5. Energy Utilization

5.1 Promotion of Energy Saving (Policy)

[Points]

- Developed countries are introducing policies directing energy customers to select energy-efficient products, such as a labeling standard, a top-runner system, and an energy management system (Table 5.1-1). Japan has introduced an energy management system, with successful results, to oblige large consumers, including factories and offices, to implement energy-saving measures.
- It is still desired that developed countries should reinforce energy-saving policies, including a specific energy consumption control system and an international standard for energy-efficient products.
- Developing countries are required to combat fundamental challenges, such as developing laws and regulations and increasing the awareness among energy customers of the importance of energy-saving efforts (Table 5.1-2). Meanwhile, the international community must help developing countries strengthen their ability to plan energy-saving policies.

[Related Data and Facts]

Table 5.1-1 Energy-saving policy outline (Developed countries and regions)

	Japan	United States	EU
Outline	Promoting energy-saving by technology. Achieving a 30% reduction in the specific energy consumption by 2030 from the 2030 level (New National Energy Strategy)	Of the total of 105 recommendations by National Energy Policy (NEP) established in May 2001, 23 are related to energy saving.	Green Paper on Energy Efficiency (2006) directs EU energy-saving policy
Energy management	➢ Energy management system Mandating large factories and offices to submit an energy consumption report and plan an energy saving measure. ➢ Effort in the transport sector Mandating transport operators (including cargo owners) to establish an energy-saving policy.	➢ Voluntary energy management systems financially supported by the government: Industrial Assessment Center (IAC) Audit Programme; Residential Weatherization Assistance Program	➢ An energy management system contemplated at the EU level
Energy-saving standard and labeling	➢ Top-runner system Establishing an energy-saving standard appropriate to the best product available in the market. ➢ Energy-saving labeling Thirteen items designated for labeling as of April 2005.	➢ Energy Star A voluntary labeling system assisted by Environmental Protection Agency (EPA) to promote the use of energy-efficient products ➢ Energy Guide Labeling is required for refrigerators, water heater, air-conditioners, and other equipment.	➢ A labeling system based on EU Directive 92/75/EEC →Applicable to many products at 7 grades from A to G ➢ Energy-saving standard (EU Directive) →Requires negotiation with the industry and EU-level coordination because the standard is legally binding. Already applied to certain products.
Subsidies and aids	➢ Providing aids for the introduction of high-performance industrial furnaces, high-efficiency water heaters, high-efficiency ventilators, and other equipment.	➢ Preferential taxation (20%) for purchases of energy-saving devices →For commercial buildings ➢ Preferential taxation(10%) for CHP introduction, etc.	➢ Subsidies already granted on national levels, with care taken not to impede competition within the EU.
Energy-saving in buildings	➢ An energy-saving action notification system and energy-saving standards ➢ Research and development of IT-based energy-saving systems (BEMS, etc.)	➢ Energy Star Energy-saving certification for buildings	➢ EU Directive (2002) for the energy efficiency of buildings →National laws enacted to come into force in 2006
Others	➢ Voluntary efforts of the industry (standby electricity reduction plans, etc.) ➢ An award system for sellers of energy saving products		➢ Deliberation under way within the Intelligent Energy for Europe Program framework concerning energy-saving standards, labeling regulations, and energy management systems

Table 5.1-2 Energy-saving policy outline (Developing countries)

	China	India	Indonesia
Outline (Objectives)	➢ The specific energy consumption of the total economy to be cut by 20% (11th 5-year program [2006 to 2010]) ➢ Ten top-priority energy saving projects	Energy saving by measures targeted at a wide diversity of consumers	➢ One of the three top national energy policies (2004) is associated with energy saving. ➢ A wide variety of measures likely to achieve 30% energy-saving
Energy management	➢ Annual publication of energy consumption in major regions and industries	➢ Consumers using more than 1MW of electricity mandated to meet energy management requirements and report the management results	➢ The 2005 energy-saving guidelines refer to the implementation of audits of industries consuming large amounts of energy.
Energy-saving standard and labeling	➢ An energy-efficient product standard apparently established	— (the necessity of a labeling system seemingly recognized)	➢ The state-owned electric power company (PLN) started an energy-saving certification and labeling system in cooperation with the government. ➢ Deliberation started concerning the establishment of an energy-saving standard for certain industry segments
Subsidies and aids	➢ Promotion of the 10 projects, etc.	➢ An energy-saving fund established under state governments ➢ Financial and technological assistance provided to ESCO businesses	—
Energy-saving in buildings	An energy-saving standard being planned for buildings	➢ "National Building Code" applied	—
Other	➢ There are few cases where energy-saving objectives have been fulfilled (partly due to unexpectedly rapid economic growth)	➢ Only four workers employed by BEE (Energy Efficiency Agency) to take charge of energy saving policy ➢ Energy saving incentives are little under the energy price control system	➢ The above policies ineffective or inactive for various reasons: ・ Reasonable electricity prices due to subsidies ・ Fund shortage for implementation of energy-saving policies ・ Low awareness of energy saving, etc.

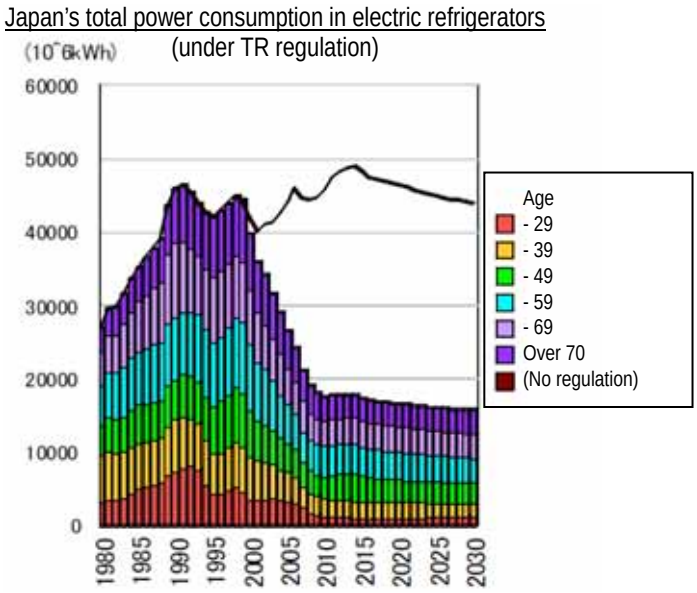
Source: Outline of Energy Saving Policy (Agency for Natural Resources and Energy)
Compiled on the basis of the following materials:
Study report on Overseas Legal Standards on Energy Consumption Efficiency of Devices (The Energy Conservation Center, Japan), 2005
Energy Efficiency Policies and Indicators (World Energy Council), 2001
Final Report on Comprehensive Technological Cooperation with Indonesia in the Energy Field (JICA), 2006
China's 11th Five-Year Plan: Energy-saving (The Institute of Energy Economics, Japan), 2006.

