ASEIC
ASEM SMEs
Eco-innovation Center

www.aseic.org

ASEM Eco-Innovation Index 2015

Country Report

I Japan I

SMBA
Small & Medium Business Administration

ASEM
SMEs
Eco-Innovation
Center

ASEM Eco-Innovation Index 2015

Country Report

Japan

ASEM SMEs Eco-Innovation Center

Contents

Contents i
Table Contents ii
Figure Contents ii
List of Contributors iii

I. Country Introduction 1
II. Overview of Eco-innovation in the Country 4
1. Defining eco-innovation 4
2. Selected eco-innovation sectors and new trends 5
III. Eco-innovation Policy 7
1. Actors supporting the eco-innovation policy 8
2. Eco-innovation policy leverages 10
IV. Analysis of ASEI Results 18
V. Practices of Eco-innovation 22
VI. Country Synthesis 24
1. Drivers and Barriers of Eco-innovation in Japan 24
2. Policy Recommendation 26

Appendix 1 33
Appendix 2 49

Tables

Table 1 Country profile 1
Table 2 Eco-innovation Policy instruments in Japan 11

Figures

Figure 1 Eco-innovation policy sector 7
Figure 2 Major institutes that attribute to the eco-innovation in Japan 8
Figure 3 Number of eco-innovation policies by supply and demand sectors in Japan 13

Published by:

ASEM SMEs Eco-Innovation Center (ASEIC)
E-2FL, Pangyo Inno-Valley 255
Pangyoro Bundanggu Seongnamsi
Gyeonggido, Korea

List of Contributors

Authors
Taeko Takahashi, Consultant
KiJoo Han, EcoServices Consulting Co., Ltd
Eunkyung Jang, EcoServices Consulting Co., Ltd.
Misun Park, Seoul National University

I. Country Introduction

Table 1 Country profile

Categories	Contents
Jurisdiction	- Civil Law
Language	- Japanese
Population[1]	- 127.1 million
Income[2]	- GDP per capita: USD 36,194 (2014) / GNI per capita: USD 34,670
Industry[1]	- Industry structure: 1:26:73 (1st:2nd:3rd)
Sustainable Index[3]	- Sustainable social index: 6.15 - Sustainable environmental index: 5.52
HDI[4]	- 0.890, Medium
Business Environment	- Ease of doing business report 2015: 29th out of 189 (down 2 rankings from 2014) - Global competiveness index 2015: 6th out of 144 (up 3 rankings from 2014) - Index of economic freedom 2015: 26th out of 157 (down 3 rankings from 2014) - Global Innovation Index 2015: 19th out of 141 (up 2 rankings from 2014)

[1] Central Intelligence Agency(CIA), 2015.12, www.cia.gov/library/publications/resources/the-world-factbook/

[2] World Bank, 2015.12, http://data.worldbank.org/indicator/NY.GDP.PCAP.CD

[3] World Economic Forum-National Competitiveness index, 2015.12, http://www.weforum.org/

[4] Human Development Index 2015 report, http://hdr.undp.org/en/content/human-development-index-hdi

Leading technologies in resource efficiency together with high standard of environmental quality represent Japan's advancement of Eco-Innovation, as is ranked at the 19th out of 141 countries in the Global Innovation Index (2015)[5]. The advancement has been supported by the nation's capacity and public policy.

Enrollment rates in primary (99.9%), secondary (101.8%)[6], and tertiary (61.5%)[7] education are high, and gross expenditure on education takes a large portion of GDP (3.5%)[8] in Japan. After school education, companies take over human development by proactively investing in employees' training with appropriate conditions for R&D. Traditional lifetime employment has also contributed to strengthening employees' expertise further. This continuous learning process makes the country rich in seeds of innovation.

Technological development has been also a key to progress Eco-Innovation. Being poor in natural resources, the country needs to promote efficient use of resources and realize technology-based economy. Supported by highly skilled workers whose precision techniques have been passed down over generations, technologies in Japan are globally recognized. Availability of the latest technologies and firm-level technology absorption in Japan are substantially high compared to other countries[9].

Japan's Eco-Innovation is strongly supported by the government through national strategies, and a number of measures to help companies, especially SMEs, are in place: financial assistance for R&D, information sharing for new business opportunities, technical supports.

---

[5] INSEAD, 2015, The Global Innovation Index 2014

[6] It includes students whose age exceeds the official age group. Thus, if there is late enrollment, early enrollment, or repetition, the total enrollment can exceed the population of the age group that officially corresponds to the level of education (https://datahelpdesk.worldbank.org/knowledgebase/articles/114955-how-can-gross-school-enrollment-ratios-be-over-100)

[7] WEF, 2015, The Global Competitiveness Report 2014-2015

[8] INSEAD, 2015, The Global Innovation Index 2014

[9] WEF, 2015, The Global Competitiveness Report 2014-2015

Momentum at the international level will take Japan's Eco-Innovation even further. What is more promising for Eco-Innovation in Japan, however, may be an integrated approach which could accelerate to bring seeds of innovation into commercialization, as well as support from consumers.

II. Overview of Eco-innovation in the Country

1. Defining eco-innovation

The term ‘Eco-innovation,’ also called the green innovation, is widely used in Japan from the governments to the private sectors with their own terms. Yet, the core concept remains the same across the sectors and the term ‘eco-innovation’ refers to an integration of innovation and ecology, benefitting economy, society and the environment.

Ministry of Economy, Trade and Industry (METI) and Ministry of Education, Culture, Sports, Science and Technology (MEXT) define ‘eco-innovation’ as “technological and social innovation based on Japan’s advanced technologies, which place value on the environment and people, aiming to realize a sustainable society” and describe it as “a new direction of innovation,” according to the Economic Growth Strategy Outline (2007). In order to put eco-innovation in practice, an integral approach of supply and demand has been adopted; Sustainable manufacturing achieves material and energy savings and enhances efficiency for both supply and demand sides. The sustainable life style aims to encourage consumers to purchase eco-products and favor on purchasing services over purchasing products. They are supported by the zero emission-based infrastructure, which consists of a future-oriented

energy supply system, environmentally friendly transport system and communities that makes use of the environment industry[30].

