Environmental Action Plan by the Japanese Electric Utility Industry

September, 2007

The Federation of Electric Power Companies of Japan (FEPC)

Contents

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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 environmental protection issues we face today have 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 electric power-related companies which comprise the Federation of Electric Power Companies (FEPC),[1] 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, as well as the measures to achieve them.

The Federation has reviewed the action plan annually since 1998 to ensure its transparency and the achievement of its targets, and has recently completed the tenth review.

1 Measures to Mitigate Climate Change

(1) Basic Policy for the Mitigation of Climate Change

The Kyoto Protocol came into force in February 2005. After the Japanese government established the Kyoto Protocol Target Attainment Plan that sets down measures necessary to achieve the target of reducing greenhouse gasses by 6%, the plan earned cabinet approval in April 2005.

To secure its effectiveness this Kyoto Protocol Target Attainment Plan has been designed to "conduct periodic evaluations and reviews of the plan in fiscal 2007 and from fiscal 2008 start to take countermeasures and policies needed for the first commitment period (fiscal 2008 to fiscal 2012)".

Thus from November last year, the government has been inspecting the progress of various countermeasures & policies raised in the Kyoto Protocol Target Attainment Plan, strengthening measures and evaluating the possibility of additional measures. Based on these evaluation results, the new Kyoto Protocol Target Attainment Plan will be approved in a cabinet meeting in March 2008.

1) The twelve 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.

Meanwhile, although growth in energy consumption in Japan is expected to slow down with the reduction in the population, structural changes in the economy and social structure, for the present, energy consumption is forecast to increase led by the private sector (household, commercial), as the Japanese people seek reater abundance in their lifestyles.

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

In light of these circumstances, achieving the goals set forth in the Kyoto Protocol targets looks to be extremely difficult, and further effort is needed. To do that, we must make use of technical innovations and ingenuity under the basic concept of achieving a balance between the environment and economy. At the same time, all involved — government, local authorities businesses, and citizens — need to be further aware of the importance of the issue of global warming, and continuous proactive efforts against global warming are imperative.

The electric utility industry is seeking to resolve the following "trilemma," working to simultaneously achieving…

- ❖ Economic growth
- ❖ Energy security
- ❖ Environmental conservation

It is doing its utmost, based on a fundamental concept of ensuring the stable supply of high-quality inexpensive electricity, to implement measures to suppress greenhouse gas emissions that focus on the promotion of nuclear power.

(2) CO_2 Emissions Suppression Targets and CO_2 Emissions

(i) CO_2 Emissions Suppression Targets

The electric utility industry has set the following as an index for CO_2 emissions suppression goal, as measured in kg-CO_2 per kWh of energy used by the end user (this is also known as CO_2 emissions intensity).

> From fiscal 2008 to fiscal 2012, we aim to further reduce CO_2 emissions intensity (emissions per unit of user end electricity) by an average of approximately 20% from the fiscal 1990 level, to about 0.34 kg-CO_2/kWh.

<Concept behind goal setting>

The amount of CO_2 emissions accompanied by the use of electricity — the target used in measures against global warming — can be calculated by multiplying electric power consumption by the CO_2 emissions intensity. Of these factors, electric power consumption can increase or decrease due to factors that the efforts of electric power companies cannot affect, such as the weather and the circumstances surrounding using electricity. For this reason, the electric utility industry adopts goals of emissions intensity reduction that can reflect their own efforts.

In cooperation with the Japan Business Federation the target period has been aligned with the first commitment period of the Kyoto Protocol. We will be working to achieve the target of reducing the average over a five year period by approximately 20%.

(ii) CO_2 Emissions in Fiscal 2006

CO_2 emissions intensity for fiscal 2006 was 0.410 kg-CO_2/kWh, a reduction by 0.013 kg-CO_2/kWh (3.1%) in comparison to fiscal 2005.

<Fiscal 2006 results>

- ❖ CO_2 emissions intensity:
  0.410 kg-CO_2 /kWh (3.1% decrease from previous year)
- ❖ CO_2 emissions:
  365 million t-CO_2 (2.1% decrease from previous year)
- ❖ Electric power consumption:
  889 billion kWh (0.8% increase from previous year)

Item \ Fiscal Year	1990 (results)	2004 (results)	2005 (results)	2006 (results)	2008 to 2012 *1 (average of five-year)
Electric power consumption*2 (billion kWh)	659	865	883	889	(est.) 921
CO_2 emissions*3 (million t-CO_2)	275 [2] *4	362 [25]	373 [26]	365 [28]	(est.) 340
CO_2 emissions intensity user end electricity *5 (kg-CO_2/kWh)	0.417	0.418	0.423	0.410	(est.) 0.37

*1 Estimates for fiscal 2008 to 2012 are based on fiscal 2007 energy supply plans, which consider GDP indicators, demand trends and other factors. The average value over the five years has been listed.

*2 Electric power consumption includes power purchased from cooperative thermal power plants, IPPs (independent power producers), and household generators and then sold.

*3 CO_2 emissions include CO_2 emissions that are emitted at the time of generation of electric power purchased from cooperative thermal power plants, IPPs (independent power producers), and household generators. They also include CO_2 emissions equivalent to transmitted and received electric power in wholesale electric power trading.

*4 Figures in parentheses represent total CO_2 emissions from the power purchased from IPPs and household generators, and CO_2 reduction efforts are expected from each source. For the purposes of calculation, calorific value is estimated from the amount of power purchased.

*5 CO_2 emissions intensity (user end electricity) = CO_2 emissions ÷ electric power consumption
CO_2 emissions are the total of CO_2 emissions for each type of fuel. It is calculated as follows:
CO_2 emissions = Calorific value attending fossil fuel combustion × CO_2 emissions coefficient
Calorific value uses figures stated in the Agency for Natural Resources and Energy's Monthly Report of

Electric Power Statistics Survey (fiscal 2006 results), etc. The fuel-specific CO_2 emissions coefficient uses the figures stated in the revised Law Concerning the Promotion of Measures to Cope with Global Warming, which came into effect in 2006.

Estimated average CO_2 emissions intensity for fiscal 2008 to 2012 is about 0.37 kg-CO_2/kWh which is over the goal, so we aim to meet the goal by further intensifying measures.

(iii) Analysis and Evaluation of CO_2 Emissions

a. Analysis of Factors Contributing to Change in CO_2 Emissions Intensity

CO_2 emissions intensity (user end electricity) was 0.410 kg-CO_2/kWh in fiscal 2006, which was down by 0.013 kg-CO_2/kWh compared to fiscal 2005.

This is because despite the slight decrease in usage of nuclear power facilities compared to fiscal 2005, the amount of hydroelectric power generation increased compared to fiscal 2005 due to high-water flows, which in turn slightly reduced the amount of thermal power generation.

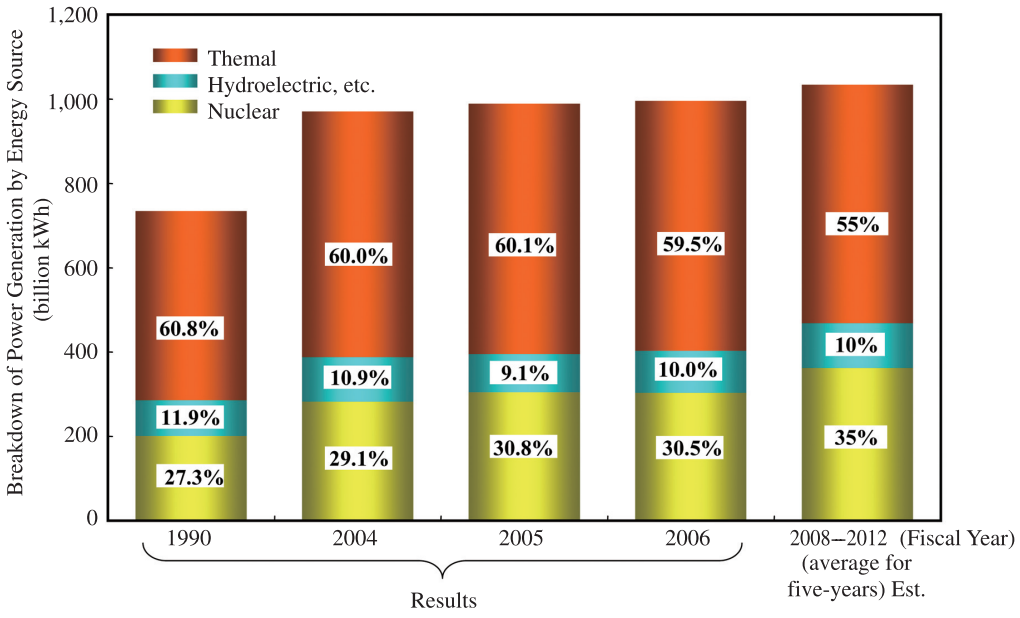
<Factors related to CO_2 emissions equability>

- ❖Decrease in nuclear power generation: Figures in parentheses are the ratio of nuclear power to overall power generated
  305 billion kWh (30.8%) in fiscal 2005 → 303 billion kWh (30.5%) in fiscal 2006
  Capacity factor of 71.9% in fiscal 2005 → Capacity factor of 69.9% in fiscal 2006
- ❖Increase in hydroelectric power generation: Figures in parentheses are the ratio of hydroelectric power to overall power generated
  90.1 billion kWh (9.1%) in fiscal 2005 → 99.7 billion kWh (10.0%) in fiscal 2006
- ❖Decrease in thermal power generation: Figures in parentheses are ratio of thermal power to overall power generated
  594 billion kWh (60.1%) in fiscal 2005 → 593 billion kWh(59.5%) in fiscal 2006

<Estimate for fiscal 2008 to fiscal 2012 (reference)>

The breakdown of power generation by energy source in fiscal 2008 to fiscal 2012 is as shown in the chart below. Hydroelectric and nuclear power generation are expected to encompass 45% of the total.

