# Measures by the Electric Utility Industry to Suppress $CO_2$ Emmisions

Efforts for environmental conservation including countermeasures against global warming, creating a recycling-based society and managing chemical substances, are key challenges for the electric utility industry. In particular, emissions of carbon dioxide ($CO_2$), a major cause of global warming, are closely related to energy utilization in economic activities and daily life, and so the reduction of $CO_2$ emissions is a major challenge for the industry.

With the major assumption of a stable supply of high-quality and inexpensive electricity to customers, the electric power companies are making the necessary efforts on both the supply and demand sides of electricity including supplying low-carbon energy, and improving/promoting high-efficiency electrical devices to enhance the efficient use of electricity by customers. The companies are also conducting various projects for R&D and international cooperation.

$CO_2$ emissions accompanying electricity consumption may increase or decrease depending on various conditions such as weather and the status of electricity use by customers, which cannot be controlled by the utilities themselves.

Therefore, the electric utility industry is striving to achieve the voluntary target of reducing the $CO_2$ emissions intensity (emissions per unit of user end electricity) averaged over the five fiscal years from 2008 to 2012, by approximately 20% from the level in FY1990 (to approximately 0.34 kg-$CO_2$/kWh) by using the $CO_2$ emissions intensity that the electric utilities can affect by their own efforts.

The user-end $CO_2$ emissions intensity for FY2011 was 0.476kg-$CO_2$/kWh, up 14% from FY1990 levels. This is attributed to the increase in thermal power generation due to the long-term shutdown of nuclear power stations after the Great East Japan Earthquake and tsunami.

## Decarbonization of Energy at Supply-side (Lowering of $CO_2$ emissions intensity)

**Expanding use of non-fossil energy sources**
- Promotion of nuclear power generation based on the premise safety assurance
- Development and expansion of use of renewable energy sources
  Hydroelectric, geothermal, solar, wind, and biomass power generation

**Improving efficiency of electric power equipment**
- Further improvement of thermal efficiency of thermal power plants
  Introduction of LNG combined-cycle power plant, Improvement of thermal efficiency of coal thermal power plants
- Reduction of transmission and distribution loss
  High-voltage transmission, low-loss transformers

**International efforts**
- Active utilization of the Kyoto Mechanisms
- Sectoral approaches
  International Electricity Partnership (IEP), etc

## Improvement of the Energy Usage Efficiency at Demand-side

**Energy conservation**
- Electrification promotion, energy conservation and expansion of high efficiency electric equipment
  Heat pumps, heat storage air conditioning, electric vehicles, and others
  Participation in energy saving and $CO_2$ reduction activities by utilizing the domestic credit system
- Utilization of untapped energy sources
  Heat recovery from river water, waste incineration facilities and substations
- PR-activities and provision of information aimed at energy conservation and $CO_2$ reduction
  Household eco-account book, exhibitions on energy-saving appliances and seminars on energy-saving
- Load leveling promotion such as with heat pump & thermal storage systems
  Thermal storage type air conditioning/hot-water supply, etc

**Efforts by electric utility industry as users**
- Efforts in office-use energy conservation and the use of company-owned vehicles
  Reduction of amount of power consumption
  Introduction of electric vehicles and fuel-efficient vehicles

## Research and Development

**Research and Development**

Supply-side
- Clean coal technology, next-generation electric power transmission and distribution technology(Smart Grid), $CO_2$ capture and storage technologies

Demand-side
- Ultra-high efficiency heat pump, electric vehicle technology,etc



# Decarbonization of Energy on the Supply-side

### *Promoting nuclear power generation assuming safety, and improving the thermal efficiency of thermal power plants further*

Nuclear power emits no carbon dioxide ($CO_2$) in the process of power generation, and even considering $CO_2$ emissions over the entire life cycle of various energy sources, those from nuclear power are lower than those from thermal power, and are even lower than those from solar or wind power.

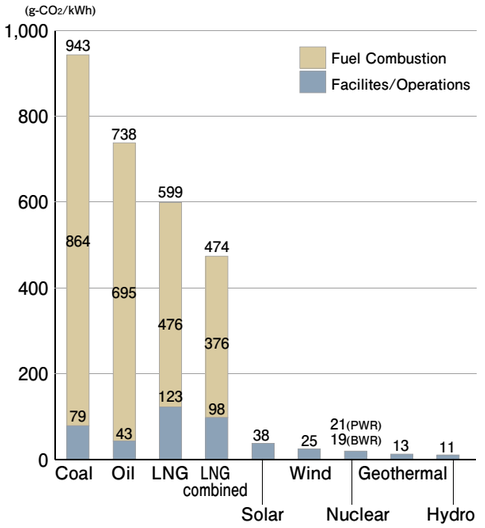
Considering that nuclear power generation will continuously play a key role in combating global warming, the industry is committed to making the utmost effort to improve the safety of nuclear power generation and to restore the trust of citizens.

