7. Cross-disciplinary Issues

7.1 Internalization of External Diseconomy in Environmental Preservation

[Points]

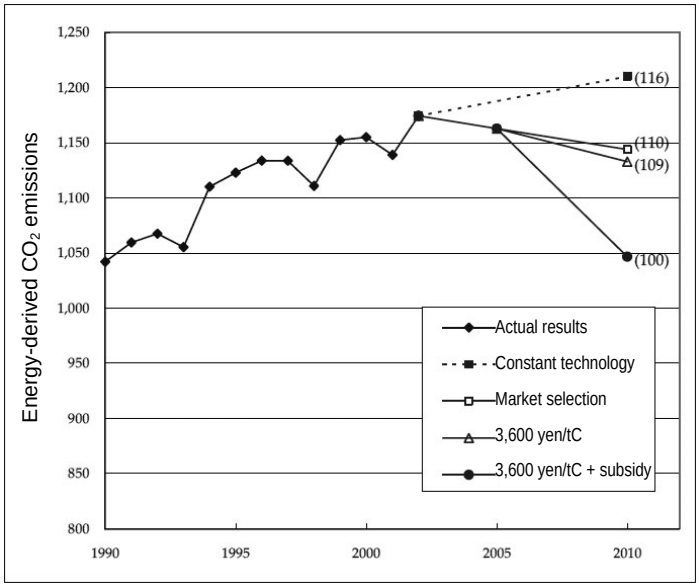
- An economic approach for internalization of external diseconomy would help establish environmental preservation policies based on the market mechanism. OECD classifies these measures into taxes and penalties, subsidies, emission trading, and deposit systems.
- Many European countries have introduced environmental tax (Table 7.1-1). Some estimates indicate that greenhouse gas reduction effects would be achieved at lower costs by spending tax revenues on global warming measures (Figure 7.1-1). In Japan, however, there is strong opposition in the industry to the introduction of environmental tax because manufactures are already making all-out efforts toward the achievement of energy saving and greenhouse gas emission reduction. Some studies conducted in Europe concerning environmental taxation policies point out that the environmental tax has only limited effects, as conventional energy taxes have already declined price elasticity of energy and introduced environmental taxes give favorable treatment to certain industry sectors (Table 7.1-2).
- Domestic emissions trading systems have been introduced into European countries and some states of the United States (Table 7.1-1) and suggest greenhouse gas reductions through effective market consolidation. At the same time, however, experts point out that equitable burden allocation is hampered because emission rights were initially allocated in an arbitrary manner (Table 7.1-3).
- While it is important to pay attention to the concept of internalization of external diseconomy, we should work out a system most suitable for each country by taking into account such factors as the existing taxation system, the willingness of the people to accept a new system, and movements in the industry.

[Related Data and Facts]

Table 7.1-1 Greenhouse gas reduction systems based on an economic approach

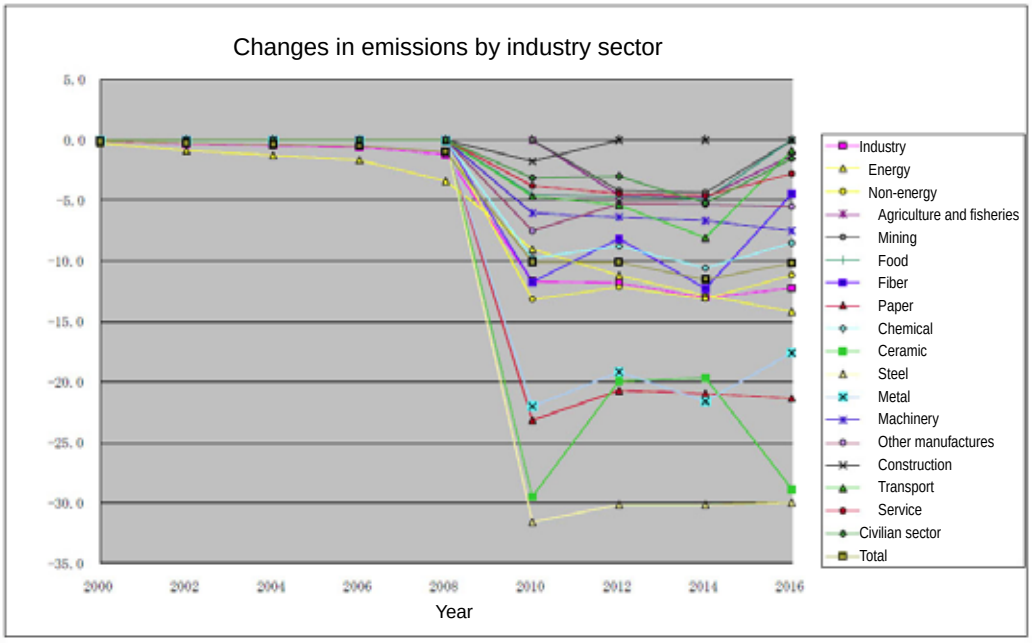
	Japan	the United States	EU				
				Germany	France	U.K.	Holland
Carbon tax	—	—	—	Environmental tax (from 1999)		Environmental tax (from 2001)	Mixed taxation system (from 1990)
Domestic emissions trading	—	· Chicago Climate Exchange · CO_2 emissions trading in 9 northeastern states	EU-ETS	Conformance to EU-ETS	Conformance to EU-ETS		Conformance to EU-ETS

Source: Compiled from relevant materials



Energy-derived CO_2 emissions

Note: The figures in the graph are emissions in 2010 (1990 emissions = 100).



Source: Central Environment Council, Joint Committee on General Policy and Global Environment, Expert Committee on Economic Analysis of Environmental tax

Figure 7.1-1 Model analysis for the effects of the introduction of environmental tax in Japan

Table 7.1-2 Posterior evaluation of the introduction of environmental tax in Sweden

AUTHOR	METHOD	SECTOR	MAIN CONCLUSION
SOU 1989	Ex ante model simulations using ENMARK and MARKAL.	All	CO_2 taxes of SEK 250/ton along with amongst other things a sulfur tax lead to 10-20% lower CO_2 emissions in the energy sector.
SOU 1991	Ex post/ex ante effect on production, production volume and regional employment.	Industry	A more uniform tax between countries would be appropriate. Lowering Swedish industry's taxes would have a (global) environmental benefit. Removal of the tax on industry would generate 10,000 jobs.
The Swedish Environmental Protection Agency 1992	Ex ante model simulations using ENMARK and MARKAL.	All	Limiting CO_2 emissions in Sweden will be very expensive when nuclear power is phased out. Electricity imports can, however, reduce costs considerably.
NUTEK 1994	Ex post 1990-94 using the MARKAL model. Ex-ante 1994-2014.	All	3-5% lower emissions in 1994 compared to a situation using the 1990 instruments. In 2005, the emissions are 20% lower than with the 1994 instruments. Demand for new instruments after 2005.
Ministry of the Environment 1994	Ex post. Including interviews with 50 district heating plants.	All	The tax has brought about a fuel change in the district heating sector. Administration costs have generally been low (SEK 3 million /year).
The Swedish Environmental Protection Agency 1995	Ex post. In-depth interviews, telephone surveys and engineering calculations.	The district heating, industry, service and household sectors.	1987-94, emissions in the sectors fell by 19%. 10% of this can be attributed to the CO_2 tax.

