TEPCO'S ENERGAY AND ENVIRONMENTAL STRATEGIES TOWARD A LOW-CARBON SOCIETY

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***ABSTRACT*:**

With the commitment to contribute to achieving a low-carbon society, The Tokyo Electric Power Co., Inc (TEPCO) has identified energy and environment strategies and started to take actions both from the supply side and the demand side of electricity.

Seen from the supply side, nuclear power generation is a key to realizing a low-carbon society. The power generation with a nuclear power unit corresponds to the CO2 reduction of 5 million tons per year. 1% increase in facility utilization rate at TEPCO's nuclear power stations would reduce yearly CO2 emissions by approx. a million tons. Thus, it is particularly important for TEPCO to steadily promote planned nuclear power development as well as to safely improve the capacity factor of nuclear power generation. Meanwhile, TEPCO has introduced a 1,500 °C combined-cycle power generation system which provides one of the world's highest thermal efficiency level of 59%. 1% improvement in TEPCO's average thermal power efficiency leads to the reduction of annual CO2 emission by 1.8 million tons. Furthermore, TEPCO has made efforts to expand application of renewable energy sources. TEPCO has announced the development of megawatt-solar power plants by 2011, totaling 30MW in supply capacity. These solar power plants will contribute to reduce CO2 emission by 14 thousand tons per year.

Regarding the demand-side, if all air conditioners and water heaters in the consumer sector and industrial sector are replaced with those powered by heat pumps, an estimated approx. 130 million tons of yearly CO2 emissions could be reduced in Japan. TEPCO successfully commercialized "Eco Cute", the world's first residential natural refrigerant heat-pump water heater. Owing to the development of advanced heat pump technologies, the scope of application for electric appliances is expanding to diverse fields. In the transportation sector, TEPCO is working in partnership with automobile manufacturers in the development of electric vehicles and aims to introduce up to around 3,000 electric vehicles in the future.

As the Japan's largest electric power utility, TEPCO aims to contribute to achieving a low-carbon society with its energy and environment strategies by integrating its initiatives for the production of low-CO2 electricity and for the efficient utilization of electricity.

KEYWORDS: environmental management, technology integration management

1. INTRODUCTION

Japan's greenhouse gas emissions totaled 1.374 billion t-CO_2 in FY2007. Achievement of the reduction target specified under the Kyoto Protocol (6% reduction on average over the 5 years from 2008 to 2012, compared to the 1990 level) remains as challenging as ever.

As an electric power company that is responsible for approx. 10% of total CO_2 emissions in Japan, TEPCO places high priority on addressing global

warming. We promote the utilization of non-fossil energies, improvement of thermal power generation efficiency, and other means of producing low-CO_2 electricity. At the same time, we also make active efforts to achieve energy-efficient utilization of electricity. By focusing on both "producing and using electricity", TEPCO contributes to the realization of a low-carbon society.

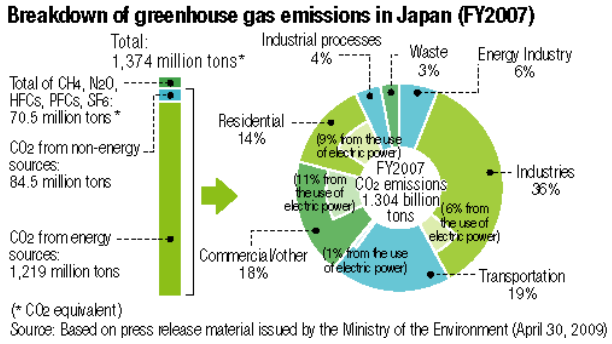


Figure 1.1

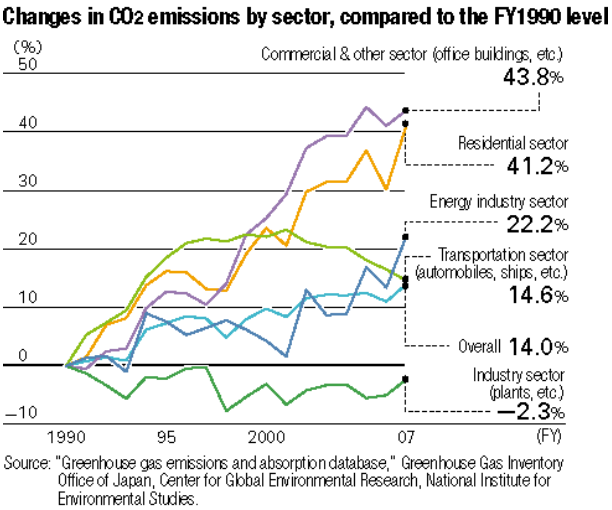


Figure 1.2

2. PRODUCTION OF LOW-CO_2 ELECTRICITY

Compared to major countries, Japan has achieved relatively low CO_2 emission intensity of about 0.4 kg-CO_2/kWh. Nevertheless, Japanese electric power companies are making every effort to produce low CO_2 electricity.

