Chapter 3 Creating a market for sustainable development in response to global challenges

As discussed in Chapter 1 and Chapter 2, recent global migration of labor, goods, money, skills, and knowledge has become increasingly prevalent and is spreading worldwide. The intensified migration of production factors among countries and regions is accelerating the integration of those economies. Such globalization has brought "light" to the world economy, including efficient distribution of global resources and improved productivity. At the same time, there is also a "dark side" to such globalization. With the rise of emerging countries taking advantage of its benefits, along with the increasing world population, it is now one of the major causes of global problems such as climate change, higher natural resource and food prices, and water shortages in many parts of the world. These issues must be addressed to ensure sustainable development.

Furthermore, there are countries in the world, primarily in Africa, that have not been able to fully benefit from the "light" and still remain in poverty. About one billion people around the world are still living the lowest form of life suffering extreme poverty[1]. The "dark side" of globalization, such as climate change, considered a likely cause of natural disasters and emerging infectious diseases, and price increases in basic goods such as food and various other commodities, has substantial impacts on the lives of the poor. There is a need to build a social framework that will enable those countries and their people to take advantage of the benefits of globalization; and it is also essential for globally sustainable developments. Poverty eradication is also one of the biggest global challenges.

In facing these global challenges in recent decades, Japan has aggressively addressed and overcome some of the problems in the process of economic development, and is now actively engaged in tackling climate change and other ongoing issues. Japan has successfully established advanced technologies and systems that contribute to addressing these problems. Japan can play important roles in achieving sustainable development, promoting innovation, and addressing the global challenges that are becoming increasingly serious as globalization of the world economy advances. In realizing this, the Japanese government should actively undertake initiatives to design market structures that facilitate the use of Japanese technologies, systems, and other resources.

It is crucial to create a market for sustainable development, where a variety of participating entities take innovative approaches in addressing challenges, integrate their knowledge and skills, and establish the market as a new economic arena. Such market will offer excellent business opportunities for Japanese corporations that have developed and accumulated applicable technologies and systems. Therefore, it is expected that Japanese corporations actively participate in and develop this new market, and in turn contribute to achieving sustainable development of the world economy.

In this chapter, based on the above problem consciousness, issues such as climate change, resources, food, water, and poverty will be discussed. For each issue, the current situations and responses of each country, as well as the possibilities for Japan to contribute to solving the challenges by applying its comprehensive capabilities including technologies and social systems will be examined. Appropriate future structures of the market in achieving sustainable development will also be

[1] People in extreme poverty are defined here as those who live on less than 1 US dollar a day (in PPP terms).

considered.

Section 1　Climate change and Japan's initiatives

Global greenhouse gas emissions are rapidly increasing due to such factors as economic growth in emerging countries in Asia and other regions. The 2007 IPCC[2] Fourth Assessment Report pointed out the possibility that global warming from increased emissions of greenhouse gases could cause changes in the global climate system, and in turn, reduce agricultural productivity, and cause water shortages and damages to health throughout the world.

Concern for these climate change problems has been growing in recent years on a global scale. In particular, 2008 marks the first year of the first commitment period under the Kyoto Protocol, and climate change was a major agenda item at the G8 Summit at Lake Toya held in July. Most of the countries in the world, including Japan, are well aware of the pressing need for action towards the global challenge of climate change. Negotiations on steps to be taken after the first commitment period of the Kyoto Protocol are now underway at the United Nations and other international forums.

In May 2007, Abe, then prime minister of Japan, to overcome serious environmental pollution and oil crisis, presented a proposal called "Cool Earth 50," addressing climate change with long-term strategies in reducing global greenhouse gas emissions. The strategies included a universal goal of halving the current level of global greenhouse gas emissions by 2050, and three principles to establish an international framework for 2013 onwards. They are (a) all major emitters must participate, thus moving beyond the Kyoto Protocol, leading to global reduction of emissions, (b) the framework must be flexible and diverse, taking into consideration the circumstances of each country, and (c) the framework must achieve compatibility between environmental protection and economic growth by utilizing energy conservation and other technologies.

Moreover, the Cool Earth Promotion Programme was presented in a special speech delivered by former Prime Minister Fukuda at the World Economic Forum's Annual Meeting (Davos Conference) in Davos, Switzerland in January 2008. Three proposals were made to the world as practical tools to implement the program, namely, Post Kyoto Framework to reduce global greenhouse gas emissions in the subsequent periods after the first commitment period, international environmental cooperation towards reduction of global greenhouse gas emissions, and innovation, including long-term targets in developing innovative technologies and shifting to a low carbon society.

In June 2008, during a speech at the Japan National Press Club, former Prime Minister Fukuda said Japan will aim to transition to a low carbon society and make it a long-term goal to cut its emissions by 60 percent to 80 percent from current levels by 2050.

In this section, the current situation and the responses of each country regarding climate change will be discussed, as well as how Japan should tackle this global challenge taking advantage of its industrial technologies and other capabilities cultivated through Japan's rich experiences. The excellence of Japanese technologies is highlighted in the following statement, "Japan, which depends heavily on energy imports from abroad, has undertaken nationwide energy saving efforts for the past

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[2] Intergovernmental Panel on Climate Change.

30 years since the first oil crisis, and successfully doubled its real GDP without increasing energy consumption in the industrial sector."[3] Required platforms, including promotion of innovative technological development will also be discussed.

1. Economic growth in Asia and climate change

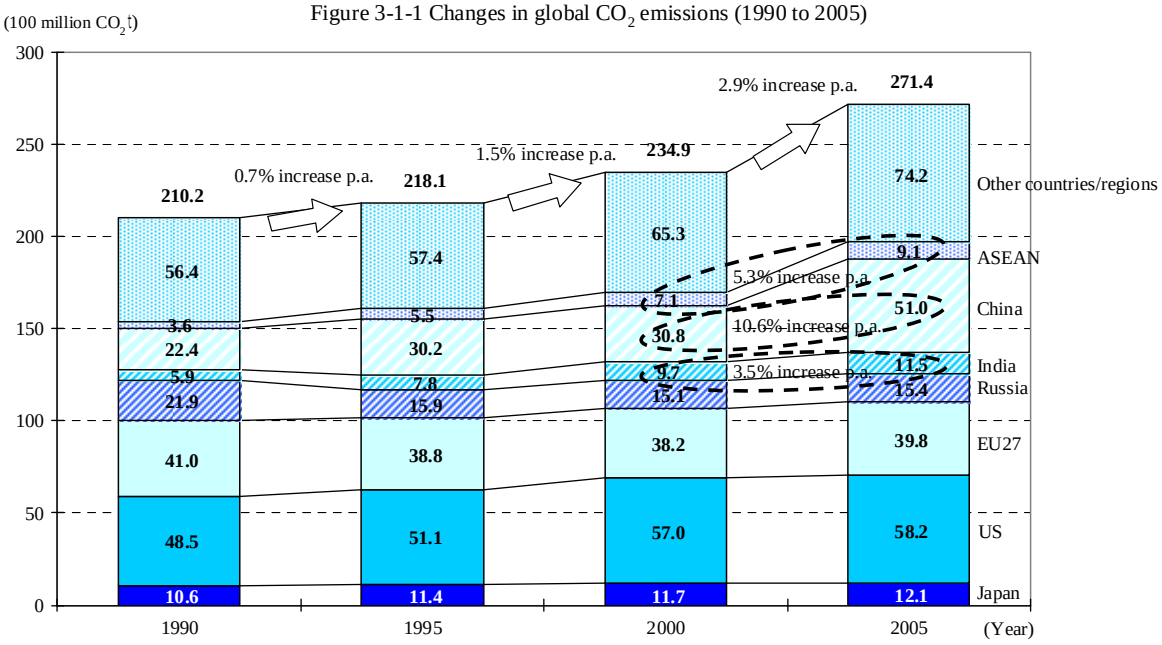
Greenhouse gases, said to be the major cause of climate change, consist of multiple gases such as carbon dioxide, methane, and nitrous oxide. In particular, carbon dioxide, which accounts for 70% of greenhouse gas emissions, is released from numerous types of human activities. Therefore, all countries and regions must work together to reduce carbon dioxide emissions.

(1) Accelerated increase in carbon dioxide emissions

(Continued growth in CO_2 emissions)

In recent years, the global energy-origin carbon dioxide emissions (hereafter, CO_2 emissions) have constantly increased[4]. Looking at the global annual average growth rates in CO_2 emissions since 1990, we see that while the figure from 1990 to 1995 was 0.7%, those from 1995 to 2000 and from 2000 to 2005 were 1.5% and 2.9%, respectively. These figures show the acceleration in global CO_2 emissions (see Figure 3-1-1).

Figure 3-1-1 Changes in global CO_2 emissions (1990 to 2005)



Note: Hong Kong is included in China.
Source: IEA(2007), *CO_2 Emissions from Fuel Combustion.*

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[3] Statement by former Prime Minister Yasuo Fukuda at the Davos Conference

[4] According to estimates of the world's major research institutions, accumulated greenhouse gas emissions from developing countries in the 20th century account for 40% of those of the entire world. A detailed analysis by country shows accumulated greenhouse gas emissions from China in the 20th century are about two or three times those of Japan. According to a different analysis's estimate, China accounted for 8.0% and Japan 2.7%. Furthermore, while accumulated CO2 emissions from India in the 20th century are close to the same level as those of Japan, accumulated methane, and nitrous oxide emissions in the 20th century are over ten times those of Japan.

(Increase in CO_2 emissions in Asian emerging countries)

In the most recent period, between 2000 and 2005, while the CO_2 emissions from Japan, the United States, and EU27 remained close to the same level, the CO_2 emissions from Asian emerging countries contributed significantly to the global increase of CO_2 emissions, with the CO_2 emissions annual growth rate in China (including Hong Kong) at 10.6%, in ASEAN at 5.3%, and in India at 3.5%. Particularly in China, during the five-year period, CO_2 emissions increased by 2.02 billion tons (equivalent to about 1.7 times the emissions in Japan in 2005), which accounted for approximately 55% of the global CO_2 emissions increase.

(2) Economic growth and CO_2 emissions

Recent growth in per capita CO_2 emissions in emerging countries is attributed mainly to their rapid economic growth, considering that their population growth in the 2000s is less than that of the 1990s[5]. The relationships between the progress of economic growth and the increase in CO_2 emissions are discussed in the following section.

(Economic growth and per capita CO_2 emissions, CO_2 emissions intensity)

Per capita GDP and per capita CO_2 emissions in major countries in the world[6] show a moderate correlation (see Figure 3-1-2). This is because countries that achieve economic growth tend to increase their consumption levels and other related reasons. Therefore, countries and regions currently with low per capita GDP are expected to increase their per capita CO_2 emissions as they realize economic growth in the future.

On the other hand, per capita GDP and CO_2 emissions intensity show a certain degree of inverse correlation (see Figure 3-1-3). This is considered to be because in countries that achieved economic growth, industrial structures tended to shift from manufacturing industries with relatively high CO_2 emissions intensity to service industries with relatively low CO_2 emissions intensity. Other factors include advancement in the implementation of energy saving and alternative energy technologies in those countries, as well as other reasons.

The share of added value from manufacturing industries in the national GDP is relatively higher in Japan and China that have achieved economic growth through direct investment by foreign manufacturers, than that in the United States and European countries. When national CO_2 emissions intensities are compared, the figure in China may be higher than those of the United States and European countries. In order to exclude the influence from industrial structures, and to verify positive effects of economic growth on CO_2 emissions efficiency, a regression analysis[7] was conducted using cross country data, with CO_2 emissions intensity as the explained variable, and per capita GDP and

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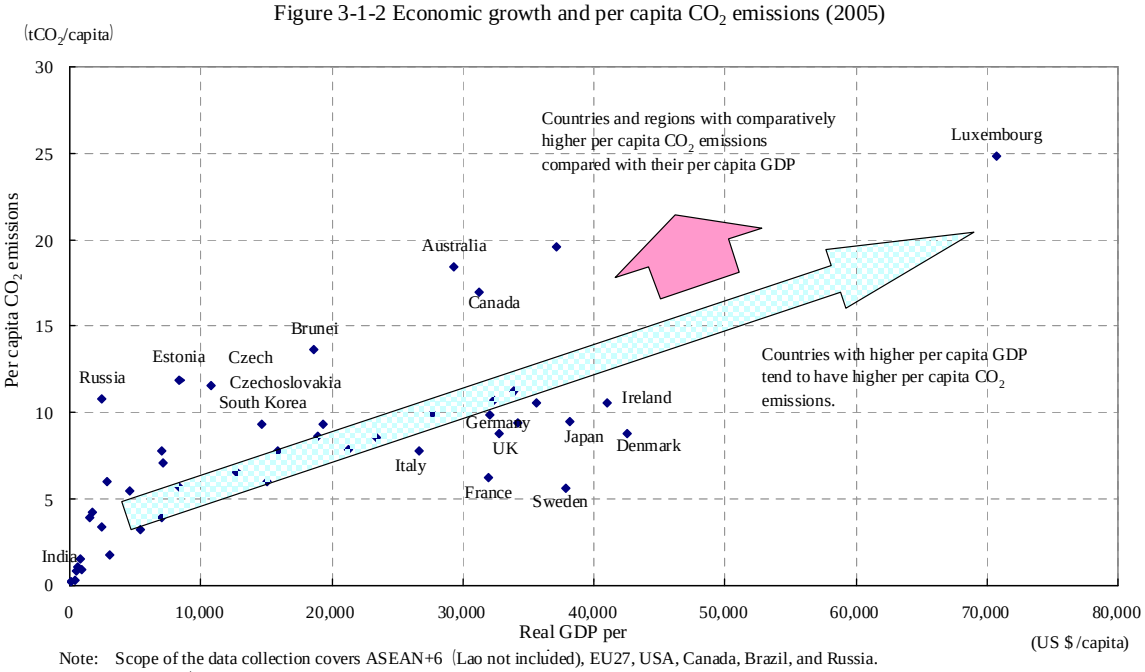
[5] Global population growth rate: 1990-1995, 1.5%; 1995-2000, 1.3%; 2000-2005, 1.2%.
Population growth rate in non-OECD countries: 1990-1995, 1.7%; 1995-2000, 1.5%; 2000-2005, 1.3%.
Source: IEA (2007), *CO_2 Emissions from Fuel Combustion*.

[6] Asia (ASEAN plus 6 [Laos not included due to statistical limitations]), EU27 (Cyprus and Marta not included due to statistical limitations), the United States, Canada, Brazil, and Russia, totaling 44 countries.

[7] For details of the analysis, see appended note 3-1.

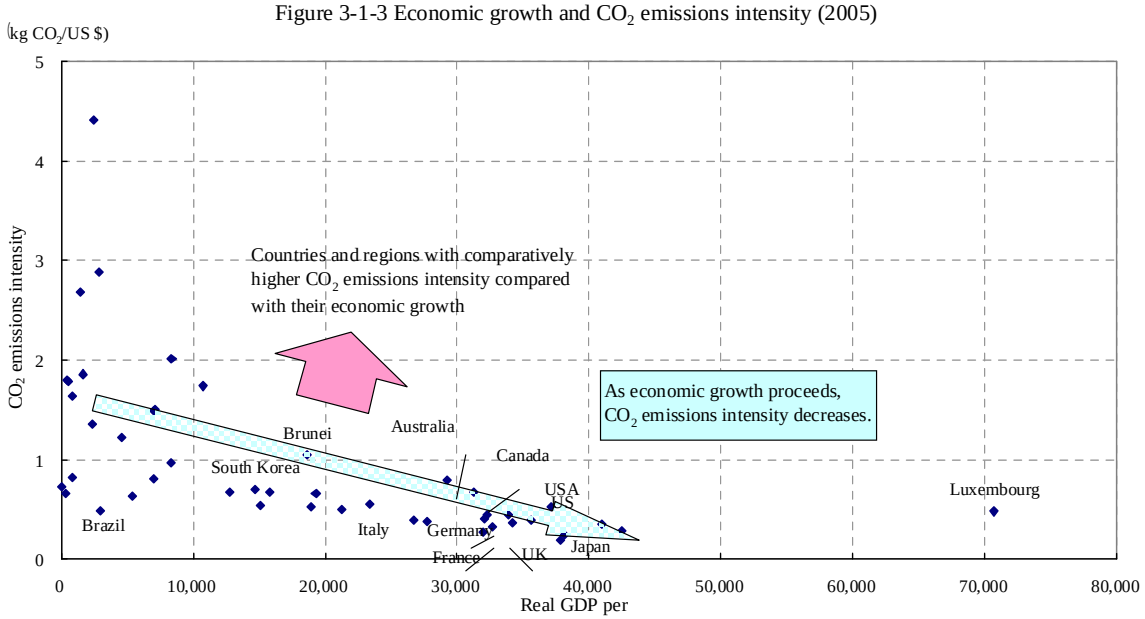
share of added value from manufacturing industries in national GDP as the explaining variable. The result was that the coefficient on per capita GDP was negative and statistically significant. Therefore, even excluding the effects from the change in the industrial structures, CO_2 emissions intensities are expected to decrease as per capita GDP grows. Mainly, this is because implementation of energy saving and alternative energy technologies usually advances along with economic growth.