Source: Part of the Table taken from Andersen, M.S. Dengsoe, N. and Pedersen, A.B. "An Assessment of the Impact of Green Taxes in the Nordic Countries", 2000

Table 7.1-3 NAP for the 1st period in main EU countries

Country	Determination of total allocable emissions	Allocation among sectors	Special allocation rule
U.K.	ETS reduction effects combined with CCP*1 estimates	Calculated on the basis of the 2002 emissions and the CCP target, with residual emissions allocated to the power sector	CHP reserve quota imposed on new facilities
Germany	Based on trends toward the Kyoto Protocol targets (*not linear trends)	Based on the 2000-2002 emissions. Allocated directly to equipment.	Equipment replacement during the applicable period is regarded as diversion, not abolition and new allocation. Posterior adjustment program established*2 No reduction requirement imposed on process emission Bonus emission quota for early action and cogeneration
France	Specific emissions in 1998-2001 x the improvement rate x production volume *Low per capita emissions and low reducible emissions claimed		No reduction requirement imposed on process and waste-derived emissions Allocation to steelmaking facilities based on proposals from the industry
Italy	Based on National Action Plan (PNR) *Emissions in 2010 failing to meet the Kyoto Protocol target	Based on the 2000 emissions. Future growth taken into account.	Emission reserve quota for new facilities*3 set up by sector Allocation to the power industry determined in accordance with a plan
Netherland	Middle value between the agreed-upon benchmark and an estimate by a research organization	Based on the 2000-2002 emissions. Future growth by sector taken into account. The reduction rate depends on the existence of any agreement. Allocated directly to equipment.	Allocation to the power industry based on a separate formula
Poland	Based on the Kyoto Protocol target	Based on the 1999-2002 emissions (except for the year when the lowest emissions are recorded). Future growth and future improvement in specific emissions taken into account.	Allocation to the power and cement industries based on a separate formula Bonus emission quota for early action and cogeneration
Slovakia	Estimated national emissions multiplied by the ratio of the target equipment	Small equipment based on the 1998-2002 emissions. Future growth taken into account.	Allocation to large facilities determined case by case through negotiation

*1. CCP: Climate Change Program
*2. The EU Committee has issued an order for modification.
*3. Emission reserve quota for new facilities: Emission quota reserves for facilities that start operations during the implementation period.
*4. BAT: Best Available Technique

Source: The Institute of Energy Economics, Japan,
"2004 Survey Report on Data, etc. Related to Global Warming Measures"

7.2 Introduction of Energy Technology Compatible with National Characteristics

[Points]

- Generally, development and introduction of new energy technology and system should be based on the regional characteristics (e.g. percentage of heat demand, load factor, energy trading with neighboring countries) and the regional needs. It should be noted that the global introduction of uniform technologies or systems can cause inefficiency.
  - (Case 1) Heat pumps and storage system

    In countries, like Japan, where large share of nuclear power exists for base load and sharp demand appears during the daytime, significant CO_2 reduction can be achieved by introducing heat pump and storage systems which stores cooled water/ice using nuclear electricity during the night and consume it during peak hours (Figure 7.2-1). However, heat pump and storage systems will not be so beneficial in countries where there are less share of nuclear power and more moderate peak demand.
  - (Case 2) Cogeneration and district heating in cold regions

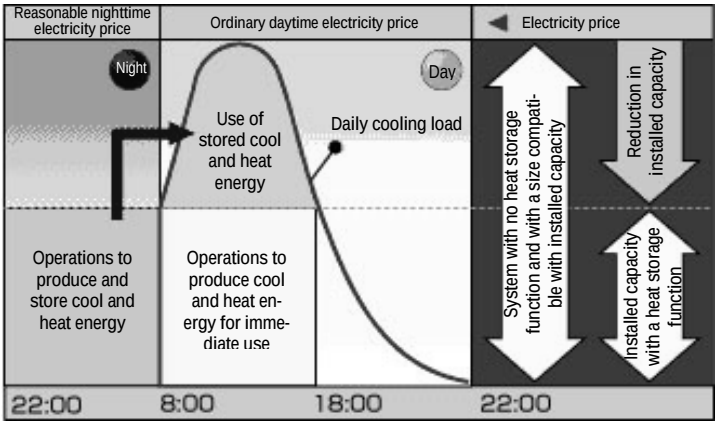
    In regions where strong heat demand constantly prevails throughout the year (Figure 7.2-2), energy systems based on cogeneration and district heating can provide higher energy efficiency. But these systems are not efficient in regions where there is less demand for heating or hot water.
  - (Case 3) Geothermal heat utilization

    If used in heat pump, geothermal energy is attractive because the use of ground heat can reduce the release of waste heat into the air, thereby alleviating the heat island phenomenon. However, ground heat is impractical in regions where the bedrock is too weak for drilling heat holes or in residential areas which require excessively complicated construction work. For these reasons, such the system should be applied to regions where bedrocks are stable and construction work is relatively easy.
- Therefore, technology transfer to developing countries also should take their regional characteristics and needs into account.
  - (Case 4) Introduction of distributed generation to unelectrified regions

    The introduction of distributed generation to unelectrified regions would help improve the public welfare of the community (Figure 7.2-3).
  - (Case 5) Introduction of conventional high-efficiency products to developing countries.

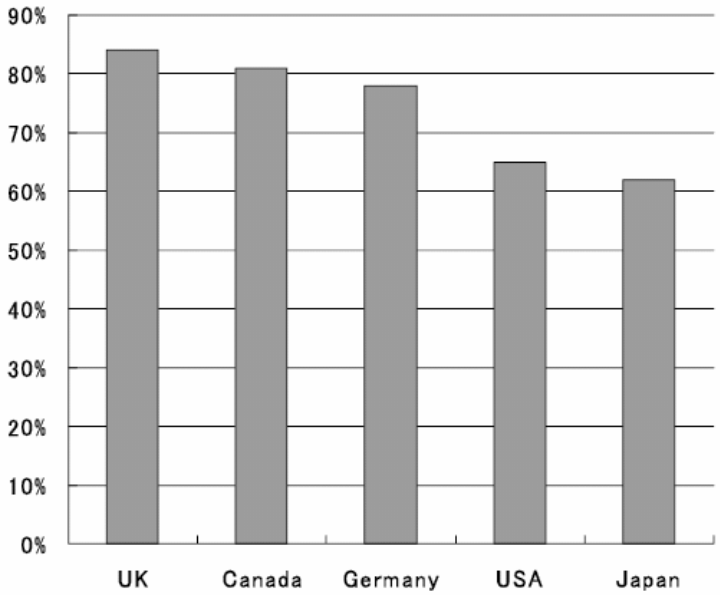
    In developing countries, the mere replacement of incandescent lamps with fluorescent lamps which are widely used in developed countries would have significant energy saving effects (Table 7.2-1).