Breakdown of power generation by energy source



Supposing the plants were operated in fiscal 2006 at the planned capacity factor of 84.2%[2] with no impact by the long-term nuclear power plant shutdowns, CO_2 emissions would have decreased approximately 39 million tons to around 326 million t-CO_2. CO_2 emissions intensity calculates out to 0.366 kg-CO_2/kWh.

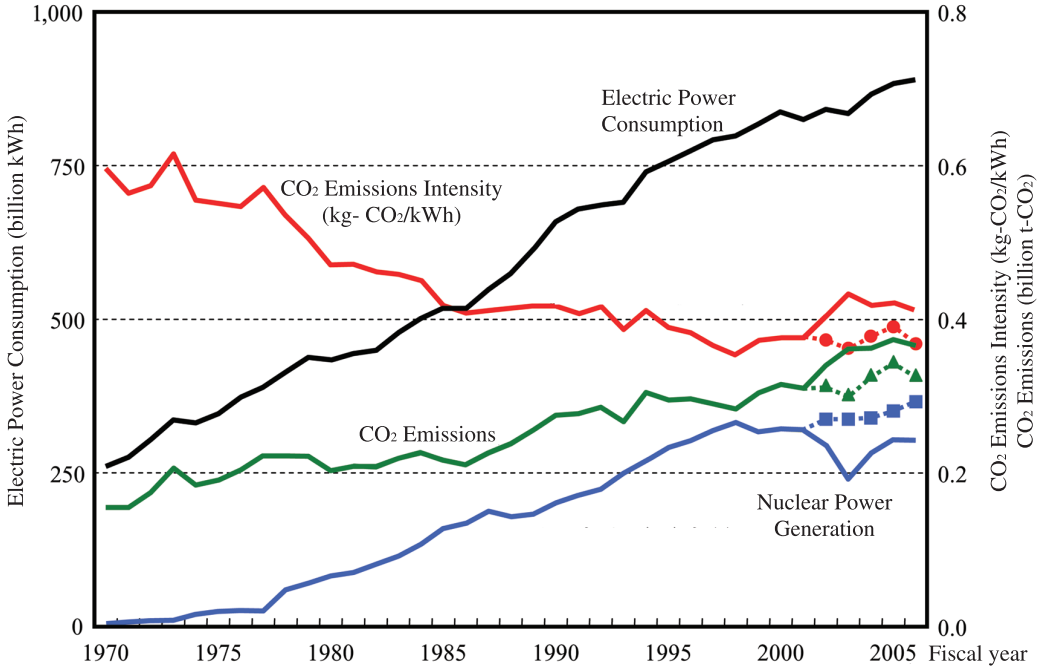
2) Capacity factor for nuclear power facilities (84.2%) for fiscal 1998

Reference

Trends in CO_2 emissions, etc. by the electric utility industry

Since the oil crises of the 1970s, power consumption in Japan has increased approximately 3.4 times, but CO_2 emissions have increased only 2.4 times. This improvement is largely the result of expanded use of nuclear power which emits no CO_2 to generate power, and of liquefied natural gas (LNG) which emits comparatively little CO_2 as well as the improved efficiency of thermal power generation. As a result, CO_2 emissions per kWh (CO_2 emissions intensity) has decreased by about 31% of the previous figure.

CO_2 emissions by the electric utility industry



* The marked dotted lines indicate estimates supposing no impact was exerted by the long-term shutdown of nuclear power plants in fiscal 2002 through 2006.

b. Results of Efforts to Suppress CO_2 Emissions

(a) Results of efforts to suppress CO_2 in fiscal 2006

<Suppression through use of non-fossil and other energy sources>

The electric utility industry is working on achieving the best mix of energy sources, balancing use of nuclear, thermal, and hydroelectric power. This is done with consideration for dealing with global warming and stable and economic supply of electric power.

If electric power generated through use of nuclear power, hydroelectric power, liquid natural gas and other energy sources is instead generated by thermal power generation other than liquid natural gas, CO_2 emissions would be approximately double current emissions.

- Result of CO_2 suppression through best mix of power sources: estimated at **405 million t-CO_2** (Fiscal 2006 CO_2 emissions: 365 million t-CO_2)

<Major results of suppression>

- Result of CO_2 suppression through nuclear power generation: 235 million t-CO_2
  Equivalent to 18% of Japan's FY 2006 CO_2 emissions (1.293 billion t-CO_2)
- Result of CO_2 suppression through LNG power generation: 92 million t-CO_2
- Result of CO_2 suppression through hydroelectric power generation: 70 million t-CO_2

(b) Results of efforts to suppress CO_2 emissions compared to fiscal 1990

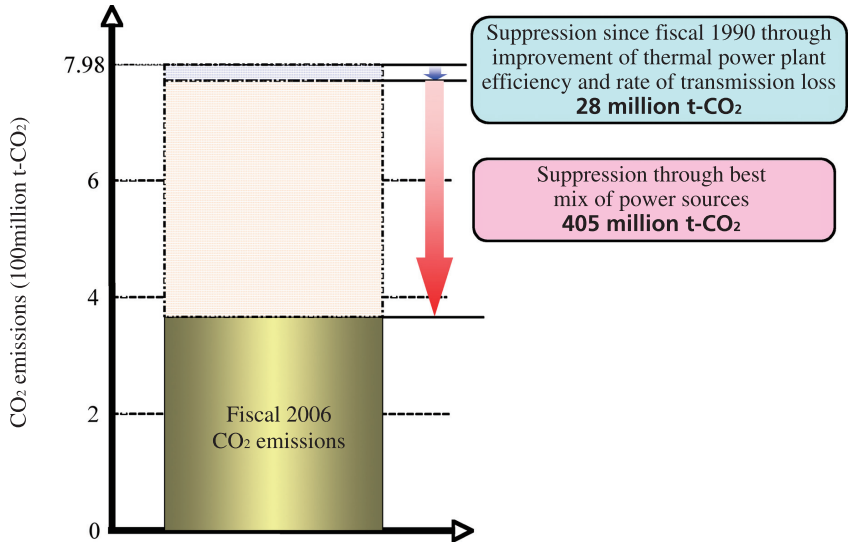
<Suppression through increased efficiency at power plants>

Improving the efficiency of our thermal power plants and improving the rate of transmission loss is provisionally estimated to have prevented 28 million t-CO_2 emissions compared to fiscal 1990. This corresponds to 7.7% of actual CO_2 emissions in fiscal 2006.

<Fuel reduction through use of non-fossil energy sources>

Fiscal 2006 nuclear and hydroelectric power generation was 104.4 billion kWh more than in fiscal 1990. Assuming the electricity was generated by thermal power, these figures correspond to 24.3 million kiloliters of crude oil. In effect, 8.9% reduction in Japan's primary supply of petroleum was achieved.

Results of efforts to suppress CO_2 emissions

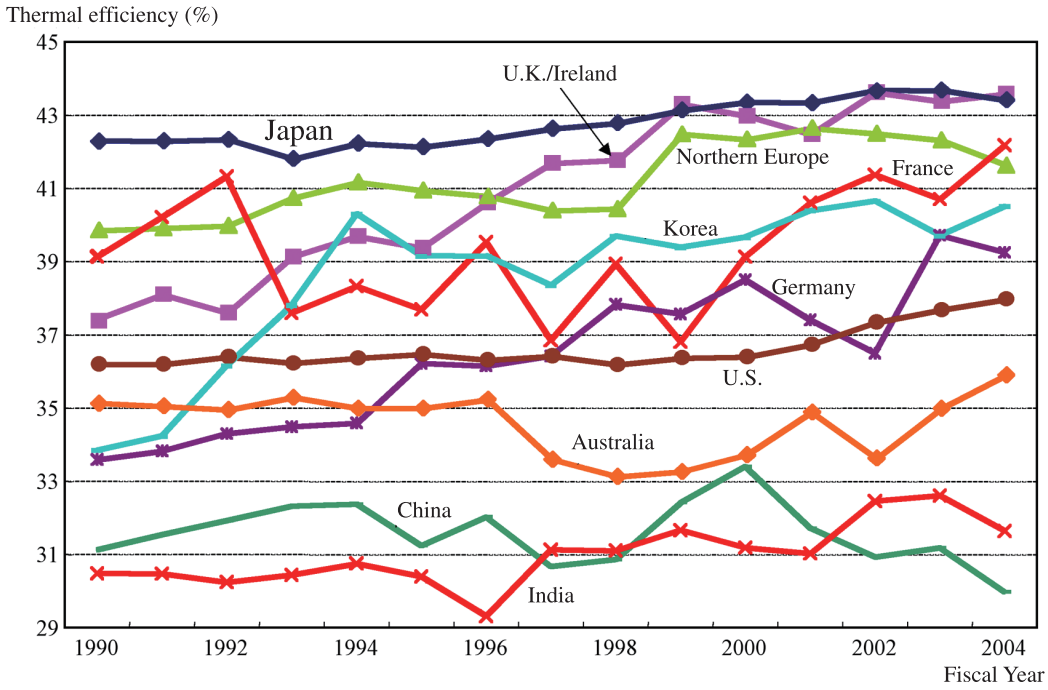


Reference

Country-by-country comparison of thermal power generating efficiency

Japan's electric utilities worked to maintain thermal efficiency through thermal efficiency management and efforts to further raise efficiency including increasing the combustion temperatures of gas turbines used in LNG combined cycle power generation and raising the temperature and pressure of steam in boiler and turbines. As a result, the thermal efficiency of Japan's thermal power plants is at the highest level in the world.

Comparison of thermal power plant efficiency in Japan with other countries



* Thermal efficiency is the gross generating efficiency based on the weighted averages of efficiencies for coal, petroleum and gas (lower heating value standard).
* Comparisons are made after converting Japanese data (higher heating value standard) to lower heating value standard, which is generally used overseas.The figures based on lower heating value are around 5 - 10% higher than the figures based on higher heating value.
* Private power generation facilities, etc. not covered.