Figure 3-1-2 Economic growth and per capita CO_2 emissions (2005)



Note: Scope of the data collection covers ASEAN+6 (Lao not included), EU27, USA, Canada, Brazil, and Russia.
Source: IMF(2008), *World Economic Outlook Database April 2008;* IEA(2007) *CO_2 Emissions from Fuel Combustion.*

Figure 3-1-3 Economic growth and CO_2 emissions intensity (2005)

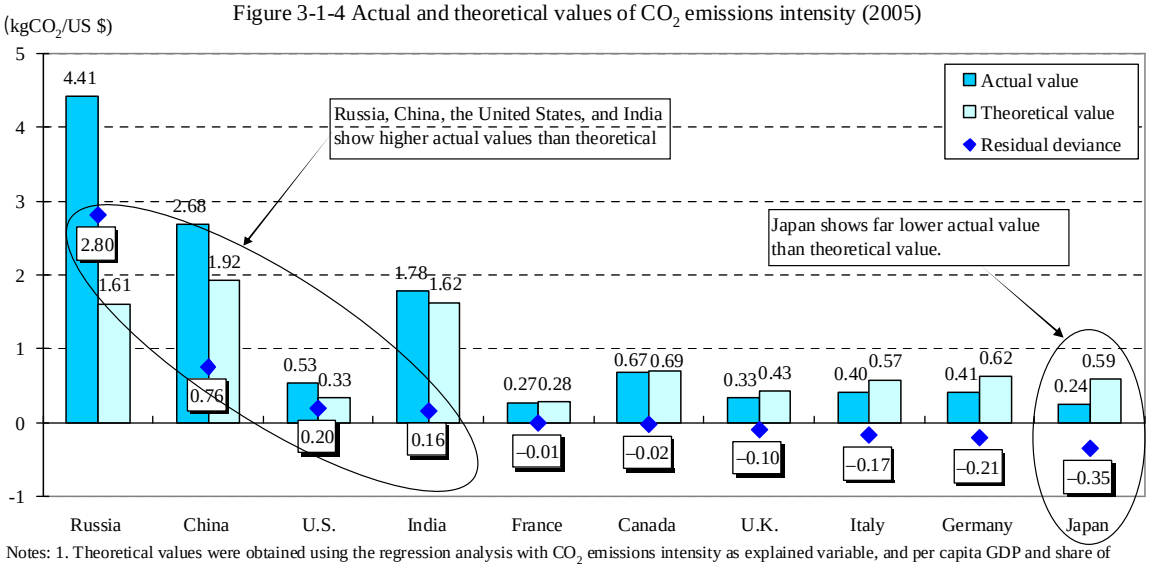


Notes: 1. CO_2 emissions intensity is calculated using the official exchange rate of year 2000.
2. Scope of the data collection covers ASEAN+6 (Lao not included), EU27, USA, Canada, Brazil, and Russia.
Sources: IMF(2008), *World Economic Outlook Database April 2008;* IEA(2007), *CO_2 Emissions from Fuel Combustion.*

(CO_2 emissions intensities in emerging countries are far higher than estimated values)

Based on the estimation results, the theoretical values obtained by the regression analysis and actual figures were compared between the seven most developed countries and China, Russia, and India[8]. The emerging countries ranked among the top in CO_2 emissions in 2005. The results showed higher actual figures than the theoretical figures for the four nations, Russia, China, the United States, and India (see Figure 3-1-4). This indicates that CO_2 emissions efficiency is comparatively low in those four nations, even taking into account the differences in degree of economic growth and industrial structures. On the other hand, the figures values were lower than the theoretical figures for the other six countries. Particularly for Japan, residual deviance was substantially larger than that of any of the other countries. This indicates a higher CO_2 emissions efficiency in Japan, even taking into account the differences in degree of economic growth and industrial structures[9].

Figure 3-1-4 Actual and theoretical values of CO_2 emissions intensity (2005)



Notes: 1. Theoretical values were obtained using the regression analysis with CO_2 emissions intensity as explained variable, and per capita GDP and share of added value from manufacturing industries in national GDP as explaining variable. For details of the analysis, see appended note 3-1.

2. Regression formula: CO2 emissions intensity = −0.265 × ln (Real GDP per capita) + 0.997 × Share of added value from manufacturing industries in national GDP

3. Targets of regression analysis: ASEAN + 6 (Lao not included), EU27 (Cyprus and Malta not included), USA, Canada, Brazil, and Russia.

Sources: IEA(2007), *CO_2 Emissions from Fuel Combustion*; World Bank, *WDI Database*.

(3) Reducing future greenhouse gas emissions

(Future CO_2 emissions forecasts —IEA World Energy Outlook 2007 Reference Scenario)

In 2005, CO_2 emissions from the United States, China, Russia, and India combined with those of Japan and EU27 accounted for approximately 70% of global emissions. Therefore, substantial reduction of global CO_2 emissions is possible if these countries with large emissions undertake aggressive measures.

The Reference Scenario is a simulation to predict the future, assembled by simply using IEA's past emissions data and other information. According to the Scenario, global CO_2 emissions are expected to increase about 1.5 times from 2005 to 2030 (see Figure 3-1-5). Furthermore, looking at the

[8] China ranked second in the world in CO_2 emissions in 2005, Russia third, and India fifth.

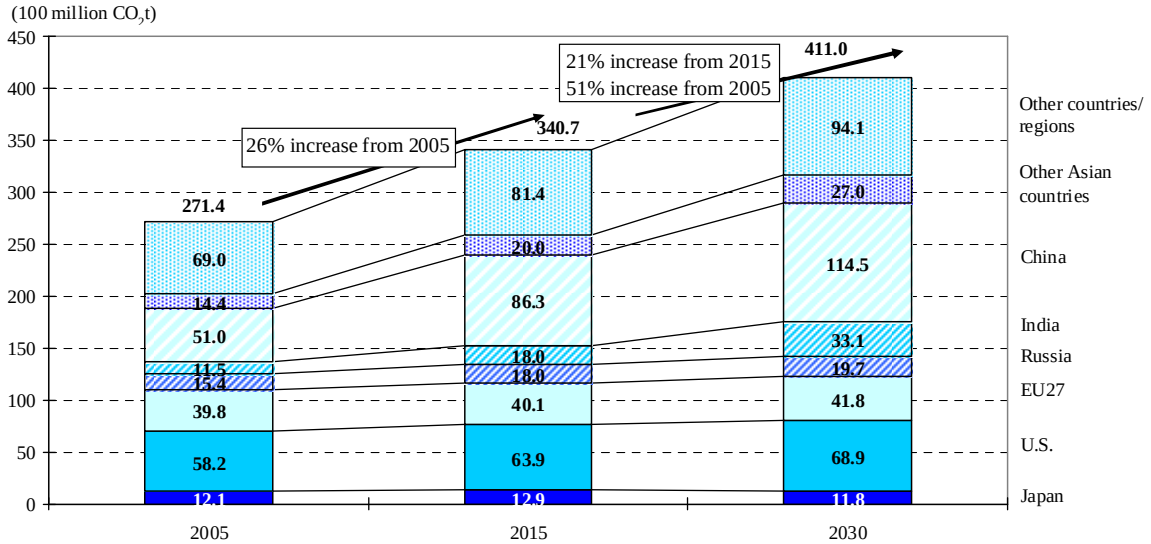
[9] Since climate, geographical and other factors are involved in CO_2 emissions efficiency, these analysis results do not immediately indicate the condition of CO_2 emissions efficiency in each country.

contribution ratios to global CO_2 emissions increase from 2005 to 2030 by country, we see that China accounts for 46% and India 16%, together accounting for over half of the global CO_2 emissions increase.

China is expected to be the world's biggest emitter of carbon dioxide by 2030, and its per capita CO_2 emissions is expected to be almost equivalent to that of EU27 due to economic growth and other factors (see Figure 3-1-6). On the other hand, China's CO_2 emissions intensity is expected to remain higher than that of developed countries with differences in industrial structures, climate, geographical, and other factors taken into account. Russia, whose per capita CO_2 emissions is higher than those of Japan and EU27, even as of 2005, is expected to increase CO_2 emissions about 1.5 times between 2005 and 2030. Furthermore, India is also expected to significantly increase its CO_2 emissions.

In particular, in countries such as Russia, China, the United States, and India, where indices including per capita CO_2 emissions and CO_2 emissions intensity show high values, their CO_2 emissions efficiency could potentially increase through broad applications of technologies and other means currently used in Japan. An aggressive approach in this matter is expected.

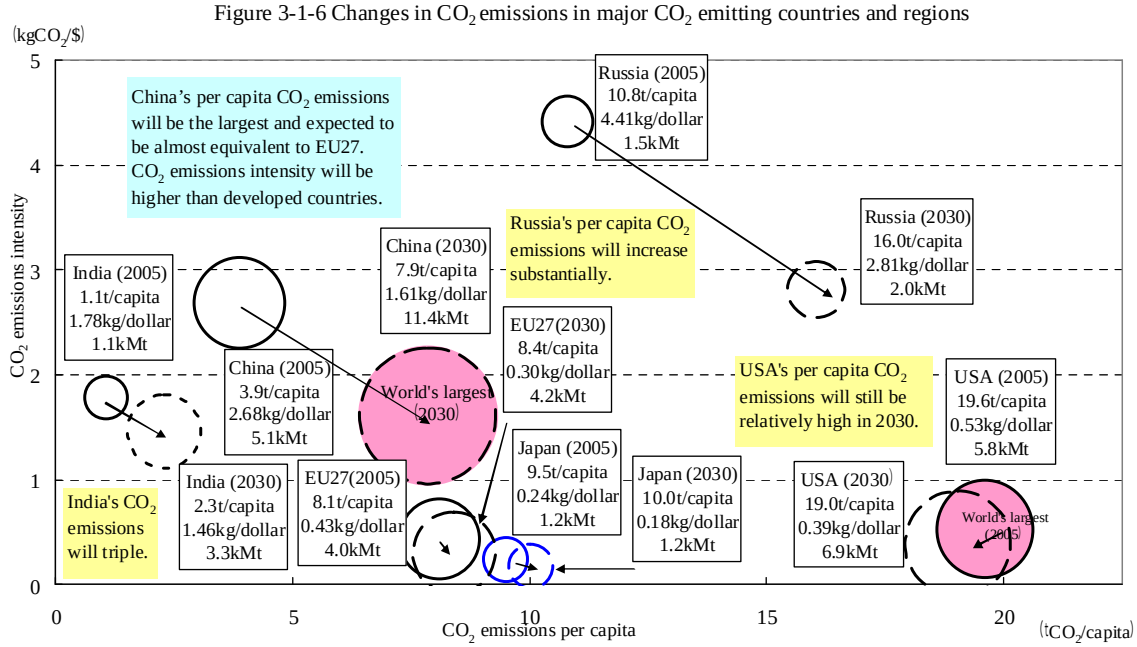
Figure 3-1-5 Global CO_2 emissions forecast (IEA World Energy Outlook 2007 Reference Scenario)



Note: Hong Kong is included in China. Figures for other Asian countries are the sum of the figures of ASEAN and other Asian countries, calculated by subtracting the figures of China and India from the "Developing Asia" figures in IEA's World Energy Outlook 2007.

Source: IEA (2007), *World Energy Outlook 2007*

Figure 3-1-6 Changes in CO_2 emissions in major CO_2 emitting countries and regions



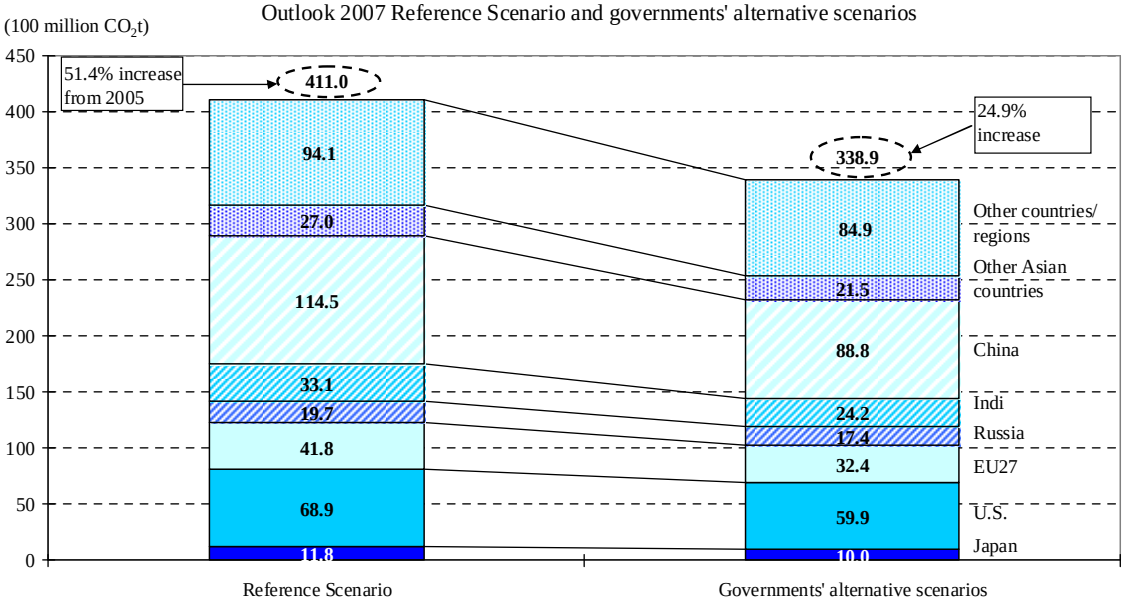
Note: CO_2 emissions intensity is calculated using the official exchange rate of year 2000. Size of circle indicates CO_2 emission volume.
Sources: IEA(2007), *World Energy Outlook 2007* ; IEA(2007), *CO_2 Emissions from Fuel Combustion.*

(Need for an aggressive approach toward reducing global greenhouse gas emissions)

In order to address global climate change problems, all countries, whether developed or emerging, must participate in initiatives to actively reduce greenhouse gas emissions. In doing so, we must find ways of simultaneously achieving both economic growth and conserving the environment.

In addition to the above-mentioned Reference Scenario, IEA disclosed an Alternative Policy Scenario in its World Energy Outlook 2007. In the Alternative Policy Scenario, effectiveness evaluations were performed on the additional energy demand restraint measures that were proposed by each government by mid-2007. The evaluation assumed that factors not related to the measures, such as GDP growth rate and population growth rate remain unchanged. In this new Scenario, the CO_2 emissions increase from 2005 to 2030, which was projected at 51.4% in the Reference Scenario, is estimated to be reduced to 24.9%, about half of the previous prediction, by introducing alternative energies and energy savings technology, including biomass energy (see Figure 3-1-7). Particularly, greater reductions in China, India and other emerging countries are expected.

Figure 3-1-7 Comparison of 2030 CO_2 emissions between IEA World Energy Outlook 2007 Reference Scenario and governments' alternative scenarios



Note: Hong Kong is included in China. Figures for other Asian countries are the sum of the figures of ASEAN and other Asian countries, calculated by subtracting the figures of China and India from the "Developing Asia" figures in IEA's World Energy Outlook 2007.
Source: IEA (2007), *World Energy Outlook 2007*.

For example, if the entire world had the same level of per GDP energy consumption as Japan, which has excellent technologies, the global energy consumption in 2005 could have been reduced by approximately one-third, from 11,434 Mtoe to 3,854 Mtoe[10]. As with CO_2 emissions efficiency, since per GDP energy consumption is also very much subject to a variety of factors including geographical conditions such as climate, and industrial structures of each country, the estimated figures should not be considered absolute values nor used for easy comparison. However, the figures indicate that there is substantial potential for energy efficiency improvement by introducing new technologies.

Moreover, by taking advantage of technological capabilities, both environmental conservation and economic development can be achieved. The improvement of energy efficiency will enable reductions in CO_2 emissions without limiting economic growth, and will also enable energy procurement costs reduction, allowing the saved funds to be invested in research and development and other areas.