2. Selected eco-innovation sectors and new trends

Japanese automobile industry has been leading the global market of environmentally-friendly vehicles since 1977, when TOYOTA started selling hybrid cars. Companies in Japan continue to pursue state-of-the-art technologies for diffusion of environmentally-friendly transportation system. Mitsubishi started developing the electric vehicle (EV) in 1966 and had continued further R&D on technologies for EV, including lithium battery. As a result, it presented the EV to the general public in 2006. Along with the increasing concerns with CO_2 emission, EV, as well as the infrastructure and services thereof, has been promoted in Japan. A number of housing companies are developing solar-power electricity generation system, which can be used in daily life at households and for charging EV as well. The system enables EV discharge its stored electricity into a house in cases of power outage. The government offers a number of subsidies, such as for purchasing EV and installing charging stations, in order to support the promotion of EV. In 2013, the METI offered US$100 billion for infrastructure of EV charging stations. The four major automobile

[30] http://www.meti.go.jp/committee/materials/downloadfiles/g70426a09j.pdf (Japanese)

companies also support the infrastructure by setting up a company, which provides further financial supports and cost for running the charging stations.[33]

The Cabinet approved the Basic Energy Plan (2014), which includes “accelerating the realization of hydrogen society.” Accordingly, demands for further advanced technologies for sustainable society have been increased. As Fuel Cell Vehicles (FCV) entered the market, development of hydrogen infrastructures became crucial. Companies of automobile, petroleum, city and industrial gas sectors together announced their participation in FCV market and installation of hydro stations, joining the Research Association of Hydrogen Supply/Utilization Technology (HySUT), which contributes to cost reduction of hydrogen infrastructure, diffusion of FCV, and Japan’s competitiveness in the international FCV market[34].

FCV and EV are the two main sectors that lead the sustainable automobile industry of the country, and there are discussions on which one is more beneficial to the country’s economy, society and the environment. The government is accelerating the realization of hydrogen society, while it budgeted 30 billion JPY for FY2014 on promotion of clean energy vehicles which include EV[35].

[33] http://toyokeizai.net/articles/-/39427 (Japanese)

[34] http://hysut.or.jp/en/index.html

[35] http://www.meti.go.jp/main/yosan2014/pr/pdf/ene_seizo_01.pdf (Japanese)

III. Eco-innovation Policy

Determinants of the eco-innovation that affect implementation and diffusion thereof in economic activities sector are linked to the system described below (Figure1). Policy support is regarded as one of inputs for implementing the eco-innovation and is evaluated in the sector of 'Eco-innovation Supporting Environment' of ASEM Eco-innovation Index (ASEI). Indicators of this category are 'Government's R&D expenditure in Green Industry,' 'Implementation of Environmental Regulations,' 'Maturity of Investment Setting for Green Technology Industry' and 'Investment Scale of Green Technology SMEs.' These simply reflect availability of environment for the eco-innovation.

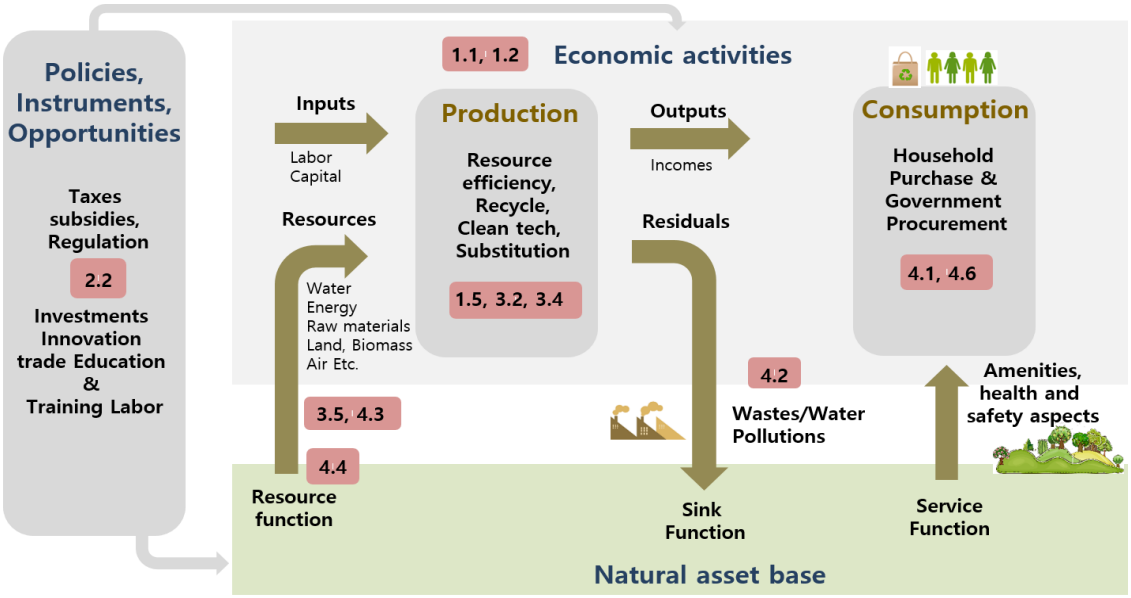


Figure 1 Eco-innovation policy sector

In this chapter, institutions that support the eco-innovation and measure supporting eco-innovation policy are examined.

1. Actors supporting the eco-innovation policy

Several institutes are active in promoting eco-innovation at national and international levels from the public to the private sectors shown below (Figure 2).

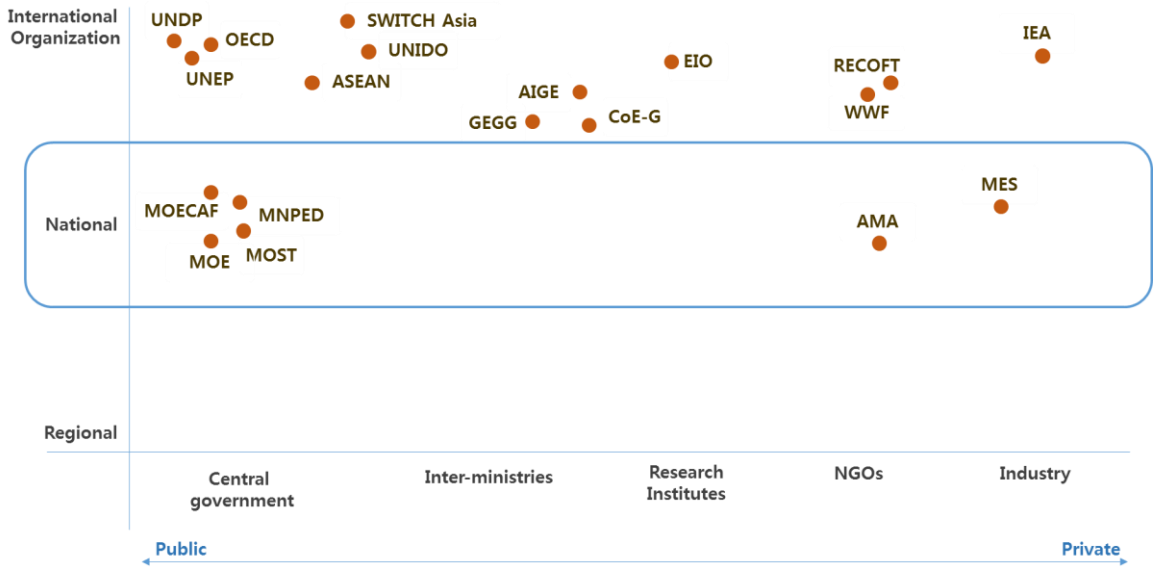


Figure 2 Major institutes that contribute to the eco-innovation in Japan

In many countries, ministries which have overall responsibility for environmental policy, and/or advancing economic and industry development, innovation, and technology policy take a lead of implementation and diffusion of eco-innovation. In Japan, MOE and METI are mainly responsible for policies related to the eco-innovation. For some cases, a government authority that deals with city development and public infrastructure is also responsible for the eco-innovation policy in the sector of eco-friendly building materials, which reduce environmental burden and/or increase energy efficiency. Ministry of Land,

Infrastructure, Transport and Tourism (MLIT) established the relevant eco-innovation policy instruments to enhance energy efficiency of public and private buildings and to optimize the transportation system of city.