In Mgmt. Vision 2010, TEPCO has established a voluntary target of "reducing CO_2 emission intensity by 20% on average during the five years between FY2008 and FY 2012, compared to FY1990".

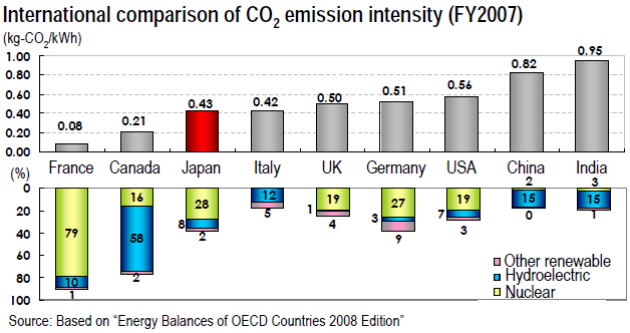


Figure 2.1

TEPCO is pursuing various initiatives for producing low-CO_2 electricity, such as by utilizing non-fossil energies of nuclear power and renewable energies, which emits no CO_2 during power generation; introducing LNG which emits a relatively small amount of CO_2 compared to other thermal power generation systems; and improving thermal power generation efficiency.

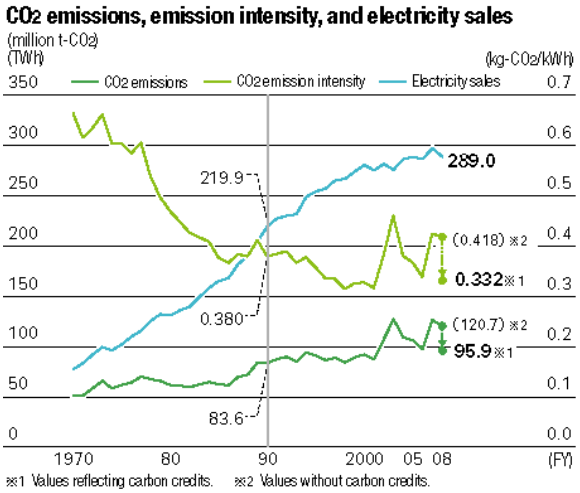
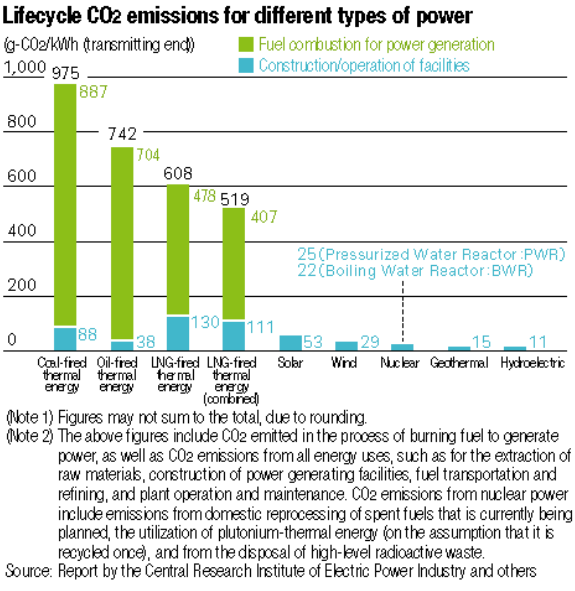


Figure 2.2



(Note 1) Figures may not sum to the total, due to rounding.
(Note 2) The above figures include CO_2 emitted in the process of burning fuel to generate power, as well as CO_2 emissions from all energy uses, such as for the extraction of raw materials, construction of power generating facilities, fuel transportation and refining, and plant operation and maintenance. CO_2 emissions from nuclear power include emissions from domestic reprocessing of spent fuels that is currently being planned, the utilization of plutonium-thermal energy (on the assumption that it is recycled once), and from the disposal of high-level radioactive waste.
Source: Report by the Central Research Institute of Electric Power Industry and others

