

**Environmental Action Plan by  
the Japanese Electric Utility Industry**

**20 September, 2002**

**The Federation of Electric Power Companies of Japan  
(FEPC)**

# Contents

Introduction .....	1
<b>1. Measures to Mitigate Climate Change</b>	
(1) Basic Policy for the Mitigation of Climate Change .....	1
(2) CO <sub>2</sub> Emissions Reduction Targets and CO <sub>2</sub> Emissions .....	2
(i) CO <sub>2</sub> Emissions Reduction Targets .....	2
(ii) CO <sub>2</sub> Emissions in Fiscal 2001 .....	3
(iii) Analysis and Evaluation of CO <sub>2</sub> Emissions .....	5
(3) Future Efforts and Issues for Reducing CO <sub>2</sub> Emissions .....	8
(i) Summary of Measures to Reduce CO <sub>2</sub> Emissions .....	8
(ii) Future Efforts and Issues .....	9
(4) Measures to Reduce Greenhouse Gas Emissions Other than CO <sub>2</sub> .....	14
<b>2. Establishing a Recycling-based Society</b>	
(1) Measures for Waste Reduction and Recycling .....	15
(i) Reductions Target for Waste Disposal .....	15
(ii) Disposal Waste in Fiscal 2001 .....	16
(iii) Future Efforts to Reduce and Recycle Waste .....	18
(iv) Increased Utilization of Reused and Recycled Products .....	18
(2) Recycling by the Nuclear Industry .....	19
(i) Establishment of the Nuclear Fuel Cycle as Part of the Recycling-based Society .....	19
(ii) Effective Utilization of Recyclable Resources from Nuclear Facilities .....	19
<b>3. Management of Chemical Substances</b>	
(1) PRTR System .....	20
(2) Efforts to Manage Chemical Substances .....	21
<b>4. Promotion of Environmental Management .....</b>	<b>21</b>
<b>5. Environmental Considerations in Overseas Projects .....</b>	<b>21</b>

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## **Introduction**

The Japanese electric utility industry has recognized environmental protection as one of society's greatest concerns and has worked actively towards its solution. The issue of environmental protection has branched out in many ways to include mitigation of climate change, managing chemical substances and promoting recycling and handling waste as we seek to build a recycling society.

These environmental problems differ from the pollution problems of the past in that each member of society is both responsible for and affected by the problem, and that these problems are closely connected with our lifestyle. Therefore, all parties must voluntarily and proactively work to reduce the burden on the environment. Recognizing this, the twelve member companies which comprise the Federation of Electric Power Companies (FEPC),<sup>1</sup> as the ones most knowledgeable about the electric utility industry, have formulated and made public in November 1996 the "Environmental Action Plan by the Japanese Electric Utility Industry." This plan establishes the targets to be achieved voluntarily, as well as the measures to achieve them.

The Federation reviews the action plan annually to ensure its transparency and the achievement of its targets, and has recently completed the fifth review.

## **1. Measures to Mitigate Climate Change**

### **(1) Basic Policy for the Mitigation of Climate Change**

Prior to signing the Kyoto Protocol in June 2002, the government set forth basic measures for meeting the goal of reducing greenhouse gases by 6% as stipulated by the Kyoto Protocol under its newly released Guideline of Measures to Prevent Global Warming and also revised its Law Concerning the Promotion of the Measures to Cope with Global Warming. However, despite short-term fluctuations brought about by economic recession and other factors, energy consumption in Japan has risen consistently,

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<sup>1</sup> The 12 electric power-related companies affected include ten members of the Federation of Electric Power Companies (Hokkaido Electric Power Co., Tohoku Electric Power Co., Tokyo Electric Power Co., Chubu Electric Power Co., Hokuriku Electric Power Co., Kansai Electric Power Co., Chugoku Electric Power Co., Shikoku Electric Power Co., Kyushu Electric Power Co. and Okinawa Electric Power Co.) as well as Electric Power Development Co. and Japan Atomic Power Co.

and this increase is expected to continue, particularly in the residential and service sectors, as the Japanese people seek greater abundance in their lifestyles.

At the same time, having experienced two oil crises, manufacturers and other industries in Japan have made great strides in energy conservation, and the country's energy consumption per unit of GDP is already among the lowest in the world.

In light of these various circumstances, achieving the goals set forth in the Kyoto Protocol is expected to be extremely difficult. If we are to meet these targets, greater awareness of the importance of the issue of global warming among all parts of society, as well as continuous and aggressive action to resolve these problems, are essential.

The industry is seeking the simultaneous achievement of the "three Es" (economic growth, energy security and environmental protection) while ensuring the stable supply of high-quality, inexpensive electricity.

## **(2) CO<sub>2</sub> Emissions Reduction Targets and CO<sub>2</sub> Emissions**

### **(i) CO<sub>2</sub> Emissions Reduction Targets**

The electric utility industry has set the following CO<sub>2</sub> emissions goal, as measured in kg of CO<sub>2</sub> per kWh of energy used by the end user (this is also known as CO<sub>2</sub> emissions intensity) with respect to the benchmark fiscal year 1990.

By fiscal 2010, we aim to further reduce CO<sub>2</sub> emissions intensity (emissions per unit of user end electricity) by approximately 20% from the fiscal 1990 level, to about 0.34 kg of CO<sub>2</sub>/kWh.

We in the electric utility industry regard this as an ambitious target, and we intend to make the utmost effort to achieve it.

While total electricity consumption is expected to increase 43% over the fiscal 1990 level by fiscal 2010, the increase in total CO<sub>2</sub> emissions is projected at only 14%.

**(ii) CO<sub>2</sub> Emissions in Fiscal 2001**

Total customer electricity consumption stood at approximately 824 billion kWh in fiscal 2001, a roughly 14 billion kWh decline (1.6%) from the fiscal 2000 level.

At the same time, total CO<sub>2</sub> emissions in fiscal 2001 stood at 0.312 billion tons of CO<sub>2</sub>, 0.005 billion tons of CO<sub>2</sub> decline (1.7%) from the fiscal 2000 level.

As a result, CO<sub>2</sub> emission intensity (user end electricity) for fiscal 2001 was 0.379 kg of CO<sub>2</sub> per kWh, basically the same level as that in fiscal 2000.

Despite the 25% increase (2.1% annual average) in electricity consumption from fiscal 1990, total CO<sub>2</sub> emissions have risen only 13%, resulting in a 10% decline (0.04kg of CO<sub>2</sub> per kWh) in CO<sub>2</sub> emissions intensity (user end electricity).