5.2 Promotion of Energy Saving (Products)

[Points]

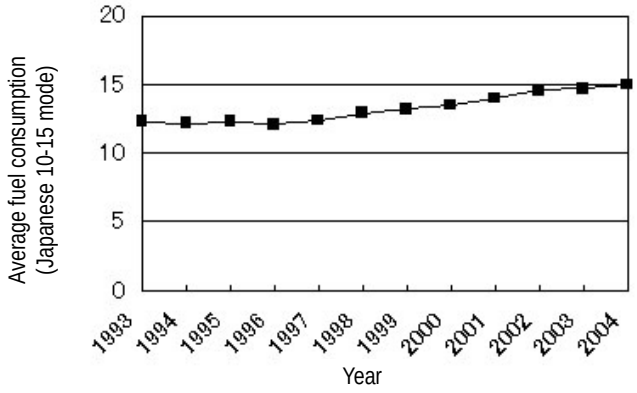
- Many developed countries are endeavoring to improve energy efficiency of end-use products by implementing innovative technologies and energy-saving policies. Effective policy includes energy-efficiency standards, including a top-runner standard and a labeling system, which has been introduced in recent years. Figure 5.2-1 and Figure 5.2-2 present recent changes in consumption efficiency of refrigerator and gasoline car in Japan. It should be noted that the target use in energy efficiency standard policy differs by country and region (Figure 5.2-3).
- To further encourage the development and use of energy-efficient products, it would be meaningful to adopt a globally standardized rule on products that are widely in use over the world.
- Developing countries are said to be lack of policy to promote energy efficiency products. Developed countries are desired to extend assistance in building their ability to plan energy policies, in addition to helping them introduce new technologies.
- Even if existing policies are producing consistent results, the government and the private sector should cooperate further to develop fundamental technologies which lead to achieve further energy saving in products. For example in Japan, it is pointed out that there is a need to shift more resources to the development of energy-saving technology in the information industry and power electronics (Figure 5.2-4).
- Developing countries are predicted to show a sharp increase in the car ownership in line with the continuing GDP growth (Figure 5.2-5). Developed countries are experiencing increases in energy consumption in the transport sector and thus are strongly urged to introduce low-emission vehicles such as hybrid cars in order to reduce environmental burden (Figure 5.2-6). Fuel-cell vehicle is also worth paying attention as one of the most promising energy-saving options.

[Related Data and Facts]



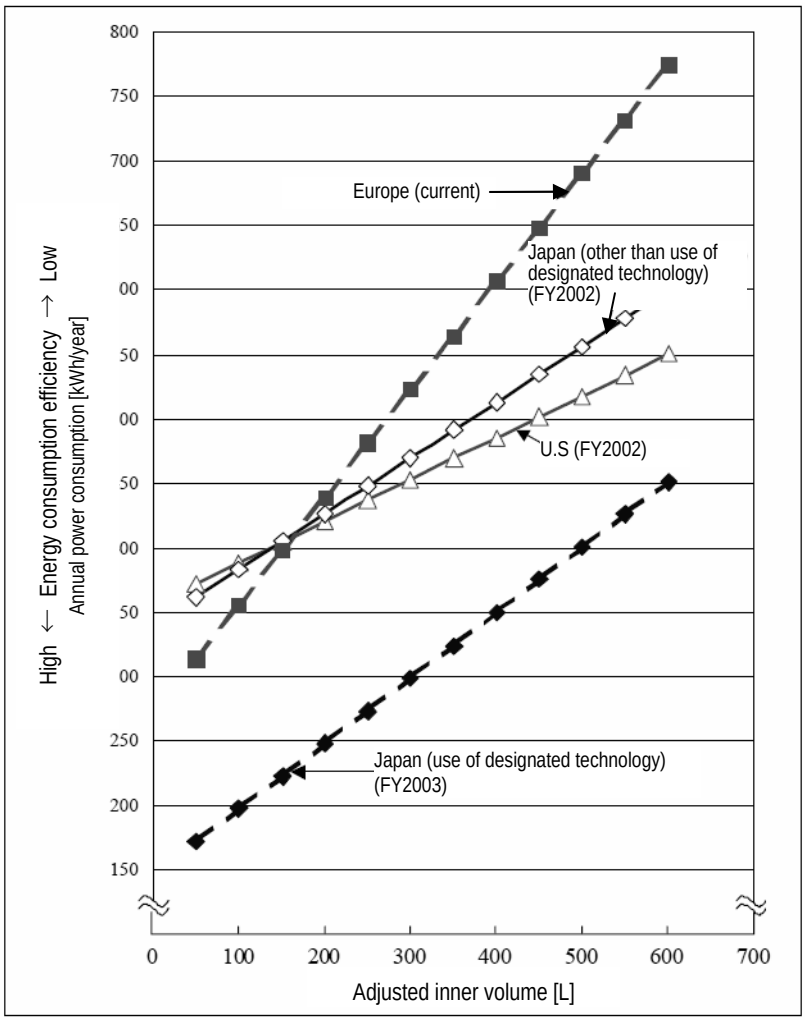
Source: K. Kaino (Research Institute of Economy, Trade and Industry), "Cost-benefit analysis and quantitative policy assessment of Top-Runner efficiency standards and regulations of home appliances under energy saving laws