The electric companies are also striving to increase the share of LNG-fired thermal power which has the advantage of relatively low $CO_2$ emissions, and to improve the efficiency of thermal power plants.

Currently operating state-of-the-art gas turbine combined cycle power plants have achieved the world's highest level of 59% in thermal efficiency, by, for example, raising the combustion temperature at the gas turbines.

Since the Oil Shocks of the 1970s, electricity demand has grown approximately 3.3-fold while $CO_2$ emissions have grown only 2.6-fold. This was achieved through measures on both the supply and demand sides, reducing the $CO_2$ emissions of energy on the supply side while improving the efficiency of energy utilization by users. As a result, $CO_2$ emissions per unit of user-end electricity have decreased by 20% from 1970 levels.

## $CO_2$ Emissions Intensity over the Entire Lifecycle by Source

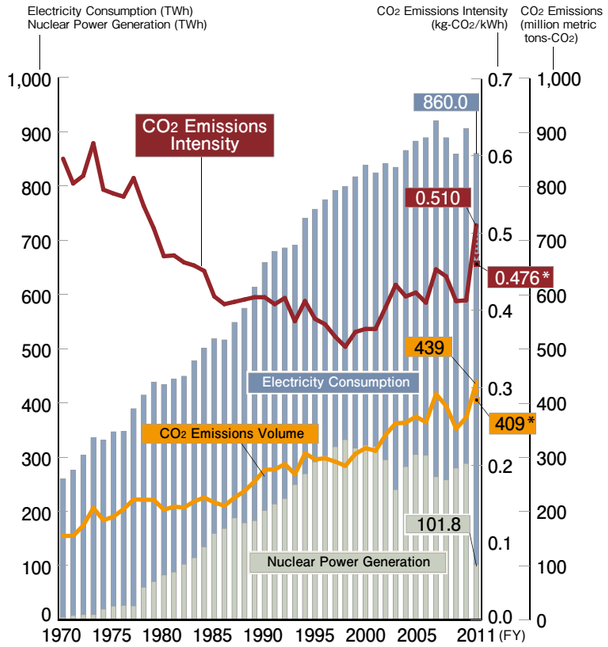



Note: (1) Based on total $CO_2$ emissions from all energy consumed in energy extraction, transportation, refining, plant operation and maintenance, etc. in addition to burning of the fuel.
(2) Data for nuclear power: 1) includes spent fuel reprocessing in Japan (under development), MOX fuel use in thermal reactors (assuming recycling once) and disposal of high level radioactive waste, and 2) is based on the capacity-weighted average of $CO_2$ emissions intensities of existing BWR and PWR plants in Japan, which are 19g-$CO_2$/kWh and 21g-$CO_2$/kWh respectively.

Source: Report of the Central Research Institute of Electric Power Industry, etc.

## Historical Trends in $CO_2$ Emissions from Power Generation

(excluding self-generators)




Note: The numerical value of "0.476*" and "409*" reflected Kyoto Mechanism credit.
Source: FEPC

# Decarbonization of Energy on the Supply-side

## Development and expansion of the use of renewable energy sources

Hydroelectric, geothermal, photovoltaic, wind, and biomass energy are all clean and renewable , and the electric utilities are striving to develop them.

For example, the electric utilities are developing mega-solar power generation plants (large-scale photovoltaic power generation plants) in addition to the efforts such as utilizing woody biomass fuel at their existing coal-fired power plants. We are planning to build Mega Solar Power Plants with a total capacity of about 140 MW at around 30 sites throughout the country by fiscal 2020, and some plants have already started commercial operation.

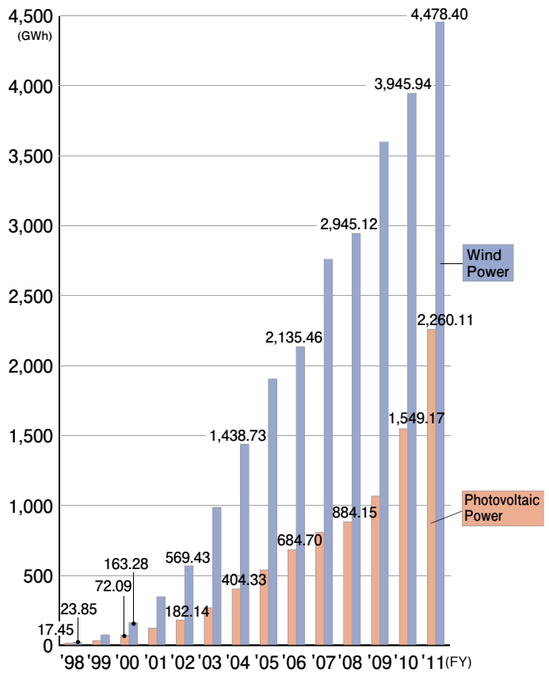
Japanese electric power companies have been purchasing electricity generated from the solar and wind power systems of our customers, and thus renewable energy sources account for about 10% of total electricity.

