machineries and equipment	
			c24-7	Lease of machineries and equipment of service sector	
			c24-8	Lease of other industrial machineries and equipment	
			c24-9	Lease of computers and related appliances	
			c24-10	Lease of communication equipment	
			c24-11	Lease of office appliances	
			c24-12	Lease of others	
			c24-13	Rental of industrial machineries	
			c24-14	Rental of working machineries	
			c24-15	Rental of civil engineering and construction machineries	
c24-16			Rental of medical appliances		
c24-17			Rental of vehicles		
c24-18			Rental of commercial machineries and equipment		
c24-19			Rental of machineries and equipment of service sector		
c24-20			Rental of other industrial machineries and equipment		
c24-21	Rental of computers and related appliances				
c24-22	Rental of communication equipment				
c24-23	Rental of office appliances				
c24-24	Rental of others				
c24-25	Rental of eco-cars				
c24-26	Car sharing				
c4	Other	c41	Long lifetime buildings	c41-1	One-hundred year residential buildings
				c41-2	Skeleton-infill housing
	c42	Electronic books	c42-1	Electronic books	

### Appendix 3 Revised Classification of Japan's Environmental Industry Statistics (continued)

Classification of Environmental Industry Statistics					
D Conservation of natural environment					
Level 2		Level 3		Level 4	
d1	Afforestation	d11	Afforestation projects	d11-1	Water amenity projects
				d11-2	City greening (including roof planting)
				d11-3	Factory greening
d2	Water resource management	d21	Water-saving equipment	d21-1	water-saving flush toilets
				d22	Rainwater utilization equipment
		d22-2	Storm water infiltration works (including storage)		
		d22-3	Recycled wastewater plumbing		
		d23	Water supply system	d23-1	Water supply
		d3	Sustainable agriculture, forestry and fishery	d31	Sustainable agriculture, forestry and fishery
d31-2	Non-wood pulp paper				
d31-3	Domestic wood use 1 (for construction and containers)				
d31-4	Domestic wood use 1 (for furniture and fitments)				
d31-5	Environmentally friendly agriculture				
d31-6	Sustainable cultivation				
d31-7	Plant factory				
d4	Other	d41	Ecotourism	d41-1	Ecotourism

Note: Compiled and translated into English by the authors based on the information from MOEJ (2014).

## About IGES

The Institute for Global Environmental Strategies (IGES), established in March 1998 under an initiative of the Japanese government, is an international research institute conducting solution-oriented and innovative policy research for realising sustainable development both in the Asia-Pacific region and globally. IGES research focuses on five areas: climate change and energy, sustainable consumption and production, natural resource management, green economy, and integrated policies for sustainable societies.

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July 2015

IGES Publication Code WP1512

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