Figure 5.2-1 Improvement in energy consumption efficiency of electric refrigerators



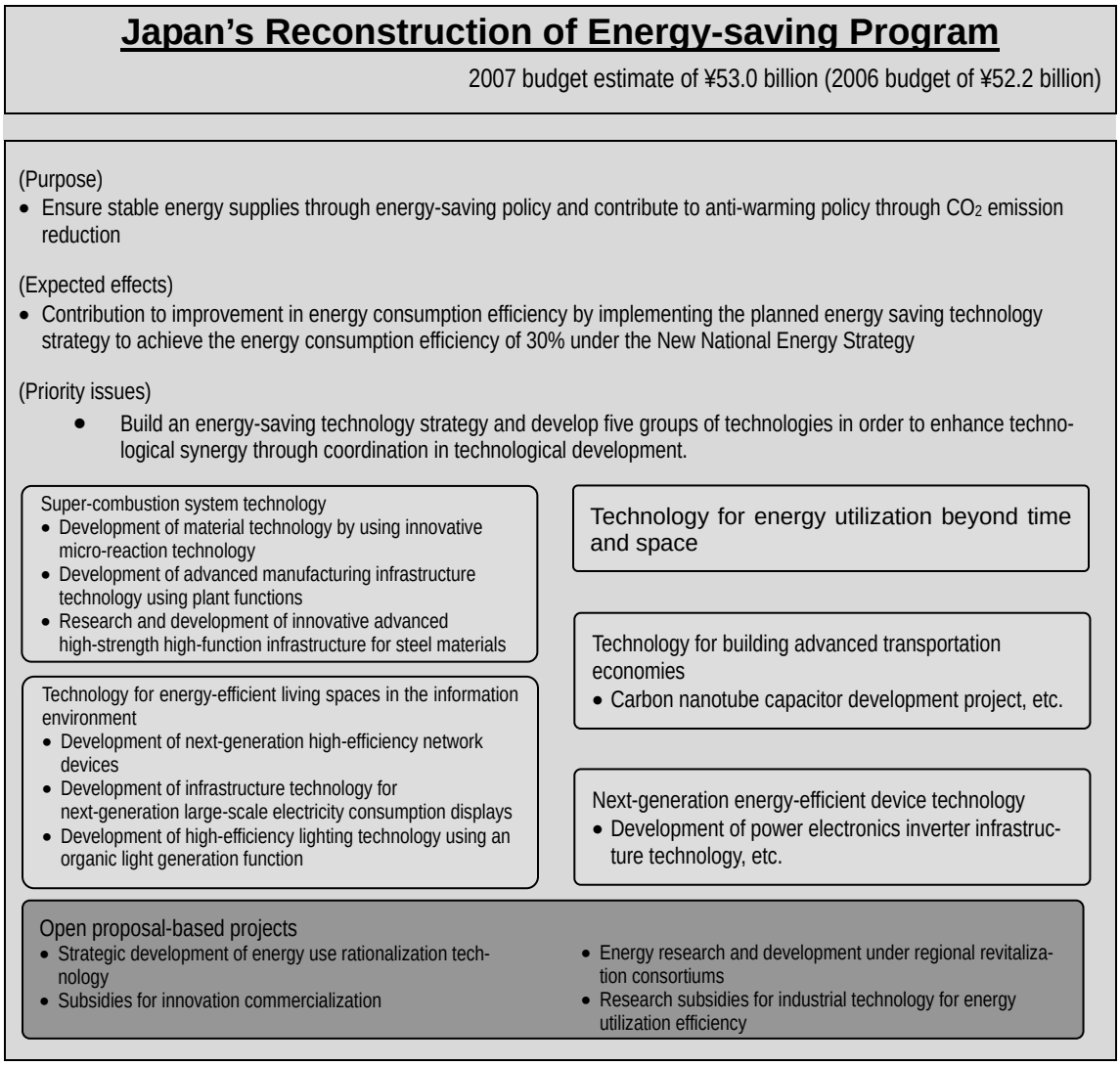
Source: Ministry of Land, Infrastructure and Transport

Figure 5.2-2 Fuel consumption of gasoline-fueled vehicles in Japan (10-15 mode)



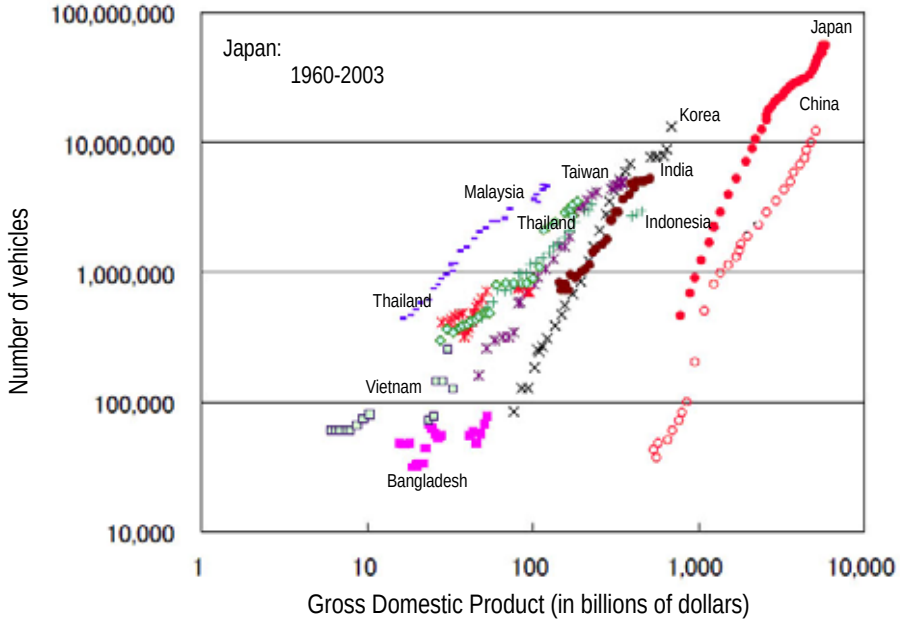
Source: Study Report on Energy Consumption Efficiency Standards in Major Countries, The Energy Conservation Center, Japan, 2003