The feed-in tariff system for renewable energy commenced in July 2012, whereupon the electric power companies are obliged to buy such electricity at a fixed price for a certain period. The cost of purchasing this electricity is finally borne by customers in the form of a surcharge which in principle is proportional to the amount of electricity consumed.

Renewable energy such as photovoltaic power has problems involving efficiency, cost of power generation and stability of output. R&D on the latest power system control technologies for combining existing power plants and storage batteries will be actively conducted to help stabilize the system, when introducing large amounts of wind and photovoltaic power, which are susceptible to the weather.

Electric utilities will keep striving to develop and improve renewable energy sources.

### Ten Electric Power Companies' Purchasing Volume of Photovoltaic and Wind Power




Source: FEPC

Mikuni Solar Power Station

Wind Power



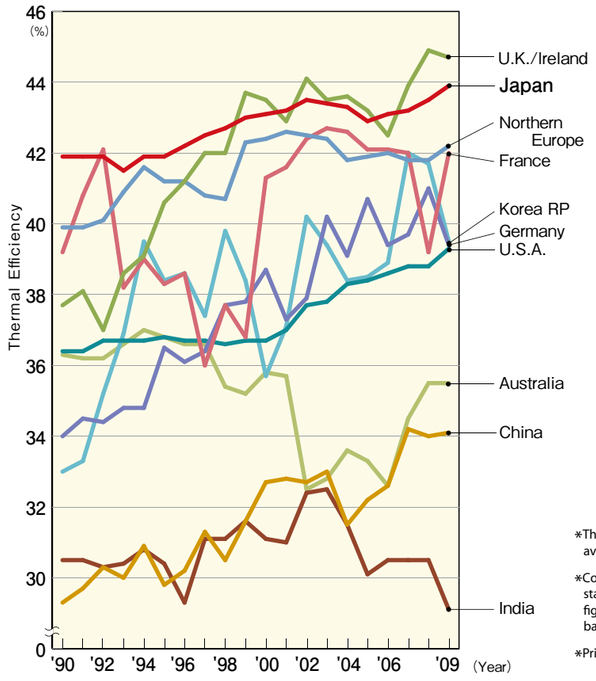
# Sharing Japan's Top-level Environmental Technologies with the World

As a result of taking various environmental measures at thermal power plants, Japan has achieved the world's top-level energy efficiency. Based on this achievement, the electric utility industry in Japan has been making efforts to establish a mechanism for sharing such advanced technologies with electric power industries in other countries (see the column).

Through the cooperation between advanced and developing countries, and with the "sectoral approaches" for sector-by-sector improvement of energy efficiency, it will be possible to achieve compatibility between economic growth and global environmental preservation. The electric utility industry of Japan has been proposing the sectoral approaches to the world as a new focus for the post-Kyoto period.

It is estimated that the introduction of Japanese technologies to coal-fired power plants in three big countries alone, namely the United States, China and India, could reduce emissions by approx. 1.3 billion tons-$CO_2$/year, which is almost equivalent to the total annual $CO_2$ emissions in Japan today.

### Comparison of Thermal Power Plant Efficiency in Japan and Other Countries




Source: ECOFYS「INTERNATIONAL COMPARISON OF FOSSIL POWER EFFICIENCY AND $CO_2$ INTENSITY August 2012」

*Thermal efficiency is the gross generating efficiency based on the weighted averages of efficiencies for coal, petroleum and gas (low heat 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.

Column

### International Electricity Partnership (IEP)

In October 2008, the FEPC of Japan, Edison Electric Institute of the United States, and EURELECTRIC of Europe jointly announced the establishment of the International Electricity Partnership (IEP) to realize a global low-carbon future through advanced electric power technologies.

On December 15, 2009, the members of IEP presented their technology roadmap entitled "Roadmap for a Low-Carbon Power Sector by 2050" on site at COP15 in Copenhagen, Denmark. In addition to providing analysis of the electric power technology and policies needed to realize a low-carbon society, this Roadmap may also be used as a guideline for transferring advanced electric power technologies to developing countries as a tool of sectoral approaches for reducing greenhouse gas emissions.

### Participation in Asia-Pacific Partnership (APP) on Clean Development and Climate

APP is a framework for inter-regional partnership for responding to the challenges of growing energy demand, energy security, climate change, and so on. Under this framework, the seven participating countries (United States, Australia, China, India, South Korea, Japan and Canada) are pursuing the development, transfer and spread of clean and energy-efficient technologies.