Fiscal Year \ Item	1990 (results)	1999 (results)	2000 (results)	2001 (results)	2005 (est.)	2010
Electric power consumption (billion kWh)	659	817	838	824	862	(est.) 943
CO <sub>2</sub> emissions (billion t-CO <sub>2</sub> )	0.277 [0.002]	0.307 [0.009]	0.317 [0.011]	0.312 [0.013]	0.31	(est.) 0.32
CO <sub>2</sub> emissions intensity (user end electricity) (kg-CO <sub>2</sub> / kWh)	0.421	0.375	0.378	0.379	0.36	(Target) 20% reduction vs. FY 1990 (about 0.34)

\*CO<sub>2</sub> emissions intensity (user end electricity) = CO<sub>2</sub> emissions ÷ energy consumption

\*Estimates for fiscal 2005 and 2010 are based on fiscal 2002 energy supply plans.

\*The figure includes CO<sub>2</sub> emissions from power purchased from cooperative thermal power plants and IPPs (independent power producers), but does not include those from PPSs (power producer suppliers). Figures in parentheses represent total CO<sub>2</sub> emissions from the power purchased from IPPs and household generators isolated from other types of supply.

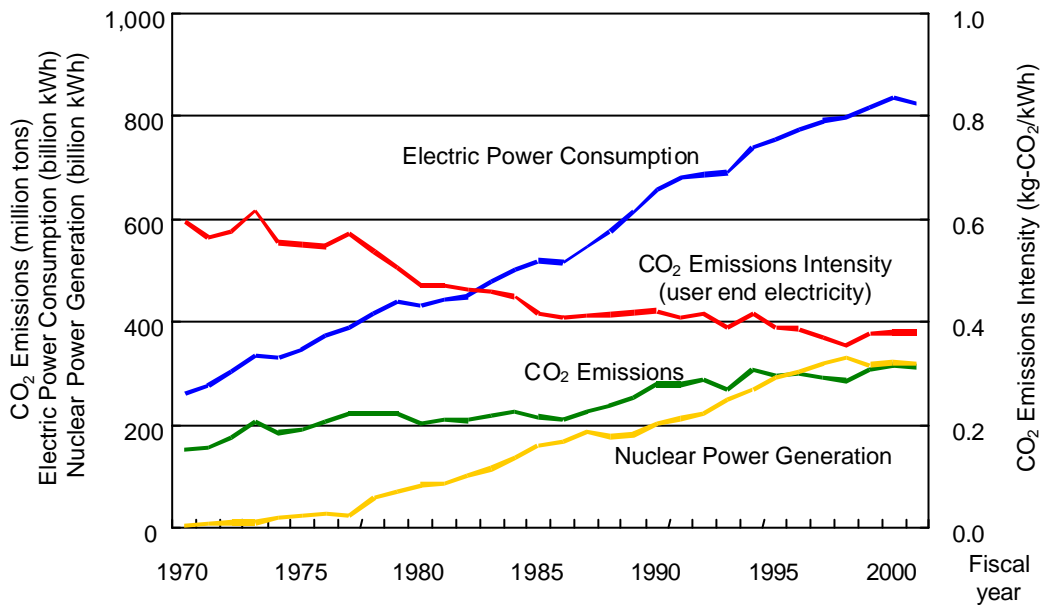
\*Figures for CO<sub>2</sub> emissions and other items represent a recalculation of fiscal 1990 figures based on national trends and changes in the numerical data regarding fuel-specific CO<sub>2</sub> emission coefficients published in the Ministry of the Environment's Report on Comprehensive Total Greenhouse Gas Emission Estimate Investigation (August 2002).

*[Box 1: Trends in CO<sub>2</sub> Emissions, etc. by the Electric Utility Industry]*

Since the oil crises of the 1970s, Japan's power consumption has increased approximately three-fold, but CO<sub>2</sub> emissions have only doubled, meaning that CO<sub>2</sub> emissions per kWh used have fallen by about 40%.

This improvement is largely the result of expanded use of nuclear power which emits no CO<sub>2</sub> to generate power, and of liquefied natural gas (LNG) which emits comparatively little CO<sub>2</sub>, as well as the improved efficiency of thermal power generation.

CO<sub>2</sub> Emissions by the Electric Utility Industry





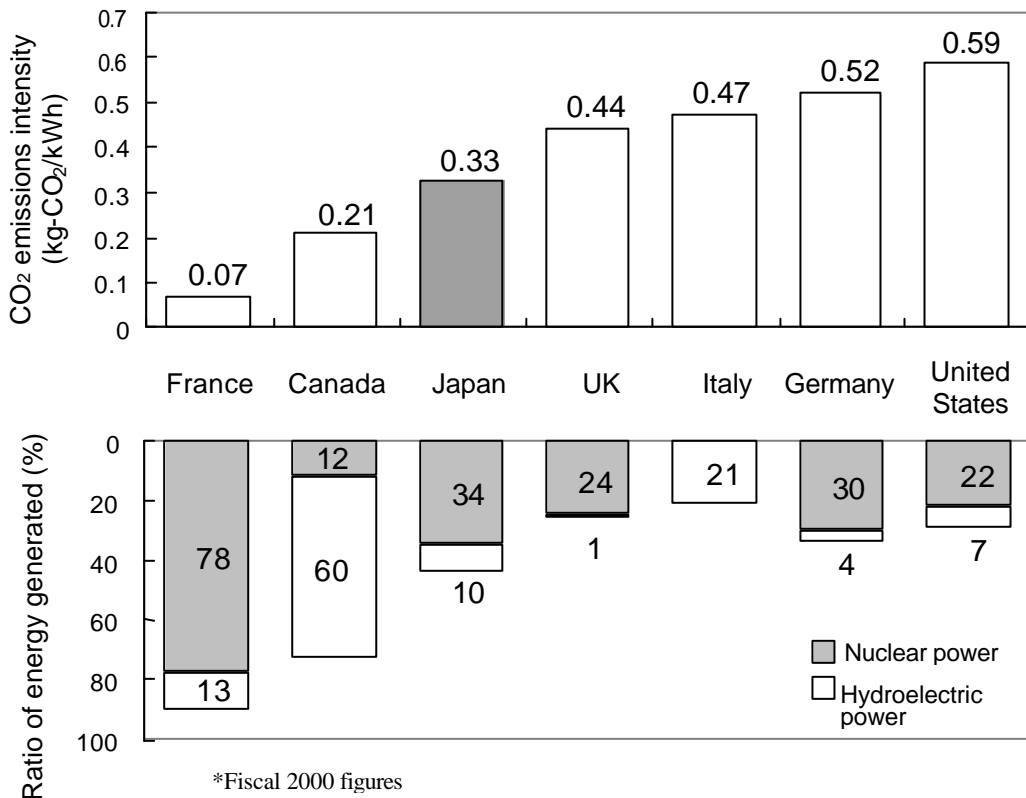
*[Box 2: International Comparison of CO<sub>2</sub> Emissions Intensity (per unit of Energy Generated)]*

CO<sub>2</sub> emissions from Japan's electric utilities accounted for approximately 1.3% of the world total in fiscal 1999 and for about 26% of Japan's total CO<sub>2</sub> emissions in fiscal 2000.