However, introduction of highly efficient alternative energy and energy saving technologies in emerging and developing countries requires assistance from developed countries in providing funds and transferring technologies. It is important for developed countries, which have already achieved economic growth, to support emerging and developing countries, while striving to reduce their own greenhouse gas emissions. As emerging and developing countries actively engage in efforts to reduce greenhouse gas emissions, while making sure such climate change countermeasures do not slow down their economic growth, developed countries should provide financial and technological supports to realize both environmental conservation and economic development in those countries.

[10] Source: IEA (2007), *CO_2 Emissions from Fuel Combustion*.

2. Measures in each countries and regions

(1) Conference of Parties to the United Nations Framework Convention on Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1992 at the Rio Earth Summit. In response to the increasing concentrations of atmospheric greenhouse gases and the resulting global warming and negative impacts on the natural ecosystem, it seeks to stabilize the atmospheric concentration of greenhouse gases. UNFCCC took effect in 1994, and as of December 2007, it has been ratified by 191 countries, including Japan, and by the European Community. The Conference of the Parties to UNFCCC is held every year since 1995.

(Arguments regarding the Kyoto Protocol)

The Kyoto Protocol was adopted at the Third Conference of the Parties to the United Nations Framework Convention on Climate Change (COP3) held in Kyoto in 1997; it was officially enacted in February, 2005. The first commitment period commenced in January 2008 (in April, for Japan[11]) and will continue till 2012. During this period, Japan is required to reduce greenhouse gas emissions by 6% from the 1990 level. However, there are many arguments surrounding the Kyoto Protocol.

○ Effectiveness in reducing greenhouse gas emissions

Achieving the emission reduction commitments under the Kyoto Protocol in developed countries is the first and most primary step toward realizing the ultimate goal of stabilizing the atmospheric concentration of greenhouse gases under the UNFCCC. However, the U.S. has not ratified the Kyoto Protocol; further, emerging and developing countries including major greenhouse gas emitting countries such as China and India are not required to reduce their emissions. As a result, the total CO_2 emissions in the 39 countries that are obligated to reduce emissions constitute only about 30% of the global CO_2 emissions. Going forward, it is important to create a new and effective framework for 2013 and beyond, where all major greenhouse gas emitting countries participate in the effort to reduce emissions, based on the principle of "Common but differentiated responsibilities and respective capabilities."

○ Fairness in setting national reduction targets

Moreover, fairness is also a point of contention. The lack of which will make it difficult to sustain long-term efforts and maintain cooperative relationships.

(a) Base year

The Kyoto Protocol base year is an argument point from the perspectives of fairness and reliability of statistical data.

The base year is useful in observing the changes in greenhouse gas emissions during a certain period. However, the problems involved in setting a base year are that reduction targets change depending on the year chosen, which, in turn, exerts some influence on the target-setting negotiations,

[11] However, the first commitment period began in Japan in January for three CFC substitute gases (HFCs, PFCs, and SF6).

and that the reduction efforts made before the base year are not reflected.

The current Kyoto Protocol base year is 1990. The CO_2 emissions in 2005 increased by 7.7% in Japan and decreased by 2.0% in the EU15, as compared to their 1990 levels. However, if the year 1995, for example, is used as the comparison base year, the figures would be 1.1% for both Japan and EU15, putting them on the same level. Thus, the figures change significantly depending on the year selected as the base year. One of the reasons behind the emissions decrease in the EU is that, after the reunification of the former West and East Germany in 1990, the CO_2 emissions in the former East Germany decreased substantially due to its sluggish economy (from 1990 to 1995, it decreased from 294.0 MCO_2t to 169.7 MCO_2t); this offset the CO_2 emissions increase in the former West Germany (from 1990 to 1995, it increased from 673.6 MCO_2t to 711.1 MCO_2t). Thus, in effect, emissions reduction was realized in reunified Germany.

Moreover, the reliability of data on greenhouse gas emissions in each county has improved in recent years. Hence, selecting a more recent year as the base year may be considered as a better benchmark.

(b) Joint fulfillment

The joint fulfillment set forth in Article 4 of the Kyoto Protocol is also a contentious issue.

Joint fulfillment is a system in which Annex I parties agree to fulfill their numerical reduction commitments jointly, and that as long as the total emissions of these parties do not exceed the total of emission amounts allocated to each party, that would be regarded as a fulfillment of their commitments. The EU has adopted this system, and the EU15 has made a unified commitment of an 8% reduction of greenhouse gas emissions (EU Bubble). Based on this commitment, the EU15 set individual reduction targets for each member state to achieve the EU wide goal of a reduction of 8%. The assigned targets for each of the EU15 member states vary greatly, from Luxembourg's 28% reduction to Portugal's 27% increase. Some advanced countries are allowed to increase their greenhouse gas emissions (see Table 3-1-8). In comparison to this, the numerical targets for UNFCCC Annex I parties vary minimally, from EU's 8% reduction to Iceland's 10% increase. Thus, it is evident that the EU has used this system to flexibly reflect each member state's condition for assigning reductions targets.

Furthermore, although the EU15 as a whole has reduced greenhouse gas emissions by 2% between 1990 and 2005, which suggests that they are making steady progress, on examining each country, it can be observed that there are countries in the EU15 where greenhouse gas emissions has substantially increased, such as Spain and Portugal, which increased their emissions from the 1990 level by 52% and 40%, respectively.

Since each country's role and responsibility are unclear under joint fulfillment, a revision of this system should be considered from the perspectives of fairness and effectiveness to create a more effective post-2013 framework where all major emitting countries participate in the effort to reduce greenhouse gas emissions.

Figure 3-1-8 Emission reduction targets and actual results in developed countries

Kyoto Protocol emissions reduction targets and 2005 results for developed countries (comparison with base year)

EU15				Countries in transition to market economy				Other developed countries			
Country	Target (%)	2005 actual (%)	Diff.	Country	Target (%)	2005 actual (%)	Diff.	Country	Target (%)	2005 actual (%)	Diff.
Portugal	27.0	40.4	13.4	Russia	0.0	28.7	28.7	Iceland	10.0	10.5	0.5
Greece	25.0	25.4	0.4	Ukraine	0.0	54.7	54.7	Australia	8.0	2.2	5.8
Spain	15.0	52.3	37.3	Croatia	5.0	15.5	10.5	Norway	1.0	8.8	7.8
Ireland	13.0	25.4	12.4	Poland	6.0	32.0	26.0	New Zealand	0.0	24.7	24.7
Sweden	4.0	7.4	11.4	Hungary	6.0	34.5	28.5	Canada	6.0	25.3	31.3
Finland	0.0	2.6	2.6	Romania	8.0	45.6	37.6	Japan	6.0	7.8	13.8
France	0.0	1.9	1.9	Czechoslovakia	8.0	25.8	17.8	U.S.	7.0	16.3	23.3
Netherlands	6.0	1.1	4.9	Bulgaria	8.0	47.2	39.2	Switzerland	8.0	1.7	9.7
Italy	6.5	12.1	18.6	Slovakia	8.0	33.6	25.6	Liechtenstein	8.0	17.4	25.4
Belgium	7.5	2.1	5.4	Lithuania	8.0	53.1	45.1	Monaco	8.0	3.1	4.9
Britain	12.5	15.7	3.2	Estonia	8.0	52.0	44.0	Turkey	N / A	74.4	N / A
Austria	13.0	18.1	31.1	Latvia	8.0	58.0	50.0	**(Reference)**			
Denmark	21.0	7.8	13.2	Slovenia	8.0	0.4	8.4	Country	Target (%)	2005 actual (%)	Diff.
Germany	21.0	18.7	2.3	Belarus	8.0	40.6	32.6	China	N / A	127.3	N / A
Luxembourg	28.0	0.4	28.4					India	N / A	95.5	N / A
EU15	8.0	2.0	6.0								

ote: Figures for China and India were taken from the IEA statistical data listed in *CO_2 emissions from fuel combustion*.
Figures for the other countries include their total emission of the six greenhouse gases

ources: European Environment Agency (2007), *Greenhouse gas emission trends and projections in Europe 2007*; UN (2007), *National greenhouse gas inventory data for the period 1990-2005*; IEA (2007), *CO_2 emissions from fuel combustion 1971-2005*; etc.

(The Third Conference of the Parties to the United Nations Framework Convention on Climate Change (COP3))

The Third Conference of the Parties to the United Nations Framework Convention on Climate Change (COP3) was held in Bali, Indonesia, in December 2007. At the COP3, the Ad Hoc Working Group on Long-term Cooperative Action (AWGLCA) was newly established under the UNFCCC in which all the parties were required to participate; further, it was decided that the parties would reach a consensus and adopt a new post-2013 framework by 2009.

The following issues are to be addressed by the AWGLCA[12]:

① A shared vision, including a long-term global goal for emission reductions

② Measurable, reportable, and verifiable nationally appropriate mitigation commitments or actions, including quantified emission limitation and reduction objectives

③ Mitigation actions by developing country Parties in the context of sustainable development, in a measurable, reportable, and verifiable manner

④ Cooperative sectoral approaches

⑤ Enhanced action on technology dissemination and transfer and international cooperation in research and development of innovative technology

⑥ International cooperation in providing support for adaptation action (special considerations are needed for countries in difficult circumstances such as those most seriously affected)

⑦ Funding for developing countries to support their mitigation and adaptation actions

[12] The first session of the AWGLCA was held from March 31 to April 4, 2008 in Bangkok, Thailand, and a future work schedule was agreed upon..

(2) Measures in each countries

(Measures in the U.S.)

○ Measure in the U.S. Federal Government and the Congress

President Bush, who had announced his country's withdrawal from the Kyoto Protocol in March 2001, proposed a new international framework beyond 2013 regarding greenhouse gas emission reduction during his remarks on United States International Development Agenda on May 31, 2007. His proposal included the following points:

(a) Major CO_2 emitting countries including rapidly growing countries such as China and India should hold a series of meetings to establish long-term targets for global greenhouse gas emission reductions.

(b) In addition to the global long-term targets, each country should set its own medium-term targets, reflecting its energy mix and future energy demands.

Based on this proposal, the Major Economies Meeting[13] was held in September 2007, followed by meetings in January and April 2008.

On April 16, 2008, President Bush announced a new global warming prevention plan to stop the increase of U.S. greenhouse gas emissions by 2025, indicating his changed attitude toward climate change.

Moreover, in the U.S., where 53% of the total electric power generation is generated from coal-fired power plants (as of 2005), technological improvements are now being promoted to reduce CO_2 emissions at these plants. One such initiative is the "Future Gen Project" undertaken by the U.S. Department of Energy[14].

Further, the U.S. is also promoting initiatives to support the expansion of nuclear power generation, including the launch of the Global Nuclear Energy Partnership (GNEP) plan in February 2006, in which 21 countries including Japan participated. The plan calls for (1) an increased use of nuclear power generation that does not emit CO_2, (2) the development of cutting-edge nuclear-fuel-cycle technology and fast reactors with higher nuclear proliferation resistance, and (3) the establishment of a highly reliable and economically efficient international framework for supplying nuclear fuels in the global market.

Meanwhile at the U.S. Congress, bills regarding the introduction of the cap and trade system[15] have been submitted by groups regardless of their party affiliation (see Table 3-1-9). Senator John McCain, Republican candidate for the 2008 Presidential Election, is one of the people who have drafted such bills. His plan calls for a U.S. greenhouse gas emissions reduction of 60% by 2050.

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[13] Participants included Japan, the U.S., China, the EU, Russia, and India.

[14] In the original "Future Gen Project" plan, it was decided that a 275 MW demonstration coal-fired power plant that emits no sulfur oxide, nitrogen oxide, or carbon dioxide be built. However, the U.S. Department of Energy changed its policy in January 2008. In the new plan, instead of building one large-size demonstration power plant, Carbon-dioxide Capture and Storage (CCS) technology will be deployed in multiple commercial power plants by 2015. A detailed discussion on CCS technology is presented in Section 3 (3).

[15] A system for trading emission allowances. First, the total amount of allowed greenhouse gas emission is determined. Then, the emission allowance (cap) is assigned to greenhouse gas emitting entities (companies, individuals, etc.). The difference between the allowed and actual emissions can be transferred (traded).

Senator Barack Obama, Democratic candidate for the 2008 Presidential Election, who is considered to be active in addressing climate change, has set a goal of reducing U.S. greenhouse gas emissions by 80% by 2050. However, both of these candidates, in their medium-term plans, aim to reduce emissions only to the 1990 levels by 2020. Moreover, one point of consideration is the fact that the U.S. Senate passed the Byrd-Hagel Resolution (1997) which state that any international agreement on global climate change must be ratified by all countries. Given the above, we need to pay attention to the U.S. attitude toward climate change under the next administration.

Figure 3-1-9 Major emissions trading scheme legislations submitted to the U.S. Congress

		Lieberman (maverick)-Warner (Rep) legislation*1	Bingaman (Dem)-Specter (Rep) legislation	Lieberman (maverick)-McCain (Rep) legislation	Boxer (Dem)-Sanders (maverick) legislation
Reduction target (US total emissions)	**2020**	19% reduction from 2005 (est.)*2	Maintain 2006 levels	Maintain 1990 levels	Maintain 1990 levels
	2030	-	Maintain 1990 levels	22% reduction from 1990	27% reduction from 1990
	2050	63% reduction from 2005 (est.)*2	60% reduction from 2006*3	Maintain 1990 levels	80% reduction from 1990
Regulation target		Coal-consuming facilities, manufacturing facilities of natural gas and petroleum products, importers of natural gas and petroleum products (covers about 80% of the total U.S. GHG emissions.)	Importers and manufacturers of fossil fuels, etc., coal-consuming facilities, etc.	Importers and manufacturers of petroleum products, etc.; facilities exceeding GHG emissions of 10,000 tons per year	Determined by the Environment Protection Agency (EPA)
Allocation method		A Combination of gratuitous allocations and auctions based on past results. Gradually increase the share of auctions.	Combination of gratuitous allocations and auctions based on past results. Gradually increase share of auctions.	Combination of gratuitous allocations and auctions	Rules set by the EPA
Cost relief measures		• Establish a Carbon Market Efficiency Board to stabilize emission allowance prices • Forward to the next period • Borrow from the next period • Utilize domestic and international relief projects	• Set a de facto price cap ("safety valve," 12 dollars per tons) • Forward to the next period • Utilize domestic and international relief projects	• Borrow from the next period • Forward to the next period • Utilize domestic and international relief projects	Rules set by the EPA
Measures to address the need for international competitiveness in China, India, etc.		From 2020 onward, in relation to products imported from the major trading partner countries without reasonable global warming countermeasures in place, the submission of emission allowances by importers are required.	From 2020 onward, in relation to products imported from major trading partner countries without global warming countermeasures comparable to those of the U.S. in place, submission of emission allowances by importers are required.	No measures proposed	No measures proposed

*1: Passed the Senate Environment and Public Works Committee (11-8). A date for consideration by the full Senate has not yet been set.
*2: The legislation regulates the total quantity of emission allowances to be issued to targeted facilities (power generation, industrial, transportation, etc.) (2050: 1,732 million tonnes, about 70% reduction from 2005 levels)
*3: The legislation also recognizes the need for developing innovative technologies that would enable the reduction of greenhouse gas.
Source: Compiled by METI from various available materials.

○ Measures of the state governments

(a) Initiatives in the 10 northeastern states[16]

In 2003, New York's Governor Pataki invited the governors of the northeastern states to join in regional discussions. On acceptance of the invitation, the Regional Greenhouse Gas Initiative (RGGI) was launched. In 2005, they concluded a memorandum on the overall scheme including a cap and trade program.

Subsequently, the RGGI began preparations for the 2009 implementation of a cap and trade system for 25 MW power generation plants in 10 northeastern states. An agreement was reached on the following reduction targets: reducing the total CO_2 emissions from these facilities to the 1990 levels between 2009 and 2014, and further reducing it by 10% from the 1990 levels by 2018[17].

[16] The 10 states included New York, New Jersey, Connecticut, Massachusetts, Maine, Delaware, Maryland, New Hampshire, Rhode Island, and Vermont.
[17] Ministry of Environment (2006), "Survey Report on the U.S. Emission Trading Scheme"

(b) Initiatives in the State of California

The California Global Warming Solutions Act (AB 32) was enacted in 2006. The Act requires that the state achieve the 1990 greenhouse gas emission levels by 2020.

