

# New Low Carbon Technology Plan

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Council for Science and Technology Policy

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## **Introduction**

According to the latest scientific knowledge, the global temperature has increased by 0.74°C in the last 100 years, the global average sea level has risen by 0.12-0.22 m, and various abnormal climatic events are frequently observed all over the world. An increase in the ground and ambient temperature may cause a significant impact on the ecosystem and human being.

Meanwhile, the global greenhouse gas (GHG) emissions are increasing. As a course of solution, Japan has proposed at the 2009 L'Aquila Summit a long-term plan to reduce 50% the global GHG emissions by 2050, and developed countries to reduce their GHG emissions by 80%. In order to give substance to the proposal, Japan has to lay out plans for promoting development of its environmental and energy technologies and domestically diffusing such technologies ahead of the world.

Japan's GHG emissions are 4% of the global emissions, and reduction of the global GHG emissions requires not only steady promotion of domestic measures but also the viewpoint of realizing effective GHG reduction all over the world. Looking at the world, energy demand is soaring in emerging counties especially in Asia due to population increase and economic growth, resulting in an increase in GHG emissions. Some emerging countries are in a state of continuous expenditure as a form of energy subsidy, potentially preventing future economic growth due to financial straits. It is important that the whole word addresses such issues in cooperation, instead of leaving them to the relevant countries only.

What is the key to solve the global environmental and energy issues? That is "development and diffusion of innovative technologies". Utilization of innovative technologies is essential in achieving both economic growth and reduction of GHG emissions, and Japan has to take initiative in the world in promoting development and diffusion of such technologies.

To date, Japan has promoted development of environmental and energy technologies such as energy conservation and use of renewable energies through public-private sector joint efforts. Japan is to take the responsibility as the country with the world's most advanced technologies and continue contributing to solving the global environmental and energy issues.

Based on such awareness of issues, on revising the "Low Carbon Technology Plan", the Council for Science and Technology Policy decided to detail (1) Identification of innovative technologies requiring short/medium-term and medium/long-term development, (2) Strengthening of policies for promoting technology development, and (3) Measures required for global expansion and diffusion of innovative technologies.

Efficiency improvement of existing technologies and promotion of thorough energy conservation are important for achieving a significant reduction in GHG emissions in a short-term view. However, it is necessary to promote development of innovative paradigm-shifting technologies in a medium- to long-term span, due to a limitation in what further improvement of existing technologies can achieve.

No matter how advanced, technologies have little use if they do not meet the needs and requirement of target countries. Therefore, it also is essential to promote development of technologies with taking into account the market and the needs of target countries, such as costs, specification, and quality. Additionally, considerations shall be given to diffusion of technologies that exert magnified effects by combining with other technologies, and establishment of systems that are ideal for developing such technologies assuming combination use from the technology development phase.

Furthermore, various policy tools will be utilized in international expansion of Japan's technologies, including promotion of Joint Crediting Mechanism, support for establishment of energy conservation systems in emerging countries, international standardization in forming the infrastructure for introducing advanced technologies and strategic utilization of public funds.

Through the present strategy, Japan will propose the course of development and diffusion of its environmental and energy technologies and express a clear view in global expansion and diffusion of such technologies in order to address global issues such as energy starvation, thereby contributing to reduction of 50% global GHG emission by 2050.

## **1. Roadmap of Innovative Technologies and Measures for Their Domestic Diffusion**

Japan currently has an edge in a majority of environmental and energy technologies. However, it is vitally important to lay out medium- to long-term technology development strategies and diffusion plans in accordance with the maturity level of each technology, in order to keep responding to global needs in future.

### **(1) Formulation of Roadmaps for Innovative Technologies**

In the present chapter, 37 technologies were identified as innovative technologies required for solving global environmental and energy issues and economic growth of various countries. Roadmaps toward 2050 have been formulated along a time axis to indicate by when and to what technological level these technologies are to be developed.