However, Japan's CO<sub>2</sub> emissions intensity (per unit of energy generated) is low in comparison with those of major European and North American countries, although not as low as Canada (which has a high ratio of hydroelectric power generation) and France (a high ratio of nuclear power generation).

Thus, it can be said that the electric utility industry of Japan has sought to implement the "best mix" of power sources, centering on nuclear power with the optimal mixture of thermal, hydroelectric and other power sources.

Country-by-Country Comparison of CO<sub>2</sub> Emissions Intensity (per unit of energy generated)



\*Fiscal 2000 figures

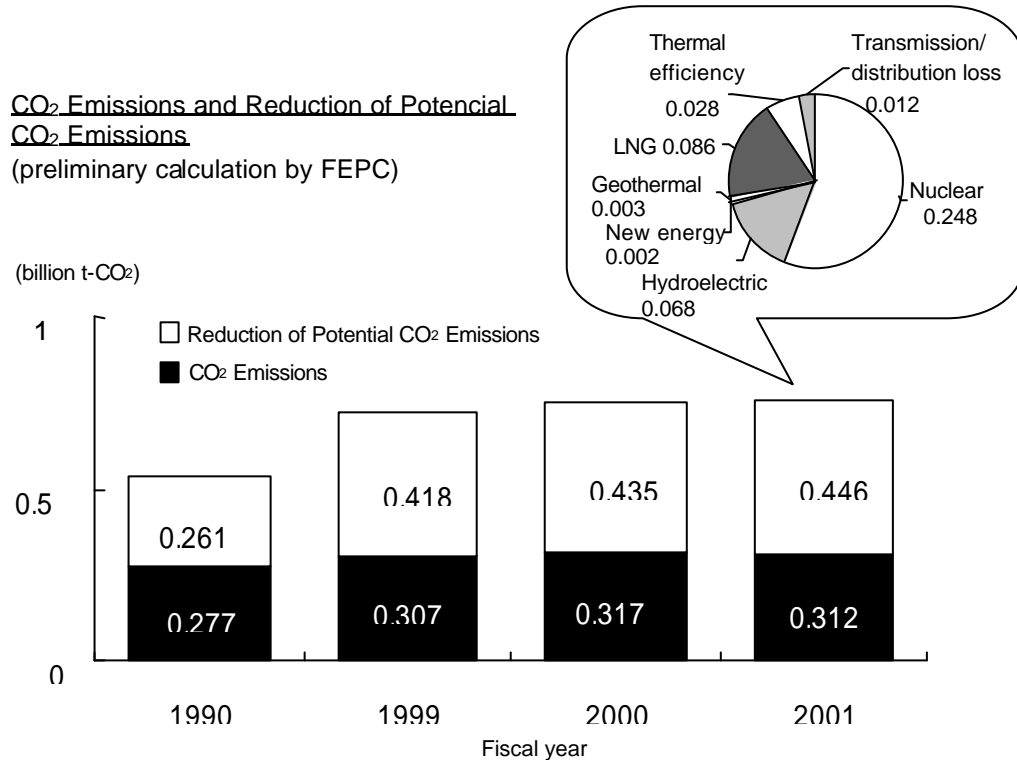
\*Source: Energy Balances of OECD Countries 1999-2000

\*Figures for Japan from FEPC

**b. Results of Efforts to Reduce CO<sub>2</sub> Emissions**

The reduction of CO<sub>2</sub> emissions through the use of non-CO<sub>2</sub> or low-CO<sub>2</sub> energy sources such as nuclear, LNG and hydro in fiscal 2001 has been calculated to be as much as 0.446 billion tons of CO<sub>2</sub>.

Of these, nuclear power is the most significant, amounting to about 0.248 billion tons of CO<sub>2</sub> emissions savings, while LNG-fired thermal power reduced CO<sub>2</sub> by 0.086 billion tons and hydroelectric power by 0.068 billion tons. The savings from nuclear power alone corresponds to 20% of Japan's total CO<sub>2</sub> emissions (1.237 billion tons of CO<sub>2</sub>) in fiscal 2000.



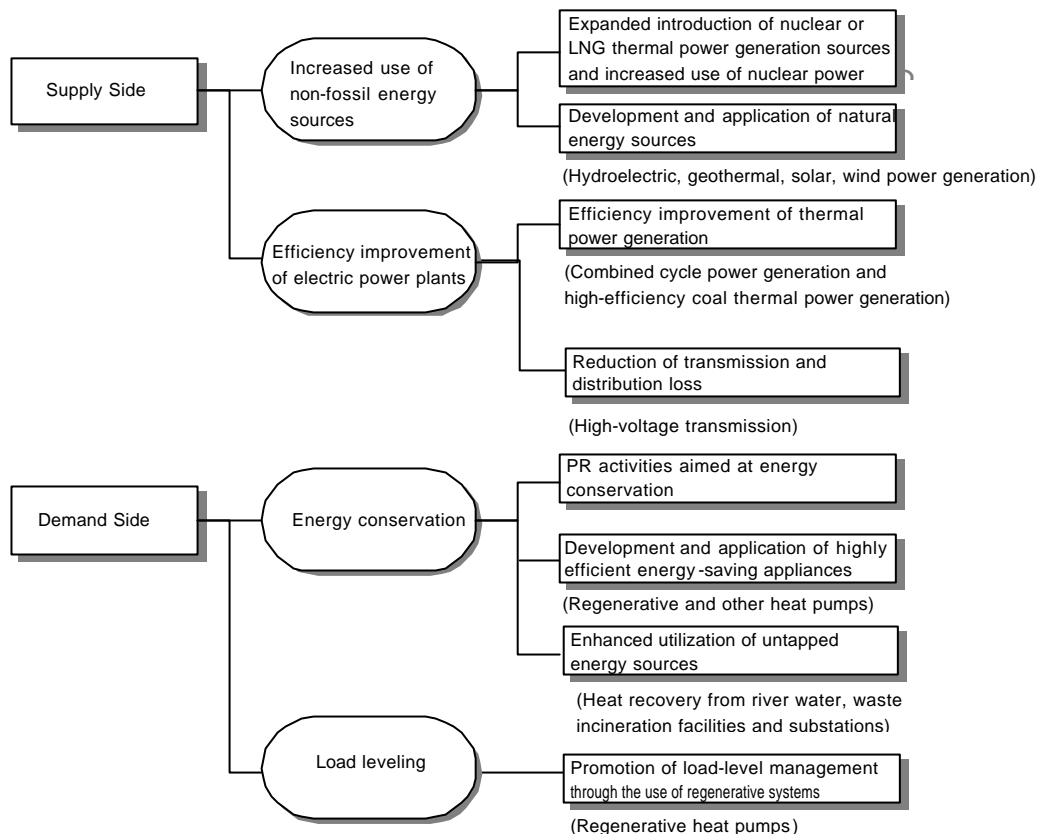
\* Figures for avoidance of CO<sub>2</sub> emissions are calculated under the assumption that all power generation would be covered by thermal power generation other than LNG if nuclear, LNG and hydroelectric power generation were not available.  
 \* Effects due to improvement in thermal efficiency and the transmission/distribution loss factor are calculated in comparison with fiscal 1970.