Figure 2.3

2.1 Utilization of nuclear power generation

Nuclear power generation is a highly effective countermeasure to global warming, as it does not emit CO_2 in the power generation process. In FY 2008, all units at the Kashiwazaki-Kariwa Nuclear Power Station remained out of service throughout the year, but facility utilization rate at TEPCO's nuclear power stations was 43.8%, hovering at around the same rate as in the previous year, owing to the safe and stable operations of the other Nuclear Power Stations. Even so, this figure is almost 30% lower than the facility utilization rate in FY2006 prior to the earthquake, while CO_2 emissions increased roughly 24% from FY2006 to 120.7 million tons in FY2008.

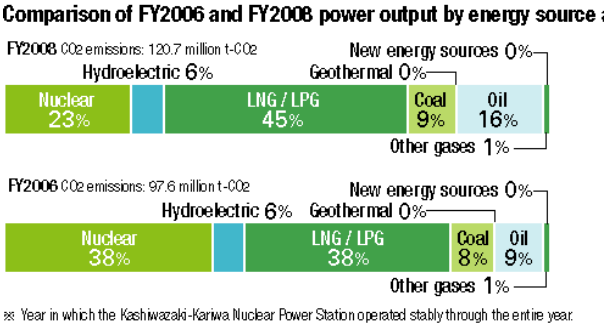


Figure 2.4

The operation status of nuclear power stations clearly has a large effect on CO_2 emissions. Hypothetically speaking, each 1% increase in facility utilization rate at TEPCO's nuclear power stations would reduce yearly CO_2 emissions by approx. a million tons.

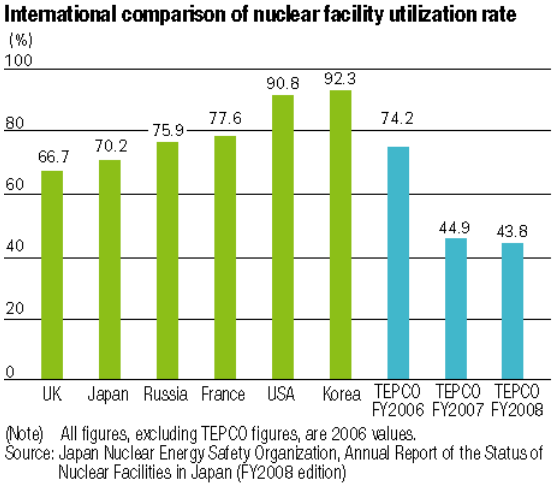


Figure 2.5

2.2 Introduction of high-efficiency power generation facilities

Thermal power generation is important to ensuring the stable supply of electricity, as it can respond flexibly to changes in power demand. TEPCO has introduced a 1,500 °C combined-cycle power generation system (More Advanced Combined Cycle (MACC) system) which provides one of the world's highest thermal efficiency level of 59%, to the Kawasaki Thermal Power Station in June 2007 and to Futtsu Thermal Power Station in July 2008. We have further plans to introduce a 1,600 °C combined-cycle system (MACC II system) to the Kawasaki Thermal Power Station in FY2016, to achieve an even higher thermal efficiency of about 61%.

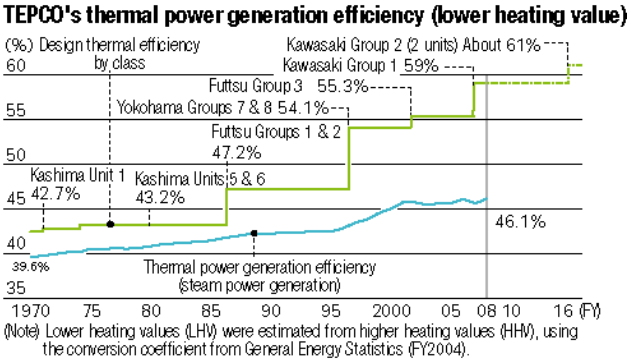


Figure 2.6

Owing to these measures for improving thermal efficiency, we are reducing about 1.8 million tons of CO_2 emissions per year for every 1% increase in average thermal power generation efficiency.