#### **(a) Review of Innovative Technologies**

On selection of Innovative technology items, taking into account technological development and changes in social conditions due to the immense damage caused by the Great East Japan Earthquake, new technologies such as introduction of renewable energies were added and some items have been consolidated.

#### **Examples of added technologies**

##### Innovative structural materials

Radically improve the fuel efficiency of transportation equipment such as vehicles through light-weighting of structural materials. For instance, use of carbon fiber composite materials in vehicles reduces the weight of the vehicles by 60%. Comprehensive fuel conservation including light weighting has a large potential to reduce the global GHG emissions of transportation equipment by about 4.7 billion tons (in 2050, estimation by the International Energy Agency (IEA)).

##### Artificial Photosynthesis

Artificial photosynthesis is a technology to convert water to hydrogen and oxygen using solar energy, and then create basic chemical materials such as raw materials for plastic products using the generated hydrogen and carbon dioxide. It converts carbon dioxide, which is the cause of global warming, into useful materials. It has potential to be used as fuel in future.

##### Geothermal Power Generation

Japan has the world's 3rd largest geothermal resources potential. Application of geothermal power generation is increasing globally; advancement of geothermal power generation technologies may result in further expanded global application. The global GHG emission reduction is about 0.5 billion tons (in 2050, estimation by IEA).

##### Solar heat utilization

There are technologies that may manifest air conditioning systems through direct utilization of the heat and power generation more efficient than solar photovoltaic power generation. Wide utilization is expected in the areas where abundant sunlight is available. The global GHG emission reduction is about 2 billion tons (in 2050, estimation by IEA)

### Marine energy utilization

A frontier technology area with an immense potential as energy worldwide, but not efficiently utilized yet. Examples are wave power, tidal power, ocean current, and ocean thermal energy conversion.

#### **(b) Strategy in Accordance with the Technology's Maturity Level and Application Time**

In order to continue diffusing advanced technologies to the world until 2050 without a break, a strategy needs to be established taking into account the time of practical application.

Specifically, in the short- to medium-term, improvement and diffusion of existing technologies are important. On the other hand, for technologies to be applied in the medium- to long-term, development of basic and applied technologies needs to be promoted for the time being, while promoting establishment of technology development systems envisaging future diffusion.

##### i) Technologies to be applied in the short/-medium term (by ~2030)

###### ○ Production • Supply sector

Aim for achieving stable energy supply, economic growth and low-carbon society in the world, not only in Japan. To that end, further advancement of high-efficiency thermal power generation technologies and cost reduction of renewable energies will be promoted, and they will be diffused globally. Over the medium-term, sustainable global energy supply will be pursued with a combination of CO<sub>2</sub> Capture and Storage (CCS) technologies.

Key technologies: high-efficiency coal-fired power generation, high-efficiency natural gas-fired power generation, wind power generation, solar energy utilization, marine energy utilization, geothermal power generation, nuclear power generation

###### ○ Consumption • Demand sector

Aim for achieving societies with ultra-high efficiency energy use through thorough energy conservation in the sectors of manufacturing, transportation and civilian.

Key technologies: next-generation automobiles, high-efficiency aircrafts, ships, and railways, intelligent transport systems, innovative devices, innovative structural materials, energy management system, energy efficient houses/buildings, high-efficiency industrial energy utilization, high-efficiency heat pumps, innovative manufacturing process

###### ○ Distribution • Supply/Demand Integration sector

Aim for establishment of the most efficient supply, distribution and demand system amid the trend where energy conversion and storage become available at the energy user side. To that end, necessary individual technologies are to be developed.