Ministries often entrust specific activities and programs to semi-government agencies for efficient and effective management of the work. Those semi-government agencies and some academic institutes dedicate to advance eco-innovation.

New Energy and Industrial Technology Development Organization (NEDO) is a non-profit government agency, which actively undertakes the development of new energy (e.g., photovoltaic, wind power, biomass and waste, geothermal power, thermal utilization and fuel cells) and energy conservation technologies, verification of technical results, and introduction and dissemination of new technologies (e.g., support for introduction). Through the collaboration of industry, government, academia and international network, NEDO promotes greater utilization of new energy and improved energy conservation. Aiming to raise the level of industrial technology, NEDO pursues R&D of advanced new technology[36]. NEDO provides private sector, universities and research institutes trust funds in R&D for energy saving, renewable energy and other environmental sound technologies.

The National Institute of Advanced Industrial Science and Technology (AIST), a public research institute, is committed to the creation and practical realization of technologies useful to Japanese industry and society, and brings innovative technological seeds into commercialization. AIST develops technologies for increasing use of alternative energy, including renewable energy source, in order to catalyze the green innovations.

[36] http://www.nedo.go.jp/

University of Tsukuba is taking a lead to connect private sector, academic institutes, governments and local community, to bring the seed of innovative technology in practice. The initiative is called “Tsukuba Innovation Eco-system,” which provides fora for researchers to share their research outputs with companies and investors. In May 2015, University of Tsukuba set up a section, which coordinates information sharing or even sales the seed of technologies among researchers and companies for commercialization. Tsukuba Global Innovation Promotion Agency (TGI), located at University of Tsukuba, assists cooperation of research institutes and strengthening of the relationships between research institutes and companies[37].

2. Eco-innovation policy leverages

Japan has attempted the eco-innovation in advance in energy sector, with a basis of the superior technologies[38]. The government of Japan has established and developed the eco-innovation policies to support implementation thereof in sustainable energy sectors, such as solar, wind, geothermal and hydroelectric power. At the same time, technological innovation for reducing the environmental burden has been implemented in the existing energy sectors, such as, nuclear, fuel and LP gas. Specific plans and programs for promoting the eco-innovation have been developed for sustainable development by establishing the “New growth strategy,” “Green Innovation Strategy” and “Strategic Energy Plan”. In order to foster the high-technology in medium-long term, “Third Science and Technology Basic Plan” has

[37] https://tsukuba-gi.jp/en/

[38] This section is adopted from “ASEM Eco-innovation Index 2014” of ASEM SMEs Eco-Innovation Center. http://www.aseic.org/center/asei/result/result_2014.do#self

been operated for capacity building of the eco-innovation of companies. The supportive policies of the eco-innovation in Japan are also established in the technology sector, environmental management and market side. The technology sector typically practices “Top Runner Approach”. The Top Runner program defines the target baseline for performance of companies at the highest level of energy efficiency and expands the regulatory or incentive policies, so that other industry competitors can achieve it as well. These policies have contributed to Japanese companies’ acquirement of comparative advantage as the first mover in the global market place, through environmentally-friendly vehicles, as well as “Eco-town project” and “3Rs” for environmental management, and “Carbon Footprint Program” and “The Eco-point Program” for environment-friendly society and green market activation.

Table 2 Eco-innovation Policy instruments in Japan

National plan and strategy	Sustainability	■ Japan’s Strategy for a Sustainable Society (2007)
	Eco-innovation	■ New growth strategy (2009-2010) ■ Green Innovation Strategy (2010) ■ Strategic Energy Plan (2010) ■ Third Science and Technology Basic Plan (2006-2010)
Programmes and actions	National	■ Top runner program ■ The Japan Environmental Technology Verification Programme (J-ETV) (2003) ■ Eco Leaf Program ■ Eco-Action 21 ■ Eco-Town project ■ Carbon Footprint Program ■ The Cool Earth Innovative Energy Technology Programme (2008) ■ 3Rs (Reduce, Reuse, Recycle) Programme
Legislation		■ Law Concerning the Promotion of Procurement of Eco-Friendly Goods and Services (Green Purchasing Law) ■ Act on Special Measures Concerning Procurement of Renewable Electric Energy Operators of Electric Utilities (2012)
Finance		■ Environment research and technology development fund
Information		■ Water Environment Partnership in Asia (2003) ■ Asia-Pacific Regional Inception Workshop on Environmentally Sound Management of Electronic and Electrical Wastes (2005)

	■ Eco Mark Program & Global Eco-labeling Network ■ Green purchasing network ■ Regional Innovation Cluster Programme ■ Keidanren voluntary action plan

Source: ASEIC Eco-Innovation Index 2014[39]

Eco-innovation policies combine investment in innovation activities and R&D, supply side measures, and incentives to create green markets, demand side measures (Appendix 1). Figure 3 shows that the number of eco-innovation projects and program in Japan counted by policy types which are categorized in terms of supply and demand sides. A balance of eco-innovation policies of Japan between supply and demand side is examined. It is balanced between supply and demand but somewhat weighted in the supply side. R&D support[40] and information services[41] are emphasized in supply side and regulations & standard[42] and technology transfer[43] are concentrated in demand side. Japan is ranked at the 3rd after US and China for R&D investment to GDP ratio, which illustrates that Japan substantially allocates public finance for innovation.

[39] http://www.aseic.org/center/asei/result/result_2014.do#self

[40] ERTDF (Environment Research and Technology Development Fund): http://www.env.go.jp/policy/kenkyu/suishin/english/ and GERF (Global Environment Research Fund): https://www.env.go.jp/en/earth/research/gerf_E/index2.htm.

[41] Asia-Pacific Environmental Innovation Strategy Project (APEIS) and Information on Nominations for an International Award for Smart Grid Projects (ISGAN AWARD) etc. (Appendix 1)

[42] J-ETV(verification of tech) : http://www.env.go.jp/policy/etv/en/ ,Top Runner Programme (performance targets) : http://www.enecho.meti.go.jp/english/toprunnner/program.pdf, http://www.eccj.or.jp/top_runner/index.html. Eco Mark Program: http://www.ecomark.jp/english/ and Product Carbon Footprint Labeling etc.