[Related Data and Facts]



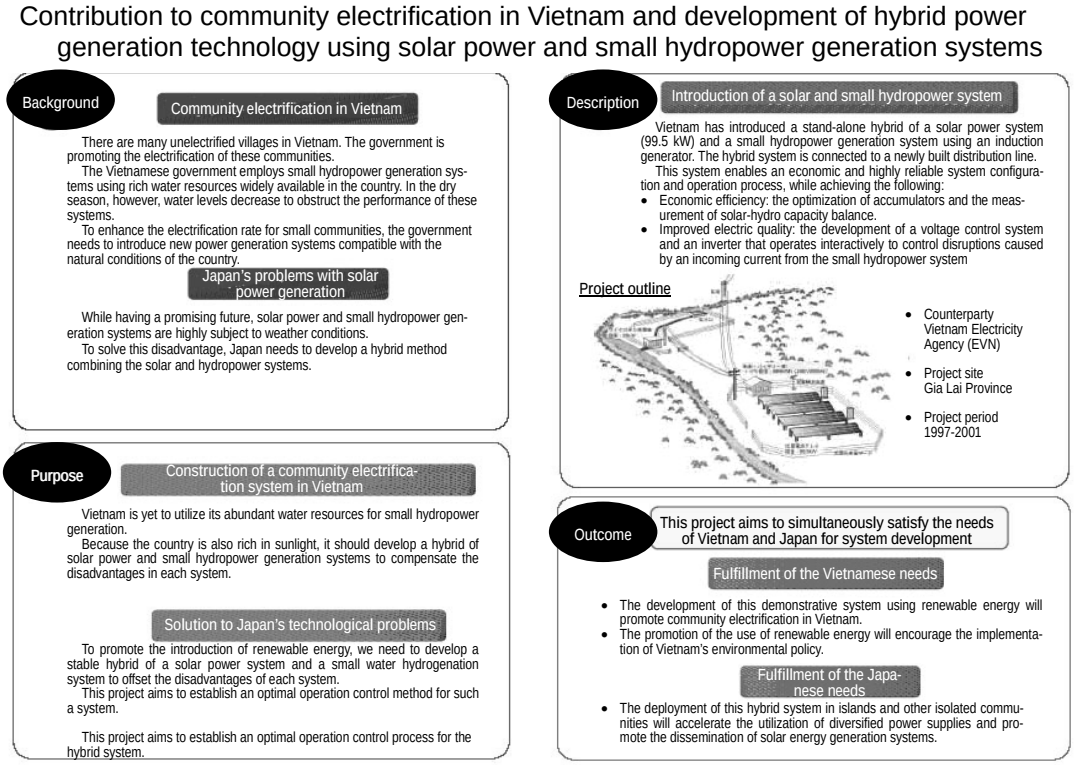
Source: Heat Pump & Thermal Storage Technology Center of Japan homepage

Figure 7.2-1 Outline of heat pump and storage systems



Source: Yoichi Kaya, "Long-term Strategy for Global Warming Prevention," 15th Debriefing Session on Industrial Technology for Earth Environment, 2006

Figure 7.2-2 Ratio of heat demand to total household energy demand



Source: NEDO

Figure 7.2-3 Community electrification project in Vietnam using solar power and small hydropower generation systems

Table 7.2-1 Energy-saving projects in developing countries

＜The Jakarta's Hotel Energy Efficiency Project＞	
Responsible organization	Pelangi (non-government research organizations engaged in environmental issues). The project started in September 2005 under financial and technical aids from USAID.
Project details	1. Seminars targeted at equipment personnel from non-star hotels in the Jakarta regions 2. Energy-efficiency diagnosis of facilities by Indonesian consultants on a commission basis 3. Seminars targeted at private businesses other than hotels (Device replacement may not be part of the project.)
＜The Fluorescent Lamp Replacement Project＞	
Responsible organization	JBIC assistance is given to the Chinese government.
Project details	1. Incandescent lamps are replaced with more expensive but more energy-efficient fluorescent lamps. 2. JBIC extends loans to the Chinese government to cover replacement costs. The government provides the proceeds for the project throughout its implementation period. 3. Buyers of fluorescent lamps receive a subsidy from government offices by showing them the purchase certificate. 4. Emission rights generated in the project will be purchased by Japanese businesses.

Source: Pelangi homepage, Nihon Keizai Shimbun

7.3 Promotion of Energy Environment Education and Establishment of New Academic Field and Academic Systems

[Points]

- Because energy and global warming issues involve several generations and thus require mid- and long-term efforts, the education of younger generations in these issues is extremely important (Table 7.3-1). While such education is given in Japan as part of school education and through NPO and other activities, there are yet few systematic programs applied in primary and secondary education concerning energy and global warming.
- Objective and well evidenced information and data should be disclosed and disseminated widely to the whole nation through publicity activities to have people recognize the significance of understanding and tackling energy and global warming issues. At the same time, it is important to analyze current publicity activities and set up an effective publicity strategy.
- Energy and global warming problems require not only scientific and technical knowledge but also studies on human aspects, including cultures and lifestyles. Because conventional academic fields are unable to fully cope with these issues, we are urged to develop new academic field and academic systems.
- In this respect, a report titled "Toward the Establishment of the Science of Energy," released in June 2000 by the Science Council of Japan's Liaison Committee on Society, Industry and Energy, stressed the importance of establishing the "Science of Energy," a new academic field to specialize in energy issues, reorganizing conventional concepts, and defining objectives and academic principles. Meanwhile, the International Council for Science (ICSU) has advocated the establishment of an energy research program that integrates human science, social science, and natural science (Figure 7.3-1).

[Related Data and Facts]

Table 7.3-1 Excerpts from the Annual Energy Report 2006 concerning energy education and publicity (1/2)

Section 10 Public hearings, publicity, and education concerning energy

1. Public hearings and publicity activities concerning energy

(1) Role of public hearings and publicity activities

Because energy is a basis for sustaining the lives and economic activities of people, it is extremely important for individuals to acknowledge energy issues as their own problems and thus do what they can in order to solve a variety of energy challenges. Thus, energy policies must be formulated through development of mutual understanding among different groups of people. For this purpose, communication and discussion should be promoted to encourage exchange of opinions among the public, the national government, local public agencies, businesses, energy producers, and consumers.

First, the government should organize public hearings nationwide to collect public opinions so as to know what people desire to know about energy and, based on their opinions, explain to the public the government's stance on energy issues. Next, in order to help people deepen their interest in, and understanding of, energy issues, the government should disclose relevant energy information, while reinforcing public hearing and publicity activities in an efficient and effective manner.

(2) Information and knowledge

The government makes available to the public information that helps people think of energy issues and policies on their own. The information should include such matters on global trends in energy production and consumption and the processes through which energy sources are imported to Japan, converted into electricity or gasoline, and delivered to consumers.

In distributing relevant information, the government makes it a point to include in such information a variety of perspectives in an equitable manner, as well as conveying large amounts of proper information in an accurate and easy-to-understand fashion.