For the purpose of achieving the set goal, it requires that the state (1) implement mandatory reporting of greenhouse gas emissions from major sources from 2008, (2) prepare a Scoping Plan to achieve reductions in greenhouse gas emissions by January 1, 2009, and (3) adopt greenhouse gas emissions limits and emission reduction measures by January 1, 2011. In addition, the introduction of a carbon cap and trade system is being considered by the California Air Resources Board as one of the policy options.

○ **Responses by the private sector**

The Chicago Climate Exchange (CCX) was established in 2003. It is a voluntary greenhouse gas emissions cap and trade scheme in which a wide range of entities participate, including electric power companies and manufacturers such as American Electric Power (AEP), Sony Electronics, Ford, and DuPont, as well as municipal governments such as the City of Chicago[18].

Moreover, in January 2007, the U.S. Climate Action Plan, signed by 10 major companies including GE and DuPont and environmental organizations in the U.S., advocated an early enactment of the climate change legislation, including the introduction of a cap and trade scheme, by the Congress. There are companies in the U.S. that are positive in introducing cap and trade systems.

(Measures in the EU)

The EU in its medium- and long-term plans set the following numerical targets:

① Reduce the total EU greenhouse gas emissions by at least 20% from the 1990 levels (30% if an international agreement is reached) by 2020.

② Increase the ratio of renewable energy in the total energy consumption to 20%.

③ Given that developing countries should take an initiative in setting targets, reduce the total emissions of the developed countries from the 1990 levels by 30% by 2020, and by 60% to 80% by 2025.

In order to achieve these targets, in November 2007, the EU announced "*European Strategic Energy Technology Plan (SET-Plan): Towards a low carbon future*;" the plan aims to promote rapid progress in developing next-generation technologies.

With the aim of supporting developing countries, the EU began the Global Climate Change Alliance in November 2007, a communication forum between the EU and the most seriously affected

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[18] AEP, one of the largest power generation companies in the U.S. indicated the following reasons for its aggressive approach in reducing emissions:

(1) Lack of emission reduction initiatives will lead to loss of trust among investors who expect corporations to be environmentally responsible.

(2) By responding earlier, they will be able to reap gains from being a forerunner, and influence the future government's policies.

Christina Stanton (2003b), "Chicago Climate Exchange (CCX) and an Overview of the Plan—Global Warming Countermeasures in the U.S. Private Sector"

countries as well as those most vulnerable to climate change. The alliance aims to coordinate development strategies and climate change countermeasures in the following five areas: (1) adaptation, (2) deforestation, (3) promotion of participation in the CDM[19], (4) decrease of disaster risk, and (5) incorporation of climate change adaptation in the efforts to decrease poverty. The EU has allocated a budget of 50 million euro, which is to be spent between 2008 and 2012, for action planning and for technological and financial support for developing countries.

Moreover, the EU launched the Global Energy Efficiency and Renewable Energy Fund to encourage (1) private sector investment in small projects concerning energy efficiency and renewables in developing and transition economies, (2) sharing of capital risk, and (3) providing joint investment options.

○ EU Emission Trading System (EU-ETS)

Based on the 2003 directive on emissions trading (EU2003/87/EC), in January 2005, the EU introduced, on a trial basis, the EU Emission Trading System (EU-ETS), a cap-and-trade type obligatory carbon trade system, which was at the time, the first in the world. In Phase II, beginning in January 2008, stricter emission caps have been set based on the results of Phase I (2005 to the end of 2007), which needed improvement (see Table 3-1-10).

Figure 3-1-10 EU Emission Trading System (EU-ETS) scheme

	Phase I (2005-2007)	Phase II (2008-2012)	Phase III (2013-2020)
Reduction target	8.3% increase from 2005 emission levels (average during 2005 to 2007 period)	5.6% reduction from 2005 emission levels (average during 2008 to 2012 period)	21% reduction from 2005 emission levels (as of 2012)
Allocation method	Grandfathering allocation method mainly used. (Maximum 5% use of the auction process was allowed; however, only few countries used it.)	Grandfathering the allocation method mainly used. (The use of benchmark allocation method is increasing in some countries. Maximum 10% use of the auction process is allowed, and more countries are planning to use it than in Phase I.)	In principle, switch to auction allocation. (Maximum 100% free allowance allocation available to sectors with a higher risk of losing international competitiveness) Target to allocate minimum two-thirds of the total emission allowances through the auction process in 2013.
Targeted gas	CO_2	CO_2. Planning to include other greenhouse gasses in some countries.	CO_2, N_2O (chemical), PFC (aluminum)
Targeted sector	Limited to energy conversion and industry sectors (about 11,500 plants)	An extension to include the aviation sector is being considered (after 2011).	Adding aluminum, chemical (ammonia, etc.), and aviation sectors, etc.
Coverage	About 49% of the total EU CO_2 emissions	N/A	N/A
Penalty	€40/t-CO_2	€100/t-CO_2	Adjusted each year based on Consumer Price Index change
Maximum use of CDM/JI	No limit set (none have been used).	Maximum use set at 20%, etc.	Residual balance carried forward from Phase II

Source: Compiled by METI from various available materials.

In Phase I, the EU-ETS imposed caps on CO_2 emissions for about 11,500 large energy-consuming facilities, which account for 49% of the total EU CO_2 emissions, and implemented cap and trade based mainly on grandfathering[20]. According to some observers, the background for implementing the

[19] CDM is a system that allows an Annex I Party of the Kyoto Protocol to implement a project that reduces greenhouse gas emission in the territory of a non-Annex I Party, and the resulting certified emission reductions can then be used by the Annex I Party to help meet its emission reduction target.

[20] In this allocation scheme, emission allowances are distributed on the basis of historic emissions.

EU-ETS included the following:

(a) Difficulties in levying environmental taxes due to political reasons (The introduction of environmental taxes would require consensus from all 27 Member States[21].)

(b) The U.K. government's intention to make London the capital of carbon trading[22]

The European Commission recognizes that the infrastructures needed for the EU-ETS to monitor, report, and verify emissions, including the registration of a market for free trading of emission allowances, have been successfully established in Phase I[23]. Moreover, the European Commission is considering an expansion of the regulation targets to include the aviation sector from 2011 onwards as well as a change in its emission allowance allocation method from the current method of grandfathering to a combination of the benchmark allocation method[24] and the auction method[25].

Furthermore, the EU has been actively promoting the establishment of an international carbon trading market, which includes the launch of the International Carbon Action Partnership (ICAP). The ICAP was formed in October 2007 by the EU members, 10 U.S. states, 2 Canadian provinces, New Zealand, and Norway; it aims to establish a global carbon trading market. In addition, Japan's Ministry of Environment participates in the ICAP meetings as an observer.

On the other hand, experts have pointed out various issues pertaining to the EU-ETS, including the following.

① Regarding the reduction targets of Phase I, there are problems in cap setting, such as moderate emissions allowances that lead to a price fall when the moderate allocation is realized.

② There are problems related to fairness and equity with respect to the cap. For example, during Phase I, in the process of creating national allocation plans that determine each country's emissions cap, there were about 800 cases[26] in all the EU countries wherein the companies sued their national governments over allocation methods and allocation amounts. Further, during Phase II, the former East European countries, such as Czech Republic, Latvia, Poland, Hungary, and Estonia, sued the European Commission over its strict demand on the allocation amount[27].

③ There are concerns about "carbon leakage" and a loss of international competitiveness among the EU companies. For example, Jean-Louis Borloo, the French Minister of Ecology and Sustainable Development, expressed his concern about "carbon leakage," which occurs when economic activities and plant locations move from the EU countries to countries with lesser or no environmental regulations. Secretary General Mr. Richmann of German Federation of Industry and Energy stated that in a situation wherein the competitors do not need to bear carbon costs,

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[21] Ministry of Environment; Ministry of Economy, Trade and Industry; Nippon Keidanren (2007), *Survey Report on the EU Emissions Trading Scheme.*

[22] Ministry of Environment; Ministry of Economy, Trade and Industry; Nippon Keidanren (2007), *Survey Report on the EU Emissions Trading Scheme.*

[23] European Commission (2006), "Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading system of the Community."

[24] Allocation method based on emission intensity (greenhouse gas emission per unit of production), etc.

[25] A method to allocate allowances to emitting entities using an auction process.

[26] Ministry of Environment; Ministry of Economy, Trade and Industry; Nippon Keidanren (2007), *Survey Report on the EU Emissions Trading Scheme.*

[27] European Court of Justice website (http://coria.europa.eu/)

domestic industries cannot pass on the carbon costs to the international market. This would lead to not only loss of the labor market but also migration of the manufacturing bases, resulting in increased emissions outside of Europe.

In fact, some of the EU companies have announced the relocation of their plants to outside of the EU region.

○ **Measuresto climate change that may develop into international trade problems**

In response to the concerns about carbon leakage and a loss of international competitiveness among the EU companies in relation to the EU-ETS, the EU is holding talks on the taxation of imported goods as well as other measures including a carbon tax.

In November 2006, it was reported that the then French Prime Minister Dominique de Villepin announced the country's policy of possibly levying carbon taxes on products imported from countries that refuse to participate in the global efforts to reduce greenhouse gas emissions[28]. Moreover, in the same month, the EU Commission's Commissioner for Enterprise and Industry Günter Verheugen reportedly proposed providing special financial support to energy intensive industries as well as levying taxes on products imported from countries that have not ratified the Kyoto Protocol. The factors behind this were that the EU's pioneering environmental initiatives would cause the EU energy intensive industries to lose their international competitiveness, and that the migration of manufacturing facilities to countries with lower environmental standards than those of the EU would have a negative impact on the global environment[29].

In the "Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and expand the greenhouse gas emission allowance trading system of the Community" announced in January 2008, there is a statement that reads as follows: "an effective carbon equalization system could be introduced with a view to putting installations from the Community which are at a significant risk of carbon leakage and those from third countries on a comparable footing. Such a system could apply requirements to importers that would be no less favorable than those applicable to installations within the EU, for example by requiring the surrender of allowances.With regard to these measures related to imports, the Directive states, "It would also need to be in conformity with the international obligations of the Community including the WTO agreement." Since the consistency issues with the WTO agreement may turn into an international trade problem, we need to focus our attention on future development.

○ **Introduction of renewable energy in the EU**

As already discussed, the EU has decided to increase the ratio of renewable energy in the total EU energy consumption to 20%. In many of the EU member states, legal actions and electric power companies' voluntary initiatives are being undertaken to promote introduction of renewable energy.

The use of renewable energy has increased in the EU in the recent years. The total wind power

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28 *Financial Times*, November 24, 2006.

29 *Financial Times*, November 24, 2006.

installation capacity in the EU25 in 2007 was 56,535 MW, increasing approximately 2.4 times in the 5 years from 2002 to 2007, while the total photovoltaic energy installation capacity in the EU15[30] in 2006 was 3,178 MW, increasing approximately 17.6 times from the year 2000 (see Tables 3-1-11 and 3-1-12).

Table 3-1-11 Changes in the wind power installation capacity of major countries

	2000	2001	2002	2003	2004	2005	2006	2007
Germany	6,104	8,754	11,994	14,609	16,629	18,415	20,622	22,247
U.S.	2,578	4,275	4,685	6,372	6,725	9,149	11,575	16,818
Spain	2,235	3,337	4,825	6,203	8,263	10,027	11,623	15,145
India	220	1,456	1,702	2,125	3,000	4,430	6,270	8,000
China	346	402	469	567	764	1,260	2,604	6,050
Japan	136	302	338	580	809	1,049	1,394	1,538
EU total	12,887	17,315	23,159	28,598	34,371	40,551	48,029	56,535

Note: The above listed courtiers were the top 5 countries with respect to wind power installation capacity in 2007, along with Japan and the EU (total). Due to statistical limitations, the figures of the EU total for 2000 and 2001 are those of EU15, and those for 2002 and onwards are those of EU25. Therefore, the figures should not be compared directly.

Source: Global Wind Energy Council (2008), *Global Wind 2007 Report*.

Table 3-1-12 Changes in the photovoltaic energy installation capacity of major countries

	2000	2001	2002	2003	2004	2005	2006
Germany	114	195	278	431	1,044	1,910	2,863
Japan	330	453	637	860	1,132	1,422	1,709
U.S.	139	168	212	275	376	479	624
Spain	12	16	21	27	37	58	118
Australia	29	34	39	46	52	61	70
EU15	181	279	385	581	1,226	2,134	3,178

Note: The above listed countries are the top 5 countries among the IEA reporting countries with respect to photovoltaic energy installation capacity. The figures of EU15 do not include those of Belgium, Greece, Ireland, and Luxembourg, where data is not availab

Source: IEA (2007), *TRENDS IN PHOTOVOLTAIC APPLICATIONS Survey report of selected IEA countries between 1992 and 2006.*

○ Measures in the transportation and consumer sectors of the EU region

In the EU, each country is undertaking various measures to reduce greenhouse gas emissions in the transportation and consumer sectors.

In the U.K. transportation sector, the Congestion Charge System was implemented in February 2003. Under this system, toll charges are levied on vehicles driving into the central London area, extending over 21 km^2, to control traffic congestion and reduce CO^2 emissions. By implementing this system, the first year's goals of significantly reducing traffic congestion by 30% and reducing CO^2 emissions by 16% from the previous year, were reportedly achieved.

In the French transportation sector, in addition to the congestion control to reduce CO_2 emissions, a large-scale bicycle sharing program was launched in Paris in July 2007, aiming to lessen car exhaust and noise pollution[31]. Moreover, in France, it is obligatory to replace single-pane window glass with

[30] The EU15 figures do not include those of Belgium, Greece, Ireland, and Luxembourg, where data is unavailable, or those of Finland, where data for 2004 onwards is lacking.

[31] JCDecaux, an advertising agency, sponsors this project in exchange for advertising rights in Paris. A total of 750 bicycle stands (3 locations at each subway station) are installed within the city of Paris, with a total of 10,000 bicycles.

double-pane insulating window glass by 2010 which will contribute to increase energy efficiency in the consumer sector.

The driving factors behind these initiatives are the increase in the emissions from the transportation and consumer sectors in the U.K. and France and the relatively declined reduction rate in other sectors than transportation and consumer sectors in Germany, where the country's total CO_2 emissions have been reduced by 12.3% from the 1990 levels due to the unification of the former East and West Germany. (see Table 3-1-13).

Figure 3-1-13 CO_2 emissions from fuel combustion by country and by sector

	U.K.		France		Germany		Japan	
	2005 emissions (Million CO_2t)	% change from 1990 (%)	2005 emissions (Million CO_2t)	% change from 1990 (%)	2005 emissions (Million CO_2t)	% change from 1990 (%)	2005 emissions (Million CO_2t)	% change from 1990 (%)
Energy conversion sector	232.8	-4.9	72.0	13.0	363.7	-12.3	512.9	26.6
Industry sector	63.5	28.8	78.2	-2.5	118.5	-34.0	268.2	-5.9
Transport sector	129.1	24.2	134.5	17.4	158.5	-0.7	249.2	18.1
Business and other sectors	24.5	-3.8	38.2	-6.7	51.7	-38.2	116.2	15.5
Consumer sector	79.9	3.9	65.5	17.2	121.0	-5.6	67.8	20.5
Total CO_2 emissions	529.89	6.5	388.38	9.3	813.48	-15.9	1,214.18	14.8

Source: IEA (2007), *CO_2 Emissions from Fuel Combustion 1971–2005.*

(Measures in China)

○ China's National Climate Change Programme

In June 2007, China announced the" China's National Climate Change Programme," which aims to reduce the city's greenhouse gas emissions. The program has the following guiding principles:

① To address climate change within the framework of sustainable development

② To place equal emphasis on both adaptation and mitigation

③ To rely on the advancement and innovation of science and technology

④ To follow the principle of "Common but differentiated responsibilities"

The specific objectives of the program to be achieved by 2010 include

① To reduce energy consumption per unit GDP by 20%

② To increase the share of renewable energy to 10% in the primary energy supply

③ To increase carbon absorption？ (absorption of CO_2 by forests, etc.) by 50 million tons over the 2005 level

By 2010, a total reduction of 950 million tons in CO_2 emissions is expected, of which 500 million tons is projected to come from the promotion of hydraulic power generation. Furthermore, a 550 million ton reduction of CO_2 emissions through the implementation of energy-saving programs is expected sometime during the 11^{th} 5-year plan period.

The fact that China, which is the largest greenhouse gas emitting country in the world, has formulated this national program is significant and deserves attention. Considering this new political direction that China has taken, Japan intends to hold talks aiming to develop a new and effective framework in which all the major greenhouse gas emitting countries participate.