$CO_2$ emissions from the seven participating countries account for more than half of global $CO_2$ emissions, and so these seven countries' efforts for reducing $CO_2$ emissions will have a global impact. Electric utilities in Japan have been actively involved in these efforts.

The activities of the APP were completed by the end of April 2011, and were taken over by the Global Superior Energy Performance Partnership (GSEP).

APP 2nd Peer Review Activity in India

# Demand-side Efforts for $CO_2$ Reduction

In Japan, the energy demand for water heating constitutes about 30% of the total energy demand in the household sector, and so energy-saving and $CO_2$ reduction measures in this area are very effective. Electric power companies have been working hard to develop and promote electric appliances and systems to reduce $CO_2$ emissions. One example is EcoCute, a water heating system with a heat pump that uses $CO_2$ as refrigerant.

EcoCute heats water by transferring the thermal energy in air, which is freely available, to water by means of refrigerant. With a *single unit* of electric energy for heat pump operation and *two units* of thermal energy from air, it produces *three units* of thermal energy.

Thanks to this principle, $CO_2$ emissions are cut by about 50% compared with conventional combustion type water heaters. Because of this advantage, the government and industry are jointly promoting the use of heat pump systems as a key means of preventing global warming in the consumer sector (household and commercial sectors). When heat pump systems fully penetrate the consumer and industrial sectors, the resulting $CO_2$ emissions reduction will amount to about 12% of the present annual $CO_2$ emissions in Japan, which is about 1.2 billion tons-$CO_2$.

Column

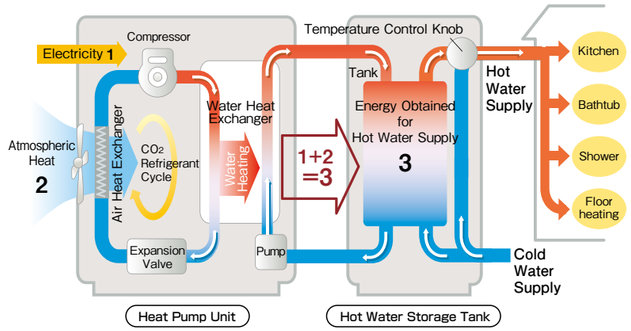
### Electric Vehicle Deployment Plan

The electric power companies of Japan have been working hard to achieve full-scale commercialization of environmentally-efficient electric vehicles, such as conducting driving tests and jointly developing new fast battery chargers with automobile manufacturers. To expand the use of electric vehicles, the electric power companies jointly decided to introduce about 10,000 electric vehicles (including plug-in hybrid vehicles) in total for commercial use by FY2020.

Electric Vehicle
(Mitsubishi Motors Corporation, i MiEV)

Fast Battery Charger

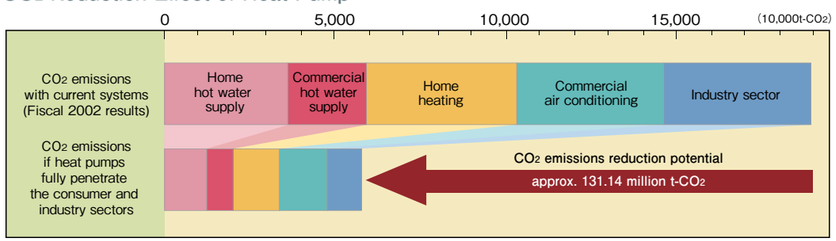
EcoCute Hot Water Supply Structure: $CO_2$ Refrigerant Heat Pump Hot Water Heater




1 Electricity Energy + 2 Atmospheric Heat = 3 Energy Obtained for Hot Water Supply

EcoCute Heat Pump Unit (left) and Hot Water Storage Tank

$CO_2$ Reduction Effect of Heat Pump




Source: Calculations by The Heat Pump & Thermal Storage Technology Center of Japan





# Strengthening International Communication and Cooperation

Japan's electric power companies remain active on a worldwide basis. In order to cope with global warming and to ensure the safety of nuclear power generation, international cooperation is indispensable. Each of the electric power companies in Japan has individual agreements with overseas utilities in order to facilitate exchanges on a wide range of information such as power generation, customer relations, distribution and quality control. The industry's top executives actively participate in international meetings such as the International Electricity Summit and the World Association of Nuclear Operators (WANO) to exchange views, while we also accept trainees from overseas. We import most of our fuel such as oil and coal from overseas countries and also keep our doors open to foreign companies on the purchase of equipment such as generators.

## Overseas Offices

Please feel free to contact your nearest office.

**WASHINGTON, D.C.**

**The Federation of Electric Power Companies of Japan, Washington Office**

The Federation's Washington Office was established in January 1994. Its principal objectives are to study U.S. energy policies and to exchange information with U.S. energy opinion leaders in order to promote a greater understanding of the Japanese electric power industry.

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