### (3) Future Efforts and Issues for Reducing CO<sub>2</sub> Emissions

#### (i) Summary of Measures to Reduce CO<sub>2</sub> Emissions

Measures by the electric utility industry to suppress CO<sub>2</sub> emissions can be broadly classified into “supply side” and “demand side” measures. Following is a summary of each.

- **Supply-side measures**
  - Expanded introduction of nuclear power generation, which emits no CO<sub>2</sub> to generate power, and of liquefied natural gas (LNG), which emits comparatively little CO<sub>2</sub>; increased use of nuclear power generation
  - Development and application of natural energy sources such as hydroelectric, geothermal, solar and wind power
  - Enhancing the efficiency of thermal power generation by introducing combined-cycle systems and high-efficiency coal-fired thermal power generation, as well as improving the efficiency of power facilities by reducing transmission/distribution power losses
  
- **Demand-side measures**
  - PR activities on energy conservation measures for customers, development and application of highly efficient, energy-conserving appliances like heat pumps, and using untapped energy sources
  - Promotion of load leveling by the use of regenerative heat systems, etc.



## **(ii) Future Efforts and Issues**

The electric utility industry continues to take measures on both the supply and demand sides to achieve its CO<sub>2</sub> emissions reduction target. Achieving the target, however, has become more difficult because of the increased time required for siting nuclear plants.

Another issue to be taken into consideration is consistency between the steps taken to expand the electricity liberalization and measures implemented to mitigate climate change.

The industry will therefore make the following efforts to meet the CO<sub>2</sub> emissions reduction goal of its Environmental Action Plan while working to meet these other requirements.

### **a. Stepping up the Promotion of Nuclear Power**

Nuclear power, which emits no CO<sub>2</sub> to generate power, should play a central role in our supply-side measures, but siting nuclear power plants has become very difficult.

The electric utility industry considers the promotion of nuclear power to be its greatest management priority, and intends to work with the national government to gain the understanding of the Japanese public about the safety of this power source and to put its utmost effort into the siting process. At the same time, the industry will work on the nuclear fuel cycle and back-end measures.

In order to improve facility usage rates, rated thermal power operation has successively been introduced at a number of sites since March 2002 as recommended by national investigations and other studies. The utmost effort will continued to be made to further improve facility usage rates.

### **b. Further Increase in the Efficiency of Thermal Power, and Reviewing Thermal Power Plant Operating Methods**

The electric utility industry has endeavored to improve the efficiency of thermal power.

A balanced mix of energy sources (LNG, coal and oil) needs to be developed and used that takes into account the supply stability and relative economic advantage of each fuel.

Improving the efficiency of thermal power directly helps to decrease CO<sub>2</sub> emissions intensity, so the industry is working to raise the gas turbine combustion temperature in LNG combined-cycle plants, and to develop technology for integrated

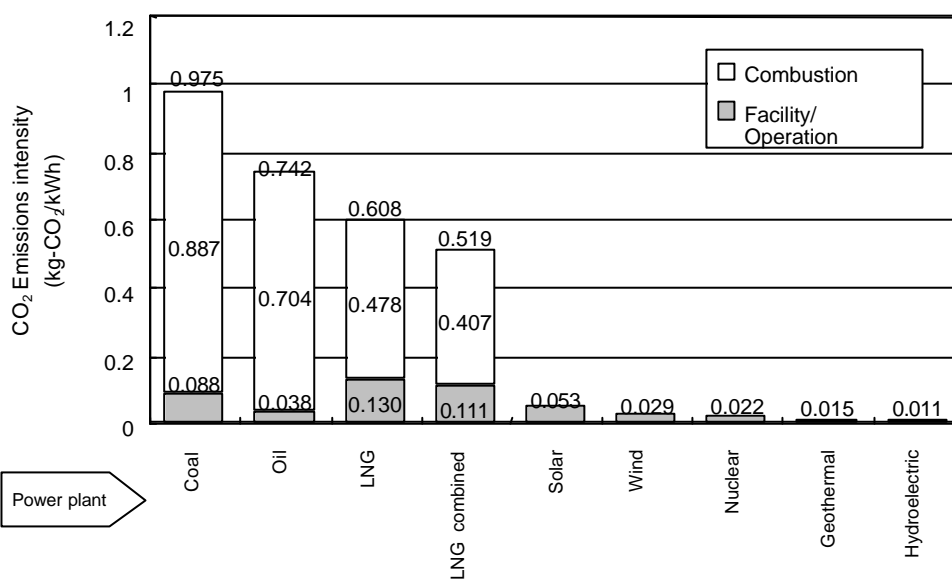
coal gasification combined-cycle (IGCC) power generation among other measures to enhance efficiency.

The industry is also improving the management of thermal power, taking into account the supply stability, economic advantages and environmental properties of the fuels.

*[Box 3: Lifecycle Assessment CO<sub>2</sub> Emissions Intensity for Japan's Energy Sources]*

A comparison of CO<sub>2</sub> emissions over the entire life cycle of different energy sources, including the stages of energy extraction, plant construction, transportation, refining, plant operation and maintenance, shows that CO<sub>2</sub> emissions from nuclear power are as low as those of solar and wind power, and that nuclear power is an ideal source of energy for mitigating climate change.

Lifecycle Assessment CO<sub>2</sub> Emissions Intensity for Japan's Energy Sources



- \* Based on total CO<sub>2</sub> emissions from all energy consumed in energy extraction, plant construction, transportation, refining, plant operation and maintenance, etc. in addition to burning of the fuel.
- \* In some cases, the sum of “fuel” and “equipment/operation” do not correspond exactly with the total values listed due to the rounding up of numerical data.
- \* Data for nuclear power includes reprocessing of spent fuel in Japan (now in the planning stages), use of Plu-thermal technology (assumes recycling once) and disposal of high level radioactive waste.
- \* CO<sub>2</sub> emissions from the uranium enrichment process are calculated according to the ratio of uranium enriched in Japan. If it is assumed that all uranium is enriched domestically, the figure for nuclear power would be 0.010kg-CO<sub>2</sub>/kWh.