(3) Public hearings and publicity activities

The government endeavors to understand public needs and opinions concerning its energy policies through public opinion surveys and homepages. The government's wide range of publicity activities include group interviews and surveys aimed at identifying the characteristics of a target group of people (e.g. age, awareness, regional characteristics).

As part of its publicity activities, the government also implements events, posts advertisements in newspapers, issues journals, distributes pamphlets, and hold symposiums and study tours. Providing as many opportunities as possible, the government hopes that people will direct more attention to energy problems and start doing what they can to help solve these challenges.

The government is endeavoring to strengthen interactive communication among people by combining public hearings and publicity activities.

Besides, the government offers information and arranges seminars so that nonprofit organizations can conduct independent activities more easily.

Table 7.3-1 Excerpts from the Annual Energy Report 2006 concerning energy education and publicity (2/2)

2. Energy education

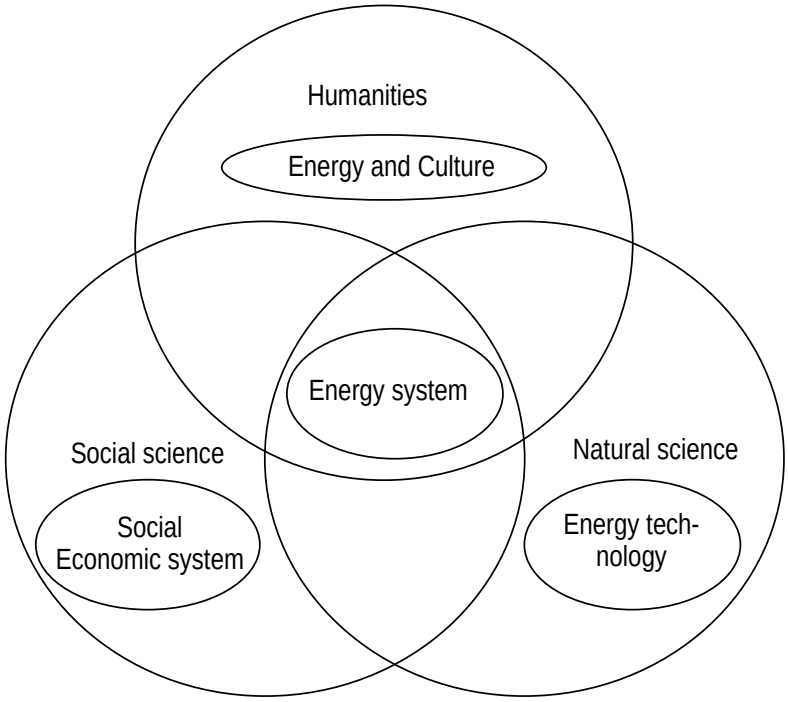
Today's children and young students are entrusted with a significant mission of choosing suitable energy sources, utilizing energy, and developing energy technology. In Japan, which lack in energy resources, it is our great challenge to help children acquire accurate scientific knowledge and deepen perspectives concerning situations revolving around energy issues. Even after school education, young people are desired to engage in energy-related activities as part of their lifelong learning.

In primary and secondary school education, energy issues have been addressed at each grade in social studies and science classes. In new curriculums introduced into primary and junior high schools in 2002 and into senior high schools in 2003, improved content is given for social studies and science concerning energy. In "comprehensive learning hours" introduced under the curriculum, students are expected to deepen their multidisciplinary understanding and learn problem-solving techniques with respect to energy and environmental problems specific to their community through practical experience and mission-oriented programs.

In order to develop an environment in which children and students can receive energy education on their own initiative in and out of school activities, the government provides support programs for teaching staff and students, as well as for schools.

In an effort to promote energy education, government agencies, educational organizations, and the industry are jointly carrying out a wide range of activities, including the compilation of energy-related teaching materials and the organization of energy facility tours.

Source: Ministry of Economy, Trade and Industry, Annual Energy Report 2006



Source: International Council for Science (ICSU) materials

Figure 7.3-1 Research program framework proposed by ICSU

7.4 Development of Energy Statistics

[Points]

- Energy and environmental policy planning requires accurate statistics of energy consumption. Energy statistics provided to IEA from developed countries are now made available for international comparison.
- In developing countries, relevant energy consumption figures are still to be developed (Table 7.4-1), while available data are less reliable. Developed countries are prompted to help developing countries enhance their technical abilities, including the development of statistical specialists and sharing research know-how. IEA is building a database for energy efficiency indexes and it is hoped that an effective statistical system will be formed to enable international comparison of data for the establishment of energy and environmental policies in each country.
- For more effective comparison of data from different countries, the international community is required to standardize the primary-energy conversion of hydro and nuclear generation and the definitions of the lower and higher heating values and other parameters.

[Related Data and Facts]

Table 7.4-1 Original data for "Energy balances of non-OECD countries"

Country	Statistics
China	-Energy Balances of China, provided to the Secretariat by the State Statistical Bureau for 1990 to 2003.
India	-Direct communication to the Secretariat from the Coal Controller's Organisation of the Ministry of Coal -Energy Statistics 2000-2001 to 2003-2004, Central Statistical Organisation, Ministry of Statistics and Programme Implementation, 2002 to 2005. -Coal Directory of India, 1992-1993 to 2003-2004, Coal Controller's Organization, Ministry of Coal, Kolkata, 1994 to 2005. -Indian Petroleum and Natural Gas Statistics 2000-01 to 2003-04, Ministry of Petroleum and Natural Gas, New Delhi, 2002 to 2005. -Basic Statistics on Indian Petroleum and Natural Gas Statistics 2003-04, Ministry of Petroleum and Natural Gas, New Delhi, 2004. -All India Electricity Statistics General Review 1998-99, 2000-01 to 2003-04, Central Electricity Authority, Ministry of Power, New Delhi, 2000, 2002 to 2005. -Annual Review of Coal Statistics, various issues from 1993-1994 to 1998-1999, Coal Controller's Organization, Ministry of Coal, Kolkata, 1995-2000. -Energy Data Directory, Yearbook "TEDDY", and Annual Report, Tata Energy Research Institute "TERI", New Delhi, 1986-1988, 1990, 1994-2000. -General Review, Public Electricity Supply, India Statistics, Central Electricity Authority, New Delhi, 1982 to 1985, 1995-1998, 2000-2004. -Monthly Abstract of Statistics, Ministry of Planning, Central Statistics Organisation, Department of Statistics, New Delhi, various editions from 1984 to March 1998, 1998-2000. Annual Report 1994-1996, 1998-1999, Ministry of Energy, Department of Non-Conventional Energy, New Delhi, 1996 and 1999. -Annual Report 1993-1994, 1998-1999, Ministry of Petroleum and Natural Gas, New Delhi, 1995, 2000. -General Review, Public Electricity Supply, India Statistics, Central Electricity Authority, New Delhi, 1982 to 1985, 1995-1998. -India's Energy Sector, July 1995, Center for Monitoring Indian Economy PVT Ltd., Bombay, 1995. -Monthly Review of the Indian Economy, Center for Monitoring Indian Economy PVT Ltd., New Delhi, various issues from 1994 to June 1999.
Brazil	Direct communication to the Secretariat from Ministério de Minas e Energia, Brasilia.
Russia	-UN ECE Questionnaire on Coal, 1992 to 2003. -UN ECE Questionnaire on Natural Gas, 1991 to 2003. -UN ECE Questionnaire on Electricity and Heat, 1991 to 2003. -UN ECE Questionnaires on Oil, 1991 to 2003. -UN ECE Questionnaires on Renewable and Waste, 1991 to 2003. -Energy trade: Direct communication to the Secretariat from the State Committee of Statistics of Russia, July 1994. -Statistical Yearbook of Russia 1994. The State Committee of Statistics, Moscow, 1994. -The Russian Federation in 1992, Statistical Yearbook, The State Committee of Statistics of Russia, Moscow, 1993. -Russian Federation External Trade, annual and quarterly various editions, the State Committee of Statistics of Russia, Moscow. -Statistical Bulletin, various editions, The State Committee of Statistics of the CIS, Moscow, 1993, 1994. -Statistical Bulletin n° 3, The State Committee of Statistics of Russia, Moscow, 1992. -Fuel and Energy Balance of Russia 1990, The State Committee of Statistics of Russia, Moscow, 1991. -Energetika, Energo-Atomisdat, Moscow, 1981 to 1987.