○ **“ Joint Communique between the Government of Japan and the Government of the People’s Republic of China on Climate Change” during the Chinese President Hu Jintao’s visit to Japan**

When the Chinese President Hu Jintao visited Japan in May 2008, the “Joint Communique between the Government of Japan and the Government of the People’s Republic of China on Climate Change” was signed by both parties. Statements in the Communique, as listed below, indicates China’s active stance towards climate change.

① China recognizes Japan’s proposal to at least halve the world’s greenhouse gas emissions by 2050, and it will study the means and measures required to achieve the ultimate goal of the United Nations Framework Convention on Climate Change (UNFCCC), which is to stabilize the atmospheric concentration of the greenhouse gases at a level that would prevent dangerous anthropogenic interference with the climate system.

② Both parties share the common understanding that Japan and China will actively participate in talks to increase the effectiveness of the process and the framework until 2012 and beyond 2013, and contribute to attaining beneficial results at the Conference of the Parties to the UNFCCC (COP) and the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (COP/MOP), scheduled to be held in Copenhagen, Denmark, at the end of 2009.

③ China regards the Japanese sector-based approach in setting and implementing emissions reduction targets and cutting emissions as an important idea.

(Measures in India)

Japan and India are strengthening their cooperative relationship. In August 2007, the then Prime Minister Shinzo Abe visited New Delhi, India, for talks with Prime Minister Manmohan Singh. The two leaders issued the ”Joint Communique between the Government of Japan and the Government of the Republic of India on Strengthening Cooperation in Environmental Conservation and Energy Security,” in which both the parties expressed their intention to engage in efforts to (1) establish a flexible, fair, and effective global framework after 2013 for fighting global warming where all countries participate and (2) join other international collaborative initiatives. They also announced concrete plans to work together to promote initiatives on energy saving, energy efficiency, and clean energy.

○ **Drafting the National Plan of Action**

India established the National Council on Climate Change in July 2007 to commence discussions to compile the National Plan of Action[32].

In relation to global warming, Prime Minister Manmohan Singh announced India’s plans in his speech at Sustainable Development and Climate Change 2008 held in New Delhi in February 2008. He stated that India is committed to maintain its per capita CO_2 emissions at levels not exceeding the average of those of developed countries, and if developed countries undertake measures to reduce per

[32] The plan was originally scheduled to be announced by year-end 2007. However, a new schedule to release the plan in June 2008 was announced during Sustainable Development and Climate Change 2008 held in New Delhi in February 2008.

capita CO_2 emissions, India would undertake equivalent reduction efforts in response. On the other hand, he also said it is not acceptable to limit growth opportunities for developing countries due to their insufficient CO_2 emissions reduction.

3. Japan's potential contribution and its political issues by using environmental technology

(1) Measures in Japan

Japan's total greenhouse gas emissions in fiscal 2006 were 1,340 million tons of CO_2 equivalents (final figure), 6.2% more than those of the 1990 levels (base year)[33]. Considering fiscal 2006 CO_2 emissions from fuel combustion that account for 88% of Japan's total greenhouse gas emissions by sector, emissions in the industries sector showed steady improvement with a reduction of 4.6% compared to the 1990 levels. Meanwhile, other sectors as a whole substantially increased their CO_2 emissions from fuel combustion from the base year levels. The emissions in commercial and other sectors increased 39.5%, in the residential sector 30.0%, in the transportation sector 16.7%, and in the energy conversion sector 13.9%, from the 1990 levels[34].

In recent years, there have been an increasing number of international discussions on long-term climate change mitigation measures beyond 2013. Japan must meet its reduction commitments under the Kyoto Protocol and aim to achieve further and continuous reduction in the long term.

("Kyoto Protocol Target Achievement Plan")

In order to fulfill its commitment under the Kyoto Protocol to reduce greenhouse gas emissions by 6% and to achieve further and continuous reduction in the long term, the Japanese government developed the Kyoto Protocol Target Achievement Plan based on the Global Warming Countermeasure Promotion Law in April 2005 and executed initiatives. Furthermore, in order to achieve the reduction targets under the Plan and in consideration of the joint discussions between the Global Environmental Subcommittee of the Environmental Committee of the Industrial Structure Council of the Ministry of Economy, Trade and Industry and the Global Environment Committee of the Central Environment Council of the Ministry of the Environment, a revised Kyoto Target Achievement Plan was approved at a Cabinet Meeting in March 2008. The newly added and enhanced measures under the revised Plan included (1) a further promotion of voluntary action plans, (2) a further improvement in the energy-saving performance of houses and buildings, (3) the reinforcement of measures for top-runner appliances, (4) enhanced energy management in factories and business sites, and (5) the further improvement of automobile fuel efficiency. Moving forward, all entities in every sector should intensify their efforts to achieve the first period commitments under the Kyoto Protocol according to the Plan.

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[33] The base year for the three CFC substitute gases (HFCs, PFCs, and SF6) is 1995.

[34] In comparison with the emissions in 1990 by sector, the emission volume for each sector was obtained by adding the distributed portion of the total emission volume from electricity generation at the supplier and the emission volume from heat generation at the heat suppliers to each sector according to its electricity and heat consumption volume to the emission volume at each final demand sector.

[Column 26] An example of the measures included in the revised Kyoto Protocol Target Achievement Plan

As mentioned above, a revised Kyoto Target Achievement Plan with additional and enhanced measures was approved at a Cabinet Meeting in March 2008. This column article introduces two of the measures incorporated in the Kyoto Protocol Target Achievement Plan.

○ **Enhanced energy management in factories and business sites**

In addition to the promotion and strengthening of voluntary action plans, there have been efforts in the industries sector to conserve energy at factories and other facilities based on the measures taken under the Energy Conservation Law.

Moreover, in relation to the efforts made at large-scale office buildings, where a significant amount of energy is consumed, the regulations under the Energy Conservation Law have been intensified since April 2003 to encourage enhanced energy management. Further, the preparation of medium and long-term plans, mandatory periodical reporting, and other activities have been stipulated.

In April 2006, the scope of the regulations under the Energy Conservation Law was expanded, and the management of heat and electricity that was traditionally conducted separately was integrated.

The Energy Conservation Law is scheduled to be revised to increase the effectiveness of the energy conservation initiatives at factories, office buildings, and other facilities. The revised law will introduce an integrated energy management system where the regulations are conducted on a "corporation-by-corporation basis" instead of the current "factory/worksite-by-factory/worksite basis." For franchised chain enterprises above a certain size, integrated energy management will be implemented where all businesses in the chain enterprise are regarded as one unit of regulation.

In addition, the government will promote objective evaluations of the performance of each initiative made by the factories/workplaces by using tools such as benchmarking, taking into account the differences in the organizational structures of companies. Further, it plans to establish frameworks in which multiple enterprises jointly undertake voluntary initiatives for energy conservation and emissions reduction (joint initiatives for energy/CO_2 reductions). Such joint efforts include the "promotion of emission reduction measures for small and medium-sized enterprises" (described in the next section) and the mutual utilization of exhaust heat from factories at industrial complexes and at other industry-concentrated areas. Providing support for large-scale partnership projects with significant potential energy-saving effects is also planned.

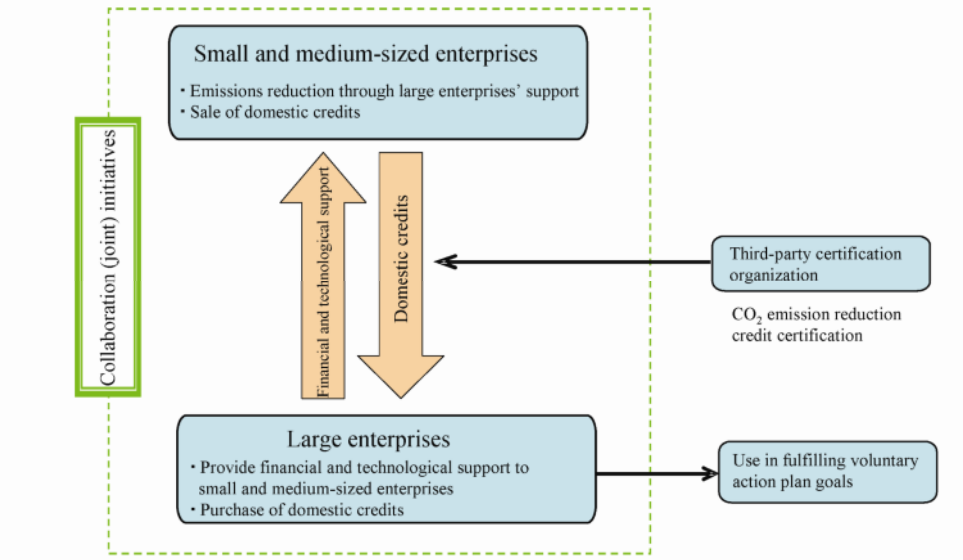
○ **Promotion of emission reduction measures for small and medium-sized enterprises**

In order to reinforce emissions reduction measures for small and medium-sized enterprises, the government will further enhance public financial support to help install emission reducing equipment at small and medium-sized enterprises.

Moreover, the government will establish a system that certifies emission reductions at small and medium-sized enterprises (including leading medium-sized enterprises and large enterprises that are not engaged in voluntary action plans), which are achieved through greenhouse gas emission reduction initiatives with technical and financial support from large enterprises. The certified emission reduction credit can be used in fulfilling the goals committed in the voluntary action plans, etc. The government will work to raise the target level of emissions reduction through this system. The system is based on voluntary participation and calls for a third-party certification organization consisting of experts in the private sector. The organization will adopt simple emission reduction credit certification standards that are similar to as those applied in the Kyoto Mechanism Credit Acquisition Programme. This will promote nationwide emission reduction initiatives, secure a certain level of strictness and be able to be added, and offer greater convenience of procedures to small and medium-sized enterprises. Furthermore, the system will correspond to and be consistent with the existing systems (the calculation, reporting, and disclosure systems under the Global Warming Countermeasure Promotion and the periodical reporting system under the Energy Conservation Law). If the initiatives under this system do not generate sufficient revenue to maintain operations, the relevant small and medium-sized enterprises can receive minimum necessary support available under the existing facility investment subsidy system, etc.

In addition, the management system for the generated “domestic credits” should be as simple as possible. A potential scheme would be for small and medium-sized enterprises and large enterprises to work in collaboration to develop, apply, and receive approval for the initiative plan (see Column Figure 26-1).

Column Figure 26-1 CO_2 emissions reduction system for small and medium-sized enterprises



Source: Compiled by METI

(Sectoral approach)

In order to ensure fairness and equity with respect to each country when setting reduction targets, Japan proposed a sectoral approach for the framework on climate change after the first commitment

period of the Kyoto Protocol. This approach was presented at various occasions during international meetings such as the Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and the Asia-Pacific Partnership on Clean Development and Climate (APP), and in initiative proposals such as the Cool Earth Partnership.

The sectoral approach is a method in which each country's reduction potentials are analyzed. Emission reductions by sector are calculated based on the projection of future manufacturing activity and verification by individual countries; subsequently, overall national greenhouse gas emission reduction targets are set by aggregating the sectoral emission reductions. This approach offers a scientific and systematic perspective in negotiations and contributes to building effective frameworks. Furthermore, the sectoral approach identifies superior technologies and practices in each sector and promotes the transfer of such technologies and experiences, resulting in an accelerated reduction of global carbon emissions

In order to practically realize the potential reductions in each sector of each country, countries should first focus on subsectors such as coal-fired power generation, steel, cement, and transportation industries to analyze the conditions and identify key initiatives that they should undertake together. In addition, joint efforts to collect data by the government and private sector at organizations such as IEA and APP must be intensified.

When the greenhouse gas emissions caps are set for each emitting entity by a top-down approach as the one adopted by the EU-ETS, the fairness and equity of the emissions caps may be questioned, as is evident in the number of lawsuits related to the second period targets of the EU-ETS. Moreover, when targets are set at levels that cannot be reached by using the technologies available at the time, it could cause problems. When the maximum emissions reduction is achieved by implementing all the existing technologies, further emissions reduction becomes impossible. As a result, economic activities including production control are limited, and an additional purchase of credits and other actions become necessary to meet the targets.

Japan proposed the sectoral approach to the Asia-Pacific Partnership on Clean Development and Climate (APP). From the view point of maintaining appropriate and realistic measures, it is effective to use a scientific and systematic method to evaluate the reduction potentials and accompanying costs by sector and by technology.

To developing countries that are considered to be in need of technological and financial support from advanced countries, the Japanese government will reinforce its assistance by identifying the best practices in technologies and measures in each sector and transferring them, in partnership with private sector companies, to each country in a manner that is suitable for its current conditions of energy efficiency, technological development, and other factors. This will help developing countries, particularly those that are major greenhouse gas emitters, to set ambitious targets and implement effective measures. Further, it will enable the establishment of a system in which technology transfers on a business basis are promoted while paying sufficient attention to the protection of property rights. In addition, this approach allows greenhouse gas emission intensity and other efficiency measurement indicators in each sector to improve on a global scale by applying the best practices. As a result, this will prevent carbon leakage, making all carbon emission reduction measures undertaken around the

world more effective.

Japan's sectoral approach has been highly evaluated by many countries. The EU leaders at the Japan-EU High-Level Consultations in April 2008 as well as and the Chinese President Hu Jintao in his visit to Japan in May stated that they evaluated the sectoral approach to be useful and effective.

(Cool Earth Partnership)

As mentioned above, the former Prime Minister Yasuo Fukuda presented a proposal named Cool Earth Partnership in a special speech delivered at the World Economic Forum's Annual Meeting (Davos Conference) in Davos, Switzerland, on January 26, 2008. This Partnership program was developed to introduce practical measures in realizing the global goal of halving the current level of global greenhouse gas emission by 2050, which was originally proposed to the world by the then Prime Minister Shinzo Abe in May 2007 in the plan called "Cool Earth 50." The plan proposes scheduling a targeted timing of emissions peak out in the process of achieving 50% emissions reduction by 2050. The Cool Earth Partnership plan has three pillars, namely, the "Post Kyoto Framework," "international environmental cooperation," and "innovation."

○ **Post Kyoto Framework**

Having been the chair country of the Hokkaido Toyako Summit in July 2008, Japan was expected to play a leading role in establishing the framework after the first commitment period of the Kyoto Protocol. In his speech, former Prime Minister Fukuda appealed to the world the importance of establishing a framework in which all countries, particularly the major emitting countries, participate to realize the peak out of global greenhouse gas emissions.

Moreover, Japan and other major carbon emitting countries announced together that they will set and implement total emissions reduction targets for each country as a practical measure for building the Post Kyoto Framework to curb greenhouse gas emissions. In setting reduction goals, Japan proposed the sectoral approach in which the reduction potentials in each sector are aggregated to decide overall goals.

○ **International environmental cooperation**

Subsequently, former Prime Minister Fukuda made a statement on international environmental cooperation. With an understanding that the world must keep striving to improve energy efficiency until innovative technologies that can drastically reduce greenhouse gas emissions are developed and can become practically usable, he stated that Japan will help transfer its advanced environmental technologies to many countries to contribute to improving the global energy efficiency. He proposed that the world share the common goal of improving the global energy efficiency by 30% by 2020.

In addition to actively supporting the efforts made by developing countries to reduce emissions through energy conservation, Japan will create a 10 billion dollar fund, called the Cool Earth Partnership, to support developing countries that would be seriously affected by climate change. Furthermore, Japan, in partnership with the U.S. and the U.K., aims to set up a multinational fund and calls on other countries to participate and donate resources.

○ **Innovation**

In order to halve the global greenhouse gas emissions by 2050, breakthroughs are essential by developing innovative technologies, such as the revolutionary iron manufacturing process, the super efficient heat pump, the electric car, as well as the groundbreaking nuclear power generation, which are completely new and radically different. For that reason, former Prime Minister Fukuda announced that Japan will prioritize research and development investments in the environmental and energy-related fields, investing approximately 30 billion dollars over the next 5 years. He also stated that Japan will implement a fundamental overhaul of the existing systems covering all areas including lifestyle, urban structure, and transportation to achieve Japan's transition to a low-carbon society and to help realize low-carbon societies around the world.

(Japan's initiative in the Asia-Pacific Partnership on Clean Development and Climate (APP))

The Asia-Pacific Partnership on Clean Development and Climate (APP) is a regional partnership among the following 6 countries: Japan, Australia, China, India, Republic of Korea, and the U.S. It was established in July 2005 with aim of addressing the issues of a growing energy demand and energy security and climate change in the Asia Pacific region; further, it was intended to complement the Kyoto Protocol. After Canada joined in October 2007, the 7 countries have jointly promoted an efficient implementation of various green house gas emissions reduction measures by developing, transferring, and spreading clean and efficient technologies.