(Source: Report of the Central Research Institute of Electric Power Industry)

### **c. Efforts for Helping to Spread the Use of Natural Energy**

The electric utility industry has been cooperating with the Green Power Fund (a program for individual consumers), and the Green Power Certificate System (for corporate users) as part of a long-term effort to promote the use of natural energy.

Voluntary efforts initiated by the private sector are most effective for advancing the use of natural energy. In line with the “Special Measures Law on the Use of New Types of Energy by Electric Utility Companies” announced in June 2002, efforts to introduce and expand the use of natural energy are continuing.

Issues such as low power density, vulnerability to weather conditions and high initial costs per unit of power generated remain with regard to solar and wind power and other natural energy sources, and efforts to resolve these problems are also necessary.

### **d. Promotion of Energy Conservation**

The electric utility industry is working to promote regenerative heat systems and CO<sub>2</sub> heat pump water heater, which limit CO<sub>2</sub> emissions by helping to save energy on the customer side and also by leveling the load on the supply side.

Increased CO<sub>2</sub> emissions from the private sector in recent years have much to do with the lifestyle of the customers, so the industry plans to step up its efforts to encourage energy conservation.

### **e. Efforts for Using the Kyoto Mechanisms<sup>2</sup>**

The electric utility industry recognizes the Kyoto Mechanisms as an important supplement to domestic measures, since they have the potential to be cost-effective resources in reducing CO<sub>2</sub> emissions.

The industry is working proactively on power technology transfer, as well as on afforestation and other projects in anticipation of the joint implementation (JI) and clean development mechanism (CDM) stipulated in the Kyoto Protocol. The industry is also working to clarify current trends, including emissions trading (ET), by reviewing detailed designs for both domestic and overseas systems, and is reviewing the application of the Kyoto Mechanisms, as well.

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<sup>2</sup> Refers to emissions trading (ET), joint implementation (JI) and the clean development mechanism (CDM) stipulated in the Kyoto Protocol.

International Cooperation Activities in the Power Sector to Reduce CO<sub>2</sub> Emissions

Project	Outline
Upgrading thermal efficiency by improving operational levels of an existing thermal power plant in Thailand	Project implemented to improve/recover the thermal efficiency of an existing thermal power plant in cooperation with Electricity Generation Association of Thailand (EGAT)
Technical cooperation in China to improve thermal efficiency of an existing thermal power plants	Project to improve the thermal efficiency of an existing thermal power plant of the electric company, Zhongguo Shandong Dianli
Installing solar power systems and small-scale hydroelectric power systems in Indonesia	Cooperative project with the government for local electrification and utilization of renewable energy in Indonesia by installing solar power generation systems and small-scale hydroelectric power systems
Joint development of tropical forest regenerating technology with Gadjah Mada University in Indonesia	Joint research project on technologies based on the symbiotic relationship between lauan trees and mycorrhizal fungi that are applicable to large-scale afforestation (from fiscal 1992)
Development with Thailand Royal Forest Department of afforestation technology to restore mangrove forest ecosystems	Experimental afforestation project in damaged mangrove forests (such as former sites of shrimp-raising ponds), seeking to restore these potentially effective carbon sinks
Afforestation business projects in Australia	Afforestation projects designed to preserve the world's forest resources and fix atmospheric CO <sub>2</sub>
Joint research on afforestation in Australia	Afforestation experiment that examines planting on coal mine sites and seeking to improve the soil with gypsum from the desulfurization process of coal-fired thermal power plants
Participation in the World Bank Prototype Carbon Fund and the European Bank for Reconstruction and Development (EBRD) fund	Prototype Carbon Fund established and operated by the World Bank and other institutions designed to provide accommodate for and invest in projects to reduce greenhouse gases in developing countries

**f. R&D on Technologies for the Effective Recovery, Disposal, Fixation and Use of CO<sub>2</sub>**

From the mid- to long-term perspective, the electric utility industry is also carrying out researches on technologies to fix and utilize CO<sub>2</sub>. Examples are technologies to recover and dispose of CO<sub>2</sub> from thermal power flue gas emissions and absorption by forested areas.

In addition, power plants often have forests on their grounds, including water conservation forests. There also help to absorb CO<sub>2</sub>, and power companies intend to maintain these forests.

*[Box 4: CO<sub>2</sub> Emissions from Office Usage and from the Company Fleet]*

Following are calculations of CO<sub>2</sub> emissions resulting from electricity consumption in the offices of the electric utility industry (services sector) and from the company fleets (transportation sector) for fiscal 2001.

(i) CO<sub>2</sub> emissions from office usage

The amount of power that the electric utility industry used in its offices (head offices, branch offices, sales offices, and rooms in various divisions) was about 1 billion kWh in fiscal 2001.

This corresponds to about 380,000 tons of CO<sub>2</sub> emissions, or approximately 0.12% of the CO<sub>2</sub> emissions (312 million tons of CO<sub>2</sub>) from production activities (combustion of fossil fuels).

In its role as a consumer of power, the electric utility industry is engaged in the following efforts to control CO<sub>2</sub> emissions from office use.

- Efficient use of air conditioning (appropriate control of room temperature, reducing usage times, etc.)
- Always turning off lights during lunch hours and other non-work times
- Encouraging use of the stairs rather than elevators
- Upgrading office equipment to energy-saving models and turning off when not in use
- Introducing regenerative cooling systems and solar-powered facilities in company-owned buildings

(ii) CO<sub>2</sub> emissions from the company fleet

The amount of fuel (gasoline and light oil) used by the industry in its own fleet of vehicles totaled about 32,000 kl in fiscal 2001. This corresponds to 80,000 tons of CO<sub>2</sub> emissions, or 0.03% of the CO<sub>2</sub> emissions (312 million tons) created by production activities (combustion of fossil fuels).

The industry is engaged in the following efforts to control CO<sub>2</sub> emissions resulting from vehicle use.

- Encouraging safe energy-conserving driving habits, such as shutting off engines when idling and avoiding harsh acceleration and deceleration
- Introducing and giving priority use to energy-efficient and electric-powered vehicles
- Operating vehicles at appropriate tire pressures
- Training of staff concerned with vehicles on how to conserve energy

#### **(4) Measures to Reduce Greenhouse Gas Emissions Other than CO<sub>2</sub>**

The combined effect on the climate of five greenhouse gases other than CO<sub>2</sub> emitted by the electric utility industry is about 1/300 of that of CO<sub>2</sub>.

The industry is putting great effort into limiting emissions of these gases through the measures described next.