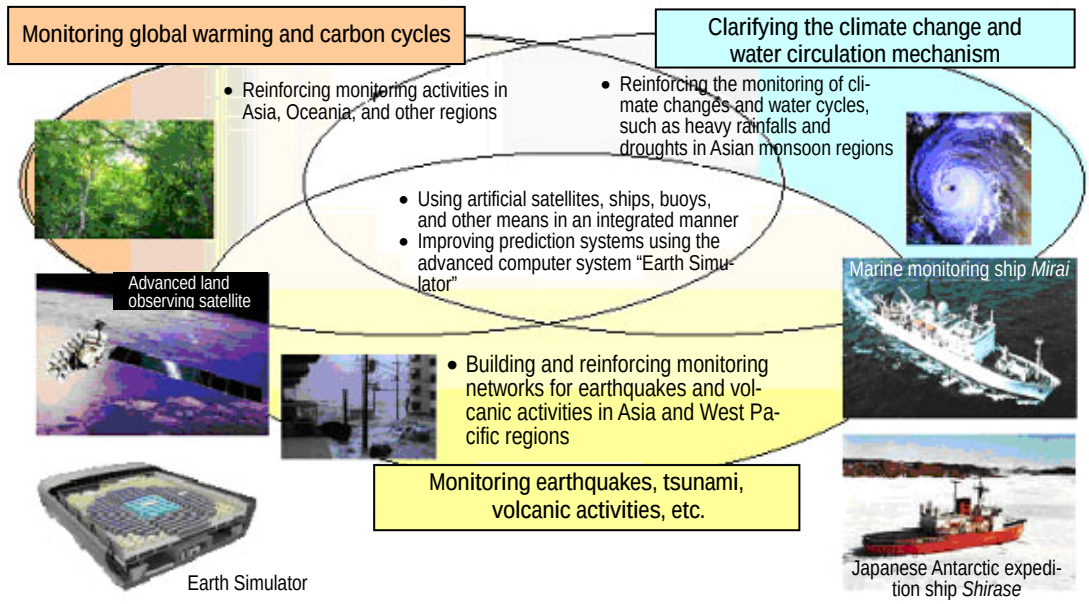
Source: IEA "ENERGY BALANCES OF NON-OECD COUNTRIES 2002-2003"

7.5 Reinforcement of Climate Prediction and Observation Technology Systems

[Points]

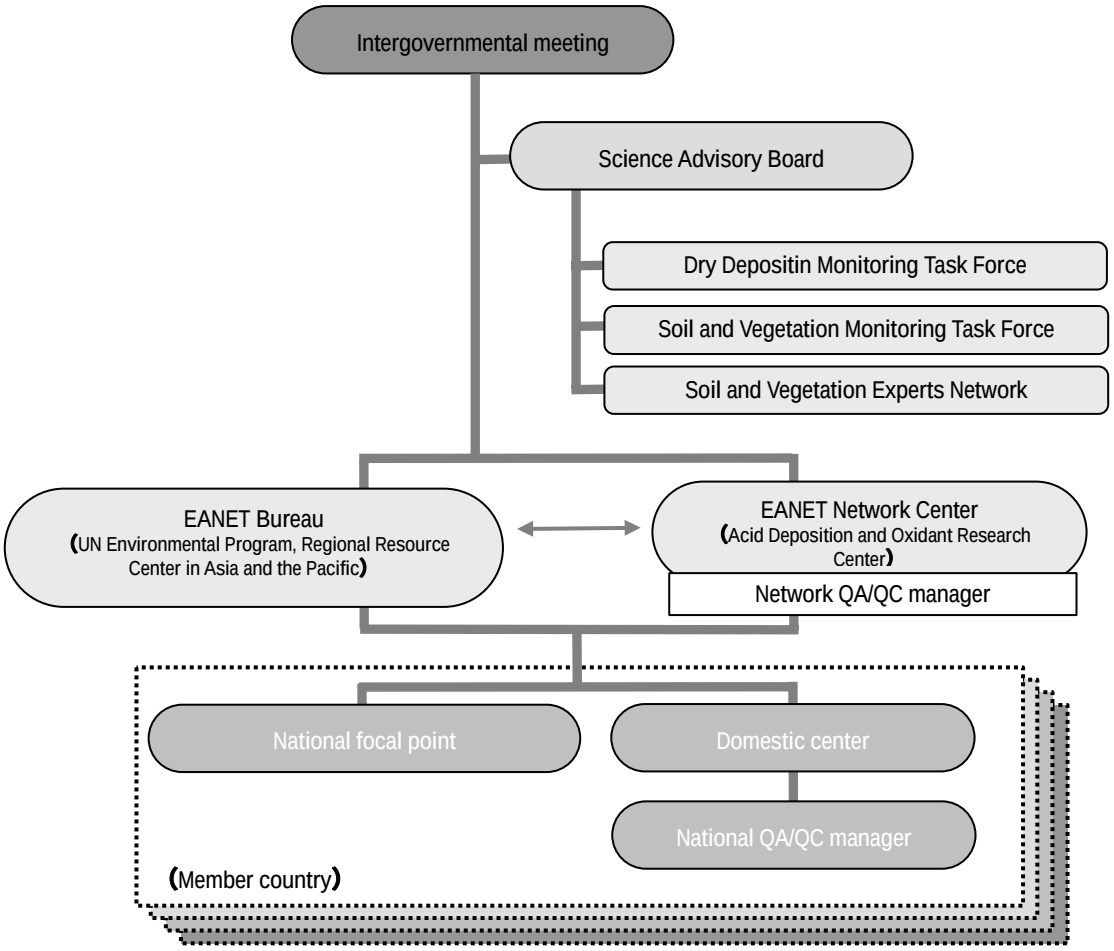
- To mitigate the impact of climate change, it is indispensable to collect and distribute information obtained by global observation, as the 2nd and 3rd IPCC assessment reports emphasized the importance of monitoring and analyzing abnormal climatic phenomena. In this respect, Japan has contributed to earth observation in a various ways (Figure 7.5-1).
- The Evian G8 Summit leaders stressed the significance of earth observation aimed at both environmental conservation and economic development. In response to the Summit statement, the countries agreed to hold a global observation summit to discuss the establishment of a global observation system by stepping up international cooperation.
- A related project is already in progress under the initiative of Asia-Pacific Network for Global Change Research (APN) to improve monitoring and analytic techniques for climatic data collected from developing countries, as well as from developed countries. Acid Deposition Monitoring Network in East Asia (EANET), a Japan-led project, aims to tackle acid rain problems in the East Asia regions (Figure 7.5-2).
- The international community is required to strengthen its efforts to improve the climatic prediction and monitoring systems.