Sources: INTERNATIONAL COMPARISON OF FOSSIL POWER EFFICIENCY, 2007 (Ecofys)

Reference

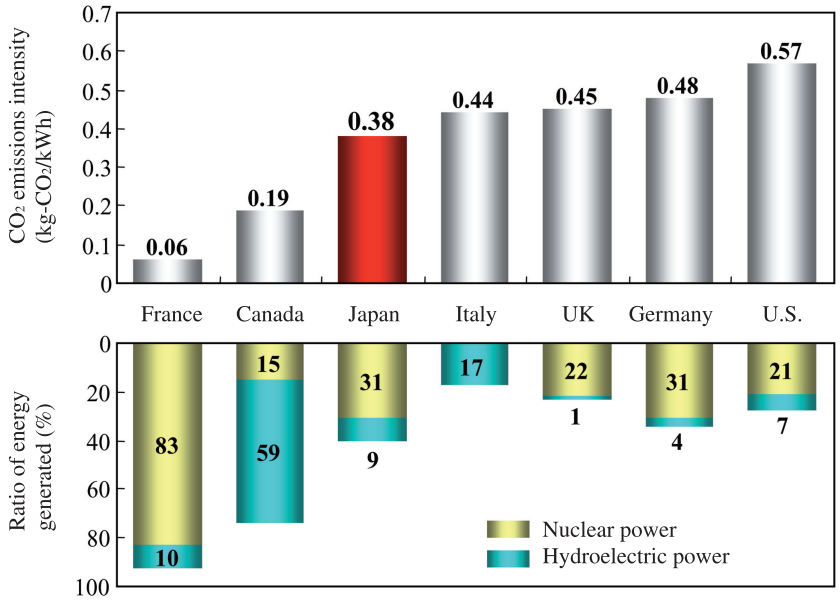
Country-to-country comparison of CO_2 emissions intensity (per unit of energy generated)

CO_2 emissions from Japan's electric utilities accounts for approximately 1.4% of the world total in fiscal 2004 and for about 28% of Japan's total CO_2 emissions in fiscal 2005.

However, CO_2 emissions per kWh of energy generated in Japan are low in comparison with major European and North American countries, although not as low as France (which has a high ratio of nuclear power generation) and Canada (a high ratio of hydroelectric 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 ratio of thermal, hydroelectric and other power sources.

Country-by-country comparison of CO_2 emissions intensity (per unit of energy generated) preliminary calculation by FEPC



* Fiscal 2005 figures
* Source: Energy Balances of OECD Countries 2004-2005
* Figures for Japan from FEPC survey

(iv) CO_2 Emissions Suppression Measures

Measures by the electric utility industry to suppress CO_2 emissions can be classified into 4 groups including "supply side" and "demand side" measures. Following is a summary of these groups.

<Supply-side measures>

- Expanded introduction of nuclear power generation, which emits no CO_2 to generate power, and of liquefied natural gas (LNG), which emits comparatively little CO_2 ; increased use of nuclear power generation
- Development and application of renewable energy sources such as hydroelectric, geothermal, solar, wind and biomass 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>

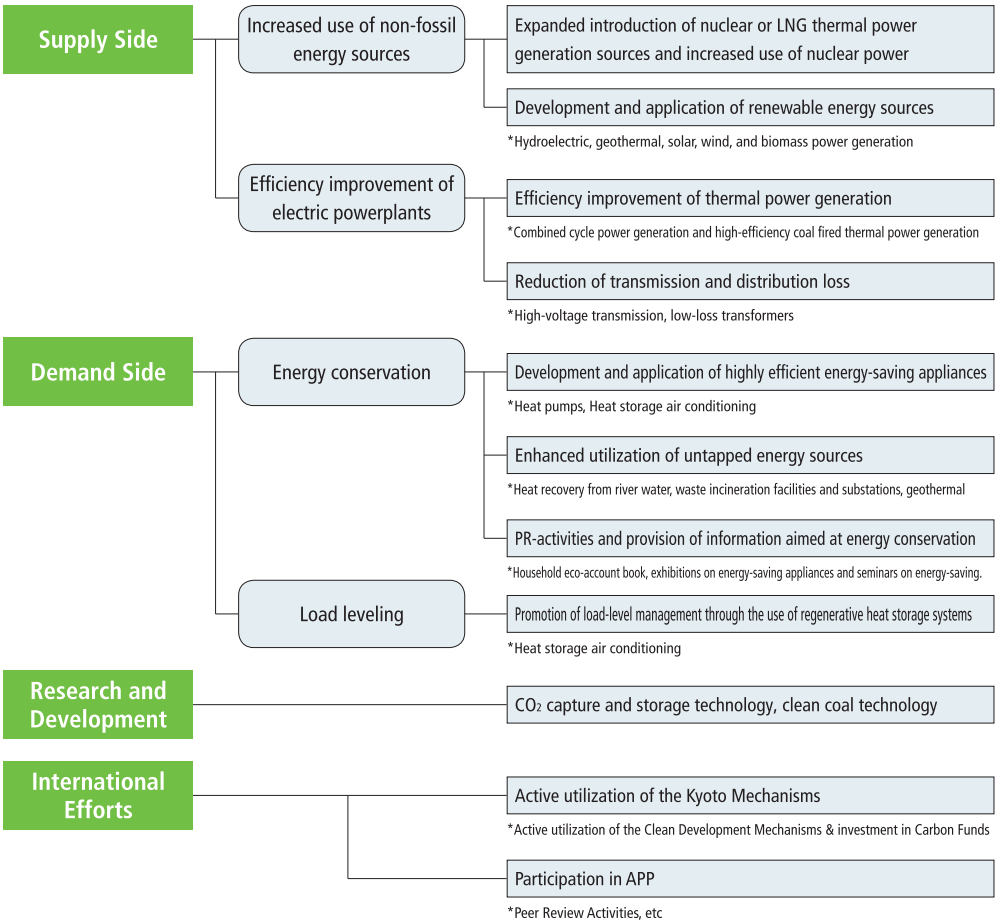
- Development and promotion of heat pumps and other highly efficient and energy saving devices. PR activities and provision of information on energy conservation measures for customers.
- Promotion of load leveling by the use of heat storage systems, etc.

<Research and development etc>

- CO_2 capture and storage technology, clean coal technology

< International efforts >

- Active utilization of the Kyoto Mechanisms
- Participation in the Asia-Pacific Partnership (APP)



a. Supply-side Measures

(a) Promotion of nuclear power on the precondition of ensuring safety and restoring trust

Nuclear power, which does not emit CO_2 in the course of generating electricity, is extremely important to the electric utility industry. We believe that it will play a central role in Japan's efforts against global warming in the future.

Nuclear power also is extremely important in the current Kyoto Protocol Target Attainment Plan for promoting measures to prevent global warming. It is positioned as a core energy source that the public and private sectors are cooperating in promoting. Also the importance of nuclear power that contributes to stable supply of energy and measures to prevent global warming is shown in the Japanese government's New National Energy Strategy formed in May 2006. It is also pointed out in the Basic Energy Plan which was revised and approved in the Cabinet in March 2007, and in "Becoming a Leading Environmental Nation Strategy in the 21st Century -Japan's strategy for a Sustainable Society," which was approved in June 2007. Thus, active use on nuclear power holds an important position in Japan's promotion of measures to prevent global warming.

The electric utility industry is making every effort to restore confidence in nuclear power and has made promotion of nuclear power its most important management issue. We will cooperate with the government to gain the understanding of local communities, local governments, and the Japanese people based on a policy of ensuring safety guarantees. Thus, we pour our greatest efforts into the following issues; "Promoting sites for nuclear power plants", "Raising the capacity factor", "Establishing a nuclear fuel cycle", "Setting up back-end measures".

We will also draw on our findings from the Niigata Prefecture Chuetsu Earthquake which occurred in July 2007 and work to further elevate trust towards earthquake-proof safety.

Furthermore, with respect to increasing the capacity factor, we will work to expand implementation of rated thermal power operation[3] (implementation is already complete at 90% of the nuclear power plants nationwide). At the same time, we will aim for intensive[4] use by means such as condition-monitoring maintenance, online maintenance, flexible operating cycles, and raised rated output. Those are actively implemented in other countries, and we are gaining the understanding of related authorities. That way we can take on improving maintenance and management technology, inspection technology, and safety assessment technology, thus further increasing the capacity factor.

