



Heat Pumps Save the Earth



Indispensable technology for low carbon society



Heat Pumps Use Renewable and Clean Energy

Advent of trump card for measures against global warming!

Reducing CO₂ emitting combustion of fossil fuels as much as possible is effective to prevent global warming.

From this point of view, heat pumps have a great advantage of no burning fuels at the places of use of heat.

Moreover, heat pumps efficiently utilize clean and inexhaustible unused energy such as "heat in the air" and "heat in the ground," which exist everywhere. As heat pumps make it unnecessary to burn fossil fuels, they significantly reduce CO₂ emissions in large quantity, and are very effective as a measure to prevent global warming.

With the wider use of heat pumps, it is no longer a distant dream to create combustion-free and low-carbon society.



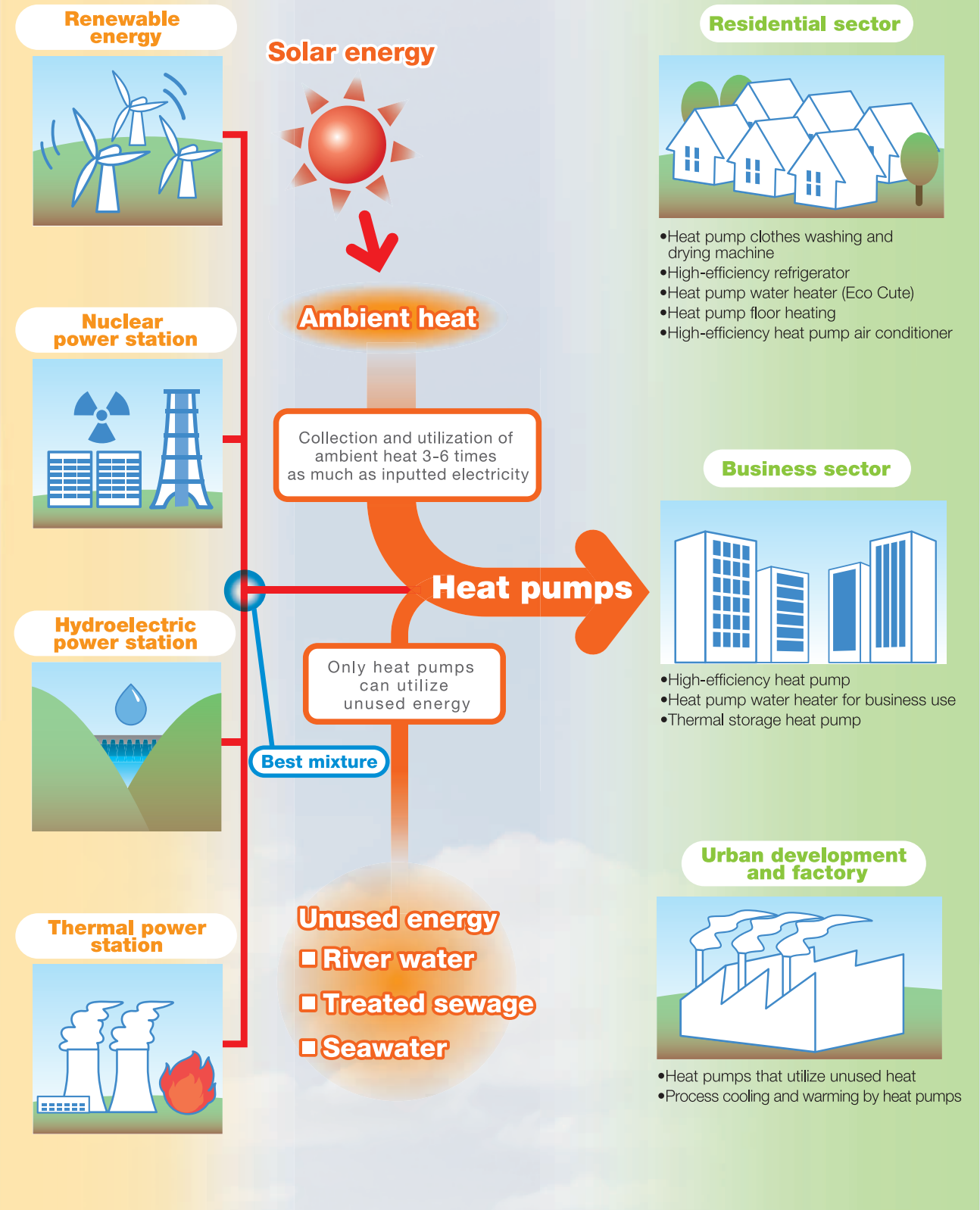
Merits 10

- 1 It is highly worthwhile for the world at large to make efforts for promotion of widespread use of heat pump as a "technology to cope with global warming."
- 2 Ambient heat, such as heat in the air and heat in the ground are "renewable energy."
- 3 Reduction in artificial waste heat and recycling of heat ease "heat island" phenomena.
- 4 Replacement of fossil fuels with ambient heat improves "energy security."
- 5 A realistic tool to "decarbonization" on the demand side.
- 6 Widespread use of thermal storage systems promotes "load leveling" of energy.
- 7 "International contribution" can be facilitated by using the energy conservation technology.
- 8 Promotion of energy conservation technology "invigorates the manufacturing industry."