Key technologies: fuel cells, high-performance electricity storage, heat storage/insulation technology

○ Other technologies to address global warming

Key technologies: GHG (e.g., methane) reduction technology, global warming adaptation technology, earth observation and climate change prediction

ii) Technologies to be applied and diffused over the medium/long-term (after ~2030)

For the CCS technology that is anticipated to be put into practical use around 2020, research and development, demonstration as well as social implementation measures will be promoted. For technologies such as artificial photosynthesis and next-generation biomass aiming at practical application around 2030, basic research will be promoted for the time being in order to accumulate technological knowledge.

Key technologies: CSS technology, artificial photosynthesis, biomass utilization, environment-conscious iron manufacturing process, hydrogen production/transport/storage, electricity transmission by superconductivity, carbon fixation by vegetation

iii) Technologies anticipated to be applied over the ultra-long term

As technologies of long-term possibility and response to potential future issues, fusion, space solar power generation, and optimization of nitrogen cycle will be conducted with a long-term viewpoint..

### **(c) Strategy that Envisages the Future Market**

i) Technology development while clarifying the needs of target countries

Aim for permeation in terms of needs-conscious technologies and products when globally deploying low-carbon technologies and products diffused in Japan. To that end, it is important to optimize technology development and product technologies whenever the necessity arises.

ii) Combination of multiple technologies and systemization

Some technologies such as smart community and hydrogen production, transport, and storage technologies require combination of multiple technologies. For such technologies, it is necessary to promote integrated technology development of multiple technologies while viewing the future market and to globally deploy them as an integrated system. It also is important to systemize technology services utilizing IT, in order to promote diffusion through comprehensive cost reduction including operation costs.

## **(2) Domestic Diffusion Measures**

### **(a) Measures for products and technologies**

Even advanced technologies may experience difficulties in diffusion due to high initial cost. In such occasions where diffusion cannot be achieved only by leaving it to the market, diffusion is to be promoted by combining appropriate measures such as financial investment promotion measures and regulatory methods.

i) Investment promotion measures

Utilize tax systems such as the Green Investment Tax Credit and the tax credit pertaining to energy efficient houses, as well as various subsidies for energy saving and renewable energy facilities. Also utilize the J-Credit Scheme where the Japanese government approves GHG emissions reduction as credits for reductions achieved through introducing energy saving and renewable energy equipment.

ii) Regulatory methods

For the Top Runner Program, its applicability will be expanded to building materials which contribute to improvement of energy efficiencies of houses/buildings, and some items such as LED globes will be added. For products containing fluorocarbon, regulations for hydro fluorocarbons and measures for promoting non-fluorocarbon and low GWP<sup>1</sup> will be implemented.

iii) Low-carbon product purchase promotion measures

Visualization and compensation for reduced/emitted amount of GHG emissions during product manufacturing will be conducted through the Carbon Footprint Program, Carbon Offset Program, and so on. Purchase of low-carbon products by consumers will be promoted through expansion of applicable products and diffusion of relevant measures.

**(b) Horizontal regulatory and social system reform**

It is important to promote regulatory system reforms to facilitate diffusion of advanced technologies and products as well as social system reforms to accelerate pioneering activities.

i) Regulatory reforms

Regulatory reforms will be conducted in order to promote introduction of renewable energies. Regulatory reforms include acceleration of environmental assessment and rationalization of safety regulations pertaining to wind power generation and geothermal power generation, rationalization of safety regulations to promote small-scale geothermal power generation utilizing existing hot spring wells, and electricity system reform. Introduction of high-efficiency coal or natural gas-fired power generation will be promoted taking into account clarification and acceleration of environmental assessment pertaining to new construction or replacement of existing facilities. Additionally, diffusion of fuel cell vehicles will be promoted by reviewing safety regulations pertaining to fuel cell vehicles and hydrogen infrastructure.

ii) Demonstration project

Demonstration projects of smart communities, environmental future cities, etc. will be promoted aiming at realizing efficient energy management, etc. Issues and solutions for industrialization of relevant technologies will be identified, aiming at improvement of their economic and functional efficiencies.