3) A method of operation that keeps the thermal output of a nuclear reactor uniform through rating. The efficiency of the turbine increases when the temperature of the seawater is low, making it possible to produce more electricity. Formerly, plants were operated at lower thermal output when the temperature of the seawater was low, in order to keep electrical output uniform

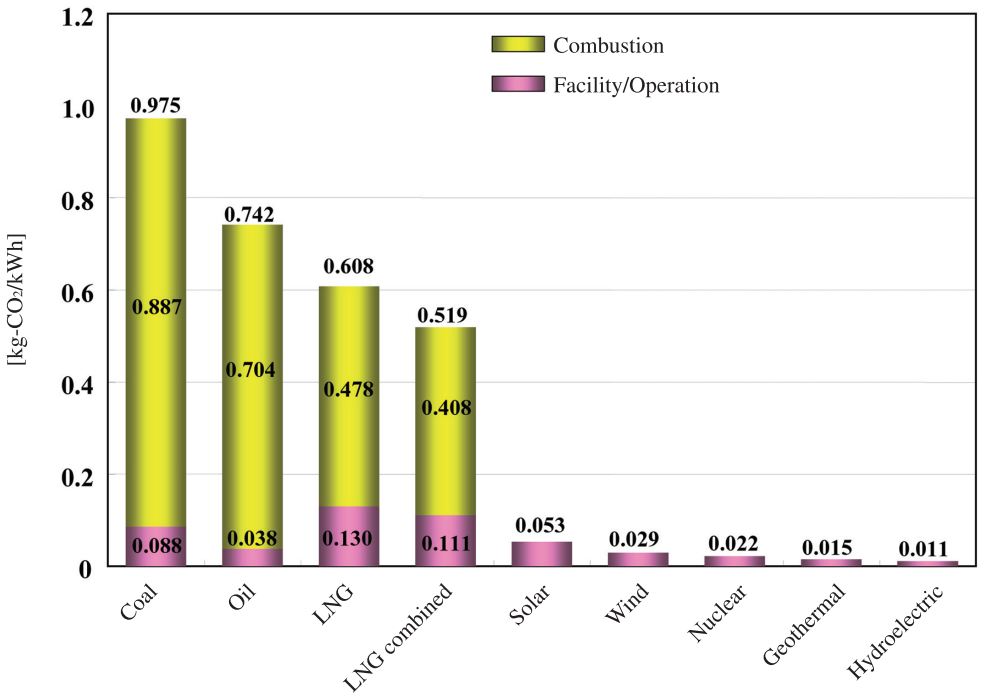
4) Other countries are moving from time-planned maintenance methods where machinery is disassembled and inspected at regular intervals to condition-monitoring maintenance methods where machinery operation data is monitored to find signs of trouble before disassembling and inspecting. Also, online maintenance where backup machinery is maintained during operations has been introduced, and operation cycles of 18 to 24 months of continuous operations are being flexibly employed. Increasing rated output for existing nuclear power plants is also being actively promoted. The result of achieving such intensive use has been high levels with capacity factors of 91.1% in the USA, 95.0% in S. Korea, 95.7% in Finland (2005 figures).
(Source: Japan Nuclear Energy Safety Organization "Status of Nuclear Facilities in Japan")

Reference

Lifecycle assessment CO_2 emissions intensity for Japan's energy sources

CO_2 emissions from nuclear power over the entire life cycle are as low as those from solar and wind power, even when comparing emissions of different energy sources in the stages of energy extraction, plant construction, transportation, refining, plant operation and maintenance. Thus, we see that nuclear power is an ideal source of energy for mitigating climate change.

Lifecycle assessment CO_2 emissions intensity for Japan's energy sources



* Based on total CO_2 emissions from all energy consumed in energy extraction, plant construction, transportation, refining, plant operation and maintenance, etc. in addition to burning of the fuel.
* 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_2 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 0.010 kg-CO_2/kWh.

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

(b) Efforts for helping to spread the use of renewable energy

Wind and solar power are clean and abundant energy sources. The electric utility industry has been cooperating with the Green Power Fund[5] (a program for individual consumers), and the Green Power Certificate System[6] (for corporate users) as part of a long-term effort to promote the use of renewable energy sources. Through the Green Power Fund, a cumulative 2.9 billion yen in subsidies has been provided for 902 cases of aid for new-energy generation facilities as of the end of fiscal 2006.

In addition, the Special Measures Law Concerning the Use of New Energy by Electric Utilities (RPS Law) mandates use of electricity such as that from new energy. The ten public electric utilities continued in fiscal 2006 to put great effort into securing use of the mandated volume of new energy. Last year, the mandated volume from fiscal 2006 to 2009 was raised, and this year it was set once again until fiscal 2014. We intend to continue to live up to our obligations.

The electric utility industry is also putting effort into the propagation and promotion of renewable energy. That includes setting up wind and solar power generation facilities and purchasing excess electricity from customers' wind and solar power generation facilities. We are also working on suppressing CO_2 emissions by mixing plant biomass and sewage sludge fuel in coal-burning thermal power plants.
However, energy sources such as wind and solar have low power density, are easily influenced by weather, and require high initial costs. Issues also remain in connection with wind power, such as the need to set up systematic links as storage batteries are needed due to high fluctuation in output, and we have to move toward solving these problems as well.

(c) 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 by intruding and expanding high efficiency facilities such as LNG combined-cycle plants when replacing aging thermal power plants and introducing new plants as improving the efficiency of thermal power directly helps to decrease CO_2 emissions intensity.

A balanced ratio of energy sources (coal, LNG, and oil) needs to be developed and used that takes into account supply stability and economic advantage and environmental impacts of each fuel. Of those sources, coal has a large supply with little deviation by region and a relatively stable price compared to other fuels. That makes it an excellent fossil fuel in terms of energy security and economic efficiency, and thus an irreplaceable energy securing stable supply of energy in the long term. For that reason, we are working to develop technology for integrated coal gasification combined-cycle (IGCC) power generation that will allow effective use of coal.
(IGCC proving tests scheduled to start in September 2007.)

The industry is also reviewing ways of managing thermal power sources that give consideration to the environment, based on fuel procurement and facilities operation restrictions and the need to ensure energy security.

5) An effort with participation by the public that aids construction of solar power plants for public use and wind power plants for environmental education purposes to promote further propagation of those energies. It is funded by donations by the public, which are matched by electric companies.

6) A system that gives substance to another value of electricity generated from renewable energy sources-the value of energy conservation (fossil fuel reduction) and CO_2 emissions reduction-through "Green Power Certificates." This is used as a self-motivated energy conservation and environmental protection measure by companies' customers.

b. Demand-side Measures

(a) Development and promotion of energy-conserving equipment

The electric utility industry has been actively working to develop and promote popularization of thermal storage systems, CO_2 refrigerant heat pump water heaters, and high efficiency commercial air conditioners that use heat pump technology. These technologies contribute to CO_2 emissions reduction by leveling the load through encouraging energy conservation and the nighttime use of electricity by customers.[7)]

7) The Kyoto Protocol Target Attainment Plan (approved by cabinet on April 28, 2005) notes the following target quantity.
Introduction of CO_2 refrigerant heat pump water heaters: approx. 5.2 million units. Introduction of high efficiency commercial air conditioners: approx. 12,000 units.

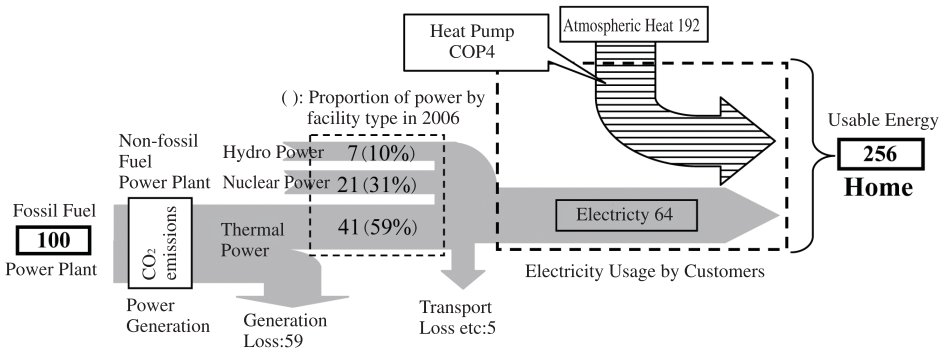
Reference

Efficient electric usage by customers

Perspectives and evaluations that follow the flow of energy from power plants to customer usage are effective in supporting the more efficient use of electrical energy. Given this perspective, promoting the popularization of high efficiency energy-saving devices is an important measure for users of electricity.

<Electricity: From the Power Plant to the Home>

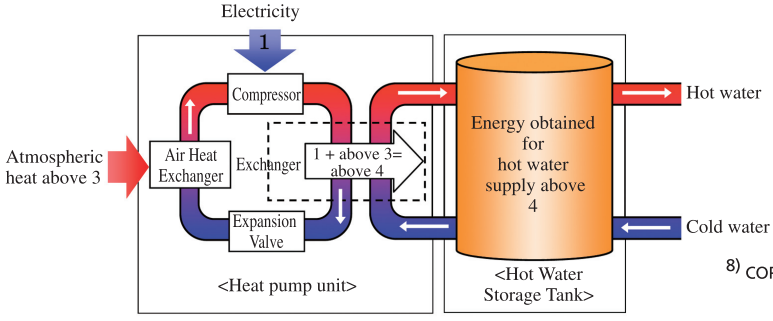
For example, 256 units of energy can be used with 100 units of fossil fuels by utilizing unused energy from atmospheric heat and other sources with a heat pump of COP 4.0 [8)]. (Sample provisional calculation)



<EcoCute Hot Water Supply System: CO_2 Refrigerant Heat Pump Hot Water Heater>

EcoCute is a hot water supply system that uses a CO_2 refrigerant heat pump to effectively incorporate heat from the air and use it as energy to heat water. Compared to conventional freon refrigerant, CO_2 refrigerant heat pumps have superior heating properties, so work is being done to extend their usage to hot water heaters. The EcoCute's average annual COP is above 4 (2006 model COP is 4.9 or greater), so it is extremely effective at conserving energy. CO_2 emissions are also reduced by roughly 50~60% compared to conventional combustion-based hot water heaters. The cumulative number of EcoCute systems introduced as of the end of 2006 has reached 830,000 units. That calculates out to approx. 600,000 t-CO_2 emissions suppressed.