[43] Demonstration of Waste Heat Recovery and Power Generation System at Steel Mill in India and Demonstration Project Systems Start Operation in Lyon, France. (Appendix 1)

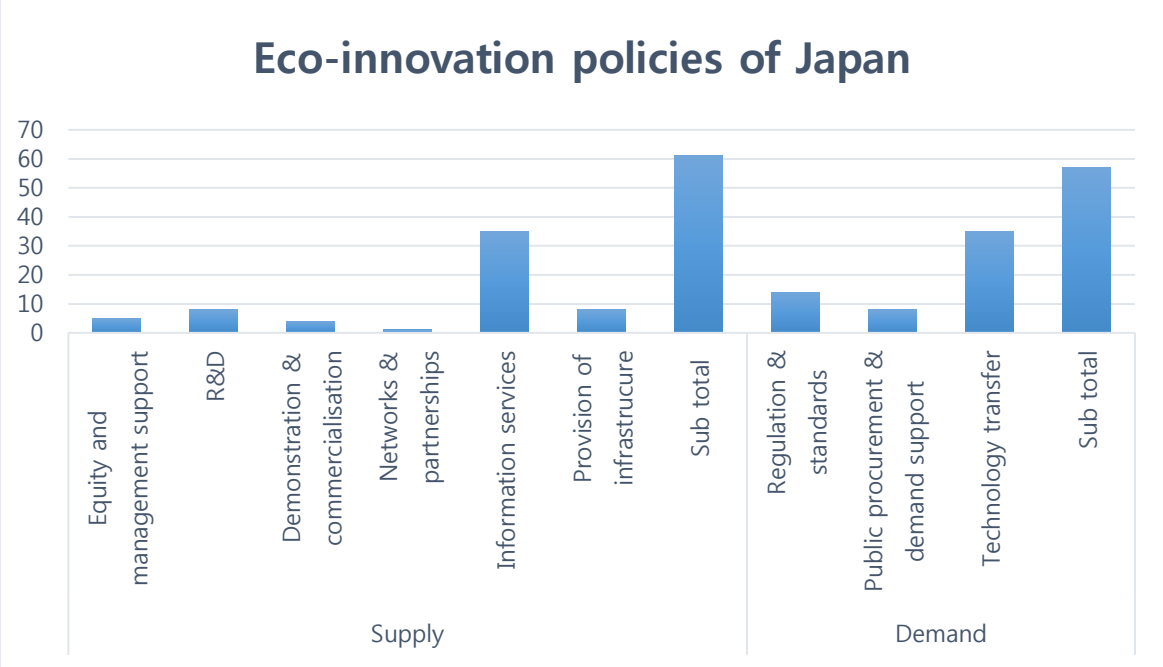


Figure 3 Number of eco-innovation policies by supply and demand sectors in Japan

In the National Growth Strategies 2015, the Cabinet announced that promoting investment for innovative ideas is one of the focal areas that can lead further growth of the country, and the R&D budget is allocated to ministries in order to set up a scheme for the creation of innovation. FY2014, over a hundred means, including subsidies and grants, were implemented by several ministries. For example, Ministry of Internal Affairs and Communications (MIC) assists the private sector and academic institutes for R&D on climate change technologies, under the Promotion Program for Reducing Global Environmental Load through ICT Innovation (PREDICT).

Government of Japan determined, in its National Growth strategies (fiscal year 2013) to support SMEs in their expansion of business into the growing business market, including the areas of environment and energy, Small Business Innovation Research (SBIR) is a collective mechanism used by a several ministries that assist R&D and commercialization of technological development undertaken by SMEs through subsidies and other means, such

as loans with low interest rate and patent fee exemption. In FY2015, the government aimed to subsidize JPY45.5billion for the SBIR[44] in total.

Environmental regulation

Policies are well supported by laws and regulation in Japan, and monitoring and enforcement are appropriately applied. There may not be laws particularly for the Eco-innovation, but the following existing laws and regulations, which assist improvement of the environmental quality, result in promotion of the Eco-innovation.

- Act on Concerning the Promotion of the Measures to Cope with Global Warming (1998)[45] is the framework for the nation, municipalities, industries, and the public to collectively implement measures against climate change issues in response to the Kyoto Protocol. It articulates roles and responsibilities of each sector in achieving the goal of reducing GHGs by 6% from the level thereof in 1990.
- An Act on Regional Use of Energy (1979)[46], requests factories, which consume massive energy, to report mid and long-term energy saving plan. It was revised in 2008 for further rationalization of energy use at industries and households, where energy consumption has been increased largely.
- Basic Law for Environmental Pollution (1967)[47] is a law that collectively implements pollution control measures, which articulated responsibilities of the government, municipalities and companies, and determined to take up Polluter Pays Principle. The Law was later merged into the Basic Environment Law (1993).

---

[44] http://www.chusho.meti.go.jp/keiei/gijut/2015/150828sbirhoushin.htm (Japanese)

[45] http://www.env.go.jp/en/laws/global/warming.html

[46] http://www.japaneselawtranslation.go.jp/law/detail_main?id=71&vm=4&re=

[47] https://www.env.go.jp/en/coop/experience.html

- Waste Disposal and Public Cleansing Law (1970)[48] defines waste disposal as well as the treatment method and facilities thereof, with a goal of waste reduction and relevant treatment. Under the Law, companies are obliged to treat industrial wastes either by themselves or though the registered waste disposal dealers.

There are several laws related to recycling, such as packing, electronic appliance, vehicles, and computers. Under the Home Appliance Recycling Act, manufactures and importers are obliged to recycle used home appliance, which retailers collect from users and bring in. Obligation of recycling motivates manufactures to design their products in a way they can be easily recycled.

Sustainable procurement

Act on Promoting Green Purchase was enacted in 2000, and it aims to create sustainable society through the public sectors' initiatives to promote environmentally friendly goods and services, as well as information sharing. It obliges Ministries and incorporated administrative agencies to develop and publicize green procurement policy and report the implementation results to the Environment Minister, while municipalities are encouraged to develop green procurement policy and to make green purchases based on the policy. Under the Basic Plan for Establishment of a Sound Material-cycle Society, which targets on green purchases, were set out for municipalities and companies in 2003. As a result, 97% of government at prefecture level and 54% at local level have implemented green purchases[49].

[48] http://nett21.gec.jp/Ecotowns/data/et_c-04.html

[49] https://www.env.go.jp/policy/csr/csr02/mat02_6.pdf (Japanese)

Along with an increase in adoption of environmental management, green purchases of companies have been strengthened. This trend is more obvious for large companies than SMEs: a survey conducted by Green Purchasing Network in 2003 shows that 96% of companies with more than 1,001 employees carry out green purchases, while companies with less than 300 employees stayed at 80%[50].