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<sup>1</sup> GWP: Global Warming Potential



## **2. Strengthening of Policies for Steady Promotion of Technology Development**

### **(1) Improvement of the Control Tower Functions of the Council**

With regard to the promotion of science, technology and innovation policies including the environmental and energy fields, vertical divisions of ministries will be removed in order to maximize the outcome of research and development. To that end, the control tower functions of the Council for Science and Technology Policy will be radically strengthened.

Specifically, for all governmental budget related to science and technology, the secretariat functions of the Council will be radically strengthened through introduction of a new system where the Council takes the initiative in budget strategy, establishment of the Strategic Innovation Program and the Strategic Promotion of Innovative Research and Development, assignment of eminent talents from the industry, academia and government, improvement of the think tank functions, etc.

### **(2) Promotion of Investment in Research and Development of Environmental and Energy Technologies**

Investment in R&D by the public sector will be promoted through promotion of industry-academia-government open innovations, promotion of efficient utilization of R&D facilities owned by R&D corporate and universities, assistance in technology development and practical application for R&D venture businesses, promotion of intellectual property strategies and international standardization, regulatory reforms for promoting innovation, etc. In addition, corporate R&D investment environment will be improved through utilization of R&D taxation systems, etc.

Through these activities, investment in R&D of environmental and energy technologies will be promoted, thereby further enhancing the advantage of Japan's technologies.

### **(3) Carrying Out New Research and Development Projects**

In order to achieve the target of a 50% reduction in global GHG emissions by 2050, it is important to cultivate the seeds of new innovation technologies as well as to promote R&D and diffusion of technologies, based on the present strategy. To that end, for the field of environmental and energy technologies, steady R&D will be promoted while the government takes the initiative in R&D of high-risk high return innovative technologies that may achieve a significant reduction of cost or dramatic improvement in energy efficiency.

### **(4) Follow-up of the Strategy**

For the initiatives described in “New Low Carbon Technology Plan” and “Roadmap and Other Items Pertaining to Each Item of Technology”, it is anticipated that the relevant parties will steadily carry out necessary activities. The Council will establish working groups, etc., in the Council in order to ensure that follow-up of consideration and progress states of ministry measures is conducted in association with the follow-up conducted for the Science and Technology Basic Plan Action Plan.

### **3. Global Expansion and Permeation Measures**

#### **(1) Overseas Diffusion and Promotion Measures for Innovative Technologies**

While Japan's CO<sub>2</sub> emissions constitute about 4% of global emissions, emerging countries are anticipated to undergo rapid economic development thereby increasing CO<sub>2</sub> emissions. Therefore, measures against issues arising from emerging countries are the urgent tasks, and as part of such measures Japan will globally spread its advanced low-carbon technologies and products. Through its technologies, Japan will take the initiative in measures tackling global warming and contribute to achieving both economic growth and overcoming the environmental and energy restrictions in emerging countries especially in Asia. To that end, Japan will radically strengthen and steadily carry out its diffusion measures and clarify its international contribution through its advanced technologies and products. The measures include promotion of projects by utilizing Joint Crediting Mechanism, formation of markets via system establishment support in emerging countries and international standardization, and assistance through strategic utilization of public funds and demonstrations. At the same time, international collaboration on R&D, etc., will be promoted.

#### **(a) Joint Crediting Mechanism**

The Joint Crediting Mechanism (JCM) is a bilateral crediting system that quantitatively evaluates the reduction or absorption of GHG emissions in developing countries achieved through diffusion of Japan's advanced low-carbon technologies and practice of response measures. The evaluated reduction or absorption will then be utilized in achieving Japan's reduction targets. Through the present mechanism, Japan assists in system designing in accordance with the needs of the target country, allocates credits, and promotes projects in which the government is involved. As a result, investment and technology transfer of private corporate with low-carbon technologies to developing countries will be promoted.