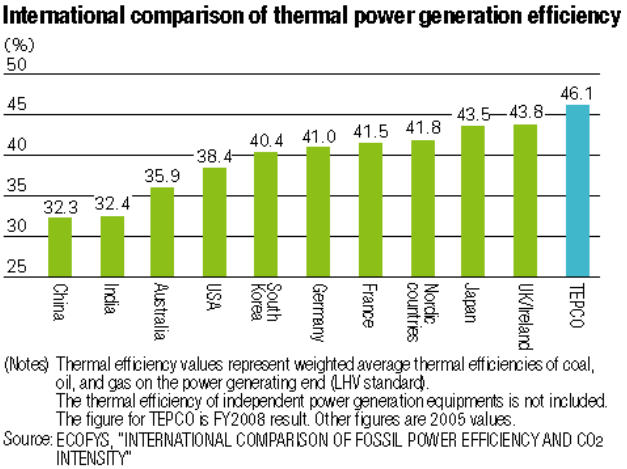


Figure 2.7

2.3 Expansion of renewable energy applications

Renewable energy covers approx. 10% of Japan's total electricity generation, which is almost as same as that of France and Germany.

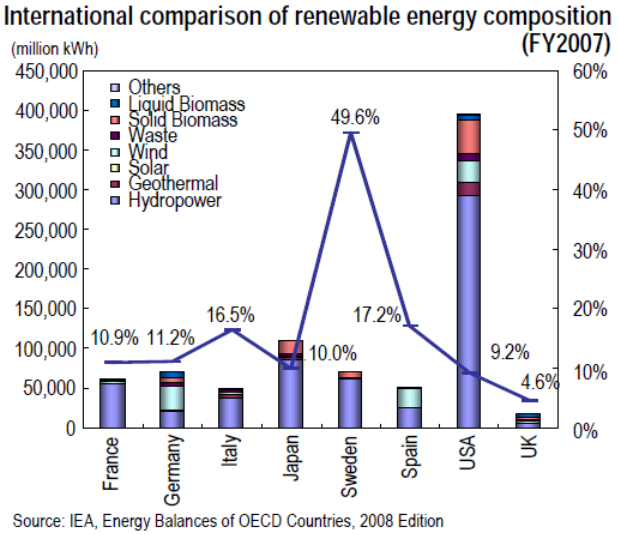


Figure 2.8

TEPCO is steadily advancing the use of renewable energies. The TEPCO group as a whole is implementing a variety of activities to expand the utilization of renewable energies, from the perspectives of increasing power generation and promoting mechanisms for their dissemination.

2.3.1 Construction of mega solar power plants

TEPCO is planning to build large-scale solar power pants in cooperation with Kawasaki City in Kanagawa Prefecture and Yamanashi Prefecture, respectively. When completed, the plants will produce a total output of around 30,000 kW, enough to supply the necessary electricity to 9,300 households for a year, and are expected to reduce annual CO_2 emissions by approximately 14,000 tons.

Overview of TEPCO's mega solar projects
(names of power plants are tentative)

Ohgishima Solar Power Plant (Kawasaki City, Kanagawa Prefecture)
Output: Approx. 13,000 kW Scheduled commencement: FY2011
Ukishima Solar Power Plant (Kawasaki City, Kanagawa Prefecture)
Output: Approx. 7,000 kW Scheduled commencement: FY2011
Komekurayama Solar Power Plant (Kofu City, Yamanashi Prefecture)
Output: Approx. 10,000 kW Scheduled commencement: FY2011(in part)

Rendering of the Ukishima Solar Power Plant

Figure 2.9

The electric power industry as a whole has plans to construct mega solar power plants in some 30 locations throughout Japan by FY2020 and their total output becomes around 140,000 kW.

By taking the initiative in introducing mega solar power generation, electric power companies are directly investigating its impacts on their power grid and are working to reduce the cost of solar panels toward their widespread dissemination.

2.3.2 Promotion of wind power projects

TEPCO is moving forward with its plan to build a wind farm straddling the villages of Higashi-Izu and Kawazu in Shizuoka Prefecture. With a total output capacity of approximately 18,000 kW, the wind farm is expected to reduce yearly CO_2 emissions by about 16,000 tons.