At the time the Act was enacted, the market scale of green procurement by national government and agencies was estimated to be JPY 20 trillion,[51] whereas the market scale of Eco Mark certified products in Japan was JPY 4.4 trillion in 2012.[52] According to the categorization of OECD's "The Environmental Goods and Services Industry (1999)," Ministry of the Environment estimated that the market scale of eco-business will reach JPY 58.4trillion, and the employment will become 1.236 million in 2020[53].

[50] https://www.env.go.jp/policy/csr/csr02/mat02_6.pdf (Japanese)

[51] http://jp.fujitsu.com/group/fri/downloads/report/research/2001/report120.pdf (Japanese)

[52] http://www.ecomark.jp (Japanese)

[53] http://www.env.go.jp/press/press.php?serial=4132 (Japanese)

Consumer information

A survey conducted in 2000 shows that Japanese consumers are highly aware of the environmental issues, yet do not carry out actions[54]. Thus, consumer demand on eco-friendly products in Japan can be described to be relatively low, as the level of demand reflects both consumer's desire and willingness to pay for a product. The main reason for this gap between desire and willingness of consumers is that decision of purchasing goods and services is largely affected by quality and price, rather than environmental consciousness. Consumers' lack of understanding on how their behaviors influence the environment may add another reason for low demand of eco-product.

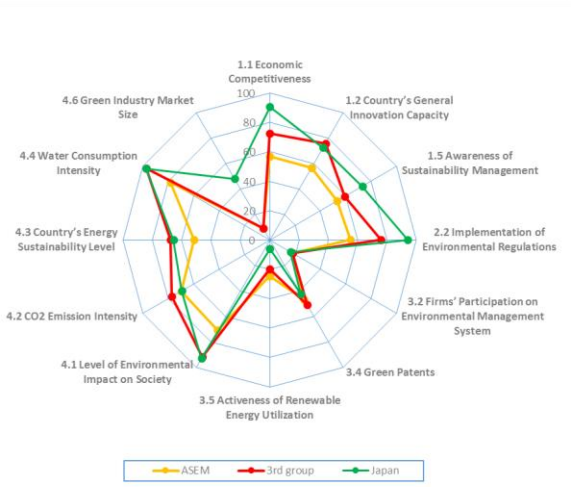
In Japan, there are several environmental labels that indicate that the product is produced with life cycle consideration for consumers. Eco Mark is the most recognizable eco-labeling system. It was established in 1989 with purposes to widely provide environmental information on goods and services for consumers and companies and to encourage manufactures and consumers to build a sustainable society. Thus the system functions as a communication tool that bridges business and consumers. From this point of view, Eco Mark can be a key to stimulate demand for eco-friendly products in Japan. Indeed, under its 3rd Action Plan (2013 – 2018), Eco Mark set strategies to promote dissemination through communication with stakeholders, collaboration with media and companies with Eco Mark certified products, and cooperation with local governments[55]

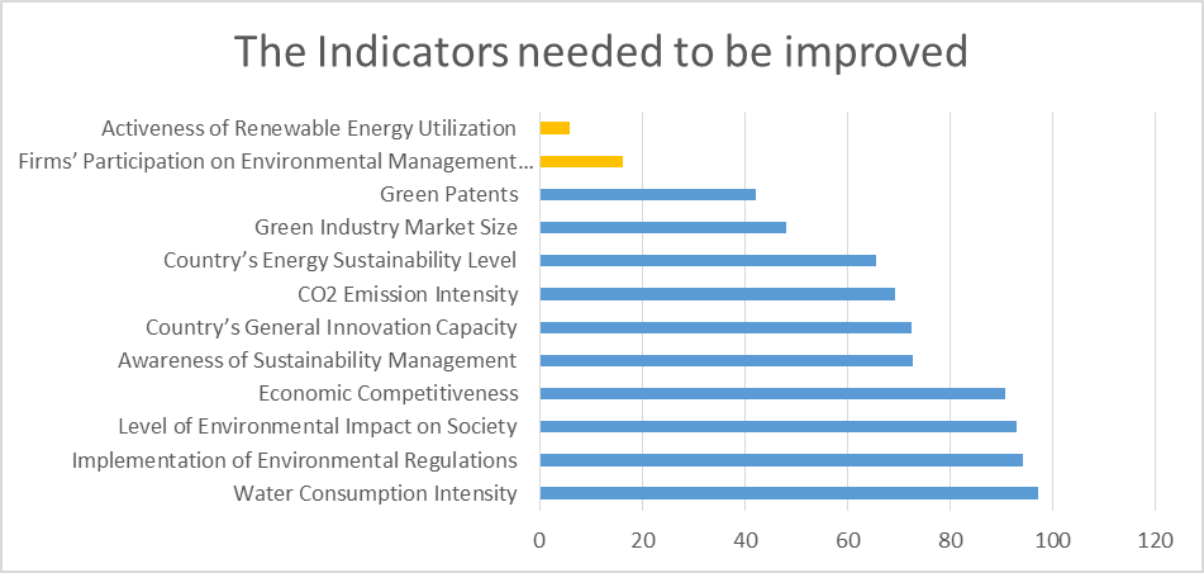
[54] https://www.env.go.jp/policy/csr/csr02/mat02_6.pdf (Japanese)

[55] http://www.ecomark.jp/english/

IV. Analysis of ASEI Results

	Score
ASEI 2015	**67.23**
Eco-Innovation Capacity	**78.68**
Economic Competitiveness	90.65
Country's General Innovation Capacity	72.60
Awareness of Sustainability Management	72.79
Eco-Innovation Supporting Environment	**94.12**
Implementation of Environmental Regulations	94.12
Eco-Innovation Activities	**21.49**
Firms' Participation on Environmental Management System	16.30
Green Patents	42.15
Activeness of Renewable Energy Utilization	6.03
Eco-Innovation Performance	**74.61**
Level of Environmental Impact on Society	93.07
CO_2 Emission Intensity	69.23
Country's Energy Sustainability Level	65.62
Water Consumption Intensity	97.15
Green Industry Market Size	47.97





Among the ASEM 51 member countries, Japan is ranked 8th for its ASEM Eco-Innovation Index. Although the country possesses strong capacity and performance with

well-functioning supporting measures for Eco-innovation, progress in Eco-Innovation Activities pushed the country down to the 8th rank among 51 countries.

Japan is ranked 10th out of all ASEM member countries and 2nd among the Asian countries for its Eco-Innovation Capacity. High scores of indicators in Country's Economic Competitiveness (1.1), Country's General Innovation Capacity (1.2) and Awareness of Sustainability Management (1.5) contribute to the high ranking in Eco-Innovation Capacity, which means that the country has a potential to achieve high standard of eco-innovation.

The level of Awareness of Sustainability Management among Japanese companies is quite high. In Japan, 19,813 companies are certified with ISO14001, as of 15 Sept 2015[56], and the number is much higher than other countries. A survey was conducted by Ministry of the Environment against a sample of large and medium-sized companies in 2013 and it shows that more than half of companies care about the environmental management (whether or not certified with ISO14001 or Eco Action 21) in selection process of their business partners.