In 2013, Japan has signed bilateral documents on the introduction of JCM with 8 countries, namely Mongolia, Bangladesh, Ethiopia, Kenya, Maldives, Vietnam, Laos, and Indonesia. Projects under this mechanism will be developed as soon as possible.

To date, in order to cultivate potential projects, 177 feasibility studies have been conducted in 30 countries across various sectors, from the civilian sector (e.g., introduction of inverter air conditioners), the industrial sector (e.g., energy conservation for factories), and to the power generation sector (e.g., introduction of biomass power generation and ultra-supercritical coal-fired power plant).

In order to officially commence the present mechanism from fiscal 2013, relevant regulations will be arranged, including formulation of credit register and measurement and evaluation methods of reduced amount. The first target is to demonstrate the system of JCM in practical projects. At the same time, formation of projects will be promoted through consideration on assistance required for strongly promoting introduction of Japan's advanced low-carbon technologies to developing countries, in collaboration with relevant ministries and relevant institutions such as the Japan International Cooperation Agency (JICA) and Japan Bank of International Cooperation (JBIC).

**(b) Formulation of Markets Where Advanced Environmental and Energy Technologies are Preferred**

- i) System establishment and standard development for promotion of energy conservation and visualization of environmental performance.

Assistance in establishment of energy conservation related systems and development of implementation structure in emerging countries will be conducted so that Japan's advanced technologies and products will be properly assessed in the markets of emerging countries.

Japan is currently implementing activities such as reception of trainees and dispatch of experts, mainly with emerging countries, in order to establish systems related to energy conservation measures and adoption of renewable energies. As a result, energy conservation systems have been implemented in some Asian countries such as China and Vietnam, referring to Japan's Top Runner Program, Energy Manager System, and Energy Saving Labeling Program. In future, Japan will promote introduction and establishment of systems and standards pertaining to visualization in these countries, utilizing bi-country and multi-country opportunities including public-private meetings and FTA negotiations.

International standardization will be specifically promoted to enable proper assessment of the environmental performance for individual products, while assistance in system establishment including introduction of standards related to quality and evaluation methods will be promoted for ASEAN countries such as Vietnam and Indonesia.

**Practical example**

Inverter air conditioners

Japan took the initiative in revising the international standard ISO16358 to enable proper assessment of advanced environmental performance of Japan's inverter air conditioners. Revised international standard is utilized by Vietnam as its national energy conservation standard. Japan will work on spreading the new standard into other major ASEAN countries. Japan will also work on establishment of inspection facilities in Vietnam by utilizing ODA, aiming at human resources development in order to improve inspection and qualification capabilities in Vietnam.

- ii) International standardization of measurement and assessment methods for process efficiency and energy consumption by products.

In order to diffuse Japan's advanced products, international standardization will be promoted on measurement and assessment methods for the efficiency of production process (e.g., iron and steel) and the energy consumption of products (e.g., inverter air conditioner, LED).

## **Practical example**

### Iron and steel

The *Calculation method of carbon dioxide emission intensity from iron and steel production* originally proposed by Japan in 2009 has come into effect in March 2013 as ISO14404. ISO14404 specifies calculation methods specific to CO<sub>2</sub> efficiency indices of iron and steel production process. The calculation methods enable accurate assessment of CO<sub>2</sub> emissions from any steelworks in the world. By packaging with Japan's energy-saving technologies in iron and steel production process, ISO14404 is to be diffused into countries such as India and ASEAN.

### LED lighting

In order to introduce highly energy-efficient LED lightings into emerging countries (e.g., Asia), assistance in formulation standards and specifications required for assessment of energy saving performance (JISC7801, JISC8105-5) and capability improvement of assessment personnel at inspection facilities will be promoted. Discussions on assistance in establishment of performance assessment system (e.g., photometry) with Indonesian and Thai governments were recently commenced; practical assistance will be promoted in future.

### iii) International standardization for development of new markets

Japan will actively participate in discussions on international standardization so that the standard will favor Japan's advantage in technologies, for markets that are likely to grow in future (e.g. quick chargers for electric vehicles, CCS).