Figure 5.2-3 Energy consumption efficiency standards for electric refrigerators



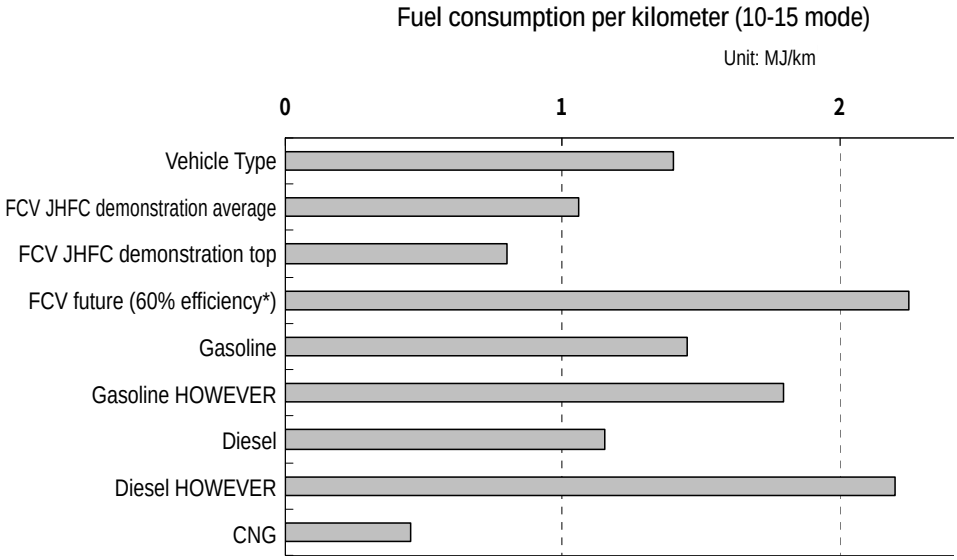
Source: Energy-saving Technology Strategy (Interim Report), Agency for Natural Resources and Energy, 2006

Figure 5.2-4 Priority issues for energy-saving technology strategy



Source: K. Minato (Japan Automobile Research Institute), Motorization and Environmental Burden in Asia

Figure 5.2-5 Correlation between the number of vehicles owned and GDP



Source: JHFC, 2005

Note: FCV : Fuel Cell Vehicle
JHFC: Japan Hydrogen & Fuel Cell Demonstration Project
HV: Hybrid Vehicle
EV: Electric Vehicle

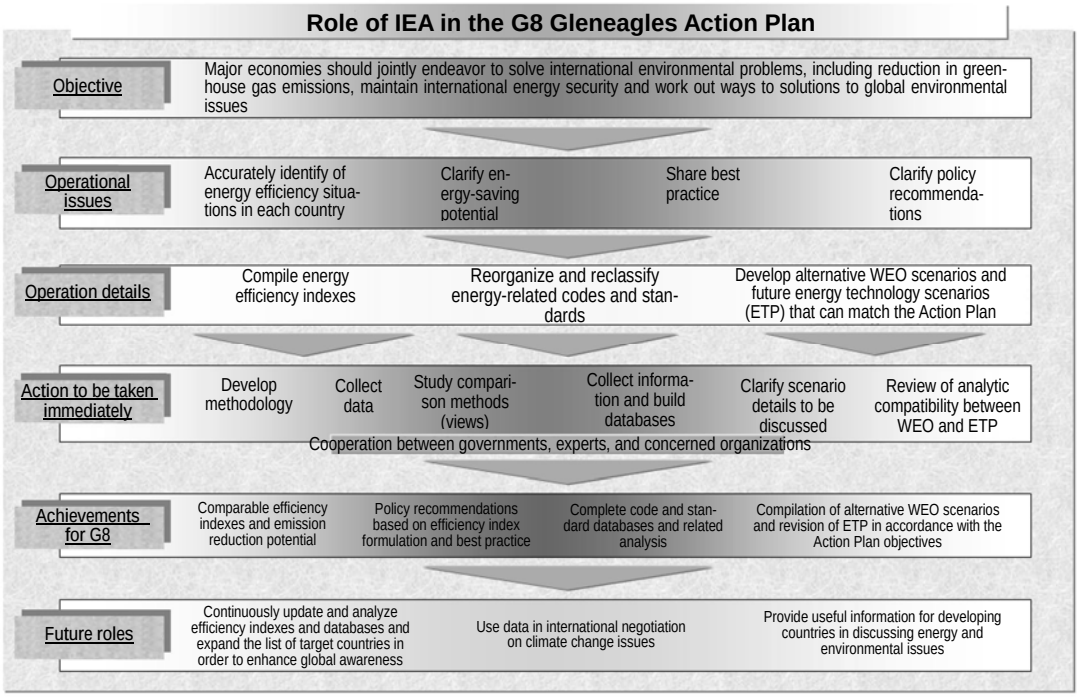
Figure 5.2-6 Overall efficiency of different types of vehicles

5.3 Promotion of Energy Saving (Process)

[Points]