Japan tops the Eco-Innovation Supporting Environment among the Asian countries, ranking at the 6th among ASEM member countries. This can be interpreted that environmental regulations are effectively enforced to support country's eco-innovation. Indeed, laws and regulations are the major instruments for policy implementation in Japan.

ASEI results show that relatively low scores in Firms' Participation on Environmental Management System (EMS) (3.2) and Activeness of Renewable Energy Utilization (3.5) lead to a low ranking in Eco-Innovation Activities. Although Japan is one of the leading countries of green technologies, the share of the Green Patents (3.4) is relatively low, making the

[56] http://www.jab.or.jp/system/iso/statistic/iso_14001.html

country ranked at the 40th and 13th among the ASEM and Asian countries, respectively. Japan's Number of firms with ISO 14001[57] per billion GDP, which is the original score of Firm's Participation on EMS (3.2), is 20th of the ASEM member countries. Although Japan has a high number of EMS certified companies, the proportion of the entire EMS companies compared to Japan's economic scale is small.

Japan has been leading technologies for renewable energy and the government offers a number of supporting projects for Smart Grid. In Comparison with total energy usage in Japan, however, quantity of renewable energy is quite low as similar as same group countries of economic development stage. 88.3% of total generated energy was from thermal power generation, the sources of which included petroleum, coal, and natural gas, while only 4.7% was from renewable energy in FY2013.[58]

As for Eco-Innovation Performance, Japan is ranked at the 4th and 3rd among the ASEM and Asian countries, respectively. The result of ASEI shows that the 'Green Industry Market Size (4.6),' like that of the electricity car and eco-friendly industry market, is quite high compared with the same stage of development group. Water Consumption Intensity (4.4) is also much higher than other ASEM countries. Together with strong policy support, Japan's state-of-the-art technologies in resource efficiency contribute to development of highly efficient industrial wastewater recycling system.

Energy Sustainability Level (4.3) is another contributing indicator that supports Japan's high Eco-Innovation Performance. There are three dimensions in energy sustainability defined by the World Energy Council: energy security, social equity, and environmental

[57] ISO 14001 is the series of ISO certification on Environmental Management System

[58] http://www.japanfs.org/ja/news/archives/news_id035081.html (Japanese)

impact mitigation[59]. Japan demonstrates effective management of primary energy supply and reliability of energy infrastructure, as well as meeting current and future demand. Energy supply is accessible across the population, ensuring social equity. Although domestic use of renewable energy is still an issue, the country is highly competitive in the development of renewable energy.

[59] https://www.worldenergy.org/wp-content/uploads/2013/01/PUB_2012_Energy_-Sustainability_-Index_VOLII1.pdf

V. Practices of Eco-innovation

Because their financial and human resource foundations are relatively weak, SMEs require supports from the government such as subsidies and information sharing. In a sense, they take part in national policy implementation through those supports. Small Business Innovation Research (SBIR) is a programme involving different line ministries to help R&D of SMEs' business, and SMEs literally contribute to national innovation strategies by advancing their own technologies.

Name of the program or project	Small Business Innovation Research (SBIR) Programme
Managing department	Cross-Ministerial mechanism participated by Ministry of Internal Affairs and Communications (MIC), Ministry of Education, Culture, Sports, Science and Technology (MEXT), Ministry of Health, Labour and Welfare (MHLW), Ministry of Agriculture, Forestry and Fisheries (MAFF), Ministry of Economy, Trade and Industry (METI)、Ministry of Land, Infrastructure, Transport and Tourism (MLIT)、Ministry of the Environment (MOE)
Starting year	1999
Investment	Budget JPY45.5billion (FY2015)
Participating firms	SMEs
Sectors	Energy, Natural resources and others
Introduction	SBIR aims to promote new business operation for SMEs. SMEs use the SBIR subsidies to participate in national R&D projects, then they will be eligible to receive supporting measures for commercialization of outputs of the R&D.
Sources	http://www.chusho.meti.go.jp/faq/faq/faq07_sbir.htm (Japanese)

One of practical example of the SBIR is "R&D for efficient heat pump technology." Receiving a commission from METI through NEDO, SMEs and an academic institute collaboratively worked on energy rationalization technology.

Name of the program or project	R&D for Air and Water Cooling Hybrid Heat Pump System with Groundwater Recycling
Managing department	New Energy and Industrial Technology Development Organization (NEDO) under the Ministry of Economy, Trade and Industry (METI)
Starting year	2007 - 2009
Investment	-
Participating firms	ZENERAL HEATPUMP INDUSTRY Co., Ltd.; Toho Chisui Co., Ltd.; Institute of Industrial Science, the University of Tokyo

Sectors	Heat pump for energy saving
Introduction	The firms received the commission of strategic development for energy rationalization technology from NEDO with the SBIR Programme, and conducted R&D for highly efficient heat pump technology, using groundwater as heat source.
Sources	http://www.nedo.go.jp/library/seika/shosai_201008/20100000000543.html

J-Good Tech assists SMEs to bring innovative seeds into commercialization by match makings with large companies. More than 2,100 SMEs have put up their profile on the J-Good Tech website, and sectors include energy, waste management, and water purification.

Name of the program or project	J-Good Tech
Managing department	Organization for Small & Medium Enterprises and Regional Innovation affiliated to METI
Starting year	April 2014
Investment	-
Participating firms	SMEs with outstanding niche-top or unique products and technologies
Sectors	Industrial manufacturer
Introduction	J-Good Tech helps SMEs to find a right partner for their new business opportunities by sharing information of companies which offer unique and advanced technologies and products on the website, bringing innovative seeds into commercialization. e.g. Nomura Kohsan Co. Ltd. is a SME with about 250 employees, which collects waste containing mercury from municipalities, companies, and treat them with its advanced mercury refining technology. The company puts up its profile on the J-Good Tech and intends to expand its business overseas.
Sources	https://jgoodtech.smrj.go.jp/?locale=en https://jgoodtech.smrj.go.jp/corporations/2184?locale=en

VI. Country Synthesis

1. Drivers and Barriers of Eco-innovation in Japan

Pushing Eco-Innovation forward

As indicated in the result of ASEI indicator analysis, Japan demonstrates high performance in the Eco-Innovation. The country has accumulated the seeds of innovation over decades, literally establishing the foundation of the Eco-Innovation supported by several measures. The international frameworks and global events are assumed to be the drivers to take the Eco-Innovation even further.

Aiming to complement Clean Development Mechanism (CDM) under the Kyoto Mechanism, the government of Japan initiated the Joint Crediting Mechanism/Bilateral Offset Credit Mechanism (JCM/BOCM), which facilitates diffusion of advanced low carbon technologies, products and system in developing countries, while contributing to greenhouse gas (GHG) emission reductions at the global level. As of November 2015, the government signed the JCM/BOCM agreement with 16 countries, and 7 JCM projects have been registered[60]. Along with the JCM/BOCM implementation, companies expect to extend their market of low carbon technologies and products outside Japan, causing those companies to offer demand-driven goods and services that meet the local needs and conditions in developing countries.