## **Practical example**

### Electric vehicles

Currently, discussions on international standardization on performance of quick chargers for electric vehicles, communications, coupler styles, etc. are in progress at the International Electrotechnical Commission. Carefully watching the movements of Europe, The US, China, and others, Japan will aim to accelerate infrastructure development through standardization and further expansion of electric vehicle markets.

### CCS

In 2011, a technical committee for CCS was established under ISO, and 5 working groups for each technology element were established. Japan leads international standardization by serving as the Convenor of the capture working group and storage working group, and actively expressing its argument by sending experts into other working groups.

**(c) Supportive Measures for Assisting Global Expansion**

- i) Strategic utilization of public funds on export of infrastructure which uses low-carbon technologies

Strategic utilization of public funds is essential in diffusion of large-scale infrastructures that requires a large amount of funds. In particular, overseas transfer of high-efficiency thermal power generation, nuclear power generation, next-generation automobiles and low-carbon society will be promoted primarily. Overseas transfer of the environmental field will be promoted through ODA, by applying preferential interest rates for international yen loans depending on the project. Additionally, the risk-taking functions will be improved by utilizing assistance from international funding by JICA and public financing by JBIC and Nippon Export and Investment Insurance.

- ii) Demonstration projects in collaboration with target countries and corporate

Japan's technologies and systems pertaining to smart communities that combine energy conservation, renewable energies, IT, etc. have been expanded globally by visualizing their advantages and efficiency through local demonstrations. In particular, to date 49 projects have been conducted in 8 countries, resulting in establishment of 574 plants.

In future, along with steady practice of demonstration projects overseas, strategic collaboration with the government and corporate of the target countries will be further promoted in order to expand diffusion after the demonstration projects.

- iii) Tariff reduction for environmental goods based on the APEC List of Environmental Goods

In the 2012 APEC Economic Leaders' Meeting, an agreement was reached to cut applied tariff rates to 5% or less by the end of 2015 for the 54 environmental goods that directly and positively contribute to green growth and sustainable development. APEC is going to conduct capacity building support in 2014 for steady implementation of the agreement. Japan will support the activities of each economy by dispatching experts, etc., and promote international expansion of Japan's low-carbon technologies such as solar panels, wind power generation facility, and large-scale gas turbine, through trade expansion caused by reduced tariffs.

- iv) Assistance in low-carbon technology business expansion through bilateral cooperation

Through bilateral cooperation, Japan will assist expansion of low-carbon technology business into countries such as India and Indonesia where populations are large and significant economic growth in future is expected. For India, several activities are jointly promoted with the Indian government. These include government-level cooperation for the transfer of clean coal technologies, promotion of cooperation on pumped-storage power generation and power transmission/distribution systems, as well as opening technology exhibitions to widely introduce and diffuse Japan's advanced environmental and energy technologies. Through such bilateral cooperation activities, Japan will continue to assist the expansion of low-carbon technology business.

#### **(d) Multi-country Cooperation on Climate Change**

Discussions on operationalization of CTCN<sup>2</sup> (its establishment was agreed in 2010) are in progress in the negotiations at the United Nations Framework Convention on Climate Change (UNFCCC). Japan will actively continue contributing to the discussions so that the needs of developing countries that may not be identified through bilateral cooperation can be delivered to the governments as well as private sectors of developed countries through CTCN, and that Japan promotes cooperation under CTCN by utilizing its technologies.

At a UNFCCC-related forum, MEF<sup>3</sup> in which main economic countries such as Japan, US, EU countries, China, India, Brazil, and South Africa participate, an US-led initiative on the improvement of energy efficiency of buildings by whole MEF members is currently under progress. Japan will make effort in achieving proper understanding of the advantage of Japanese equipment and building materials and their international diffusion through such initiatives.