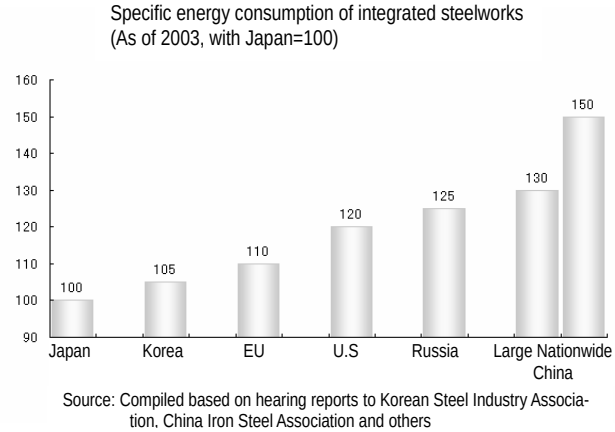
- There are wide differences among developed countries in specific energy consumption in the manufacturing process, necessitating their effort to further improve energy efficiency (Figure 5.3-2).
- Standardized specific energy consumption, an energy efficiency index, is expected to contribute to the establishment of technological targets and the promotion of voluntary efforts among private businesses. Nevertheless, researchers have presented varying specific energy consumption estimates. At 2005 Gleneagles Summit, the leaders agreed to formulate a unified energy-efficient index for each sector in order to make standardized efficiency comparison (Figure 5.3-1).
- Japan, still lacking sufficient data concerning the potential and costs of greenhouse gas emission reduction, should step up coordination between the industry and the academia to collect accurate data and analyze them. By contrast, the EU has developed a relevant database concerning the potential and costs for each sector. Based on this, researchers are analyzing the data to predict effects of greenhouse gas reduction on industrial processes (Figure 5.3-3).
- It is necessary to address energy consumption during the use of products, as well as energy consumption during production. For example, in the steel industry, the use of advanced steel materials has contributed to reductions in CO_2 emissions, sufficiently offsetting increases caused in the production process (Figure 5.3-4). It is desirable to establish a unified approach that would enable evaluation of energy-saving effects in the whole lifecycle of a product.

[Related Data and Facts]



Source: The Institute of Energy Economics, Japan

Figure 5.3-1 Role of IEA in the G8 Gleneagles Action Plan



Source: Compiled based on hearing reports to Korean Steel Industry Association, China Iron Steel Association and others

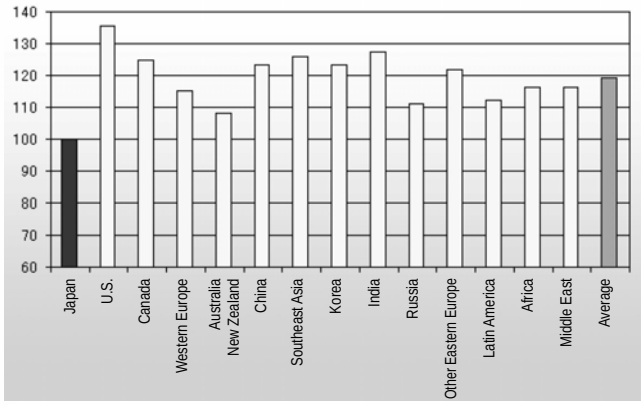
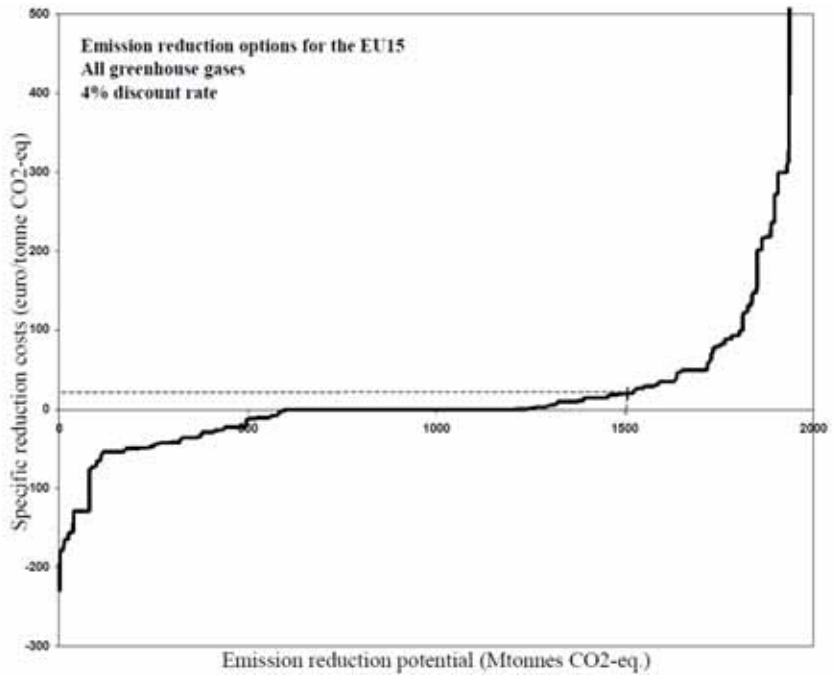


Figure on the left: Specific energy consumption of integrated steelworks
Source: Japan Iron and Steel Federation
Figure on the right: CO_2 emissions per ton
Source: Japan Cement Association
Original source: Battelle /WBCSD "Toward a Sustainable Cement Industry Substudy 8: CLIMATE CHANGE (March 2002)"

Figure 5.3-2 Energy consumption and specific CO_2 emissions in the industry



Source: Kornelis Blok, David de Jager and Chris Hendriks, "Economic Assessment of Sectoral Emission Reduction Objectives for Climate Change", 2001

Note: Bottom-up analysis results based on global warming databases (GENESIS, which provides data concerning greenhouse gas emissions in EU for the 1990-1998 period, about 250 reduction measures and technologies, 2010 emission scenarios, potential emission reductions, emission reduction costs, and other figures). Besides industry processes, greenhouse gas emission reduction was taken into account in connection with energy supply, energy conversion, transport, commercial use, agricultural use, and waste disposal.