Overview of TEPCO's Higashi-Izu Wind Power Station

Location	
Higashi-Izu-cho and Kawazu-cho, Kamo-gun, Shizuoka Prefecture	
Power generation plan	
Rated output of each unit	1,670 kW
Number of units	11
Total rated output	18,370 kW
Scheduled start of operations	
October 2011	

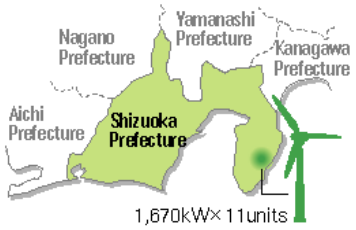


Figure 2.10

Eurus energy Holdings Corporation is a wind power company belonging to the TEPCO Group. As of March 31, 2009, the company operates wind power generation facilities with a total capacity of 1,740 MW in three regions and six countries throughout Asia, North America, and Europe.

Wind power generation capacity

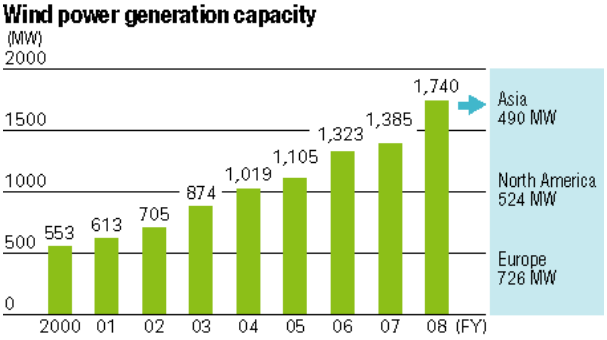


Figure 2.11

2.3.3 Purchasing electric power from customers

TEPCO actively purchases electric power from solar, wind and other natural energy facilities operated by customers. The Japanese government has set a goal of increasing the total capacity of solar power generation systems in Japan twenty-fold by 2020 and forty-fold by 2030.

Solar and wind power generation systems deliver outstanding environmental performance, but as they are easily affected by natural conditions, they need to have a backup of system electric power to achieve stable output. TEPCO gives due consideration to these issues as it actively promotes the utilization of renewable energies.

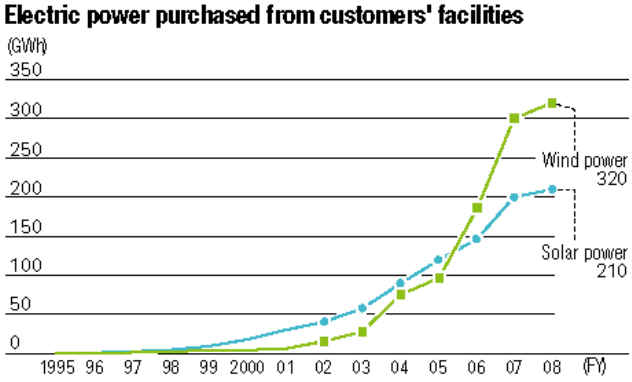


Figure 2.12

3. ENERGY-EFFRICIENT UTILIZATION OF ELECTRICITY

Low-carbon energies and CO_2 reduction measures at the energy utilization stage are indispensable to minimizing CO_2 emissions throughout society. To achieve the highest possible energy use efficiency, TEPCO promotes the development and dissemination of high-efficiency products while maintaining the convenience and comport of affluent living.

3.1 Development of high-efficiency products

Heat pumps require only a small amount of electricity to gather ambient heat, but produce about three to six times greater heat energy than the electric energy they use.

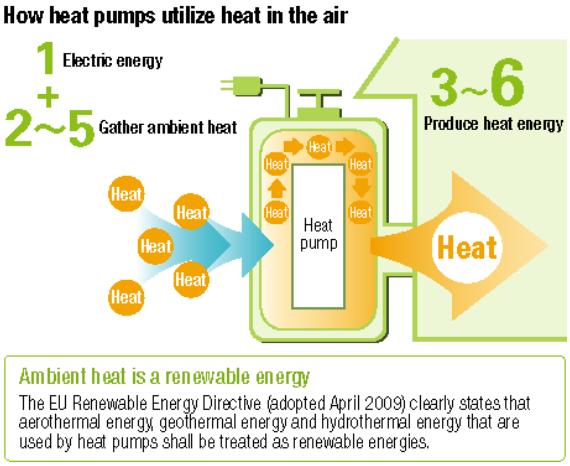


Figure 3.1

If all air conditioners and water heaters in the consumer sector (residential and commercial) and industrial sector are replaced with those powered by heat pumps, an estimated approx. 130 million tons of yearly CO_2 emissions could be reduced in Japan (corresponding to roughly 10% of total CO_2 emissions in Japan). Heat pumps are expected to deliver greater energy efficiency in the future, and are indispensable to realizing a low-carbon society.