[60] http://www.meti.go.jp/press/2015/11/20151119002/20151119002.html (Japanese)

The case of Nomura Kohsan Co., Ltd., a medium-sized enterprise offering mercury recycling system, is another indication that the international framework works as a driver of the Eco-Innovation. Minamata Convention on Mercury adopted in 2013 became a turning point of the company to contribute to the international cooperation. In April 2014, the company signed a Memorandum of Understanding with the United Nations Industrial Development Organization (UNIDO) for cooperation on the management of mercury-containing waste, especially in Southeast Asia.

Olympic is a powerful motivation for pursuing the Eco-Innovation. Because of the large-scaled public procurement of infrastructure, Olympic is a single event that is powerful enough for a host country to shift its direction towards a sustainable society. Based on the Cabinet Decision, “Comprehensive Strategy on Science, Technology and Innovation 2014,” the government of Japan sets the Tokyo Olympic 2020 as the occasion to exhibit Japan’s scientific and technological innovation. Specifically, the hydrogen energy system is one of the projects under the scheme. Accordingly, a number of supportive measures are offered. Regulations, which could act as barriers for the hydrogen energy diffusion will be reviewed, and Tokyo Metropolitan government announced that it will provide subsidies for installation and operation of the hydrogen stations, as well as for promotion of FCV.

Making the momentum stagnated

Low mobility rate of employees/researchers from one company to another and lack of coordination for collaboration may make the Eco-Innovation difficult to be put into practice. With high amount of investment in R&D and low mobility of employees/researchers, one specialized R&D can be further conducted in depth over time. Consequently, Japan is rich in seeds of innovation, thus, it has a high potential for creating innovation. However, with the

low mobility rate of employees, there is a subtle amount of communication and collaboration outside of their own companies, creating a culture of keeping the outputs of R&D within their own companies. This closed culture hinders commercialization of Eco-Innovation, which requires collaboration of different stakeholders.

Externality of social and environmental costs may be another barrier to the Eco-Innovation. In Japan the Eco-Innovation has been largely growing through supply-driven performances. If the country maintains a higher performance in the Eco-Innovation, the equilibrium between supply and demand becomes critical. A survey conducted in 2000 shows that Japanese consumers are highly conscious about the environmental issue, yet the relevant actions do not come along[61]. This is because they consider quality and price of products to make a decision of purchase, instead of considering the social and environmental costs of the product.

2. Policy Recommendation

Increase awareness of international agreements and encourage enterprises to incorporate Eco-Innovation into business operation. It is crucial to bring the commitments that a country agreed at international level down to the practical level. Sustainable Development Goals was adopted in September 2015. Countries including Japan are to design their own national planning to implement the global agreement at the practical level, involving stakeholders at all levels. Accordingly, an enterprise needs to increase its level of

[61] https://www.env.go.jp/policy/csr/csr02/mat02_6.pdf (Japanese)

understanding on the corresponding national action plan and to integrate the business development into daily operation.

Develop a mechanism to accelerate an open innovation, involving a range of stakeholders. Open innovation catalyzes knowledge and technology sharing beyond sectors and companies, resulting in a convergence of the R&D outcome and commercialization. As SMEs typically face challenges in securing financial and human resources, SMEs and venture companies will have a chance to become the main part of technological innovation streamline through open innovation. In addition, facilitation for company-to-company collaboration also needs to be enhanced. In order to put seeds of innovation into practice, each sector and company is to bring its own comparative advantage in a collaborative work. Local governments may need to play more active role in supporting companies, because of their strong ties with local SMEs. Chamber of Commerce, industry associations, and municipalities could be in a good position to coordinate cross-sectoral collaboration for incubation of Eco-Innovation, utilizing their existing networks.

Enhance environmental education and activities to rigidly support the Eco-Innovation from the demand side. Until now, the Eco-Innovation in Japan has been slanted towards the supply side, taking advantage of the advanced technology. Building capacity of taking the environmental and social impact into consideration as results of one's behavior will rear judicious customers and electors, who are in favor of internalization of environmental costs in purchasing products and services, and supportive for environmentally sound policies.

Develop strategies to increase the use of renewable energy. ASEI result has identified that proactive use of renewable energy is a key for the country to progress Eco-Innovation even further. There are, however, several challenges to promote renewable energy, such as land use regulations, low efficiency in power generation, and high cost of facilities. Thus,

national strategies to overcome these challenges are to be developed across relevant ministries.

[References]

ASEIC. 2014. 2014 ASEM Eco-Innovation Index. Korea.

Eco mark office. Available online: http://www.ecomark.jp (accessed on March 2016)

Fujitsu Research Institute. Available online: http://jp.fujitsu.com/group/fri/downloads/report/research/2001/report120.pdf (accessed on March 2016)

INSEAD. 2015. The Global Innovation Index 2014

Japan Accreditation Board. Available online: http://www.jab.or.jp/system/iso/statistic/iso_14001.html (accessed on March 2016)

Leflaive, Xavier. 2008. “Eco-Innovation Policies in Japan.” http://www.oecd.org/japan/42876953.pdf.

Ministry of Economy, Trade and Industry. Available online: http://www.meti.go.jp/committee/materials/downloadfiles/g70426a09j.pdf (accessed on March 2016)

Ministry of Economy, Trade and Industry. Available online: http://www.meti.go.jp/main/yosan2014/pr/pdf/ene_seizo_01.pdf (accessed on March 2016)

Ministry of Environment. Available online: https://www.env.go.jp/policy/csr/csr02/mat02_6.pdf (accessed on March 2016)

Ministry of Environment. Available online: http://www.env.go.jp/press/press.php?serial=4132 (accessed on March 2016)

Porter. 1990. The Competitive Advantage of Nations, New York: Free Press

Research Association of Hydrogen supply/Utilization Technology. Available online: http://hysut.or.jp/en/index.html (accessed on March 2016)

The Small and Medium Enterprise Agency. Available online: http://www.chusho.meti.go.jp/keiei/gijut/2015/150828sbirhoushin.htm (accessed on March 2016)

Tokyo Keizai Newspaper. Available online: http://toyokeizai.net/articles/-/39427 (accessed on March 2016)