Figure 5.3-3 Potential for, and cost of, reduction of greenhouse gas emissions in EU

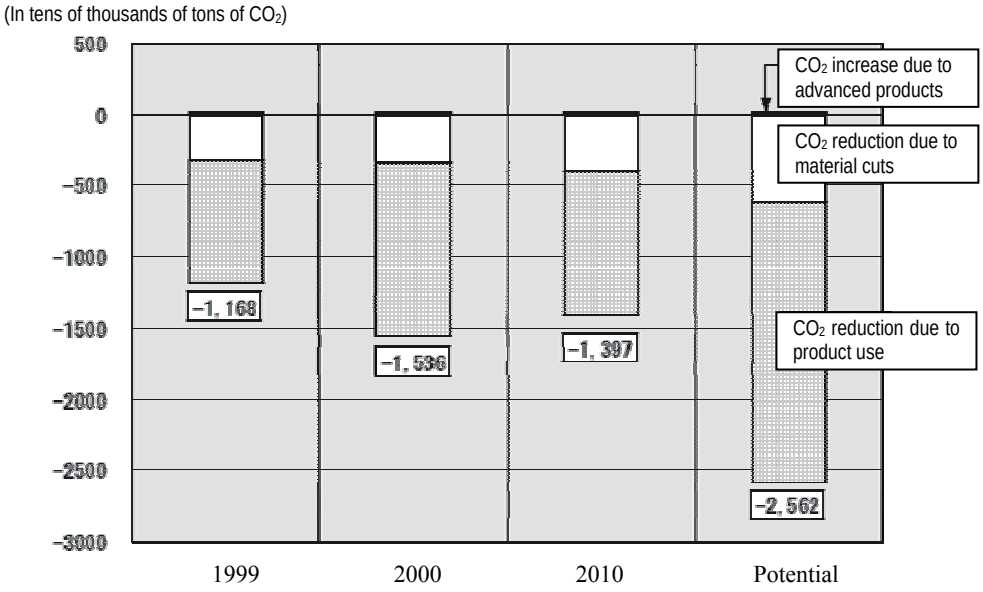
Table 5.3-1 Greenhouse gas reduction

Emission breakdown per sector Mt CO_2-eq.	*Emissions in 1990 or 1995*	*Emissions in 2010 FTRL*	*Emissions in 2010 FTRL (including progress until 1998/2000)*	*Emissions in 2010 under Kyoto target conditions*	*Change from 1990 or 1995*	*Change from 2010 FTRL*	*Change from 2010 FTRL (including progress 1998/2000)*
Direct emisisons							
Energy supply - CO_2 fuel related [1/2]	1268	1960	1551	1298	2%	-34%	-16%
Direct and indirect emisisons							
Energy supply - other emissions	58	45	42	42	-1%	1%	0%
Fossil fuel emissions[3/]	95	61	43	51	-46%	-16%	18%
Industry[3/]	1463	1984	1623	1113	-24%	-44%	-31%
Transport [4/]	776	1134	1114	1069	38%	-6%	-4%
Households	749	843	759	567	-24%	-33%	-25%
Services	413	653	560	434	5%	-34%	-23%
Agriculture	417	396	407	382	-8%	-4%	-6%
Waste	166	169	124	144	-14%	-15%	16%
Total	**4138**	**5284**	**4672**	**3801**	**-8%**	**-28%**	**-19%**

Source: C. Hendriks, D. de Jager, K. Blok et al. (2001): Bottom-up Analysis of Emission Reduction Potentials and Costs for Greenhouse Gases in the EU, Ecofys and AEA Technology, Utrecht, 2001

Note: FTRL, short for "frozen technology standard level," assumes no technological progress. Greenhouse gas emissions in 2010 are 5284Mt-CO_2 at FTRL in the base year of the Kyoto Protocol (1990/1995) and 5284Mt-CO_2 at FTRL of the assessment year (2000 for energy-derived emissions and 1998 for other emissions).

The Kyoto Protocol set the 2010 emission target for 4672Mt-CO_2, while it is estimated that the reduction cost of about 20 Euro/t-CO_2 will be required to achieve the target. The industrial sector will play a vital part in achieving the reduction target.



Source: Study on contribution of steel products to energy savings in society from LCA viewpoint, The Institute of Energy Economics, Japan

Note: Although the production of advanced steel materials causes an increase in CO_2 emissions, it will lead to reduced use of such materials due to their reinforced strength and reduced energy consumption of the products due to their reduced weight (as seen in improved efficiency on vehicles). This Figure shows how CO_2 emissions change during the lifecycle of six high-function materials (reinforced steel materials for vehicles, high-tension thick steel plates for ships, stainless steel plates for trains, high-strength H-section steel for buildings, directional electromagnetic steel plates for transformers, and heat-resistant high-strength steel tubes for boilers).

Figure 5.3-4 LCA assessment of CO_2 emission reduction effects (advanced steel products)