#### **(e) Promotion of Multi-country Cooperation on Energy**

Japan has been utilizing frameworks for multi-country activities and cooperation to promote energy conservation and introduction of renewable energies, such as CEM<sup>4</sup>, IPEEC<sup>5</sup>, and IRENA<sup>6</sup>. Meanwhile, Japan has been organically connecting private activities and existing governmental activities to achieve technology transfer through establishment of working groups for public-private partnerships between voluntary countries such as GSEP<sup>7</sup>. It is important to further expand and deepen such cooperative activities.

Additionally, activities specific to the Asia-Pacific region will be conducted by utilizing ERIA<sup>8</sup>, such as formulation of energy conservation roadmaps for the region and estimation of energy saving potentials through cooperation of experts in the region, for the purpose of reducing energy demand in the East Asia region.

Japan will also work on education and diffusion initiatives of advance cases to each economy at APEC by introducing Japan's energy conservation programs such as the Top Runner Program. Furthermore, cooperation on energy and environmental conservation and cooperation on improving energy storage and emergency response capabilities have been promoted at EWG<sup>9</sup>, APERC<sup>10</sup>, etc. These cooperative activities have been achieved through demonstrations of low-carbon model towns and peer reviews of energy conservation and low-carbon policies among participating economies, for the purpose of enhancement and environmental improvement of economic growth and energy security in the Asia-Pacific region where further increase in energy demand is expected. Low-carbon model towns have already been in operation at one selected city in China, Thailand and Vietnam respectively.

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<sup>2</sup> CTCN: Climate Technology Center and Network

<sup>3</sup> MEF: Major Economies Forum

<sup>4</sup> CEM: Clean Energy Ministerial

<sup>5</sup> IPEEC: International Partnership for Energy Efficiency Cooperation

<sup>6</sup> IRENA: International Renewable Energy Agency

<sup>7</sup> GSEP: Global Superior Energy Performance Partnership

<sup>8</sup> ERIA: Economic Research Institute for ASEAN and East Asia

<sup>9</sup> EWG: Energy Working Group

<sup>10</sup> APERC: Asia Pacific Energy Research Centre

**(f) Demonstration and diffusion of Japan's low-carbon technologies through collaborations with UNIDO**

Awareness of Japan's low-carbon technologies will be promoted at multi-country venues through collaboration and utilization of knowhow and knowledge of UNIDO<sup>11</sup>. Specifically, establishment and diffusion of Japan's low-carbon technologies in developing countries (e.g., Africa) will be promoted through demonstrations etc. by making contributions to UNIDO. During that activity, multi-faceted benefits will be proposed to the target countries by utilizing other low-carbon technology diffusion measures such as bilateral crediting systems.

**(g) Clarification of low carbon performance of Japan's environmental and energy technologies**

Overseas transfer of Japanese products will be promoted by conducting MRV (Measurement, Reporting, Verification) of emission reductions in order to clarify the low carbon performance and thus the advantages of Japan's environmental and energy technologies. During that activity, reliability of MRV will be improved by utilizing certification authorities.

**(h) Utilization of methods similar to Life Cycle Assessment**

Life Cycle Assessment method will be utilized to promote reduction of GHG etc. for the whole life cycle of products. Visualization of reduction contribution for the whole life cycle will result in improvement in the image of Japan's environmental products and companies.

Effective PR of reduction contribution to domestic and global societies requires high clarity and reliability of calculation methods. To that end, international standardization of Japan's calculation methods will be promoted.

**(2) Research and Development Collaboration with Other Countries and International Organizations**

Policies and R&D involved with low-carbon/sustainable societies (e.g., energy conservation, renewable energies, recycling) have been a global trend lately, and the idea has been spreading not only into the government and research institutions but also into the industrial fields. In order to organically connect technological knowledge and experiences and fully utilize limited resources in Japan, it is necessary to strategically exert mutually complementary effects through enhancement of collaborations with policies and R&D of other countries and international organizations as well as the discussions on international frameworks. To that end, international cooperation will be further improved through information sharing, etc., among existing international organizations (e.g., IEA), bi-country and multi-county intergovernmental discussions, public-private cooperation talks, etc.