One of APP's prominent characteristics is the organization of 8 sectoral Task Force groups[35] that cover about 60% of the energy consumption and CO_2 emissions in the member countries. By sharing information among each sector and by adopting a sectoral approach wherein the government and private sector work together, it becomes feasible to implement effective emissions reduction measures that take into account the unique conditions of each sector.

For example, with regard to the Steel and Cement Task Force groups for which Japan serves as the chair country, Japan conducted the "Energy Conservation/Environmental Analysis Project" for factories in China and India, in which the experts on energy conservation and environment were dispatched to analyze conditions and provide advice. In the steel sector, the projects have been conducted for Taiyuan Steel (Shanxi Province), Jinan Iron & Steel (Shandong Province), Jiangyin Xingcheng Special Iron & Steel (Jiangsu Province) in China and Steel Authority of India (Rourkela) in India. This project will continue on an as-needed basis in the future.

With respect to the Power Generation and Transmission Task Force group, engineers from each country gathered at the coal-fired power generation plants in Japan and India and exchanged views and shared information on efficiency improvement in operation and maintenance. In April 2007, 50 engineers from the APP member countries including China and India participated in peer review

[35] The 8 sectoral groups are (1) Cleaner Use of Fossil Energy, (2) Renewable Energy and Distributed Generation, (3) Power Generation and Transmission, (4) Steel, (5) Aluminum, (6) Cement, (7) Coal Mining, and (8) Buildings and Appliances

activities[36] held at a thermal power plant in Japan.

Regarding the Coal Mining Task Force group, a Japanese training program was conducted in China with the aim of transferring Japanese advanced coal mine technologies to foreign coal producing countries and was introduced as part of the information sharing activities.

The Steel Task Force group, for which Japan serves as the chair country, estimates CO_2 emission reduction potentials in the steel sector to be approximately 130 million tons (equivalent to about 10% of Japan's annual CO_2 emissions)[37], based on calculations using reduction effect and penetration rate of each energy efficient technology.

Furthermore, at the APP Policy and Implementation Committee (PIC) meeting held in Seattle, U.S., in May, 2008, Japan proposed the establishment of the Road Transport Task Force to energize APP's activities. It was agreed that Japan would host a workshop for further discussions before the next PIC meeting in fall 2008.

Currently, over 100 projects are being undertaken by each of the APP sectors. Going forward, the governments and private-sector entities will continue to work together in promoting a variety of sectoral activities such as the evaluation of reduction potentials, identification of best practices, fostering of human resources, technological development, and experimental demonstrations.

(Japan's leadership role in the global framework)

From March 14 to 16, 2008, the Fourth Ministerial Meeting of the Gleneagles Dialogue on Climate Change, Clean Energy and Sustainable Development (Gleneagles Dialogue)[38] was held in Makuhari, Chiba, Japan. About 200 delegates attended the meeting, including government officials such as ministers responsible for environment and energy from the G8 countries as well as the major emitting countries like China, India, and Brazil (21 countries and regions) and representatives from the World Bank, IEA and other international organizations, industries, NGOs, and NPOs. In the last meeting of the Dialogue, which was cochaired by the then Minister of Economy, Trade and Industry Akira Amari and the then Minister of Environment Ichiro Kamoshita, discussions were held focusing on technologies, financing and investment, and the framework for 2013 and beyond, after the first commitment period of the Kyoto Protocol (the Future Framework).

Climate change was one of the main topics of discussion at the G8 Hokkaido Toyako Summit held from July 7 to 9, 2008, and discussion results from the last Dialogue meeting were reported. As the chair country of the summit and being a leading nation in environmental conservation, Japan played a

[36] The purpose of the peer review activity is to provide opportunities for engineers from the APP member countries to share the best practices regarding the operation and maintenance of coal-fired power generation plants of approximately the same age. The peer review activities include power generation engineers' meetings to exchange honest views based on their repeated visits at plant sites, developing a database of review items, creating a check-list for efficiency improvement, and compiling a handbook for horizontal information sharing.

[37] The calculation was performed before Canada joined the APP. The figure shows the reduction potentials in the 6 countries excluding Canada.

[38] The Gleneagles Dialogue is an international conference on climate change that was established based on the agreement reached at the Gleneagles Summit in 2005. The first meeting was held in the U.K. in November 2005. The second meeting was held in Germany in October 2006, and the third, in Mexico in September 2007. The fourth and most recent meeting was held in Japan.

leadership role, aiming for successful discussions at the United Nations on the framework for 2013 and beyond.

(2) The growing environmental market and Japan's potential contribution by using its environmental technology

(Japan's experience and responses to climate change)

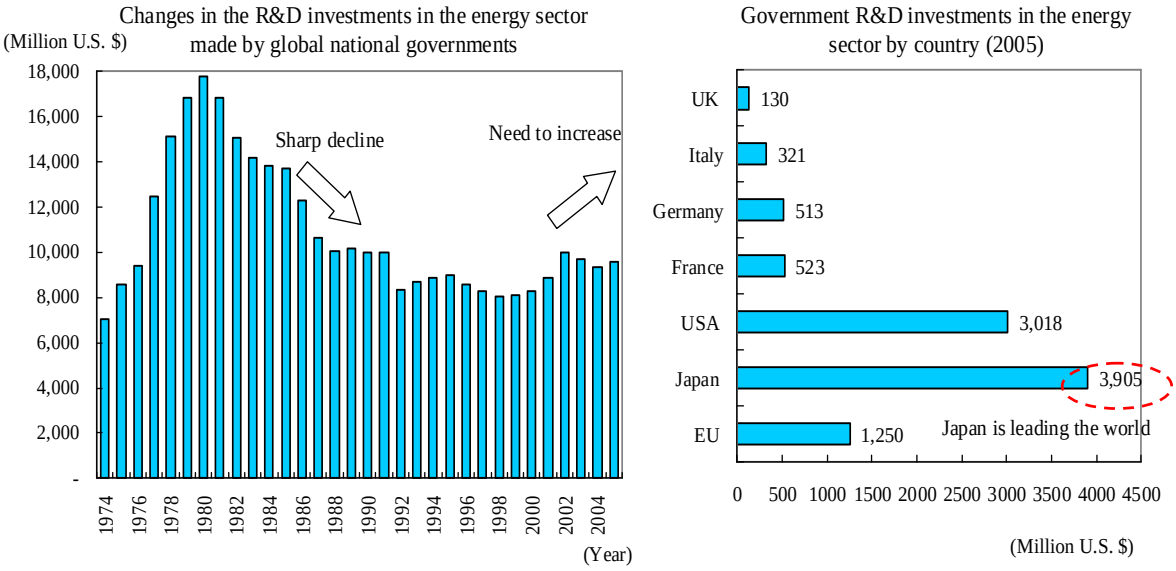
The excellence of Japanese technologies is highlighted in the following statement: "Japan, which depends heavily on energy imports from abroad, has been undertaking nationwide energy saving efforts for the past 30 years ever since the first oil shock, and successfully doubled its real GNP without increasing energy consumption in the industrial sector." It can be said that Japan has been pursuing both economic growth and environmental protection. In order for the world to realize a society that can achieve both economic growth and environmental protection, Japanese enterprises should aggressively expand overseas operations so that valuable environmental experiences can be shared with Asian countries as well as other countries and regions, and Japanese advanced environmental technologies can be transferred to those areas.

(Promoting the development of innovative technologies for achieving long-term targets)

While the medium-term measures to address climate change rely on existing technologies, achieving long-term targets such as halving the current level of global greenhouse gas emission by 2050 proposed by Japan in the "Cool Earth 50" initiative would surely require the development of completely new and radically innovative technologies. The global research and development investments in the energy sector by the national governments, which sharply increased in the 1970s in response to the oil shock, began to drop significantly in 1980 and have been sluggish since the late 1980s (see Figure 3-1-14). Fighting global climate change calls for sustained research and development investments, and therefore, increased investments by national governments are expected.

Japan's public investments in this sector are the highest in the world, higher than those of other developed countries. Furthermore, in March 2008, the Agency of Natural Resources and Energy of Japan developed the "Cool Earth: Energy Innovation Technology Plan" that identified 21 technologies as the key areas for innovative development work and presented technological roadmaps. Furthermore, the Plan presented ideas on how the international community should work together, including global sharing of the roadmaps and strengthened partner relationships such as the CCS (described later). Innovative technological development will require huge investments. For this reason, the global sharing of the technology maps and the roadmaps is crucial to avoid redundant investments between countries and to effectively develop innovative technologies together. Steady implementation of the plan is expected not only to lead the development of the innovative technologies but also to contribute to mitigating global climate change.

Figure 3-1-14 Global R&D investments in the energy sector by national governments



Source: IEA (2007), R&D database.

(Growing environmental market)

As global climate change becomes an increasingly serious concern with countries undertaking measures to fight it, markets for new energy technologies such as biomass energy and photovoltaics and environment-related markets involving energy efficiency technologies and other technologies are expected to grow continuously.

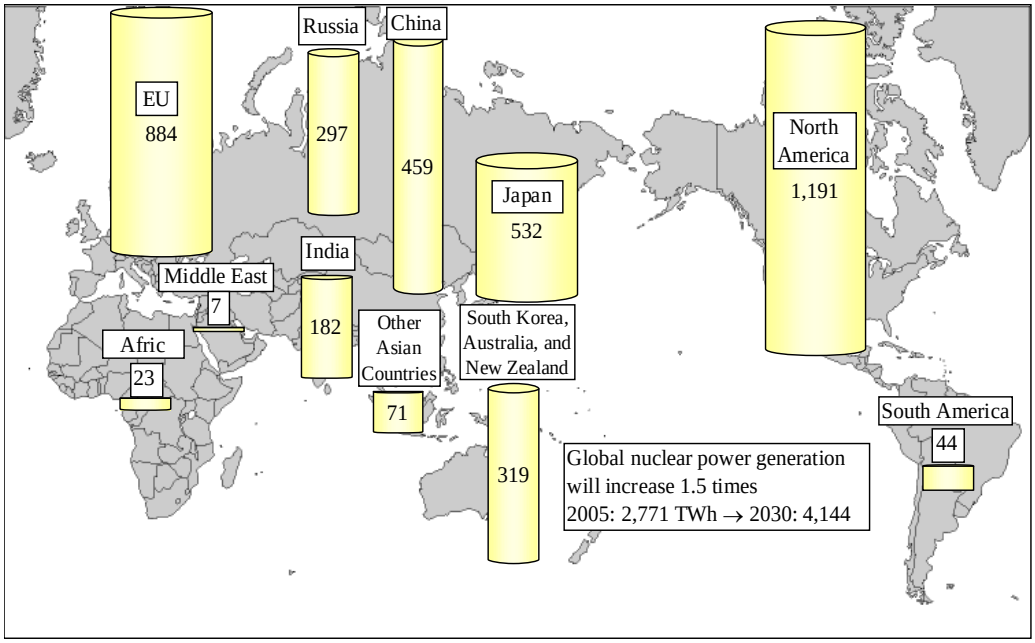
For example, the Alternative Policy Scenario in the IEA's "World Energy Outlook 2007" disclosed the global power generation capacity based on the type of energy sources available in 2005 and provided forecasts for 2030. According to the Scenario, power generation through non-fossil fuel sources is expected to grow substantially. For example, power generation from photovoltaics will grow 117.3 times and from wind power 16.2 times, from 2005 to 2030. These numbers indicate the future potential of the environmental market (see Table 3-1-15 and Figure 3-1-19).

Figure 3-1-15 Power generation forecasts based on the type of energy source
(Alternative Policy Scenario, IEA)

	Power generation (TWh)		Increase (times)
	2005	2030	2030/2005
Coal	7,334	10,716	1.5
Oil	1,186	844	0.7
Gas	3,585	6,602	1.8
Nuclear power	2,771	4,144	1.5
Hydraulic power	2,922	5,403	1.8
Biomass	231	1,166	5.0
Wind power	111	1,800	16.2
Geothermal power	52	190	3.7
Photovoltaics	3	352	117.3
Wave power	1	24	24.0
Total power generation	18,197	31,240	1.7

Source: IEA (2007), *World Energy Outlook 2007*.

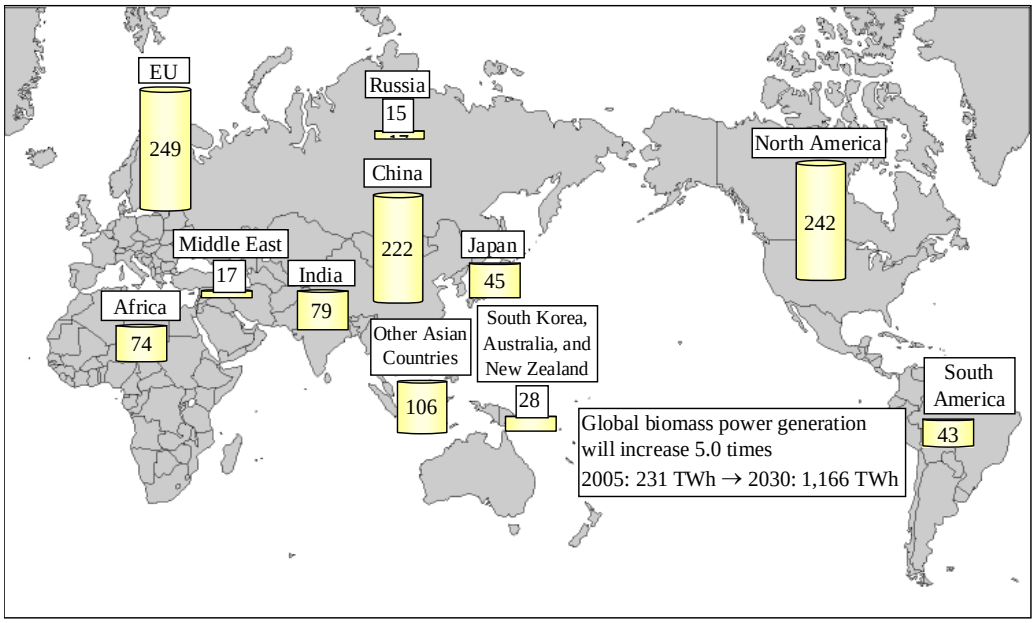
Figure 3-1-16 Nuclear power generation capacity in 2030 (Alternative Policy Scenario, IEA)



Note: China's figure includes that of Hong Kong. The figure for Other Asian Countries was obtained by subtracting the figures of China and India from the "Developing Asia" figures in IEA's World Energy Outlook 2007.

Source: IEA (2007), *World Energy Outlook 2007.*

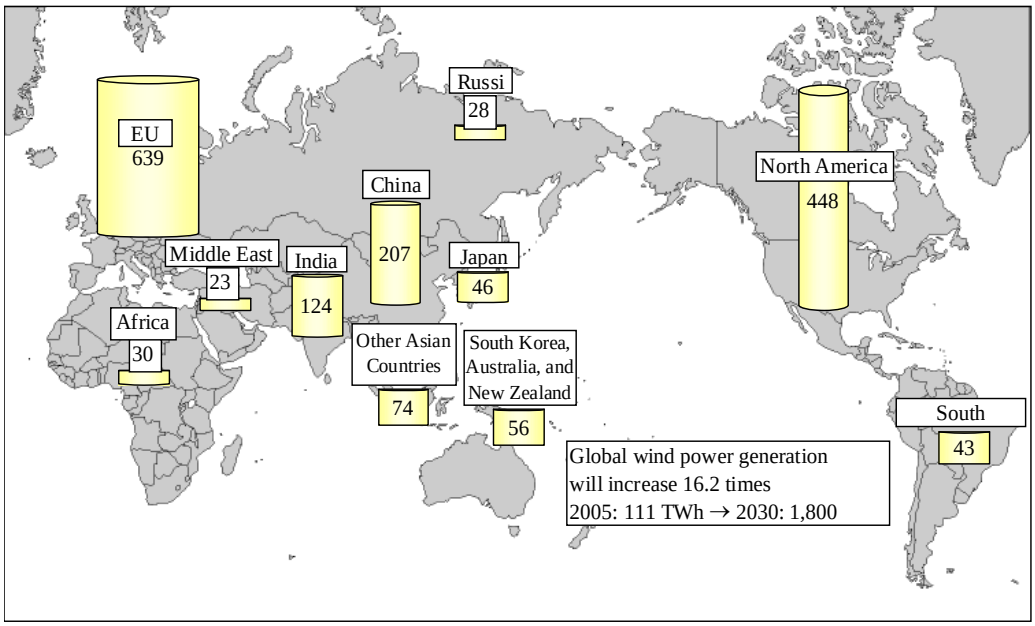
Figure 3-1-17 Biomass power generation capacity in 2030 (Alternative Policy Scenario, IEA)



Note: China's figure includes that of Hong Kong. The figure for Other Asian Countries was obtained by subtracting the figures of China and India from the "Developing Asia" figures in IEA's World Energy Outlook 2007.