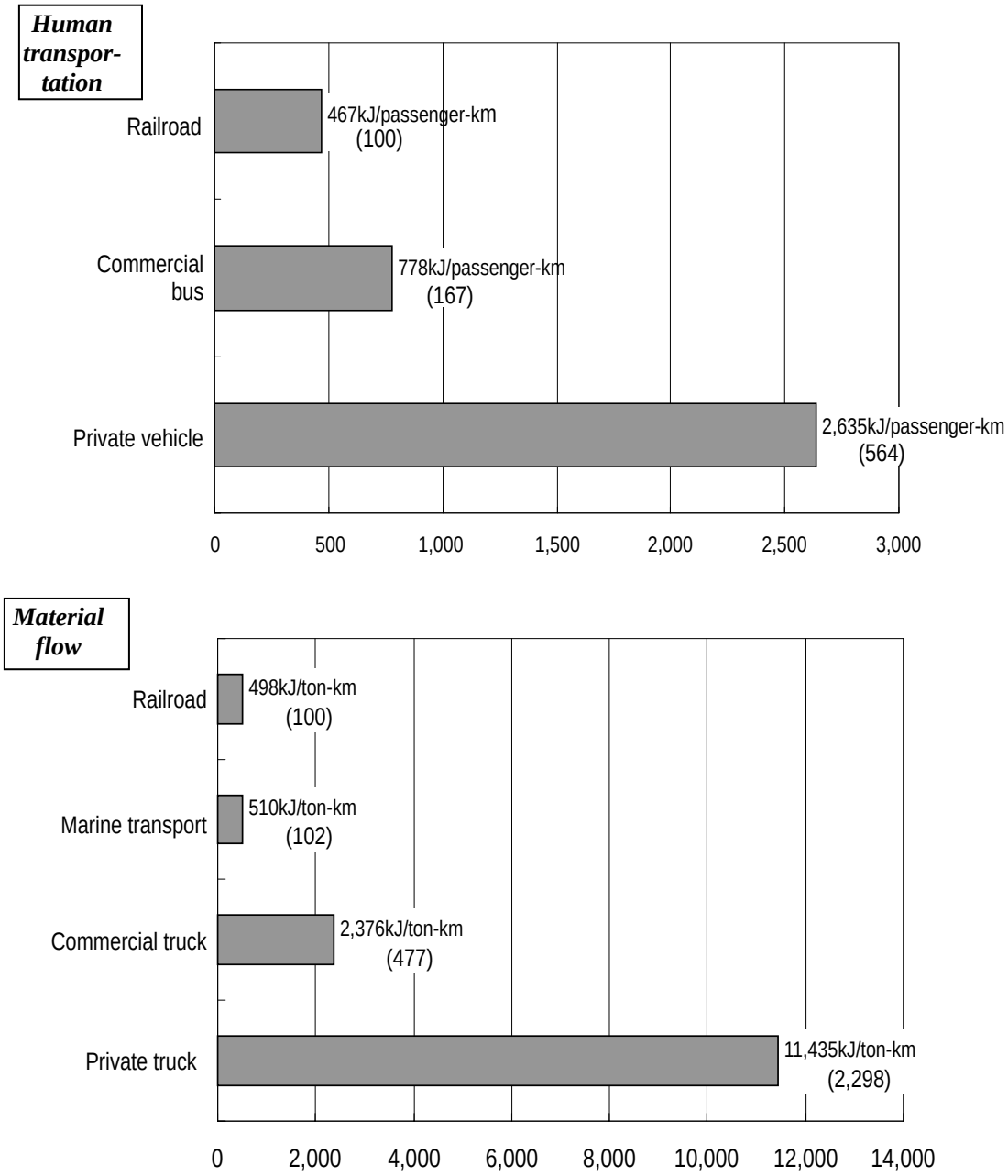
5.4 Promotion of Energy Saving (Construction of Social Infrastructure)

[Points]

- As part of our efforts to develop energy-saving society infrastructure, it is important to promote the energy-saving buildings applying wall insulation and utilization of solar- and geo-heat, and to develop urban traffic networks such as a light rail transit (LRT) system (Figure 5.4-). In addition to infrastructure development, modal shift schemes such as promotion of public transit systems enable highly efficient energy savings and CO_2 emission reductions.
- Freiburg, often referred to as the Environmental Capital of Germany, has introduced streetcars, dedicated bicycle lanes and parking spaces, an energy-efficient housing system, and other social infrastructures. To accelerate the use of these systems, the city also implemented a number of measures, including an environment-oriented commuting card service named "Regiokart," a regulation to control the entry of bicycles to downtown areas, and a park-and-ride system. These actions have brought about significant environmental benefits.

- In urban areas, it is essential, by applying the lifecycle assessment approach, to assess environmental impacts of total energy consumption and CO_2 emissions that cover the entire stages of lifecycle, ranging from urban development and construction to operation and disposal of urban infrastructures. Such assessment would help building energy-efficient communities. Especially, developing countries, where urban infrastructures are less developed, are encouraged to plan energy-efficient cities to reduce energy consumption in the transport sector by developing compact cities and public transport systems (Figure 5.4-2).
- To overcome these challenges, developed and developing countries should join forces to share information about lifecycle assessments and improve their accuracy. In urban development, developed countries are desired to provide their technologies for developing countries to plan cities that meet the needs and characteristics of each community.

[Related Data and Facts]

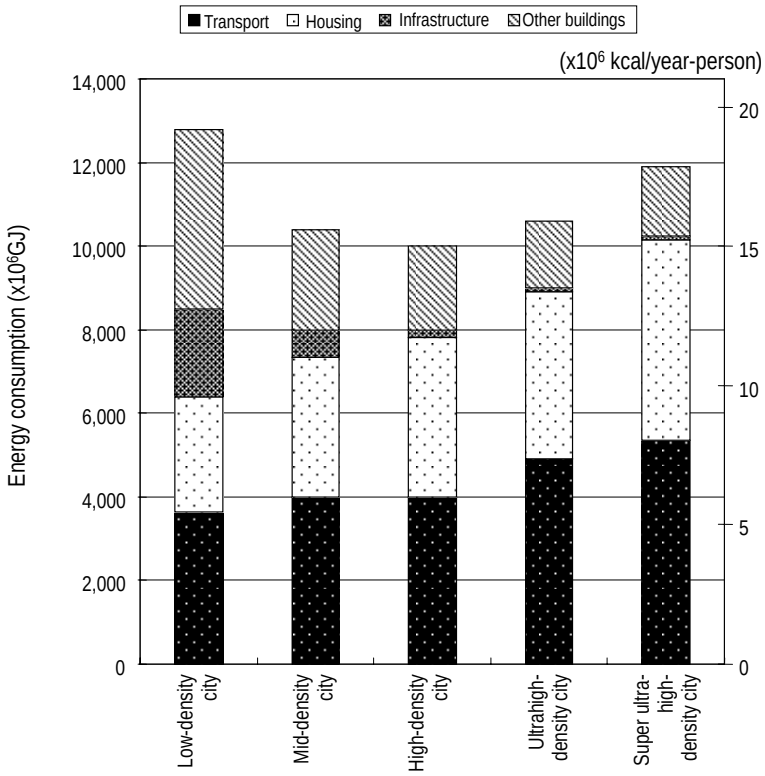


Source: Transport Energy Directory 2006, Ministry of Land, Infrastructure and Transport

Note: The figures in parentheses are index numbers with railroad =100.