[Related Data and Facts]



Source: the 36th session of Council for Science and Technology Policy

Figure 7.5-1 Japan's contribution to earth observation activities



Source: http: //www.eanet.cc/jpn/

Figure 7.5-2 Organization of EANET

7.6 Deepening of Discussion on the Establishment of Post-Kyoto Protocol Objectives

[Points]

- In compilation of the United Nations Framework Convention on Climate Change, European countries insisted that the members should pledge to stabilize greenhouse gas emissions at the 1990 level by the end of 2000. The proposal was rejected by the United States, which countered that the stabilization efforts would require enormous amounts of money while sufficient amounts of scientific evidence were not available. Proposing the "Pledge and Review" method, Japan recommended that the stabilization should be a nonbinding target instead of an obligation.
- It was agreed that member countries should "reduce" their greenhouse gas emissions to their 1990 levels, instead of "stabilizing" the emissions at these levels, while obliging them to "implement necessary policies and actions," not to "achieve their targets."
- Upon the adoption of the Kyoto Protocol, discussion was started on greenhouse gas reductions after 2000, which was not addressed in the UNFCCC. Amid concerns over the potential failure to achieve their 2000 reduction targets, momentum grew for the establishment of a new protocol. This resulted in the adoption of the Berlin Mandate, under which "quantities targets" were imposed on developed countries alone, with developing countries free from any new obligations.
- In the assignment of quantitative targets, several methodologies were proposed including the following: the use of basic units such as per GDP or per-capita emissions, the commitment by each country to a reduction rate and successive reductions, allocation based on total permissible emissions, and application of a reduction rate lowered from the standard reduction rate by using an index. Finally, the member countries agreed to make a list of the results of negotiations on the respective targets for countries.
- The 2005 COP/MOP1 meeting started discussion on the post-Kyoto Protocol, aiming to establish an international framework for 2013 and later years. This discussion should address the way to simultaneously ensure both environmental conservation and economic development.
- There are multiple options for emission targets (Table 7.6-1). Some of them have been presented for deliberation in the post-Kyoto Protocol meetings (Table 7.6-2, Table 7.6-3). Among them, we should select the most effective and practicable proposal.
- To reflect equitability in the establishment of targets, it should be noted that equitability must be based on three aspects: (1) equitability based on the allocation of total global emissions, (2) equitability based on the results of implementation of the system, and (3) equitability in the process of determining allocations of total global emissions.

[Related Data and Facts]

Table 7.6-1 Approaches to target determination: Case 1

	Outline	Advantage	Disadvantage
Quantitative approach (Cap and trade)	The Kyoto Protocol is maintained. The government is obliged to comply with the absolute emission target. To cut related costs, each country is permitted to use emission trading. The government is responsible for the outcome.	• Emission reduction effects are ensured. • The initial target can be achieved at a minimum cost (efficiency). • Each country is permitted to set up a policy at its own discretion.	• Equitability in initial burden allocation cannot be guaranteed. • Costs (unit reduction prices) are unforeseeable. • Fund transfer takes place from a country buying emission rights to another selling them. • Hot-air generation is not possible to avoid.
Price approach (Internationally uniform carbon tax system)	The achievement of targets is measured by prices not by emissions. The reduction measures include a unified carbon tax (or a coordinated carbon tax system) to achieve reduction targets through the market mechanism.	• The initial target can be achieved at a minimum cost (efficiency). • Costs are foreseeable. • No fund transfer takes place between countries. • Excessive costs can be avoided. • The generation of hot air is prevented.	• Environmental effects are difficult to ensure. • Countries have difficulty introducing their own tax system. • Agreement is difficult concerning proper tax rates. • Differences exist among countries in prioritization of global warming issues.
Hybrid policy	Countries are required to achieve quantitative targets. Once emission costs reach an upper threshold price, the country will issue emission rights without limitation at this price.	• Net costs can be reduced through issuance of additional emission rights. • The benefits of the price approach can be maintained.	• All member countries have to introduce an emission trading system as a prerequisite. • Conflicts can occur between the established target and the claims of each country. • A uniform maximum price is difficult to set. • Theoretical problems remain.
Efficiency improvement objective	Objectives are established for energy consumption on the basis of GDP or production levels and for improvement in greenhouse gas emission efficiency. A wide range of measures are applied, including efficiency improvement from a BAU emission level and a benchmark system.	• Efforts are reflected directly in the results. • Economic growth is taken into account. • The generation of hot air is prevented. • Participation by developing countries can be accelerated.	• Environmental effects are difficult to ensure. • Some inefficiency is involved. • Agreement is difficult to reach on targets and indicators. • Emission right trading may be restricted.
Policy and action implementation	Countries pledge to introduce polices and actions against global warming. Policies may be adjusted through negotiation. The government takes responsibility for the outcome of actions taken.	• Policies and actions are more feasible. • Policies are not formulated to match the situation in each country. • Past policies and measures as implemented in the GATT can be used for policy decisions.	• Environmental effects are difficult to ensure. • Some inefficiency is involved. • This will not be the mainstream of global warming measures. • An international surveillance system is required.