1 (Electricity energy) + above 3 (Atmospheric heat) = above 4 (Energy obtained for hot water supply)



8) $COP = \frac{\text{Cooling or Heating Capacity (kW)}}{\text{Heat Pump Power Consumption (kW)}}$

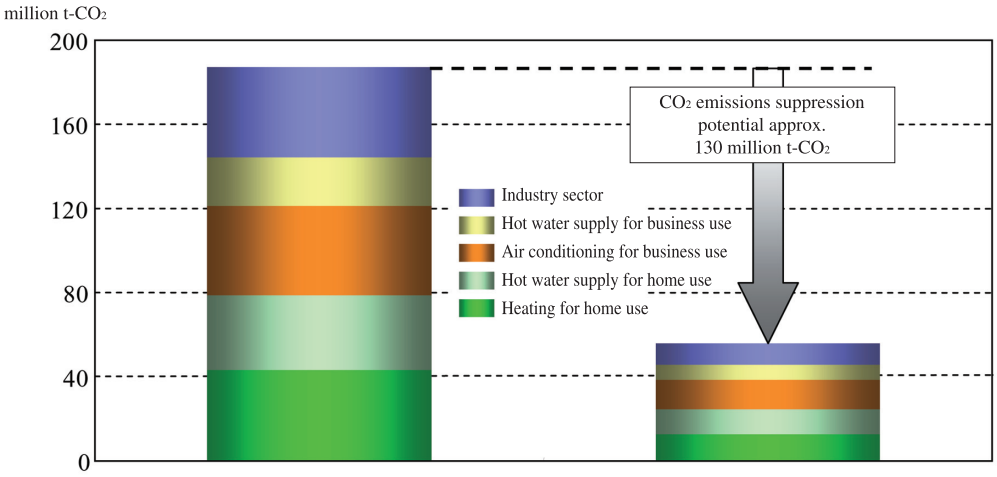
COP = (Coefficient of Performance)

Reference

Possibility for CO_2 emissions suppression through heat pump use

If heat pump systems are spread through air conditioning and hot water supply in the civilian sector (homes and businesses), and for heating & ventilation purposes such as warming and drying in the industrial sector, it would allow CO_2 emissions to be suppressed by approx. 130 million t-CO_2 per year. This is equivalent to approx. 10% of Japan's CO_2 emissions in fiscal 2005 (1,293 million t-CO_2).
(Calculations by The Heat Pump & Thermal Storage Technology Center of Japan)

Possibility for CO_2 emissions suppresion for home and business through heat pump use



CO_2 emissions with current systems (heating, hot water supply, air conditioning) (Fiscal 2002 results)

CO_2 emissions if heat pumps become popular in civilian and industry sectors.

Reference

Examples of CO_2 reduction and energy savings through implementation of high efficiency heat pump systems]

Implementation example	Overview
Implementation of high efficiency heat pump / heat storage system in new office building	Energy consumption reduced approx. 30% over no measures taken by implementing daylight use and solar shielding, high efficiency heat pump / heat storage air conditioning, and Building and Energy Management System (BEMS).
Implementation of high efficiency heat pump / heat storage system in district heating and cooling systems	CO_2 emissions intensity reduces approx. 60% by implementing heat pump and heat storage system that utilizes atmospheric heat and building exhaust heat.
Implementation of high efficiency heat pump in hotels	Annual reduction of 1,500 t-CO_2, 12% of energy consumption, and more than 100 million yen in energy costs by implementing high efficiency heat pump for hotel air conditioning.
Implementation of high efficiency heat pump / heat storage system in semiconductor plants	Shift from cogeneration to high efficiency heat pump/ heat storage system, resulting in 32% suppression in CO_2 emissions over before implementation.

Educational poster for Household Eco-Account book

(b) PR-activities and provision of information aimed at energy conservation

The Electric Utility industry also plans to actively roll out initiatives that contribute to the promotion of energy conservation by customers. These include providing information that helps customers in their energy saving activities and proposing measures through diagnosing their energy usage.

From this fiscal year we have positioned the promotion of our "Household Eco-Account book" as the approach for the whole industry, and decided to actively work to expand its use.

To date, the promotion of this Household Eco-Account book was carried out by each electricity company through their sales offices, web pages and meter inspection notices. From this year, as an activity in which the entire industry will participate in, we will create a poster to be displayed at all of the offices. Each company will make best efforts to expand employee participation, and actively seek customer participation.

Also in "Cool Earth 50" announced by Prime Minister Abe in May 2007, he proposed the development of a national movement with the motto "1kg of CO_2 reduction per person per day".

Perceiving the promotion of reductions in CO_2 by a national movement as an effective measure, and endorsing its motive, the Electric Utility industry has decided to carry out this movement. Through these kinds of activities, we hope this will help to "raise national consciousness" for the prevention of global warming.

Reference

Efforts in providing information on energy saving and CO_2 reduction to employees and customers

- Environmental education for employees through Environmental Trainer System and e-Learning
- Presenting energy conservation information to customers via a website, such as an energy saving level check and money saving tips for using and choosing home electronics.
- Introduction of energy saving ideas for the household by season, by passing out calendars and household bookkeeping ledgers with tips on saving energy.
- Holding exhibitions on energy- saving appliances and seminars on energy-saving.
- Visits to customers' houses and implementation of ampere measurement of electric devices, as well as contract/energy-saving advice.

c. Efforts in Research and Development

In response to the problem of global warming, the industry recognizes the necessity of a mid- to long-term vision, and is working on development of supply- and demand-side technologies as well as technologies for environmental protection. Specifically, we are working on R&D for technologies, which help customers conserve energy, capture and storage of CO_2 contained in the gases emitted by thermal power plants, and are related to nuclear power and for using forests as carbon sinks.

<Examples of efforts in technical development to solve the global warming problem>

● Technologies to allow efficient use of electricity

We are supporting and promoting further technical development of CO_2 refrigerant heat pumps that contribute to energy conservation and reduction of CO_2 emissions, to meet the target of 5.2 million devices installed by fiscal 2010. We are also working on making other types of heat pumps and technologies that use thermal & electric storage more efficient and compact.

● CO_2 capture and storage technologies

This technology is positioned as an effective innovative technology for preventing global warming, so we will promote research and development since it is considered to be one of the options needed by the Electric Utility industry to prevent global warming in the medium to long term. As for CO_2 capture technology, we will continuously work on its improvement, and development toward cost savings and reductions in energy loss. We will work on basic research and development into CO_2 storage technology, along with evaluating technical trends in Japan and abroad.

● Clean coal technology

Development of clean coal technology that efficiently uses coal — a fuel with stable supply and is economical — is necessary from a standpoint of ensuring energy security and protecting the environment. Thus we are working on integrated coal gasification combined-cycle (IGCC), an example of technologies to make next-generation coal-buring thermal power plants more efficient. Currently we are carrying out verification research on a half-scale (250 MW) proving plant. Operational tests to verify reliability, economic efficiency, and operation tests are scheduled to start from September 2007.

d. International Efforts

(a) Efforts to utilize the Kyoto Mechanisms [9)]

Promoting and utilizing the Kyoto Mechanisms holds an important position in the Kyoto Protocol Target Achievement Plan from the standpoint of Japan's contributions to preventing global warming. Thus the electric utility industry recognizes the importance of the Kyoto Mechanisms as measures that complement domestic policy because of their contribution to preventing global warming and their cost effectiveness in suppressing CO_2 emissions.

<Major activities of the electric utility industry>

- Conducting feasibility studies and projects overseas that help reduce greenhouse gasses, including biomass power generation, thermal efficiency improvement projects and afforestation projects.
- Providing investment to such entities as the World Bank s Carbon Fund and the Japan Greenhouse Gas Reduction Fund (JGRF) that Japanese industry participates in as one.

Of the investment in those activities, total investment in the Carbon Fund is expected to be approximately 28.5 billion yen.

The contribution in CO_2 reduction through efforts such as the Kyoto Mechanism above is affected by approval of the United Nations and host countries. However, it is forecasted to come to become around 70.0 million t-CO_2 by 2012.

We will continue to promote projects that utilize such efforts as the Kyoto Mechanism and afforestation, and will utilize CO_2 emissions suppressed by global warming prevention projects such as the Kyoto Mechanisms in achieving our targets.

Investments to major carbon funds

Fund	Expected investment
World Bank Prototype Carbon Fund (PCF) World Bank Community Development Carbon Fund (CDCF) World Bank BioCarbon Fund (BioCF)	60.5 million dollars (7.3 billion yen)
Japan Greenhouse Gas Reduction Fund (JGRF)	52.0 million dollars (6.2 billion yen)

Calculated as 1 USD=120 Yen

9) Refers to international emissions trading (ET), joint implementation (JI) and the clean development mechanism (CDM) stipulated in the Kyoto Protocol.

Examples of CO_2 reduction and absorption by electric utilities overseas

Project	Outline	Start period
Bhutan micro hydropower CDM project	UN CDM Executive Board approved CDM project to provide electricity to a region without it by constructing a micro hydro power plant	2003~
Fuel switch project in Chile	CDM project approved by the United Nations CDM Executive Board for switching fuel from coal and petroleum to natural gas at food production plants	2003~
Methane capture and combustion from swine manure treatment in Chile	CDM project to collect and combust methane released in the air from state-of-the-art animal waste facilities approved by the CDM Executive Board	2004~
Landfill gas reduction project in Brazil	CDM project approved by the CDM Executive Board for recovering and incinerating biogas emitted by waste disposal facilities, reducing greenhouse gases	2002~
China micro hydropower CDM project	CDM Executive Board approved CDM project to construct a micro hydro power plant and sell the power to a local electric power company	2003~
Biopower rice husk power project in Thailand	CDM Executive Board approved project to effectively use rice husks that are disposed of through combustion as fuel for power generation	2003~
Electric generation using palm frond biomass in Malaysia	CDM Executive Board approved project using palm fronds produced in palm oil manufacturing process as fuel for power generation	2006~
Hydroelectric plant regeneration project in Vietnam	CDM Executive Board approved project to regenerate the Son Mak power plant which is not producing electricity	2006~
Electric generation operation in Honduras using sugar cane residue	CDM Executive Board approved project for a biomass electric generation project using as fuel sugar cane residue (bagasse) generated in the sugar production process	2002~
Micro Hydro power project in Indonesia	Japanese government approved project to sell electric power to the Indonesian national power company, by generating hydro power from the unused pressure differential in irrigation canals	2008~
Afforestation business projects in Australia	Afforestation projects designed to preserve the world's forest resources and fix atmospheric CO_2	Implemented multiple times

(b) Participating in the Asia-Pacific partnership on clean development and climate

The Asia-Pacific Partnership on Clean Development and Climate, also known as APP, is a regional partnership by public and private sectors among the United States, Australia, China, India, South Korea, and Japan formally established at a meeting of Ministers in Sydney, Australia in January 2006. Its goal is to appropriately deal with the environmental pollution, stable supply of energy, climate change, and other problems arising with the increasing energy demand in the Asia-Pacific region.