Source: IEA (2007), *World Energy Outlook 2007.*

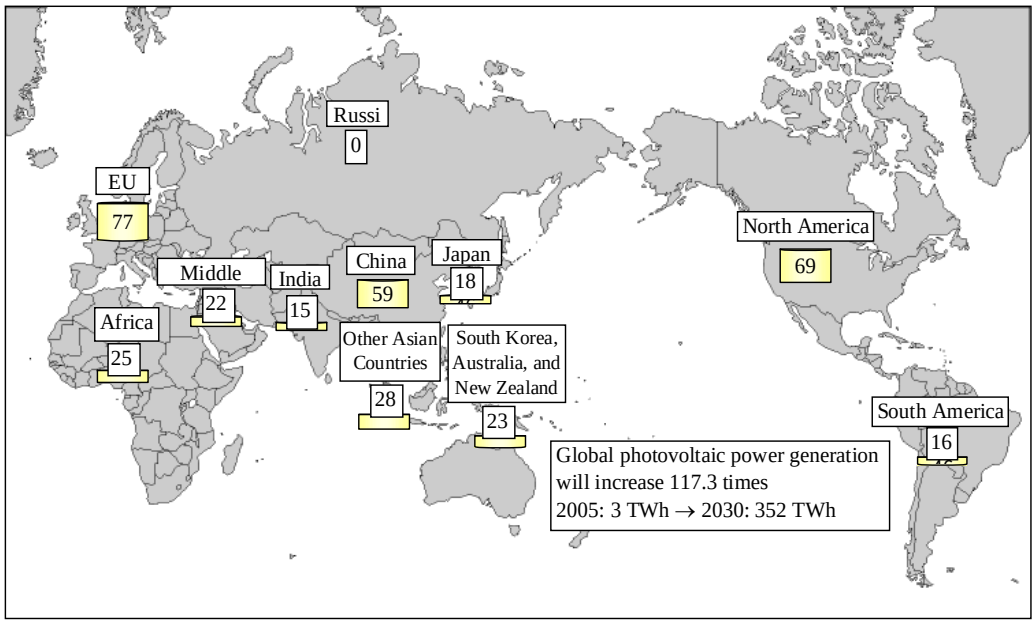
Figure 3-1-18 Wind power generation capacity in 2030 (Alternative Policy Scenario, IEA)



Note: China's figure includes that of Hong Kong. The figure for Other Asian Countries was obtained by subtracting the figures of China and India from the "Developing Asia" figures in IEA's World Energy Outlook 2007.

Source: IEA (2007), *World Energy Outlook 2007.*

Figure 3-1-19 Photovoltaic power generation capacity in 2030 (Alternative Policy Scenario, IE



Note: China's figure includes that of Hong Kong. The figure for Other Asian Countries was obtained by subtracting the figures of China and India from the "Developing Asia" figures in IEA's World Energy Outlook 2007.

Source: IEA (2007), *World Energy Outlook 2007.*

In the Asian region, wind power generation is expected to increase 50.6 times and biomass power generation 25.4 times, exceeding the global growth rates. Photovoltaic power generation, which has thus far not been implemented to a great extent, is expected to grow to 98 TWh, equivalent to about one-third of Japan’s coal-fired power generation in 2005 (see Table 3-1-20).

Table 3-1-20 Power generation forecasts in Asia based on the type of energy source (IEA)

	Power generation (TWh)			Increase (times)	
	2005	2030		2030/2005	
		Reference Scenario	Alternative Policy Scenario	Reference Scenario	Alternative Policy Scenario
Coal	2,730	9,364	6,440	3.4	2.4
Oil	214	194	183	0.9	0.9
Gas	428	1,391	1,242	3.3	2.9
Nuclear power	113	456	712	4.0	6.3
Hydraulic power	617	1,547	1,968	2.5	3.2
Biomass	16	204	407	12.8	25.4
Wind power	8	246	405	30.8	50.6
Geothermal power	17	48	53	2.8	3.1
Photovoltaics	0	30	98	—	—
Wave power	0	0	1	—	—
Total power generati	4,143	13,480	11,510		2.8

Note: The figure for Asia is that of "Developing Asia" in IEA's World Energy Outlook, which includes China, India, and the ASEAN countries (excluding Singapore).

Source: IEA (2007), *World Energy Outlook 2007*.

In the Reference Scenario, the total accumulated investment in the power generation sector from 2006 to 2030 is 4.6 trillion U.S. dollars.

(Japan's internationally high competitive environmental technologies)

Japan possesses highly advanced energy conservation technologies as well as new energy technologiesas described below. As global climate change becomes an increasingly serious concern and countries undertake initiatives to address it, Japan could contribute to reducing global greenhouse gas emissions if the Japanese enterprises with advanced environmental technologies aggressively and appropriately develop their operations overseas.

(a) Energy conservation technology

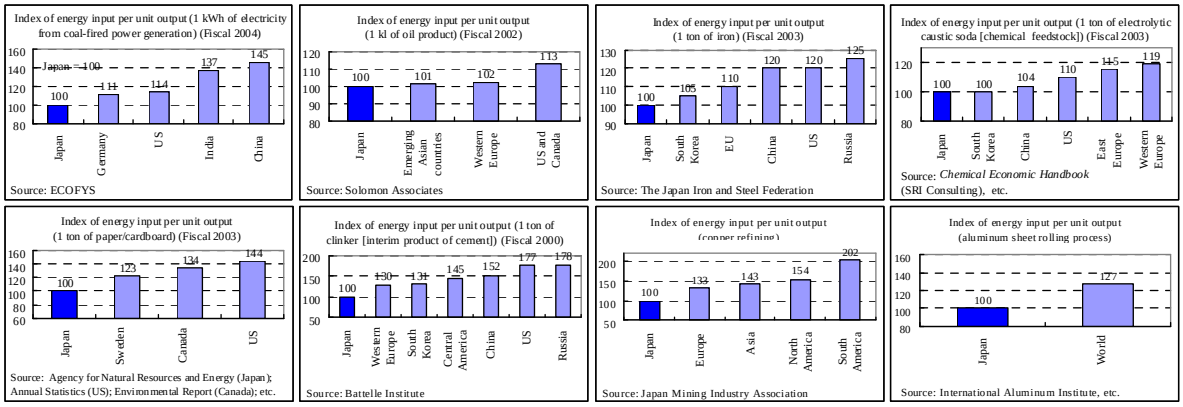
Japan possesses leading energy conservation technologies. When compared internationally based on per production unit energy consumption in major industries, Japan has the highest levels of energy efficiency in the world in many industrial sectors[39] (see Figure 3-1-21).

In addressing the global challenge of reducing greenhouse gas emissions, it is important for Japan to play a major role in contributing to the efforts by disseminating its advanced energy conservation

[39] For example, the energy required to generate 1 kWh of electricity in Japan is the lowest in the world along with those in the U.K., France, and the Northern European countries; on the other hand, those in India and China are about 1.4 times more than that of Japan. The index of energy input per unit output (1 ton) of clinkers (an interim product of cement) is lower in Japan than in any other country or region. The amount of energy required to produce clinkers in China is about 1.5 times more than that required in Japan, and those of the U.S. and Russia are about 1.8 times more. Moreover, the index of energy input per unit output (1 ton) of iron in Japan is the lowest among countries such as Republic of Korea, the EU, China, the U.S., and Russia, suggesting that Japan has the highest energy efficiency.

technologies to other countries.

Figure 3-1-21 Comparison of the basic unit based on major industry sectors



Source: Nippon Keidanren (2007), *Results of the Fiscal 2007 Follow-up to the Keidanren Voluntary Action Plan on the Environment - Section on Global Warming Measures.*

(b) Battery-related technologies

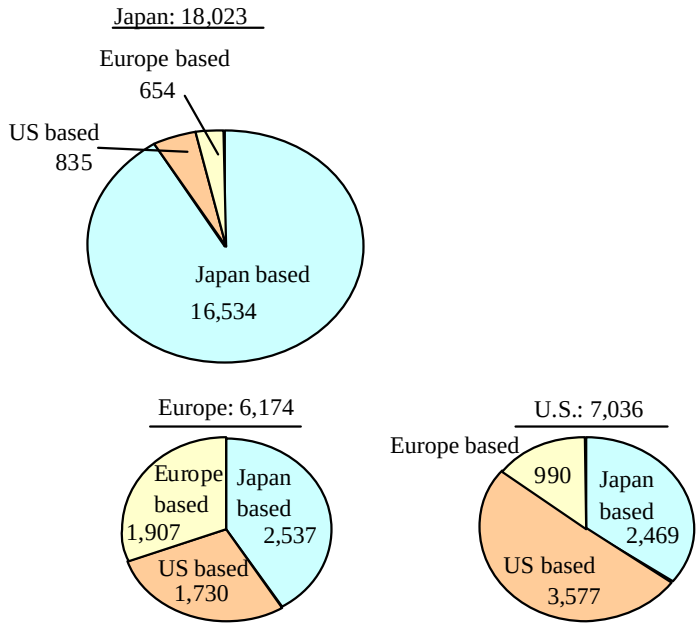
Fuel cells using hydrogen as fuel is an advanced and highly energy efficient technology that does not produce CO_2.Considering the number of patents applied for fuel cell in Japan, Europe, and the U.S., we can see that the number of applications from Japan-based companies is the highest among the three regionswhich indicates that Japan is the leading country in the fuel cell technology (see Figure 3-1-22).

Furthermore, the development of fuel cell vehicles is under way, aiming for practical application within the next several years. Currently, public road tests are being conducted, and researchers are working on cost reduction and extending driving distances. When the fuel cell vehicles are commercialized and spread throughout the world, the use of fuel cells will increase accordingly. The potential demand for fuel cells is extremely high.

Moreover, the Japanese companies in the battery industry have large shares in the global consumer-use battery markets, nickel-cadmium battery (51%), nickel hydride battery (74%), and lithium ion battery (57%)[40]. The energy storage technology is a technology for temporal leveling of electric load, and it allows the efficient use of generated electricity. For this reason, this technology holds the key to the mitigation of climate change, and its demand is expected to increase as the area of application expands.

[40] Source: Research group on the next generation battery technologies for the new generation vehicles (2006), “Proposal regarding the future of the next generation vehicle fuel cells.” The market share figures for each type of battery are as of 2005 based on production volume.

Figure 3-1-22 Number of applied patents related to fuel cell



Source: Japan Patent Office (2007), *Fiscal 2006 investigative report on trends of patent applied technology*

(c) Photovoltaic power generation

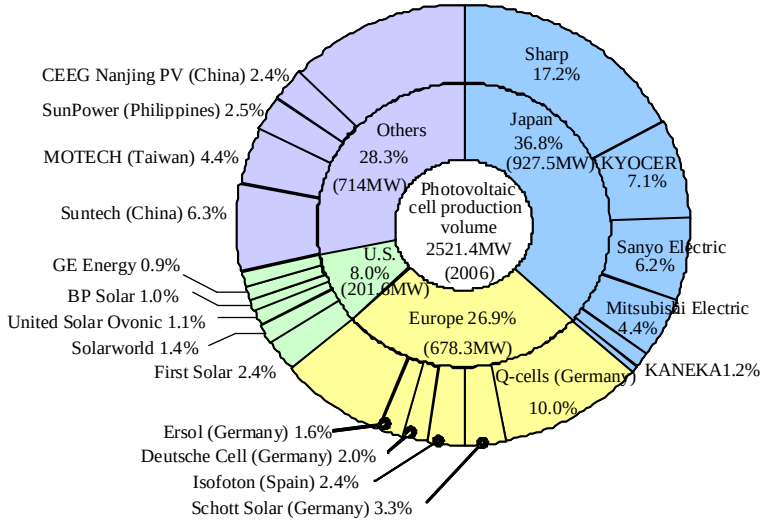
Japan was the global leader in the production of photovoltaic cells from 1999 to 2006. Its share in the global production is 40% (see Figure 3-1-23).

However, Germany's production accelerated, and it became the global leader in 2006. On the other hand, Japan's production is slowing down (see Table 3-1-24)[41].

As forecasted in the IEA's Scenario[42], the photovoltaics market is expected to grow substantially. Increased business activities in this field by Japanese companies are expected.

[41] Japan had been the global leader in the production of photovoltaic cells until 2006; however, due to the insufficient supply of silicon and other reasons, it lost its leading position to Germany in 2006.
[42] See Table 3-1-19.

Figure 3-1-23 Photovoltaic cell production share by country and by company (2006)



Sources: Agency for Natural Resources and Energy, Japan (2007), Toward increased introduction of new energies
PV News (April 2007)

Figure 3-1-24 Changes in the photovoltaic cell production volume by country and by region

(Unit: 10,000 kW, except where noted otherwise)

	Year	1999	2000	2001	2002	2003	2004	2005	2006
Japan	Production volume	8.0	12.9	17.1	25.1	36.4	60.2	83.3	92.8
	YoY change (%)	163.3	160.8	133.1	146.6	144.9	165.3	138.5	111.4
Europe	Production volume	4.0	6.1	8.6	13.5	19.3	31.4	47.0	67.8
	YoY change (%)	119.4	151.7	142.4	156.3	143.2	162.6	149.7	144.3
U.S.	Production volume	6.1	7.5	10.0	12.1	10.3	13.9	15.4	20.2
	YoY change (%)	113.2	123.3	133.8	120.2	85.4	134.6	111.0	130.9
Others	Production volume	2.1	2.3	3.3	5.5	8.4	14.0	30.2	71.4
	YoY change (%)	109.6	114.2	139.3	168.8	152.2	167.2	215.7	236.4
Total	Production volume	20.1	28.8	39.1	56.2	74.4	119.5	175.9	252.1
	YoY change (%)	130.0	142.9	135.8	143.8	132.5	160.6	147.2	143.4

Source: PV News (April, 2007).

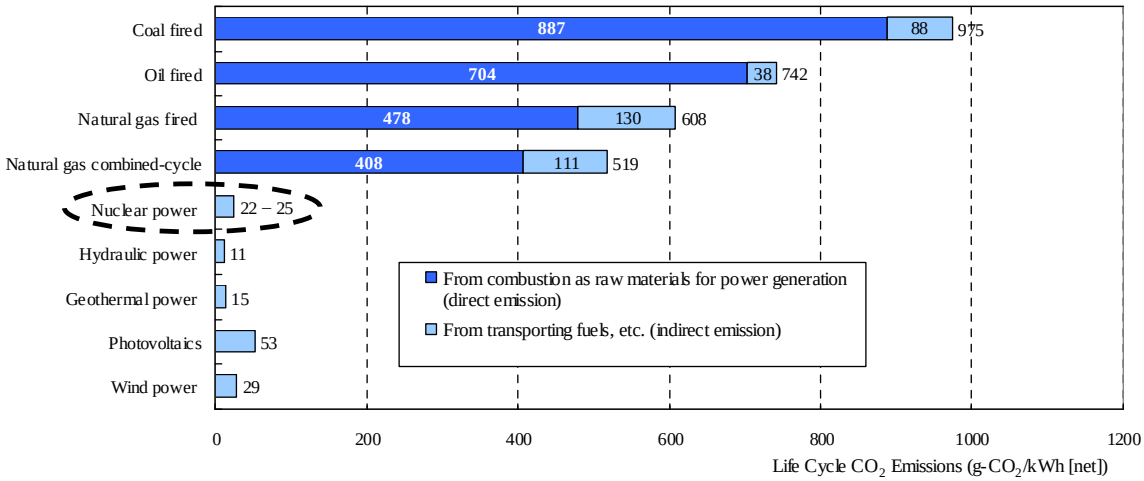
(d) Nuclear power generation

Nuclear power generation does not produce CO_2 in the power generation process, and the CO_2 emissions from fuel transportation are held to lower levels (see Figure 3-1-25). More and more plants and projects to construct nuclear power plans are being launched given the deeper understanding that nuclear power generation is an effective solution to address 2 of the major global challenges: tight energy supply-demand conditions and climate change.