WEF. 2015. The Global Competitiveness Report 2014-2015

[Appendix 1] Policy measures addressing eco-innovation in Japan

Category	Group of Policy	Type of Policy	Specific policy
Supply side	Technology Capacity (R&D)	R&D Funds	・ ERTDF(Environment Research and Technology Development Fund) ・ GERF(Global Environment Research Fund) ・ Japanese Carbon Fund ・ Industrial Cluster Policy ・ Energy Bank
		Collaborative Grants	-
		R&D Infrastructure	・ RITE(Research Institute of Innovative Technology for the Earth) ・ TDM(Promotion of Traffic Demand Management)
	Business Support	Venture capital funds	・ J-VETS(Japan's Voluntary Domestic Emissions Trading Scheme
		Public guarantee funds	-
		Tax incentives	・ Green investment tax reduction ・ Tax Scheme for Promoting Investment in the Reform of the Energy Demand-Supply Structure
		Management verification	・ Eco Action 21 ・ Annual ISGAN Award
		Commercialization	・ Demonstration Operations of a Hybrid Inverter System for Unified Control of Solar Panels and Storage Batteries ・ Innovative Design and Production Technology Project
	Organizational Capacity (Education support)	Training courses for companies, entrepreneurs	-
		Advice/consulting for start-ups, companies, entrepreneurs	-
		Placement schemes for students	-
	Network	Clusters, science-technology parks	・ Industrial Cluster Policy, Eco-town projects
		Technology Platforms and innovation networks / Foresight and common vision building	・ Asia-Pacific Environmental Innovation Strategy Project (APEIS) ・ Environmental information strategy ・ Commemorating One-Year anniversary of Smart Community Demonstration Project in Hawaii ・ IEA PVPS workshop at WCPEC-6 ・ Exhibition at Pollutec 2014 ・ IRED 2014 International Conference on Smar Communities

			・Event for Smart Community Demonstration Project in Manchester, UK ・10th ADEME-NEDO Seminar ・Taiwan-Japan Science and Technology Forum ・The Fourth EU-US-Japan Trilateral Conference on Critical Material ・Exhibition and Business maching activities on Energy Technology in India ・Workshop with IEA ・Information on Norminations for an International Award for Smart Grid Projects (ISGAN AWARD) ・Seminar on UK-Japan Cooperation and Investment Promotion in the Energy Sector ・6th Germany-Japan Environment Forum ・World Future Energy Summit 2014 ・India-Japan Energy Forum 2013 First Technology Exhibition will also be held to Accelerate the Dissemination of Japan's Energy Technology ・NEDO Forum ・Innovation for Cool Earth Forum (ICEF) ・Seminar on the Model Project of Cogeneration System in Uzbekistan ・Exhibition at JEC Europe 2015 ・Exhibition in the National Cherry Blossom Dstival in US ・Portugal-Japan Joint Seminar ・Sunshine Plan' Symposium ・Japan-India Energy Forum 2015 ・Seminar on Wind Power Generation System Demonstration in Kamchatka Krai, Russia ・11th ADEME-NEDO Seminar ・7th German-Japanese Dialogue Forum for Environment and Energy ・Seminar on Bioethanol Production in Thailand ・Energy Conservation and Environment Technology Forum in Beijing ・NEDO Forum for region
		Market intelligence and other forms of information sharing	・Energy Demonstration Project in Overseas
Demand side	Regulation and Standards	Regulations, Targets, cap and trade schemes	・Legislation-based performance targerts ・Cool Earth 50
		Performance standards, labeling, certification	・J-ETV(verification of tech), Top Runner Programme(performance targets), Eco Mark Program ・Product Carbon Footprint Labeling ・Qualification of Venture Capital Firms to Partner in NEDO Technology-based Startup Supporting Program ・Wearable Walking Assistance Robot Achieves International Safety Standard
	Public procurement	Green procurement and green purchasing	・Law on Promoting Green Purchasing ・The Green Purchasing Network ・IGPN(International Green Purchasing Network) ・Green Contract Law
		R&D procurement	-

	Technology transfer	Advisory support for technology adopters	・NEDO Feasibilities for the Demonstration of Smart Grid-related Technologies in India ・Preliminary Investigation of Smart Community Demonstration Project in Slovenia ・Feasibility Studies for the Demonstration of Smart Community Technology in Germany ・Feasibility Studies Aimed at Introducing an Integrated Distribution Management System in Slovenia ・Energy Efficiency Building Demonstration Project in the U.S ・Demonstration of "Green Hospitals" in Vietnam ・A New High-Efficiency 2 MW Gas Generator ・Demonstration of Waste Heat Recovery and Power Generation System at Steel Mill in India ・Demonstration of Highly Efficient Coal Preparation Technology in India ・Demonstration Project Systems Start Operation in Lyon, France ・Preliminary Survey for Smart Grid Demonstration Project in Poland ・Preliminary Survey for Smart Grid Demonstration Project in Slovenia ・Model Project for an Energy Efficient Building in Shanghai ・Demonstration of Equipment for Effective Use of Biomass and Waste at a Cement Plant in Malaysia ・Traing to Accelerate Solar Photovolatic Deployment in Developing Countries ・NEDO Project EVs sharing Promotion Event in Lyon ・Demonstration of a High Efficiency Gas Turbin Generation System in Uzbekistan ・Smart Community Demonstration Project in Malaga, Spain ・Testing Operation for the Rice Husk Gasfication Power Generation Project in Cambodia ・Demonstration of an Advanced Environmentally-Councious High Efficiency Arc Furnace Project in Thailand ・Smart Grid Demonstration Project Completed in New Mexico ・First Smart Community Demonstration Project in Canada ・Smart Community Project in Putrajaya, Malaysia ・Local Energy Production and Consumption Model Smart Community Demonstration Project in Speyer, Germany ・Energy Conservation Demonstration Project in the US (Texas) ・China-Japan Joint Project in Heilongiiang Province, China ・Bioethanol Production Technology Demonstration in Thailand ・Smart Community Project in California ・Wind Power Gerneration System Demonstration in Kamchatka Krai, Russia ・Smart Community Demonstration Project in France_Demonstration of Positive Energy Building Begins in Lyon, France ・Demonstration Project Using a Battery Energy Storage System to Stabilize Distribution Networks Begins in Spain ・Smart Community Demonstration Project in Oshawa, Canada ・Smart Grid Demonstration Project in Haryana, India ・Smart Community Demonstration in Oshawa, Canada ・JCM Fiseability Studies and Demonstration Project ・EAGLE (Coal Energy Application for Gas, Liquid and Electrocity) pilot project
		Financial or fiscal support for technology adopters	・Low interest loan programme for environmentally friendly buildings

	Support of private demand	Tax incentives for consumers	-
		Pre-commercial procurement	-
		Demand subsidies (e.g eco-vouchers, consumer subsidies)	・ Subsidy for Residential PV systems ・ Eco-Car Tax Break and Subsidies for Vehicles
		Awareness raising and information provision	・ Cool Biz & Warm Biz ・ Promotion of Efficient Freight of Railway Transport ・ Promotion of Traffic Demand Management (TDM) ・ Guidebook on Energy Conservation in Buildings
	Market structure	Distribution channel support	-
	Related industry	Related industry along value chain	-

* '-' is not recogni*zable*