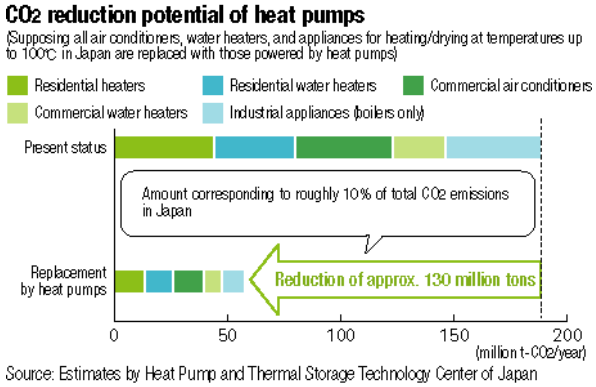


Figure 3.2

In collaboration with electric appliance makers, we are actively promoting the development and dissemination of high-efficiency products with heat pumps that respond to customer need for high environmental performance and economic efficiency.

3.2 Initiatives in the Residential Sector

Air conditioning (heating) and water heating account for more than 40% of CO_2 emissions from the home, and holds the key to CO_2 reduction in the residential sector. High-efficiency appliances

powered by a heat pump, such as air conditioners and water heaters, generate many times more heat energy than the electric energy they use, and release significantly less CO_2 compared to combustion-type appliances.

3.2.1 Promoting the use of Eco Cute heat-pump water heaters

In May 2001, TEPCO successfully commercialized "Eco Cute", the world's first residential natural refrigerant (CO_2) heat-pump water heater. Recognizing the environmental advantage of Eco Cute water heaters, the Japanese government has established measures to promote its use, such as by providing subsidies to purchasers. As a result, domestic manufacturers have marketed approx. 1.7 million units as of March 31, 2009.

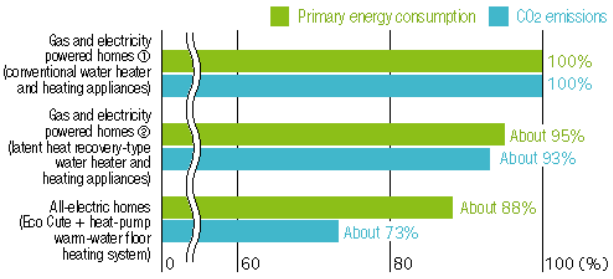
Figure 3.3

We have also made independent efforts on our part to encourage our customers to use Eco Cute. As a result, we have installed a total of more than 470,000 Eco Cute units in our service area by the end of FY2008, corresponding to a total CO_2 reduction of about 700,000 tons from FY2001.

3.2.2 Environmental performance of all-electric homes

By using heat-pump air conditioners and Eco Cute water heaters, all electric homes are expected to reduce energy consumption by around 12% and release about 27% less CO_2 compared to conventional homes that use both electricity and gas.

Comparison of primary energy consumption and CO_2 emissions



Calculation conditions

1. Building condition: 2-story wooden single-family house, with a 4LDK layout occupying about 122 m² 2. Family composition: 4 members 3. Insulation performance: Equivalent to next-generation energy saving standard for region IV 4. Yearly load: Cooling: 8.0 GJ/year; heating: 6.3 GJ/year; floor heating: 2.4 GJ/year; cooking appliances: 2.0 GJ/year; water heating: 20.2 GJ/year; 24-hour ventilation, etc.: 1.5 GJ/year; lighting outlets: 10.8 GJ/year 5. Primary energy heating intensity: Electricity (9.76 MJ/kWh, all-day average); city gas (45 MJ/m³, 13A)
6. CO_2 emission intensity: Electricity 0.332 kg-CO_2/kWh (FY2008 TEPCO performance); city gas (enforcement ordinance for the Law Concerning the Promotion of Measures to Cope with Global Warming) 7. Equipment efficiency

	Electricity and gas powered homes ①	Electricity and gas powered homes ②	All-electric homes
Cooling	Air conditioning		
	4.23		
Heating	Air conditioning		
	4.56		
Floor heating	Conventional water heater and heating appliances	Latent heat recovery-type water heater and heating appliances	Heat-pump water-water floor heating system
	0.80	0.87	3.73
Cooking	Gas range		IH cooking heater
	0.56		0.90
Water heating	Conventional water heater and heating appliances	Latent heat recovery-type water heater and heating appliances	Eco Cute
	0.80	0.95	3.20

Figure 3.4

Air conditioners (heating) and IH cooking utensils are also ideal for use in well-insulated homes, because they do not emit combustion gas, release little steam, and therefore keep indoor air clean.