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<sup>11</sup> UNIDO: United Nations Industrial Development Organization

**(a) Collaboration with roadmaps formulated by international organizations such as IEA**

The roadmaps of the Strategy will be utilized for promotion of all R&D in the world through collaboration with roadmaps formulated by international organizations such as IEA. Especially, in order to promote technological solution of the energy issues and global warming through international cooperation, Japan will conduct analysis of future prospect and relevant policy proposals as well as active contribution to international cooperation projects, in cooperation with the IEA's Committee on Energy Research and Technology.

**(b) Utilization of bi-country/multi-country joint development programs and international joint projects**

Through bi-country (e.g., Japan-US) and multi-country cooperation on clean energy technologies, R&D of advanced and innovative clean energy technologies will be promoted by further strengthening and expanding international joint research projects where strengths of participating countries can be fully utilized.

Based on the Japan-US summit agreement made in November 2009, Japan and US drew up the "Japan-US Clean Energy Technologies Action Plan" and commenced research collaboration. Further expansion of collaboration systems will be promoted centering on the "renewable energy technologies utilizing solar power generation, geothermal, and the National Institute of Advanced Industrial Science and Technology Fukushima Renewable Energy Institute" whose joint promotion was agreed in July 2013 by the ministers of both countries.

**(c) Global awareness fostering through utilization of the Conference of the Parties to the UNFCCC (COP)**

Discussions on a new framework that is to come into effect and be implemented from 2020 are in progress in the negotiations at the UNFCCC. Japan will express its thoughts so that the importance of environmental technologies will be acknowledged by including not only an emission reduction target but also policy measures including R&D for these technologies regarding registering and evaluation.

The "Fifth Assessment Report of the UN Intergovernmental Panel on Climate Change (IPCC AR5)" will become the prerequisite of such negotiations. Japan has been contributing to IPCC AR5 through research using world's most advanced climate change prediction technologies, and will maintain an active contribution.

Additionally, taking into account the importance of responding to the needs of developing countries pertaining to R&D of environmental technologies, Japan will maintain its active contribution toward the operationalization of CTCN and TEC<sup>12</sup> whose establishment was agreed at the COP16 held in 2010.

Furthermore, international understanding on the past contribution and future contribution possibilities of Japan's technologies to the measures against global climate change will be promoted through presentations and discussions at side events and other venues.

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<sup>12</sup> TEC: Technology Executive Committee



**(d) Contribution to solutions of global environmental issues by utilizing scientific knowledge achieved through international collaborations**

Taking into account international discussion on global environmental issues currently in progress at GEO<sup>13</sup> and so on, research on science and technology that will become the base of measures against global warming will be strengthened through international collaborations. The science and technology include earth observation technologies, utilization of observation data, global warming mitigation measures, and disaster impact mitigation technologies. During that, contribution of scientific knowledge to practical solutions of global environmental issues will be accelerated through collaboration with international activities that contribute to development of human resources.

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<sup>13</sup> GEO: Group on Earth Observations

## **Conclusion**

Japan has been promoting research and development of environmental and energy technologies through public-private sector joint efforts in order to overcome its low energy self-sufficiency and the two energy crises. As a result, Japan's technologies have become highly advanced. Some of Japan's technologies may contribute to solving global warming issues, and Japan will actively transfer such technologies to the world. Meanwhile, Japan will keep promoting domestic research and development and will establish an environment conducive to further promoting development by the private sector. Through these activities, Japan will continue contributing to measures against global warming that may become more severe in future.

Additionally, Japan will strive to widely propagate its ideas described in the present strategy to both developed and developing countries alike, in the hope that the world actively pursues similar actions.