Source: M. Yamaguchi, T. Sekine, “Post-Kyoto Protocol Framework” (*Mitagakkai Zasshi*, Issue 98-2), July 2005

Table 7.6-2 Approaches to target determination: Case 2

Proposal for systems	Outline
Multistage approach	• Maximum permissible absolute emissions should be imposed on more countries, with more stringent reduction obligations being incrementally applied in the future.
Sector-specific CDM	• Developing countries should be obliged to introduce CDM projects aimed to achieve a target specified for each sector.
Sustainable development policy and action	• As with sector-specific CDM projects, developing countries should be obliged to incorporate into their economic plans a greenhouse gas emission reduction policy ("development priority proposal").
Brazil's proposal	• As a means of burden allocation, an emission reduction target should be imposed on each country based on the impact of its past emissions on temperature rises. This rule is based on the polluter-pays principle to allocate common but differing responsibilities.
Triple-take approach / multi-sector convergence approach	• Under the triple-take approach, a country is divided into three sectors: (1) civilian and other sectors, (2) energy-intensive manufacturing sector, and (3) power generation sector. Emissions are calculated by sector. A country's emissions are calculated by totaling the emissions in the three sectors. Reduction targets are set by taking into consideration the country's fuel composition, economic structure, living standards, and other domestic factors. • Although similar to the triple-take approach, the multiple-sector convergence approach reflects domestic factors more flexibly and accurately in that, under convergence approach, a country is divided into seven sectors (power generation, household, transport, industry, service, agriculture, and waste).
Convergence approach	• Global Common Institute, a British NGO, has proposed that reduction targets should be applied in such a way that countries will have the same per-capita greenhouse gas emissions on mid- and long-term basis.
Safety valve approach	• Countries should be permitted to trade emission quotas at a fixed price after a maximum allowable price is set for an emission quota. This approach is a hybrid of emissions trading and a carbon tax because an emission quota traded at a fixed price can be considered as a carbon tax.
Carbon-intensity target	• No absolute emission cap should be imposed. A target should be set in such a way that it can be adjusted on the basis of GDP, population, and other factors.
Coordination for standardization (emissions, fuel efficiency, technology, etc.)	• Countries should be obliged to apply a greenhouse gas emission standard and an energy-efficiency standard to each technology or product. This concept is called "sector approach" or "bottom-up approach."
International carbon tax	• A consensus should be formed to oblige each country to introduce a common or adjusted carbon tax agreed upon internationally. As a tax is imposed on carbon emissions, fossil fuel prices are expected to increase in accordance with the carbon content, encouraging fuel conversion and energy savings.
Double-track approach	• Countries should be permitted to choose at their discretion from multiple obligations set within a single framework. • For example, in the first track, countries are given legally binding targets and are permitted to use the Kyoto mechanism in order to achieve their targets. In the second track, countries are legally mandated to establish and implement a plan against climate change by selecting non-binding targets and incorporating into their plan necessary policies and actions against climate change.
Technology fund	• Countries should agree to set up an international fund for research and development of anti-warming technologies.
Regional responses	• The multinational process should be replaced with, or complemented by, an inter-regional process, because the latter can facilitate regional agreement and implementation of individual policies.

Source: Edited by Y. Takamura, Y. Kameyama from "Future Course of Global Warming Negotiation," (*Daigaku Tosho*), 2005.

Table 7.6-3 Approaches to target determination: Case 3

Approach	Major Advantages	Disadvantages/ Challenges
The Kyoto Protocol-Style Targets *Extending fixed targets to developing countries with links to flexibility and accountability mechanisms*	• Familiarity and simplicity • Advance knowledge of environmental benefits • Flexibility in implementation • Respects national circumstances	• Limited political acceptability • Data requirements • Incentives to establish weak targets
Sustainable Development Policies and Measures (SD-PAMs) *Voluntary action oriented around sustainable development*	• Builds on national sustainable development priorities • Respects national circumstances • Easily integrated into The Kyoto Protocol • No emissions cap	• Ensuring action and accountability • Measuring climate benefits • Financing
Sector-Clean Development Mechanism (Sector-CDM) *Sector-wide market mechanism*	• Familiarity and compatibility with the Protocol • Development benefits • Rests on the polluter pays principle • Gradual capacity building • Cost-effectiveness • No emissions cap	• Relies on Annex I investment • Technical requirements and capacity • National coordination effort • Political opposition
Dual-Intensity Targets *Two dynamic targets with links to flexibility and accountability mechanisms*	• Reduced economic uncertainty in establishing targets • Reduces risk of hot air targets • Potentially easier to agree on dual targets	• Data requirements • Complexity • Interactions with international emissions trading • Lack of environmental certainty
Adaptation of Brazilian Recommendations, as suggested in Chapter 7 *Fixed target, global allocation scheme with links to flexibility and accountability mechanisms*	• Procedural fairness and simplicity • Science-driven • Rests on established principles • Compatibility with The Kyoto Protocol mechanisms • Rewards of early developing country action	• Data requirements • Limited global acceptability • Limited flexibility for varying country circumstances
Per Capita-Based Entitlements *Fixed targets, global allocation scheme with links to flexibility and accountability mechanisms*	• Procedural fairness and simplicity • Strong ethical basis • Enhances cost-effectiveness through global trading • Incentives for developing country participation • Amalgamates well with the Kyoto architecture	• Limited global acceptability • Limited flexibility for varying country circumstances • High dependence on trading for success

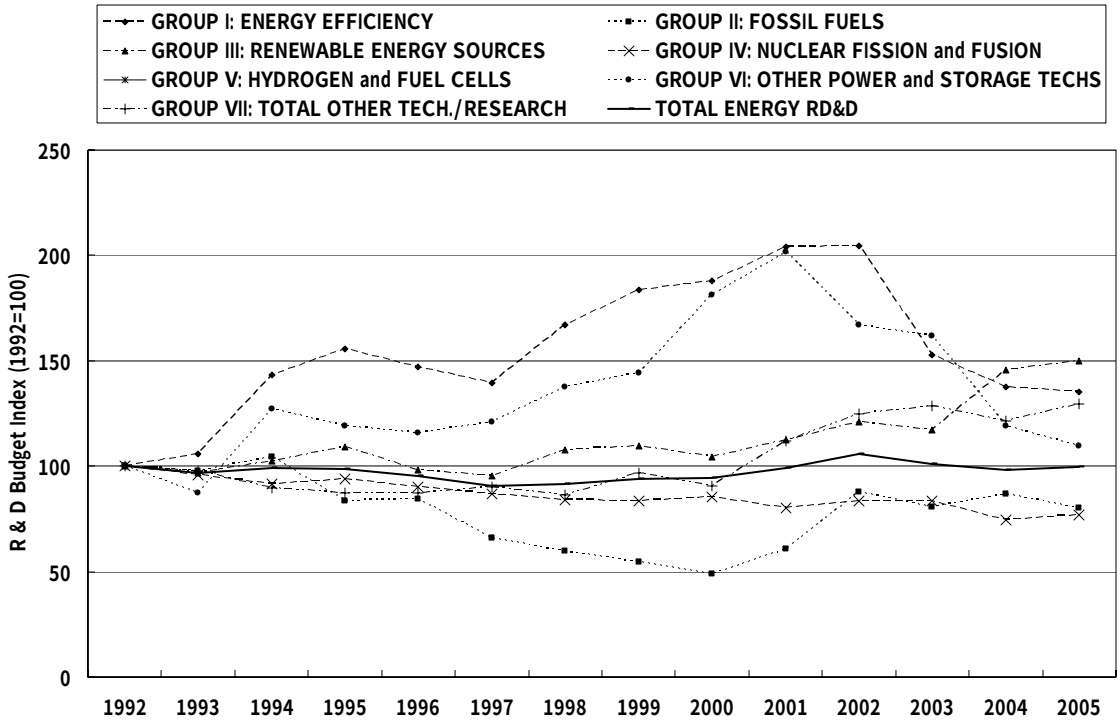
Source: "Building on the Kyoto Protocol, Options for Protecting the Climate", World Resources Institute, 2002

7.7 Appropriate Allocation of Research and Development Budget for Energy-related Technology

[Points]

- In OECD countries, research and development budgets for the energy-related technology have remained almost the same since 1992 (Figure 7.7-1, Table 7.7-1). Each country is advised to allocate its budget so as to reflect the growing importance of energy and global warming issues in a more appropriate manner, weighing them against other problems.
- To ensure appropriate budget allocation by sector, it is important to specify the essential elements of research and development under a mid- and long-term energy and global warming strategy. International coordination is urged to promote for efficient technological research and development.