##### **(i) Sulfur Hexafluoride (SF<sub>6</sub>)**

Since no effective alternative gas is known at this stage, SF<sub>6</sub>, a gas with superior insulation properties, is essential for a stable electric power supply as an insulation medium for gas-insulated devices. Although the electric utility industry must continue to use it, the industry adopted the Voluntary Action Plan of the Japanese Electric Utility Industry to Reduce SF<sub>6</sub> Emissions in April 1998. Under this plan, the industry has worked to reduce emissions by 2005 to 3% of SF<sub>6</sub> contained when devices are inspected, and to 1% when they are disposed of. By aggressively applying gas recovery systems and working to recycle the recovered gas, the industry has made substantial progress in containing emissions. Emission ratios in 2001 have already been reduced to 4% during mechanical inspections and 3% during disposal, and the industry aims to meet its targets by continuing its efforts in this area.

##### **(ii) Hydrofluorocarbon (HFC)**

HFC is principally used as a refrigerant for air-conditioning equipment. The industry foresees a continuing shift from CFCs, whose use is restricted by law, to HFC substitutes. The industry will make the utmost effort to prevent leakage during device installation and repair and to recover and recycle the gas.

##### **(iii) Perfluorocarbon (PFC)**

Liquid PFC is used as a refrigerant and an insulating medium for certain types of transformers. Since it is used in liquid form, it is easy to recover and recycle, and there is no fear of leakage to the environment, either during normal operation or upon disposal.

##### **(iv) Nitrous Oxide (N<sub>2</sub>O)**

N<sub>2</sub>O emissions occur at thermal power plants due to the combustion of fuels. N<sub>2</sub>O emissions by the electric power industry account for about 1.5% of total N<sub>2</sub>O emissions in Japan. The industry is making the utmost effort to reduce its emissions, primarily by improving thermal efficiency.

##### **(v) Methane (CH<sub>4</sub>)**

The concentration of CH<sub>4</sub> in flue gases emitted in the burning of fuel at thermal power plants is less than the concentration in the atmosphere, meaning emissions are essentially zero.

## 2. Establishing a Recycling-based Society

Efforts are currently underway in Japan to help our society evolve from the mass production/mass consumption/mass disposal model to a reduce/reuse/recycle model, and thereby create a “recycling-based society” that puts little load on the environment.

The electric utility industry has been voluntarily working toward the realization of such a recycling-based society, and continues to promote the effective use of resources by producing renewed resources from waste products<sup>3</sup> and other materials and by establishing nuclear fuel cycles.

### (1) Measures for Waste Reduction and Recycling

Waste produced by the electric utility industry includes coal ash from thermal plants, construction waste materials like discarded concrete poles from power distribution works, and scrap metal such as electric cable. There are also byproducts, an example of which is gypsum produced by thermal power generation facilities.

Total waste volume has been increasing as the total amount of power generated has risen with the growth in energy consumption. This figure of the volume is expected to climb to 10 million tons in fiscal 2010, twice the level produced in fiscal 1990.

The electric utility industry considers the reduction of waste volume ultimately disposed of an important issue in responding to the increase in waste volumes and is increasing efforts to curtail generation increase and promote the production of renewed resources.

#### (i) Reductions Target for Waste Disposal

Waste disposal serves as an indicator of waste reduction in the electric utility industry, and the following waste disposal target has been set.

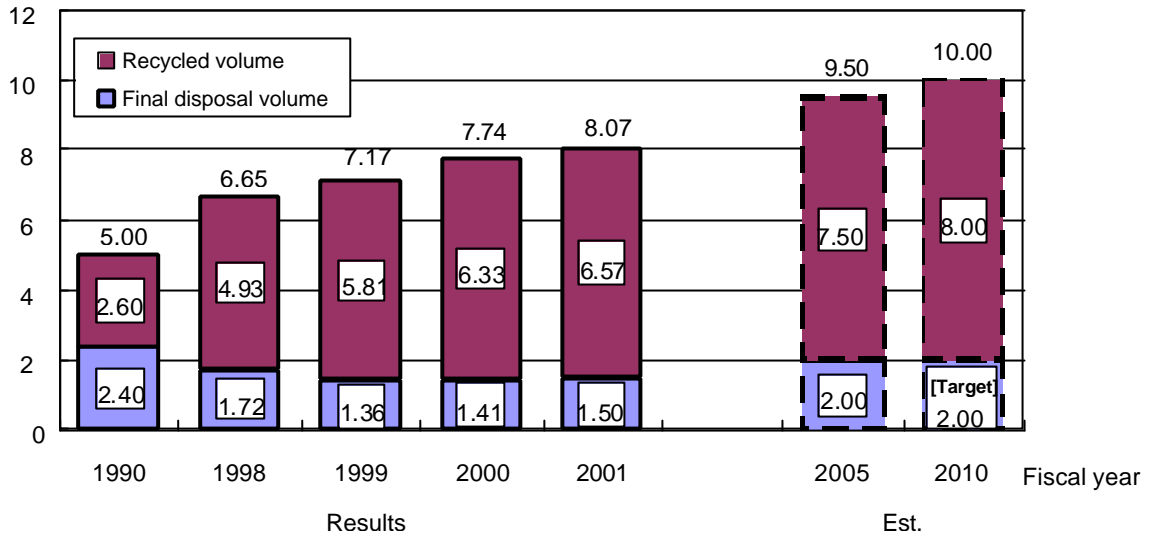
By fiscal 2010, we aim to reduce the amount of final waste disposal to 2.0 million tons, less than the 2.4 million tons of fiscal 1990.

We in the electric utility industry continue to intend to make the utmost to achieve these goals.

Promoting renewed resources generated from coal ash, the most urgent priority, and with generation expected to double from the fiscal 1990 level of 6.5 million tons by fiscal 2010, the industry is working to expand the total volume of waste converted into renewed resources to 5.0 million tons, more than three times the fiscal 1990 level.

<sup>3</sup> Waste products include those defined as industrial waste (defined under the Law Concerning the Processing and Cleaning of Waste Products, including certain products of value) and those generated secondarily through production activities (byproducts). Radioactive waste is not included in the definition of waste products. It is handled in a separate, more appropriate manner.

Electric Utility Industry Target for Reducing Final Waste Disposal  
(million tons)

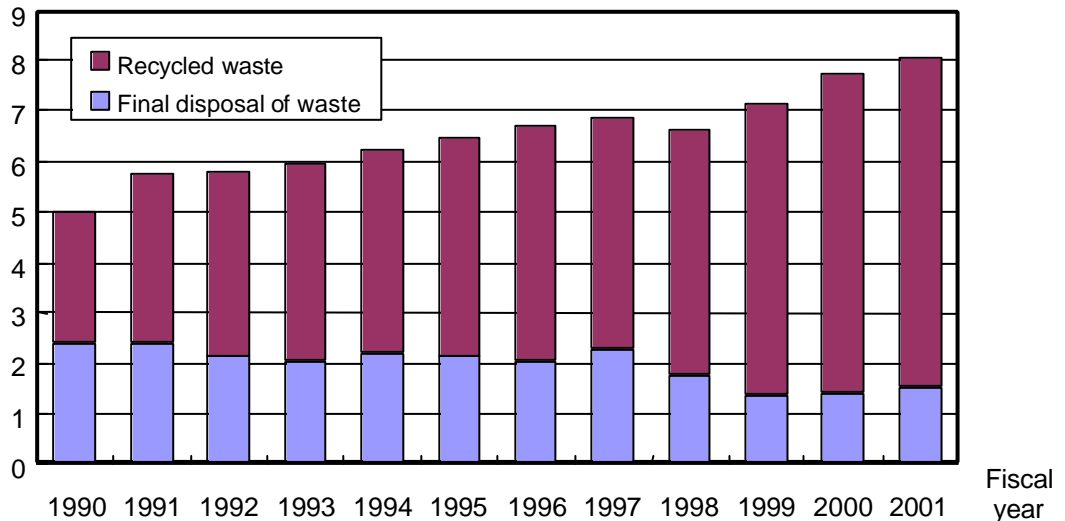


\*Fiscal 1990 level includes some estimates.