Since the CO_2 emissions of the 6 participating countries exceed 50% of the total global amount and because striving to reduce the emissions of these 6 countries would have great significance, the Electric Utility industry is actively participating in these activities.

Reference

1st Peer Review for the maintenance & improvement of thermal efficiency in aged coal-fired power stations. [10)]

From the 16th - 20th of April 2007, the First Peer Review for the maintenance & improvement of thermal efficiency in aged coal-fired power stations was held at J-Power Co's Takasago Thermal Power Station and Tokyo Electric Power's Hitachinaka Thermal Power Station under the joint sponsorship of the Ministry of Economy, Trade and Industry and the FEPC.

Through future peer reviews best practice in ownership and maintenance can be carried out and spread to participating APP countries, and we anticipate improved efficiency from power plants where efficiency has declined since commencing operation. Power plants that have already achieved high efficiency should be able to prevent reductions in efficiency in the future.

In the case of preliminary calculations assuming an improvement in efficiency by 1%, or prevention of reduction in efficiency by 1%, we could expect a suppression of 120 million t-CO_2 throughout all the nations participating in the APP.

The First Peer Review (Takasago Thermal Power Station)

Group Discussion

On-site discussion

(The Federation's web site: http//www.fepc.or.jp/env/warming/007.html)
(APP website: http://asiapacificpartnership.org/)

10) Peer reviews are composed of open discussions between power generation engineers based on continuous visits to power generation plants in APP participating countries. Power engineers from APP participating countries aim to share best practices in the operation & maintenance of aged coal-fired power stations that have been operating for a similar number of years, through activities such as the creation of checklists of items related to improving efficiency & handbooks for the involvement of peer groups.

e. Other Efforts

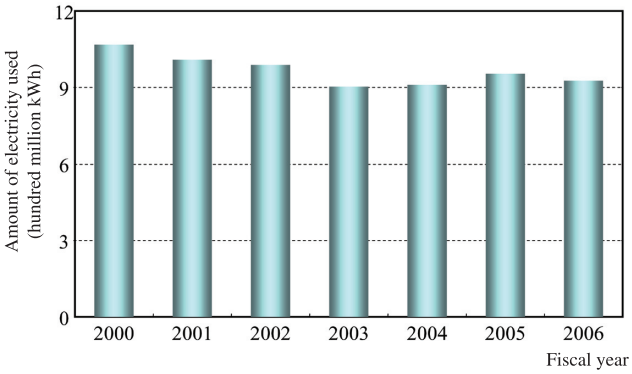
CO_2 emissions from the civil and transport sectors are on the rise, requiring immediate measures.

Since 2000, the electric utility industry has been implementing measures to reduce consumption of electricity for offices (classified as civil business sector) and of fuel for its own transport (classified as transport sector) that it intentionally is involved in. Each company has set targets, and in this way is making efforts to suppress CO_2 emissions.

(a) Electric utility industry efforts in office use

Total electricity used in company facilities such as head offices, branches, and sales offices for fiscal 2006 was 930 million kWh (equivalent to 380,000 t-CO_2 emissions) in the whole electric utility industry. That means since fiscal 2000 approximately 140 million kWh (approximately 13%) has been reduced. This is a reduction of approximately 20,000 t-CO_2 when viewed in terms of CO_2 emissions.

Trends in amount of electricity used in offices



Major efforts

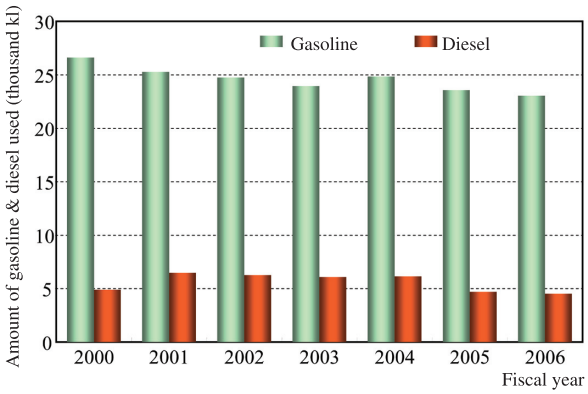
Major targets (specific targets are set by each company)
❖ Reduction in electricity usage ❖ Reduction in the amount of copy & printer paper purchased and used ❖ Reduction in water usage ❖ Construct an environmental management system in each company's facilities, and set targets for each workplace

Details of specific efforts
❖ Participation in the Team Minus 6% project ❖ Efficient operation of air conditioning (thorough temperature control, reduced usage time, etc.) ❖ Turning off lights at lunch and after hours, less use of lighting; Reduced usage of elevators by promotion of using stairways ❖ Switching office appliances and lighting equipment to energy-conserving models, and turning off power supply when not needed. ❖ Energy management in company-owned buildings ❖ Introduction of ice thermal storage system air conditioning Introduction of ice thermal storage system air conditioning ❖ Introduction of highly efficient water heaters for commercial use ❖ Introduction of solar power generation equipment ❖ Restriction of flow by tightening water valves ❖ Application of shielding films to windowpanes

(b) Efforts in the use of company-owned vehicles

Total use of fuel (gasoline, diesel) for company-owned vehicles in fiscal 2006 was 28,000 kl(equivalent to 66,000 t-CO_2 emissions) in the whole electric utility industry. That means since fiscal 2000 approximately 4,000 kl (approximately 12%) has been reduced.
This is a reduction of about 10,000 t-CO_2 when viewed in terms of CO_2 emissions

Trends in the amount of fuel used by company-owned vehicles



Major Efforts

Main Targets (specific targets are set by each company)

- Reduction in the amount of fuel used by vehicles
- Improvement in the rate of introduction of fuel efficient vehicles
- Implementing a day when use of private cars is discouraged

Details of Specific Efforts

- Introduction of low-polluting & fuel efficient vehicles such as electric vehicles and vehicles using clean energy
- Enforcing fuel-efficient driving
- Driving with correct tire pressure
- Enforcing the turning off of idling engines when stopped
- Efficient vehicle use (confirming route beforehand, implementation of carpools)
- Making logistics more efficient through concentrating coal centers and using larger coal transport vessels. 5,600 t-CO_2 reduced annually
- Making distribution more efficient through joint delivery amongst all group companies, resulting in 20% reduction in the number of trucks

Reference

Efforts in forest utilization and management

The electric utility industry is cooperating with afforestation and forest management activities in various locations including management of company-owned forests and greenery at power plants.

<Examples of forest preservation and planting efforts>

- Forest management and preservation in Oze-Tokura Mountain Forest (18,200 hectares)
- "Invitation to the Forest" forest activity with participation by the public utilizing company-owned forests
- 1 million tree planting (Kyushu Homeland Forestation Program)
- Environmental tree planning program (approx. 100 hectares)

(v) Future Efforts and Issues

The targets of the environmental action plan by the Japanese electric utility industry were set factoring in utmost effort of the industry based on a review of supply and demand at the time of its establishment in 1996, the nuclear power development plan, and other issues. Target values set are among the highest in industry, and we recognize that it will be a challenge to meet those.

At the end of last year, in cooperation with the Japan Business Federation, it was decided to extend the year for achievement of the targets in the voluntary action plan to match the first commitment period of the Kyoto Protocol. As a result our target has become more challenging.

Even in the midst of this situation, the electric utility industry has adhered to initial targets by adding new measures such as improving facility usage rates for nuclear power plants through various inventive modifications, developing and popularizing energy saving devices, actively utilizing the Kyoto Mechanisms by participating in CO_2 reduction projects. And we are considering and aggressively pushing forward with both supply-side and demand-side initiatives.

The industry plans to steadily implement existing measures and commit its full efforts to achieve its objective by further strengthening the following initiatives[11] in order to improve effectiveness.

- **Promotion of nuclear power on the precondition of ensuring safety and restoring trust**
- **Further improvement of the efficiency of thermal power generation and review of methods for managing thermal power sources**
- **Active utilization of the Kyoto Mechanisms, etc.**

11) The Kyoto Protocol Target Attainment Plan (approved by the cabinet on April 28, 2005) notes the following.
- ◉ Electric energy sector CO_2 emissions intensity reduction: Follow up on voluntary target achievement through the following approaches by the industry.
  - ▶ Increase of capacity factor of nuclear power facilities through scientific, rational operations management.
  - ▶ Further improve thermal efficiency in thermal power generation and arrangement of thermal power source operation methods, taking into account environmental characteristics.
  - ▶ Gain credit (emissions reductions) in the Kyoto Protocol by the industry's use of Kyoto mechanism.

- Zanpa Shiosai no Mori forest restoration
- Presenting seedlings to customers (schools, etc.) for planting
- Participation in afforestation volunteer programs
- Management of company-owned forests for water source cultivation
- Setting of forest preservation policies

<Examples of using domestic materials>

- Use of wood from thinned forests in environmental reports and business cards
- Research in effective use of carbonized bamboo
- Utilization of driftwood (construction material and gardening materials)

(3) Measures to Suppress Greenhouse Gas Emissions Other than CO_2

The combined effect on the climate of five greenhouse gases other than CO_2 emitted by the electric utility industry is about 1/370 of that of CO_2. The industry has been putting great effort into suppressing emissions of these gases through the measures described next.

(i) Sulfur hexafluoride (SF_6)

SF_6 is a gas with superior insulation and arc suppressing properties that is safe to humans and is stable. The electric utility industry uses SF_6 for gas blast circuit breakers and gas-insulated switches. The gas is essential for stable electric power supply in Japan with its small land mass as SF_6 allows for equipment to be constructed compactly, it is safe, and is sustainable. While SF_6 has been indicated to be a gas with high greenhouse effect properties, the industry plans to continue using it as no effective alternate gas is known at this stage.