[Related Data and Facts]



Source: IEA Energy Statistics - R&D Statistics

Note: "GROUP V: HYDROGEN and FUEL CELLS" is not shown in the graph because the budget data in 1992 is not available.

Figure 7.7-1 Energy-related R&D budget of OECD countries

Table 7.7-1 Energy- related R&D budget of OECD countries

TIME	1995		2005		2005/1995
	million USD	share	million USD	share	
GROUP 1: ENERGY EFFICIENCY	1239.681	13.1%	1075.015	11.2%	0.87
I.1 Industry	428.821	4.5%	150.069	1.6%	0.35
I.2 Residential Commercial	328.834	3.5%	157.159	1.6%	0.48
I.3 Transportation	405.042	4.3%	216.977	2.3%	0.54
I.4 Other Conservation	76.955	0.8%	550.808	5.7%	7.16
GROUP II: FOSSIL FUELS	1050.234	11.1%	1006.86	10.5%	0.96
II.1 Total Oil & Gas	490.444	5.2%	506.23	5.3%	1.03
II.1.1 Enhanced Oil & Gas Production	165.78	1.7%	88.747	0.9%	0.54
II.1.2 Refining Transp. & Stor. of Oil and Gas	..	..	..	..	..
II.1.3 Non-Conventional Oil and Gas Production	18.93	0.2%	24.075	0.3%	1.27
II.1.4 Oil and Gas Combustion	..	..	..	..	..
II.1.5 Oil and Gas Conversion	..	..	..	..	..
II.1.6 Other Oil & Gas	305.734	3.2%	393.408	4.1%	1.29
II.2 Total Coal	559.793	5.9%	430.098	4.5%	0.77
II.2.1 Coal Prod. Prep. & Trans.	..	..	..	..	..
II.2.2 Coal Combustion	264.53	2.8%	286.522	3.0%	1.08
II.2.3 Coal Conversion (excl. IGCC)	180.059	1.9%	66.833	0.7%	0.37
II.2.4 Other Coal	115.204	1.2%	76.744	0.8%	0.67
II.3 Total CO2 Capture and Storage	..	..	70.532	0.7%	..
II.3.1 CO2 Capture/Separation	..	..	62.661	0.7%	..
II.3.2 CO2 Transport	..	..	0.044	0.0%	..
II.3.3 CO2 Storage	..	..	7.827	0.1%	..
GROUP III: RENEWABLE ENERGY SOURCES	808.596	8.5%	1113.208	11.6%	1.38
III.1 Total Solar Energy	399.408	4.2%	500.714	5.2%	1.25
III.1.1 Solar Heating & Cooling (incl. Daylighting)	59.923	0.6%	60.375	0.6%	1.01
III.1.2 Photovoltaics	279.231	2.9%	362.662	3.8%	1.30
III.1.3 Solar Thermal Power and High Temp. Apps	60.254	0.6%	77.678	0.8%	1.29
III.2 Wind Energy	134.529	1.4%	161.385	1.7%	1.20
III.3 Ocean Energy	2.719	0.0%	4.74	0.0%	1.74
III.4 Total Bio-Energy	167.64	1.8%	300.284	3.1%	1.79
III.4.1 Prod. of Transport Biofuels incl. from Wastes	..	..	23.562	0.2%	..
III.4.2 Prod Other Biomass-Derived Fuels incl Wastes	..	..	83.749	0.9%	..
III.4.3 Applications for Heat and Electricity	..	..	27.129	0.3%	..
III.4.4 Other bio-energy	..	..	22.593	0.2%	..
III.5 Geothermal Energy	86.65	0.9%	54.47	0.6%	0.63
III.6 Total Hydropower	17.646	0.2%	31.444	0.3%	1.78
III.6.1 Large Hydropower (capacity >10 MW)	15.34	0.2%	10.556	0.1%	0.69
III.6.2 Small Hydropower (capacity <10 MW)	2.306	0.0%	20.888	0.2%	9.06
III.7 Other Renewables	..	..	60.172	0.6%	..
GROUP IV: NUCLEAR FISSION and FUSION	4736.705	50.0%	3883.237	40.5%	0.82
IV.1 Total Nuclear Fission	3616.384	38.1%	3168.059	33.0%	0.88
IV.1.1 Light-Water Reactors (LWRs)	449.173	4.7%	130.834	1.4%	0.29
IV.1.2 Other Converter Reactors	304.575	3.2%	145.632	1.5%	0.48
IV.1.3 Fuel Cycle	1239.261	13.1%	1008.982	10.5%	0.81
IV.1.4 Nuclear Supporting Technology	1256.759	13.3%	1712.047	17.9%	1.36
IV.1.5 Nuclear Breeder	366.613	3.9%	150.231	1.6%	0.41
IV.1.6 Other Nuclear Fission	..	..	20.334	0.2%	..
IV.2 Nuclear Fusion	1120.321	11.8%	715.178	7.5%	0.64
GROUP V: HYDROGEN and FUEL CELLS	..	..	281.048	2.9%	..
V.1 Total Hydrogen	..	..	127.949	1.3%	..
V.1.1 Hydrogen production	..	..	..	..	..
V.1.2 Hydrogen storage	..	..	..	..	..
V.1.3 Hydrogen transport and distribution	..	..	..	..	..
V.1.4 Other infrastructure and systems R&D	..	..	..	..	..
V.1.5 Hydrogen end uses incl.comb; excl.fuel cells	..	..	..	..	..
V.2 Total Fuel Cells	..	..	153.1	1.6%	..
V.2.1 Stationary applications	..	..	..	..	..
V.2.2 Mobile applications	..	..	..	..	..
V.2.3 Other applications	..	..	..	..	..
GROUP VI: OTHER POWER and STORAGE TECHS	373.465	3.9%	343.236	3.6%	0.92
VI.1 Electric Power Conversion	209.718	2.2%	179.026	1.9%	0.85
VI.2 Electricity Transm. & Distr.	108.869	1.1%	129.024	1.3%	1.19
VI.3 Energy Storage	54.876	0.6%	35.189	0.4%	0.64
GROUP VII: TOTAL OTHER TECH./RESEARCH	1274.2	13.4%	1883.715	19.7%	1.48
VII.1 Energy System Analysis	..	..	..	..	..
VII.2 Other	..	..	..	..	..
TOTAL ENERGY RD&D	9482.881	100.0%	9586.32	100.0%	1.01

Source: IEA Energy Statistics - R&D Statistics

Note: The figures refer only to R&D budgets of national governments.