**(ii) Disposal Waste in Fiscal 2001**

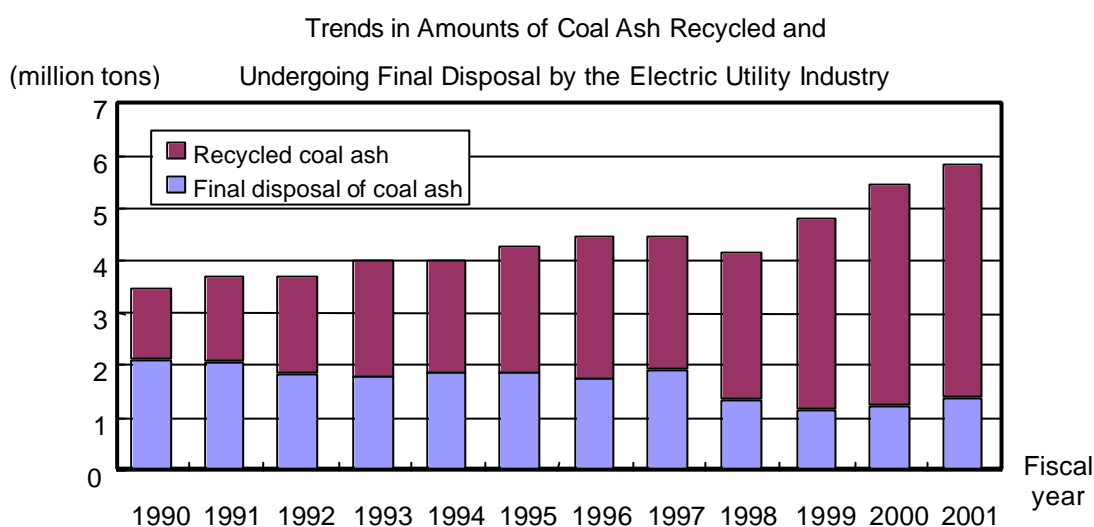
Waste generated by the industry amounted to 8.07 million tons in fiscal 2001, an increase of 0.33 million tons from the fiscal 2000 level. This increase was due to the rise in coal ash generation accompanying the increase in total coal fired power generation. On the other hand, the recycled volume has increased by 0.24 million tons from the previous year to 6.57 million tons. This result is that final disposal of waste in fiscal 2001 was 1.50 million tons, an increase of just 0.09 million tons over fiscal 2000.

Trends in Amounts of Waste Recycled and Undergoing Final Disposal by the Electric Utility Industry  
(million tons)



Coal ash makes up the greatest part of the waste, accounting for 5.82 million tons, of which 4.46 million tons is recycled, mostly as a raw material for cement or as an admixture for concrete.

Renewed resources are produced from nearly all of the total scrap metal generated, and every possible effort is made to produce renewed resources from other waste products as well. All gypsum, which is a byproduct of the desulfurization process, is used to produce renewed resources such as gypsum boards and as an ingredient for cement.



\* After coal ash has been buried, its final disposal sites are used as construction sites for new power plants and other industrial facilities.

**Trends in Recycling of Major Types of Waste and Byproducts**

(1,000 tons)

Type		Fiscal 1990	Fiscal 1999	Fiscal 2000	Fiscal 2001	
Waste	Combustion residue	Volume generated	3,470	4,790	5,440	5,820
		Recycled volume (Recycling rate)	1,370 (39%)	3,660 (76%)	4,200 (77%)	4,460 (77%)
	Dust and soot	Volume generated	400	470	360	390
		Recycled volume (Recycling rate)	210 (53%)	390 (83%)	300 (83%)	340 (87%)
	Coal ash	Volume generated	140	150	150	150
		Recycled volume (Recycling rate)	130 (93%)	140 (93%)	150 (96%)	140 (94%)
Construction waste material	Volume generated	850	1,470	1,570	1,530	
	Recycled volume (Recycling rate)	850 (100%)	1,470 (100%)	1,570 (100%)	1,530 (100%)	

\*Waste includes products of value.

\*Figures for construction waste material and scrap metal in fiscal 1990 are estimates.

\*Gypsum from desulfurization process is all sold.

\*Recycling rates are calculated on an actual volume basis. (Figures for the volume generated and recycled volume are rounded to the nearest ton.)

**(iii) Future Efforts to Reduce and Recycle Wastes**

To maintain the best mix of power-generating sources, the electric utility industry regards coal as the second most important fuel for baseload power after nuclear power. In the long term, coal-fired thermal power plants will supply the base and middle load demands. Using wastes such as coal ash will be an important task.

The industry, therefore, is working on new applications for further efficiency improvements in thermal power generation, greater reduction of wastes such as coal ash and the development of applications and technology to handle large volumes of coal ash in a stable manner over time.

The industry intends to maintain complete utilization of the desulfurizing byproduct, gypsum. Efforts to reduce, reuse and recycle other wastes will continue to be made, in order to reduce the amount undergoing final disposal.

**Examples of Recycling**

Major type of waste or byproduct		Major recycling applications
Combustion residue, dust and soot	Coal ash	Raw material for cement, fertilizer, construction materials (soil enhancement and sand replacement)
	Heavy Crude oil ash	Vanadium recovery and combustion enhancement
Sludge		Raw material for cement
Construction waste material		Structural material for new construction, roadbed material and recycled asphalt
Scrap metal		Recycled distribution lines and ingredient for metal products
Scrap glass and scrap ceramics		Tile and block material, structural material for new construction and roadbed material
Gypsum from desulfurization process (byproduct)		Gypsum board material and raw material for cement

\*Source: Examples of Recycling Applications for Waste Materials by the Electric Utility Industry

**(iv) Increased Utilization of Reused and Recycled Products**

Recognizing that recycling resources and the use of environmentally friendly products are critical to forming a recycling-based society, the electric utility industry is promoting green purchasing and expanding the use of reused and recycled products.