Although the electric utility industry must continue to use SF_6, we adopted the Voluntary Action Plan of the Japanese Electric Utility Industry to Reduce SF_6 Emissions in April 1998 that takes into account suppression of SF_6 emissions to the atmosphere and recycling. Under this plan, the industry has worked to suppress emissions by 2005 to 3% of SF_6 contained when devices are inspected, and to 1% when they are disposed of. Through these continuous efforts targets have been met in the 2004 and 2005 results. In 2006 the ratio of 2% during disposal was just slightly over target, despite meeting targets during mechanical inspections. The industry aims to continue to meet its targets by continuing its efforts in this area.

These initiatives have earned FEPC, along with the Japan Electrical Manufacturers' Association (a group of electrical equipment manufacturers) and the Japan Chemical Industry Association (whose members manufacture SF_6 gas) the Minister of Economy, Trade and Industry's Award at the Ozone Protection and Global Warming Prevention Awards (sponsored by Nikkan Kogyo Shimbun). This honor indicates the high regard for the total effort to suppress emissions across different industry sectors.

(ii) Hydro fluorocarbon (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) Per fluorocarbon (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_2O)

N_2O emissions occur at thermal power plants due to the combustion of fuels. N_2O emissions by the electric power industry account for about 2.4% of total N_2O emissions in Japan. The industry is making the utmost effort to reduce its emissions, primarily by improving thermal efficiency.

(v) Methane (CH_4)

The concentration of CH_4 in flue gases emitted as unburned combustible content in the burning of fuel at thermal power plants is less than the concentration in the atmosphere, meaning emissions are essentially zero.

(4) Response to the Problem of Global Warming from a Long-term Perspective

In responding to global warming, a long-term perspective and global initiatives are essential. With next year being the first commitment period of the Kyoto Protocol, in Japan the plan for achievement of Kyoto Protocol targets is being reviewed. Internationally, specific "Post-Kyoto Protocol" discussions are being held, such as the United States' agreement to participate in discussions about the next framework, held in June at the G8 summit in Germany.

In these circumstances, considering that it is an important stage for deciding the future framework for measures to combat global warming, the electric utility industry made proposals to the government in April this year. These proposals included "We should aim to construct a framework that all countries can participate in, including the U.S., China and India." and "If we consider that CO_2 emissions are inseparable from energy supply & demand, we should implement thoroughly an international approach which determines the energy efficiency index for each sector based upon that sector's special characteristics, and aim to set targets that come from balanced effectiveness."

Electricity is indispensable for sustainable socioeconomic development, and with environmental measures is a valid form of energy. The electric utility industry has a corporate social responsibility to make maximum efforts from 2013 onwards to prevent global warming and construct a sustainable society.

We in the electric utility industry will continue to go forward with proactive measures to prevent global warming, centering on the following 4 activities that make use of our industry traits.

● Promotion and effective use of nuclear power

- As the most effective measure for global warming, nuclear power is the trump card for simultaneously achieving **economic growth**, **energy security**, and **environmental protection**. Thus, we are working to promote use of nuclear power as well as to establish a nuclear fuel cycle.
- We will utilize new and existing facilities as efficiently as possibly by raising the capacity factor.

● Contribution toward the shift to a low-carbon society

- We will contribute to the ever more efficient use of energy by our customers through the development and promotion of high-efficiency heat pump devices, provision of energy conservation information and diagnosis of energy usage.

● Active support for other countries

- We will contribute to preventing global warming on a global scale, by carrying out international cooperation through initiatives such as the Asia-Pacific Partnership on Clean Development and Climate (APP) and technology transfer to developing countries.

● Development of innovative technologies

- We are contributing to the growth and achievement of technical development in areas such as supercritical thermal power, integrated coal gasification combined cycle and CO_2 capture & storage technologies.

2 Establishing a Recycling-based Society

Contemporary Japan is promoting the 3Rs of "reduction, reuse, and recycling" to form a recycling-oriented society with less burden on the environment.

In 2007 there are also plans to review "The Fundamental Plan for Establishing A Sound Material-Cycle Society" which is the basis for Japan's waste & recycling policies

*The Fundamental Plan for Establishing A Sound Material-Cycle Society was established based on the Fundamental Law for Establishing A Sound Material-Cycle Society to comprehensively and systematically promote measures related to the formation of a sound material-cycle society.

In light of this situation, the electric utility industry has been voluntarily working toward the achievement of such a recycling-based society. It is promoting more effective use of resources by recycling waste products[12] 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 power plants, construction waste materials such as 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 volume of waste generated has been increasing as the total amount of power generated is rising with the growth in electricity demand. This figure of the volume is expected to climb to 9.6 million tons in fiscal 2010, almost 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 of waste reduction and recycling.

(i) Waste Recycling Rate Targets

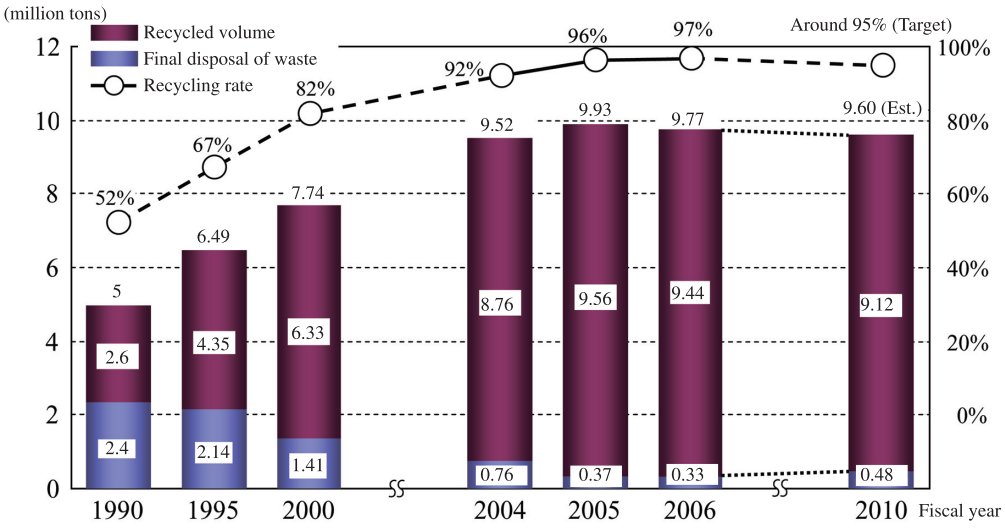
The electric utility industry has been working on waste reduction with an initial target of keeping final disposal amount less than 2.4 million tons, or fiscal 1990 levels. But, with the promotion of 3R activities, we reduced the target to 2.0 million tons, and then to 1.5 million tons. Also, since fiscal 2005 we have targeted at 90% recycling rate as an index which is not significantly influenced by fluctuations in electricity demand. Then in fiscal 2006, having revised the target value to 5 points higher, we aim to maintain our waste recycling rate for fiscal 2010 at around 95%.

Through fiscal 2010, we aim to maintain our waste recycling rate at around 95%.

(Final waste disposal amount is estimated to be 0.48 million tons at the target recycling rate.)

12) Waste products include those defined as industrial waste (defined under Waste Management and Public Cleaning Law, 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.

Waste recycling rate targets for the electric utility industry



* The place of disposal after final disposal (disposal in landfills) is utilized as land for power generation facility expansions or other industrial land uses. Some of the coal ash used there is counted from fiscal 2004 as recycled as land development material according to government interpretation.

(ii) Fiscal 2006 Waste Recycling Results

Waste generated by the industry amounted to 9.77 million tons in fiscal 2006, a decrease of 0.16 million tons from the fiscal 2005 level. This is because the amount of power generated from coal-fired thermal power plants decreased. On the other hand, the recycled volume has decreased by 0.12 million tons from the previous year to 9.44 million tons. The result is that a recycling rate of 97 was achieved in fiscal 2006, a 1% increase over fiscal 2005.

Coal ash makes up the greatest part of the waste, accounting for 7.05 million tons. Of that, 6.83 million tons are recycled, mainly as raw material for cement and admixture for concrete, or as land development material.

Renewed resources are produced from nearly all of the total scrap metal and the construction waste material 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.

Trends in reutilizing major types of waste and byproducts

(10,000 tons)

Type			Fiscal 1990	Fiscal 2004	Fiscal 2005	Fiscal 2006
Waste	Combustion residue, dust and soot (Coal ash)	Volume generated	347	697	724	705
		Recycled volume (Recycling rate)	137 (39%)	631 (91%)	697 (96%)	683 (97%)
	Construction waste material	Volume generated	40	36	36	42
		Recycled volume (Recycling rate)	21 (53%)	35 (98%)	35 (97%)	41 (97%)
	Scrap metal	Volume generated	14	17	19	20
		Recycled volume (Recycling rate)	13 (93%)	16 (98%)	18 (99%)	19 (98%)
Byproducts	Gypsum from esulfurization process	Volume generated	85	183	190	187
		Recycled volume (Recycling rate)	85 (100%)	183 (100%)	190 (100%)	187 (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 1,000 tons.)

(iii) Future Efforts to Promote 3R

The electric utility industry continues to work on the following issues in order to form a recycling-based society.

- Coal ash:
  Recycling of coal ash remains an important issue, thus we are working on the development of applications and technology to handle large volumes of coal ash in a stable manner.
- Desulfurized gypsum:
  We will maintain 100% recycling rate.
- Other wastes:
  Actively implement 3R.

Examples of reuse

▶ The industry is working on maintaining and improving thermal efficiency in thermal power plants to reduce generation of coal ash and other waste products.

Examples of reuse

- New reusable steel containers were developed to replace wooden crating materials for transport of switchboard. In addition to being reusable, they improve work efficiency for installment switchboard.
- Some of the insulation material attached to gas turbine equipment exhaust duct is being reused.
- Wooden drums for power line packing are recycled and modified for reuse as planters and other products.
- Power meters that have passed their rated lifespan are inspected and repaired then reused as meters after receiving certification.