International alliances between nuclear power plant manufacturers have been formed in recent years. There are currently 4 major alliance groups andJapanese companies are involved in 3 of them. Furthermore, Japanese companies have developed safe and reliable nuclear power generation technologies and experienced a relatively low number of unscheduled shutdowns compared to other countries (see Figure 3-1-26). They have made considerable technological contributions to the development of nuclear power generation[43].

[43] In fact, Japanese companies are involved in 18 nuclear plant construction projects out of the 30 projects

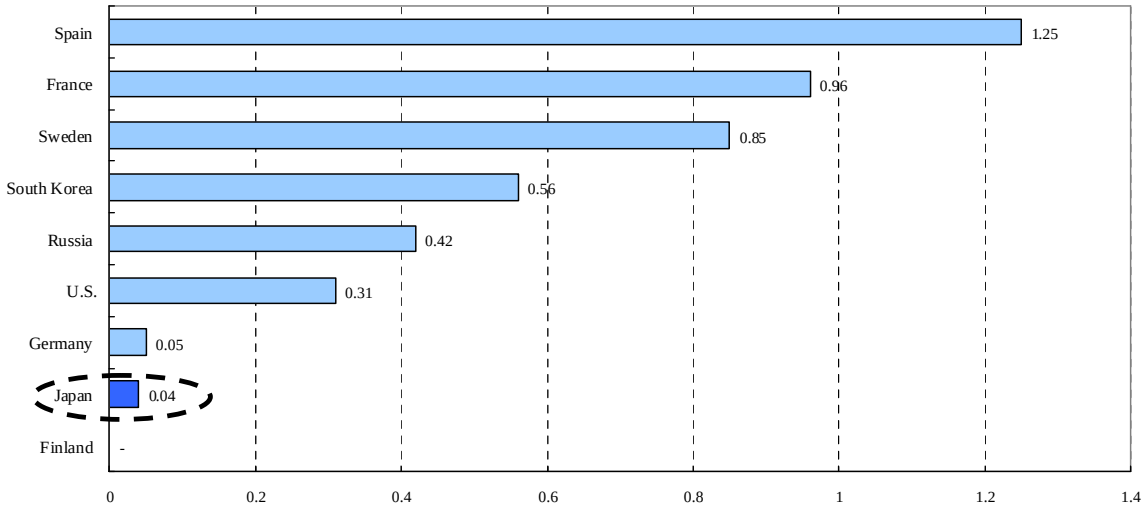
Figure 3-1-25 CO_2 (methane included) emissions per unit of power generation by type of energy source



Sources: Central Research Institute of Electric Power Industry (2001), *Evaluation of nuclear power generation technologies based on life cycle CO_2 emissions*
Central Research Institute of Electric Power Industry (2000), *Evaluation of power generation technologies based on life cycle CO_2 emissions*

Figure 3-1-26 International comparison of unscheduled nuclear reactor shutdown incidents

Ratio of unscheduled nuclear reactor automatic shutdown incidents per 7,000 operation hours by country (2006)



Note: Obtained using the following formula: Number of unscheduled nuclear reactor automatic shutdown incidents during operation hours × 7,000/nuclear reactor operation hours
Source: Japan Nuclear Energy Safety Organization website; IAEA-PRIS.

(e) High-efficiency coal-fired power generation

In the Alternative Policy Scenario in the IEA's "World Energy Outlook 2007," the global power generation from coal-fired plants was expected to grow by about 34,000 TWh, or 1.5 times from the 2005 levels by 2030. In particular, in the Asian region including China and India, a continuous increase of coal-fired plant construction and a corresponding 37,000 TWh increase in power generation are expected.

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that are being planned in the U.S. Some foreign governments have shown interests in the high quality engineering capabilities that Japanese companies have accumulated in their rich plant construction experience, and are reportedly considering collaboration projects with them.

Considering the power generation efficiency of coal-fired plants in each country in 2004, efficiency of Japan was 41.5%, while that of China and India showed very low levels of efficiency with 29.8% and 3.7% respectively. By applying Japanese technologies at the new coal-fired plants to be constructed in China, India, and other countries from now on, substantial CO_2 emissions mitigation can be achieved. At the leading-edge coal-fired power generation plants that are in operation in Japan, a power generation efficiency of 43% has been achieved. A power generation efficiency of 53% is targeted to be achieved by 2015 by using the integrated coal gasification combined cycle technology[44], and an efficiency of 60% by 2025 by using the integrated coal gasification fuel cell combined cycle technology[45].

By incorporating the Carbon-dioxide Capture and Storage (CCS) technology, which is one of the 21 selected technologies in Japan's "Cool Earth: Energy Innovation Technology Plan," zero emissions can be achieved at coal-fired power plants.

CCS is a technology to limit CO_2 emissions to the atmosphere by separating and capturing CO_2 from the exhaust gas of large emission sources such as thermal power plants and storing or sequestering it underground or below the sea floor for a very long time. In recent years, this technology has attracted attention both in Japan and abroad as a new and powerful option that helps substantially reduce CO_2 in the atmosphere in a short period of time. The U.S., Canada, Europe, China, and other countries are also developing this technology and multiple large-scale demonstrations and commercial projects are being planned and implemented.

The most central issue in commercializing this technology is cost. In particular, the costs involved in the separation and capturing processes are high. Japan is currently taking aggressive steps in promoting key technologies such as the separation membrane technology and chemical absorption technology to realize substantial cost reduction in these processes. Furthermore, Japan is also working to improve the accuracy of the monitoring technology for monitoring the conditions after the implementation of the CCS technology, based on the data from demonstration projects.

(3) Issues pertaining to the dissemination of Japanese environmental technologies
(Significant amounts of investment for introducing considerable energy-efficient facilities are expected in China and India)

The IEA estimates that in order for China and India to reduce CO_2 emissions from the levels in the Reference Scenario to those in the Alternative Policy Scenario in the IEA, a total investment of 362 billion dollars in these countries is required to introduce considerable energy-efficient facilities during the period from 2006 to 2030.

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[44] In this technology, a gas turbine generator generates electricity using coal gas from a coal gasifier, and at the same time, the waste gas is used to make steam to generate additional electricity via a steam turbine. This technology combines the gas turbine power generation technology and the steam turbine power generation technology.

[45] In this technology, in addition to the mechanism in the integrated coal gasification combined-cycle technology, purified coal gas is sent to a fuel cell where an electrochemical reaction occurs to generate electricity. This technology combines three power generation technologies, namely, fuel cell, gas turbine, and steam turbine.

It is desired that Japanese companies, which have superior environmental technologies, contribute to address the global challenge of climate change as well as achieve further growth by actively developing huge potential environmental markets in Asia.

(Possibility of Japanese environmental products losing international competitiveness)

As mentioned above, Japan have superior environmental technologies; however, there are areas in which Japan is not the most advanced. For example, in the area of wind power generation, where the greatest rate of increase in power generation from 2005 to 2030 is expected in the Asian region according to IEA's estimate[46], there have been lower levels of implementation in Japan than in the European and North American countries, China, and India; this has been partially due to climatic and geographical factors, etc[47]. Although Germany is unsuitable for photovoltaic power generation in terms of weather conditions, German companies have gained international competitiveness. Further, research and development efforts in these areas are expected to achieve international competitiveness.

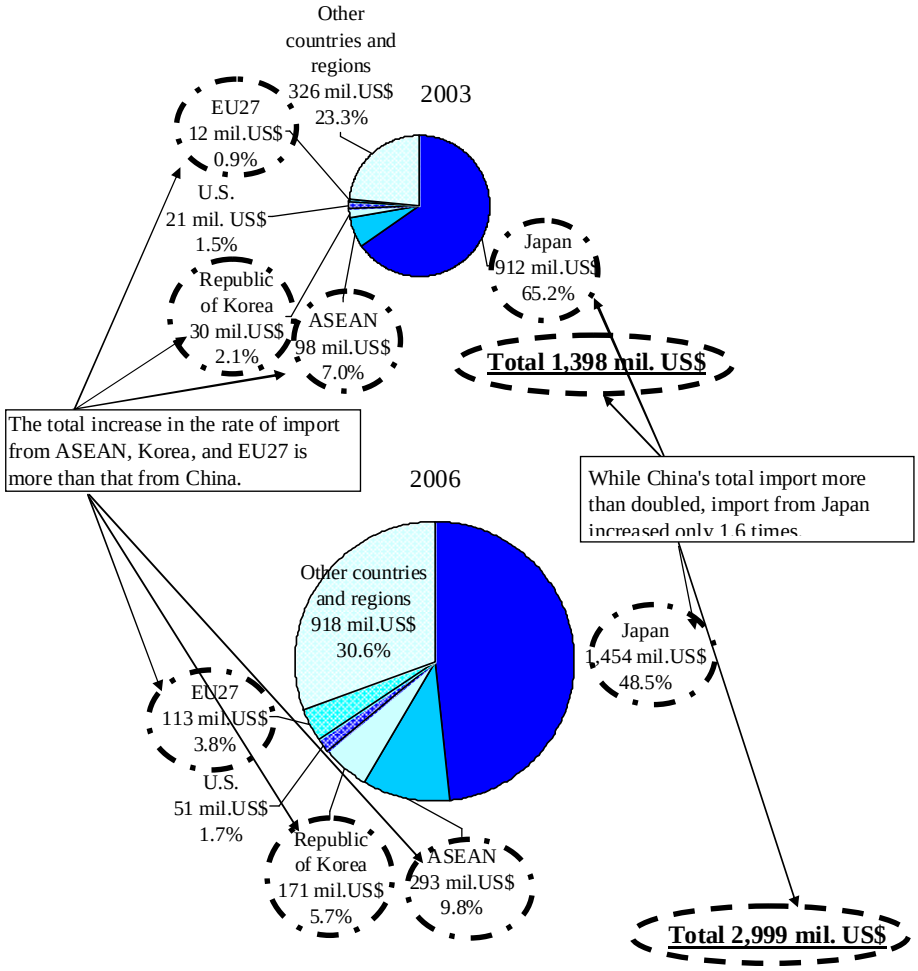
Moreover, in the areas wherein Japan has maintained its competitiveness, due to intensified competition with the EU and Asian countries, Japanese products have been losing shares in international markets in recent years. For example, considering China's import trend with respect to the semiconductor material used in manufacturing photovoltaic cells, although Japan is considered to have international competitiveness, the share of Japanese products in China's total imports has decreased. Specifically, China's import of photosensitive semiconductor devices and light-emitting diodes (HS code 854140) from Japan increased about 1.6 times from 2003 to 2006; however, China's total imports more than doubled during the same period. As a result, Japan's share decreased substantially. On the other hand, the shares of ASEAN, Republic of Korea, and the EU27 expanded (see Figure 3-1-27).

Similarly, with regard to China's import of thermal energy storage related products such as heat pumps and other energy-saving products, the import amount from the EU27 accounts for one-third of the total import amount, while Japan's share decreased from 15% in 2003 to 12.5% in 2006. In addition, the import amount from Korea, which was less than that of Japan in 2003, grew to exceed that of Japan in 2006 (see Figure 3-1-28).

As described above, it can be stated that in China's rapidly growing environmental market, although the export value of Japanese products has been increasing, the market shares of those products have been declining. Thus, Japanese companies are losing competitiveness to their counterparts in the EU and Asia.

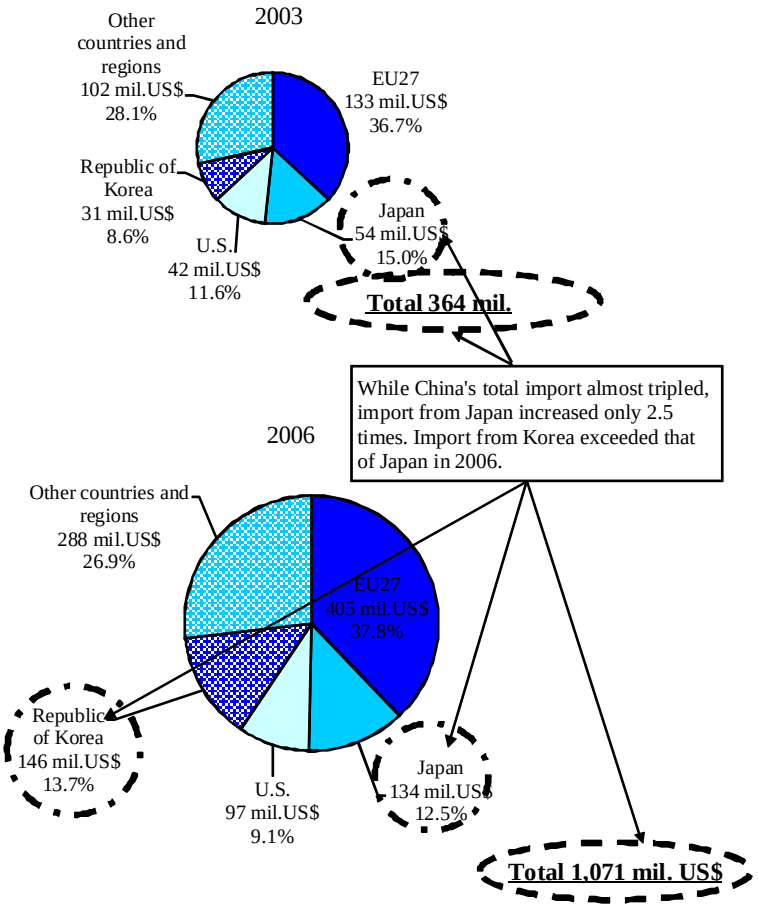
[46] See Figure 3-1-20.
[47] See Table 3-1-11.

Figure 3-1-27 Changes in China's import of photosensitive semiconductor devices and light-emitting diodes



Note: Import of HS code (6 digits) 854140
Source: U.N., *COMTRADE*.

Figure 3-1-28 Changes in China's import of thermal energy storage related products



Note: Thermal energy storage related products as defined by OECD
Specifically, total of HS code (6 digits) 381500, 700800, 701990, 841950, 841990, 853931, 902810, 902820, 90321(
Source: U.N., *COMTRADE*.

(Strategic issues in the development of emerging country markets by Japanese companies)

One of the factors that caused the loss of international competitiveness of the Japanese products is considered to be Japanese companies' business strategies in emerging country markets.

In relation to the strategic issues involved in the development of emerging country markets by Japanese companies, the following specific issues were pointed out in a report that discussed the marketability of the environmental business in China and Japanese companies' business strategies[48].

① Japanese companies tend to apply Japanese business models, in which they are engaged only in the manufacturing and sales of machines and equipment in their overseas operations. However, since this model does not generate sufficient earnings, new comprehensive business models such as those that cover the entire project need to be developed.

② Japanese companies are not conscious enough to meet the specific needs of the market in selling

[48] Kim Hyun Min (2004), "Marketability of the environmental business in China and Japanese companies". This report pointed out specific strategic issues involved in the development of emerging country markets by Japanese companies based on the hearing survey performed on related parties in the environmental business in Japan and China.

their products. As a result, they tend to sell expensive, higher specification products than actually needed.

③ In order to collect necessary information from local governments and markets, translate customer needs into products, and raise capital locally, foreign companies need to collaborate with local businesses, hire local employees, and localize technologies as well as fund procurement. However, Japanese companies have not made enough progress in this area.

(Overseas business development and market creation by Japanese companies)

In Japan, there are companies that are aggressively developing overseas businesses by utilizing their advanced environmental technologies as well as companies that are enhancing their production capacities in preparation for the future expansion of the environmental market[49].

Eurus Energy Holdings Corporation, the largest wind power generation company in Japan, is aggressively developing its wind power generation business in Spain. Since the company launched its first wind power generation plant in Spain in 1998, it has steadily expanded its business. With 3 new wind power plants that began commercial operations (87,000 kWh) at the end of April 2008, the total wind power installation capacity at all operating wind power plants in the country exceeded 500,000 kWh.

Japan Steel Works, Ltd., which began manufacturing 2,000 kW wind power generators in 2006, will reportedly triple its production capacity to prepare for the future expansion of the wind power generation market.

Taking into account the abovementioned issues, it is desired that Japanese companies actively develop their overseas businesses, which will contribute to addressing the global challenge of climate change. For this purpose, it is important that the Japanese companies inform their potential overseas customers that their environmental technologies are highly cost-effective and create schemes to promote their technologies. Initiatives to increase demand and create new markets are also expected.

[49] As mentioned above, in the nuclear power generation sector, Japanese companies are involved in 3 major alliance groups out of the 4 existing ones. Toshiba has received construction orders for 6 new plants in the U.S., and other companies have also successfully received orders from abroad.