## **(2) Recycling by the Nuclear Industry**

### **(i) Establishment of the Nuclear Fuel Cycle as Part of the Recycling-based Society**

The nuclear fuel cycle makes it possible to recycle uranium and plutonium recovered from spent fuel. For Japan, which depends on imports for about 80% of its primary energy supply, this could be a very effective method for assuring a stable supply of energy. It would enhance the properties of generated nuclear power, which provides superior supply stability and is also consistent with the concept of a recycling-based society.

A spent fuel reprocessing plant is currently under construction in Aomori Prefecture to help establish the nuclear fuel cycle, and it is scheduled to enter operation in 2005. Due to the current energy policy in Japan which dictates that there should be no surplus plutonium, the industry is promoting its ‘Plu-thermal’ plan. This technology enables the plutonium recovered from spent fuel to be used as MOX fuel (Mixed Oxide Fuel — pellets of uranium mixed with plutonium) in existing light-water reactors. The industry will work to gain public understanding of this plan to enable its progress. In the future, the most effective scenario will be to use fast-breeder reactors currently under development. If this technology is realized in the future, it could dramatically improve the availability factor of the uranium resource.

### **(ii) Effective Utilization of Recyclable Resources from Nuclear Facilities**

The Nuclear Safety Commission of Japan in March 1999 established clearance-level standards for nuclear power plant scrap metal and waste concrete classified as “not requiring handling as radioactive materials.”

The legal system for handling such waste is currently under review by the government. When the legal system has been determined, the industry will work towards the effective use of these recyclable resources.

### 3. Management of Chemical Substances

#### (1) PRTR System

The electric utility industry has carried out independent PRTR (Pollutant Release and Transfer Register) studies since 1997, even before the relevant laws were enacted, in an effort to precisely monitor release and transfer volumes at power generators and other facilities as the amount of special chemical substances gradually increase.

A system for reporting emission volumes and other factors was introduced in April 2002 and was based on the Law Concerning the Reporting, etc. of Releases to the Environment of Specific Chemical Substances and Promoting Improvements in Their Management (the PRTR Law). Under this system, electric utility companies gather information on the release and transfer volumes for specific chemical substances at each of their facilities and report their findings to the national government.

The release and transfer volumes in the electric utility industry for fiscal 2001 are illustrated in the table below. Under the preparatory measures set forth in the PRTR Law, establishments that handle at least five tons of specified Type I chemical substances (excluding special specified Type I chemical substances) are required to report on these substances in fiscal 2001 and 2002. The figures in the following chart, however, represent totals for establishments that handle at least one ton of these chemical substances.

Total Release and Transfer of Chemical Substances (Results for fiscal 2001)

Chemical codes	Chemical	Volume released to the environment (kg/year)				Volume transferred (kg/year)		Applications, etc.
		Air	Water	Soil	Landfill	Sewer	Other	
16	2-Amino ethanol	0.4	0	0	0	0	560	Feed water-processing agent
30	Bisphenol A epoxide	72	0	0	0	0	0	Used in painting
40	Ethylbenzene	17,000	0	0	0	0	0	Used in painting
63	Xylene	170,000	0	0	0	0	0	Used in painting, power-generation fuel
121	Dichlorodifluoromethane (CFC-12)	200	0	0	0	0	0	Air conditioning refrigerant
144	Dichloropentafluoropropane (HCFC-225)	20,000	0	0	0	0	0	Used in painting and to launder clothing
177	Styrene	6,300	0	0	0	0	0	Used in painting
179	Dioxins	710	0.053	0.090	15	0	190	Waste incinerators
217	Trichlorofluoromethane (CFC-11)	260	0	0	0	0	0	Air conditioning refrigerant
227	Toluene	32,000	1.0	0	0	0	0	Used in painting, power-generation fuel
253	Hydrazine	14	2,800	0	0	31	28	Feed water-processing agent
286	Bromotrifluoromethane (Halon-1301)	1,700	0	0	0	0	0	Heating medium for cryogenic power generation
299	Benzene	240	0	0	0	0	8.6	Power-generation fuel
304	Boron and its compounds	0	51	0	0	0	0	Cooling water-processing agent
311	Manganese and its compounds	0	54	0	0	0	0	Catalyst for flue-gas desulfurization
353	Tris phosphate (dimethyl phenyl)	0	0	0	0	0	28,000	Turbine control oil

\* Chemical codes represent the number assigned to each chemical under the PRTR Law.

\* Units in this table for release and transfer volumes for dioxin substances are measured as [kg/year mg-TEQ/year].

\* Figures for dioxin substances represent sum totals that include release and transfer volumes from those establishments designated in the Law Concerning Special Measures against Dioxins. Figures for all other substances represent sum totals that include release and transfer volumes from each establishment that handles at least one ton of the Type I chemical substances specified in the PRTR Law or at least half a ton of the special Type I chemical substances specified by this law.

\* It has been confirmed that the volume of dioxin released or transferred is within the emission limits stipulated in the Law Concerning Special Measures against Dioxins.

## **(2) Efforts to Manage Chemical Substances**

The electric utility industry continues to make the following efforts to properly manage chemical substances and reduce emissions.

- ? By following management documentations such as control manuals, the industry performs proper control of substances, covered by law, such as those found in turbine control oil and boiler feed water processing agents, and it endeavors to reduce the amount used by improving operating methods.
- ? The industry is taking appropriate steps to reduce emissions of ozone-depleting chemicals used as refrigerants, cleaners and cryogenic power generation media. These steps include reducing the amount used through proper usage, leakage prevention, recovery and recycling and replacement with alternatives.
- ? Efforts are also being made to reduce emissions of regulated chemical substances by reevaluating the methods used to paint instruments, piping and other materials.
- ? The industry thoroughly controls the combustion waste incinerators to minimize the amount of dioxins emitted from them. Dioxin emissions have also been limited by reusing waste in order to limit the use of incinerators or to shut them down to the extent possible.

## **4. Promotion of Environmental Management**

Members of the electric utility industry have been among the first to create environmental departments and set up in-house environmental management systems. They have reported on their environmental protection efforts through environmental action reports.

According to each member's policy, the industry has voluntarily and actively worked to improve in-house environmental management systems in line with the international standards of the ISO14000 series, and to earn ISO14001 certification at their representative sites. The industry has also paid close attention to other societal trends, such as environmental accounting and environmental auditing.

These efforts will continue in the future to ensure that we place even less burden on the environment.

## **5. Environmental Considerations in Overseas Projects**

The electric utility industry has always paid attention to environmental considerations in undertaking overseas projects and intends to continue doing so.

The industry will continue its active engagement in the form of technical assistance to foreign countries by accepting trainees from developing countries and sending experts from Japan.