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 oil ash 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
Waste plastic		Raw material for plastic
Gypsum from desulfurization process (byproduct)		Gypsum board material and raw material for cement

* Examples of Reuse & Recycling appear in the following sections

(iv) Increased Utilization of Reused and Recycled Products

Recognizing that the use of environmentally friendly products in addition to going forth with 3R for waste products and recycling resources is critical to forming a recycling-based society, the electric utility industry has been actively working to promote green purchasing and to expand the use of reused and recycled products.

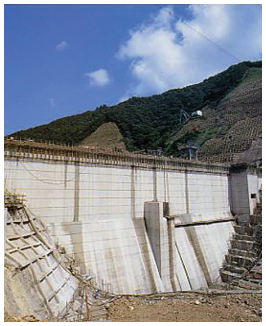
Reference

Specific examples of recycling (partial)

Coal ash (Fly ash)

Coal ash from coal-fired thermal power plants
(Photo: Fly ash. Fly ash is collected by electric dust catchers, making fine round particles.)

Use as admixture for concrete



Fly ash is used in dam constructions because when fly ash is mixed, uncracked concrete with increased strength and water-tightness is produced.

Use as spray material

Replacing some of the material used in sprayed concrete for tunnel construction with fly ash reduces spattering when spraying, achieving conservation of materials and less dust, thus improving the work environment.

Use as concrete secondary products

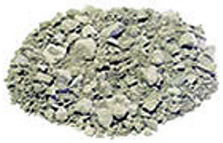
By mixing fly ash in cement, the amount of cement used can be reduced and concrete products with superior characteristics such as increased strength produced (Photo: Wave-dissipating blocks.)

Use as material for artificial zeolite

Artificial zeolite is made from alkali-treated coal ash and utlilized as deodorant filters for air cleaning devices for home usage and as soil improvement material.

Coal ash from coal-fired
(Fly ash)

Use as substitute for gravel



Recycled by mixing coal ash and cement with water and additives, and used in construction as a substitute for gravel.

Use as fertilizer

We develop and distribute a potassium silicate fertilizer that uses coal ash as its main ingredient

Use as a structural material for concrete used in bank protection works

It is being used as a structural material for bank protection works. Also, because it has the effect of absorbing eutrophic xubstances it can be used to improve the water quality of waterways and to improve sedimentary layers.

Coal Ash (Clinker Ash)

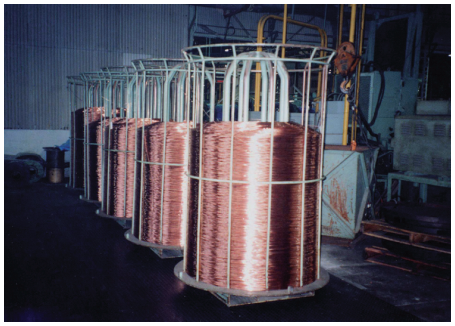
Coal ash from coal-fired thermal power plants
(Photo: Clinker ash. Clinker ash is pulverized from the lumps of ash that fall to the bottom of boilers.)

Use as water-retentive blocks

These are being used to make comfortable streetscapes because they have the ability to retain water which reduces increases in the temperature of paved surfaces, and because its exceptional ability to absorb water prevents puddles forming when it rains.

Scrap metal

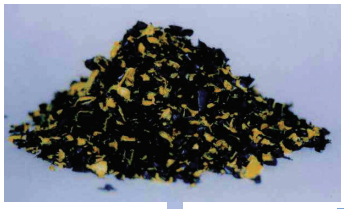
Old, replaced copper and aluminum power lines are cut up, crushed, and separated by material.



Recycle as metal materials (Photo: Recycled power lines)

Waste plastic

Old, replaced polyethylene branch line guards.



Plastic covers are separated by material, crushed, cleaned, and recycled as raw material (repelleted).

Recycle as raw material for plastic (Photo: Support wire guard.)

Gypsum

Gypsum removed from thermal power plant fuel gas desulfurization equipment (byproduct)

(To extract sulfur oxides in exhaust fuel gas, lime and sulfur oxide are made to react, and SOx is removed as gypsum.)

Recycle as raw material for gypsum board and cement

(Photo: Gypsum board)

Waste concrete pillars

Discarded concrete poles from power distribution works are cut and pulverized to be recycled as foundation materials for public buildings

Others

Mussels and other shellfish attached to power plant cooling troughs

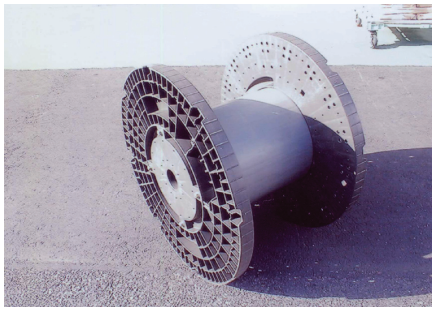
Shellfish undergo interim processing such as composting or incinerating.

Reuse after interim processing as fertilizer, soil enhancement material, cement raw material, etc.
(Photo: fertilizer)

Reference

Specific examples of reuse (partial)

Drums used for power distribution lines



Drums used for distribution lines have been changed from wood to a lightweight resin that can be re-used

Steel containers for the transportation of switchboard

New reusable steel containers were developed to replace wooden crating materials for transport of switchboard.

(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 2007. 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 Power Facilities

The Nuclear Reactor Regulation Law was revised in the 2005 ordinary session of the Diet.Under that revision, waste from nuclear facility demolition and operation that has extremely low levels of radiation and of which the effects on humans can be disregarded can be classified as "that which does not need to be treated as radioactive waste" (hereafter, "cleared substances"), upon receiving strict governmental confirmation of measurement and judgment results. It can then be treated the same as normal valuable resources or waste.

The electric utility industry is working to actively make use of scrap metal and wasteconcrete from nuclear facilities as recyclable resources that have been confirmed by authorities to be cleared substances in line with the revised law. Until the system for cleared substances takes firm hold in society, the electric utility industry will transport such waste to disposal companies and disposal facilities only upon their understanding that it came from nuclear facilities. Furthermore, we will take the initiative ourselves in reuse of that material.

3 Management of Chemical Substances

(1) Volume of Chemical Substance Release

The electric utility industry has carried out PRTR Law (Law Concerning the Reporting, etc. of Releases to the Environment of Specific Chemical Substances and Promoting Improvements in Their Management) 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 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. Release and transfer volumes for fiscal 2006 are shown in the table below. The majority of emissions into the environment are emissions into the air from painting, while the majority of transported waste is processed asbestos from removing products containing asbestos and processed waste oil from replacing turbine control oil.

Total release and transfer of chemical substances (Results for fiscal 2006)

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	0	0	0	0	4,700	Feed water-processing agent
26	asbestos	0	0	0	0	0	150,000	insulating material, sealing material etc.
30	Bisphenol A type epoxy resin	140	0	0	0	0	0	Used in painting
40	Ethylbenzene	48,000	0	0	0	0	100	Used in painting
43	Ethylene glycol	3,900	0	0	0	0	0	Heat-source water for heat supply
63	Xylene	140,000	0	0	0	0	680	Used in painting,power-generation fuel
121	Dichlorodifluoromethane (CFC-12)	500	0	0	0	0	0	Air conditioning refrigerant
124	2,2-dichlo-1,1,1 Trifluoromethane (HCFC-123)	1,300	0	0	0	0	0	Air conditioning refrigerant
144	Dichloropentafluoropropane (HCFC-225)	10,000	0	0	0	0	0	To launder clothing
162	Dibromotetrafluoroethane (Halon 2402)	2,000	0	0	0	0	1,800	Fire extinguishing material
177	Styrene	15,000	0	0	0	0	4,400	Used in painting,Plastic fixation agent
179	Dioxins	12	0.057	0	0	0	26	Waste incinerators
227	Toluene	16,000	0	0	0	0	4.6	Used in painting,power-generation fuel
253	Hydrazine	11	2,500	0	0	0.8	890	Feed water-processing agent
286	Bromo-trifluoromethane (Halon-1301)	0	0	0	0	0	1,200	Fire extinguishing materia
299	Benzene	150	0	0	0	0	0	Power-generation fuel, Painting
307	Poly-alkyl ether	0	0	0	0	0	9,200	Anti-scattering agent for coal storage
311	Manganese and its compounds	0	310	0	0	0	1,700	Wastewater treatment agent
353	Tris phosphate (dimethyl phenyl)	0	0	0	0	0	19,000	Turbine control oil

* Chemical codes represent the number assigned to each chemical under the PRTR Law.
* Volume transferred is the amount transferred from the plant for processing as waste, etc.
* 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 Reduce Chemical Substance Release

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, etc. 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 from painting instruments, piping and other materials by reducing painting frequency, shifting to paints with lower proportions of such substances and other measures.
- The industry thoroughly controls the combustion waste incinerators to minimize the amount of dioxins emitted from them. Dioxin emissions have also been reduced by reusing waste in order to limit the use of incinerators or to shut them down to the extent possible.
- New use of asbestos is prohibited by law. We are working to identify the situation surrounding asbestos currently in use, and are going forward with appropriate processing and systematic removal.

4 Promotion of Environmental Management

Members of the electric utility industry have established environmental departments and set up in-house environmental management systems. They have reported on their environmental protection efforts through CSR reports and websites.

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.

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 long trained personnel in environmental fields by accepting trainees from developing countries and providing technical assistance by dispatching specialists from Japan. With regard to participation in projects overseas and technology collaborations, the industry has conducted initiatives in consideration of local environmental issues and global-scale environmental preservation. These include biomass power generation, reforestation and measures to reduce the environmental impact of thermal power plants.

The electric utility industry plans to continue to aggressively promote these kinds of initiatives that give adequate consideration to the environment.

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