Figure 5.4-1 Effects of public transport systems and a modal shift

(Specific energy consumption by means of transportation)



Source: Relationships between Compact Urban Structure and Energy Burden, Ministry of Land, Infrastructure and Transport, City and Regional Development Bureau

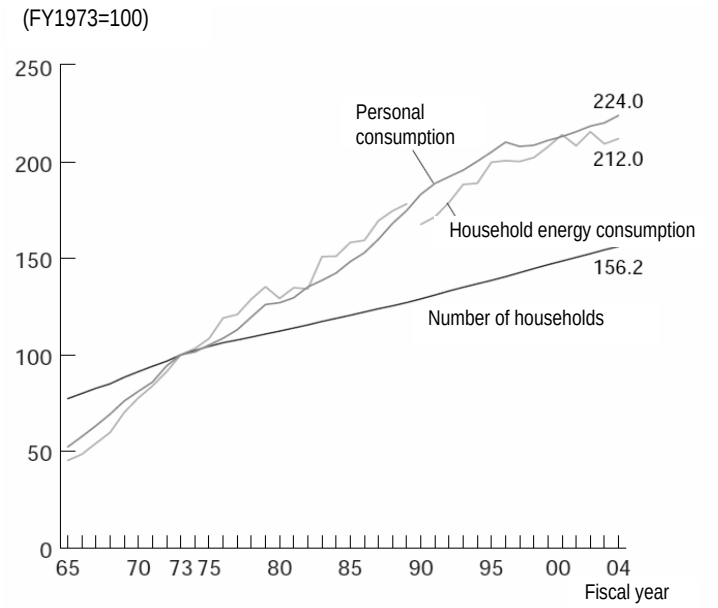
Figure 5.4-2 Estimates for energy consumption reduction effects of a compact

5.5 Promotion of Energy Saving (The Life of the People)

[Points]

- Household energy consumption has continued to grow year by year. Factors behind the increase include such structural changes in society as lifestyle changes among people who pursue conveniences and comforts, increase in the number of households, and a growing ratio of elderly people (Figure 5.5-1).
- However, perspectives on environment problems vary widely among countries due to difference in political, economic, and cultural backgrounds. For instance, some studies have found that Japanese people associate environment issues with traditional and family-oriented ways of thinking rather than with altruistic or social feelings (Table 5.5-1). Other studies also suggest that some "environmentally friendly" lifestyles will not necessarily lead to effective reduction in greenhouse gases (Table 5.5-2).

[Related Data and Facts]



Source: Cabinet Office, "Annual Report on National Accounts"; The Institute of Energy Economics, Japan, "Energy and Economic Statistics Handbook"; Resources and Energy Agency, "Comprehensive Energy Statistics"
Note: "Comprehensive Energy Statistics" applies a revised calculation method to figures for FY1990 and later.

Source: Ministry of Economy, Trade and Industry, Annual Energy Report 2005

Figure 5.5-1 Changes in energy consumption in Japan's household sector

Table 5.5-1 Value structure of "Lifestyle Guidelines"

	Thailand		Japan		U.S. (reference)
1st factor	Biospheric–altruistic		Biospheric-tradition		*Biospheric-altruistic*
	Unity with nature	0.804	A world at peace	0.787	Unity with nature
	Self-discipline	0.717	Family security	0.765	Protecting the environment
	Protecting the environment	0.627	Respecting the Earth	0.48	Respecting the Earth
	Equality	0.607	Protecting the environment	0.610	A world at peace
					Equality
					Social justice
2nd factor	*Tradition*		*Altruistic*		*Egoistic*
	Family security	0.756	Influence	0.622	Authority
	Respecting the Earth	0.631	Equality	0.581	Wealth
	Honoring parents and the elders	0.629	Self-discipline	0.576	Influence
	A world at peace	0.61	Social justice	0.562	
	Social justice	0.493	Unity with nature	0.520	
3rd factor	*Egoistic*		*Egoistic*		*Tradition*
	Authority	0.780	Wealth	0.789	Honoring parents and the elders
	Influence	0.700	Authority	0.780	Family security
	Wealth	0.615			Self-discipline

Source: Midori Aoyagi-Usui et al. (National Institute for Environmental Studies) "Pro-environmental Attitudes and Behaviors: An International Comparison"

Note: The above provides the findings of an analytic survey by Jewish anthropologist Schwartz concerning general values for people (such as "unity with nature" and "self-discipline"). In Japan, for instance, because a correlation is seen among value parameters "a world at peace," "family security," "respecting the Earth", "Protecting the environment", "respect of parents and the elderly" (with support=1 and non-support=0), it can be interpreted that Japanese people possess potential value parameters "biospheric-tradition". Conducted using value items different from those for Japan and Thailand, the U.S. survey results are provided just for reference. Similar surveys were made in Holland and the Philippines. .

Table 5.5-2 Estimated CO_2 emission reduction in the eco-lifestyle

Lifestyle	Eco-life Type	Network Type	Belt-tightening Type	Retrospective Type	Service-oriented Type
Lifestyle image	Purchasing eco-products while maintaining the current consumer awareness levels	Living in distributed locations by using the Internet and minimizing commuting and travel	Spending more money on leisure and hobbies by cutting other expenses	Avoiding overspending by following traditional custom and wisdom of life	Using services, such as leases and rentals, instead of buying and holding property
Approval rate	17.0%	19.2%	32.2%	18.6%	3.5%
Reduction effect [A] CO_2 (kg)/month	-102.3	-55.4	-76.9	-61.8	-27.5
Rebound effect [B] CO_2 (kg)/month	+29.7	+50.4	+32.9	+21.1	+1.7
Reduction effect [A–B] CO_2 (kg)/month	-72.6	-5.0	-44.0	-40.7	-25.8

Source: M. Kosaka (National Institute of Advanced Industrial Science and Technology), "Development from product-oriented LCA to social LCA

Note: "Rebound effect" refers to an increase in CO_2 emissions due to an increase in environmental burden. For instance, belt-tightening people increase environmental burden when they make a trip overseas using money earned with frugality.