Recognized for their environmental performance, economic efficiency, and comfort, all-electric homes are increasing yearly. There are now more than 600,000 all-electric homes in our service area.

3.3 Initiatives in the Industrial and Commercial Sector

Heat pumps are also effective in reducing energy consumption and CO_2 emissions from air conditioners and water heaters in office buildings and factories. Owing to the development of advanced heat pump technologies and IH technologies that provide high efficiency and performance in electrified kitchens and industrial electric heating systems, the scope of application for electric appliances is expanding to diverse fields.

3.3.1 Industrial sector: Reducing steam and increasing facility usage rates in factories

In the industrial sector, significant improvements are being made in the efficient utilization of steam energy in various manufacturing processes, such as heating and drying, hot water production, and air conditioning.

The Hamura Plant of Hino Motors, Ltd. has renewed its boiler facilities and reviewed its steam ducts, as well as has adopted TEPCO's proposal for employing high-efficiency heat pumps, as the first step toward reducing steam use. Through the utilization of heat pumps, Hamura Plant has succeeded in reducing CO_2 emissions by roughly 30% compared to emission levels three years ago, prior to the installation of the heat pumps.

3.3.2 Commercial sector: Utilization of ESCO services

In the commercial sector, there are growing needs to conserve energy and reduce CO_2 emissions, particularly in relation to air conditioners, which consume the largest amount of energy in an office building. In response to these needs, Japan Facility Solutions, Inc. (JFS), a TEPCO Group company, provides ESCO services for the simultaneous reduction of CO_2 emissions and energy costs by applying its high expertise in energy-saving technologies and subsidy policies.

Hosei University has utilized the service in a number of projects for constructing new buildings and renewing its air conditioning facilities, and has succeeded in reducing 2,625 tons of CO_2 in FY2008.

3.4 Initiatives in the Transportation Sector

In the transportation sector, the development of fuel-efficient vehicles and the increase in modal shifts have improved physical distribution efficiency, and CO_2 emissions have begun to show a gradual decreasing trend. However, as we are still largely dependent on gasoline, light diesel oil and other fossil energies, further efforts need to be made toward realizing a low-carbon society.

TEPCO is working in partnership with automobile manufacturers in the development of electric vehicles. We are currently utilizing Mitsubishi Motors' "I MiEV" and Fuji heavy Industries' "R1e" as company vehicles at our offices and plants, to evaluate their performance, convenience, and practicality.

Figure 3.5

Electric vehicles can make a significant contribution to reducing CO_2, because they emit only about a fourth of the amount of CO_2 that is emitted by gasoline vehicles in the same class. We plan to replace around 310 of our approx. 8,500 commercial vehicle with electric vehicles within FY2009, and aim to introduce up to around 3,000 electric vehicles in the future. By doing so, we expect to reduce approx. 2,600 tons of CO_2 per year.

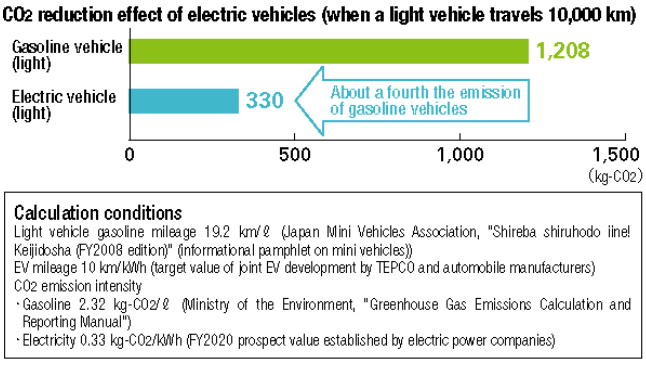


Figure 3.6

4. SUMMARY

Worldwide CO_2 emissions are steadily increasing and causing concern about the expanding

impacts of global warming. As the Japan's largest electric power utility, TEPCO aims to contribute to achieving a low-carbon society with its energy and environment strategies by integrating its initiatives for the production of low-CO_2 electricity and for the efficient utilization of electricity.

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