- 9 Heat pump technology can evolve as an "advanced environmental technology" because it is expected to find other large fields of application in the future.
- 10 "High feasibility" that allows anyone to immediately address practical application of heat pump technology.

Energy strategy for low-carbon society

Toward the supply system not dependent on fossil fuels

Toward the demand system not dependent on fossil fuels





Keywords of Measures against Global Warming Are "Carbon Free" and "Non-Combustion"

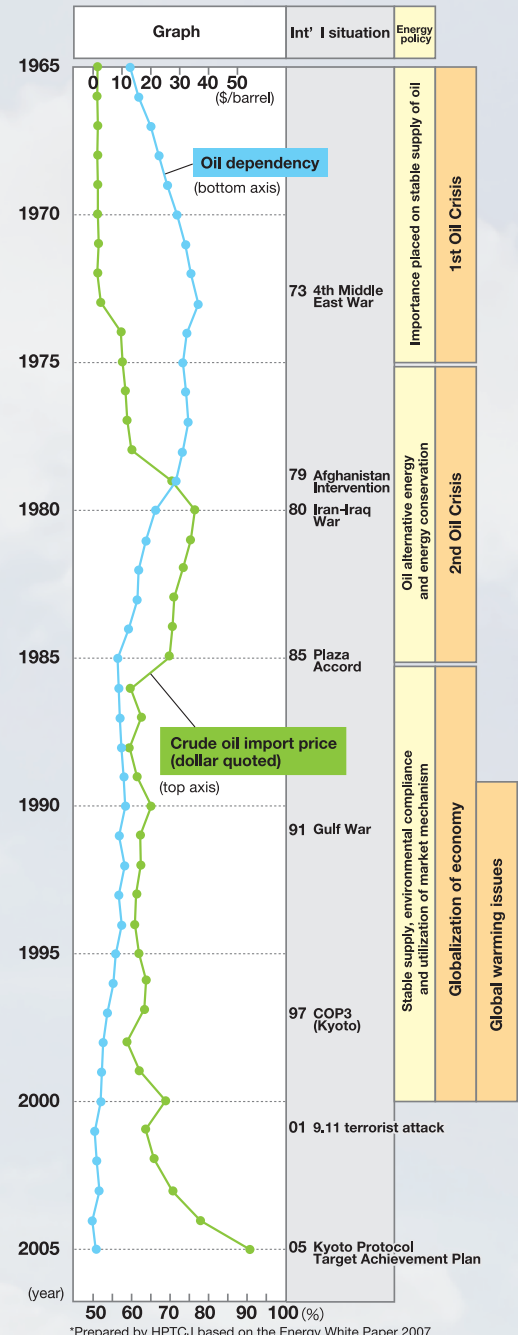
Eco-friendly system promises a breakaway from fossil fuels

Global warming receives much attention as an environment issue deeply involved in a question, "Life-or-Death" of human beings. Its most serious cause is greenhouse gas emissions generated by burning fossil fuels. The solution is to change the structure of society. Keywords are "Carbon Free" and "Non-Combustion." Reduction in energy consumption and realization of low-carbon society not depending on burning of fossil fuels is an urgent necessity.

Heat pumps that need no combustion, and therefore, emit no greenhouse gas such as CO₂, among others. If the electricity consumed by Heat Pumps, which is very small, is generated by renewable energy, overwhelming effects of CO₂ reduction and energy conservation can be yielded.



Changes in oil prices and dependency on oil, and Japan's energy policy



After the 1st oil crisis, oil dependency has decreased to not a few extents during the past years, but still remains at more or less 50% now. In the current energy policy of the government, a large importance has been given, in addition to the globalization of economy, to the response to global warming issues.

Decreasing Arctic ice on the warming earth



1979

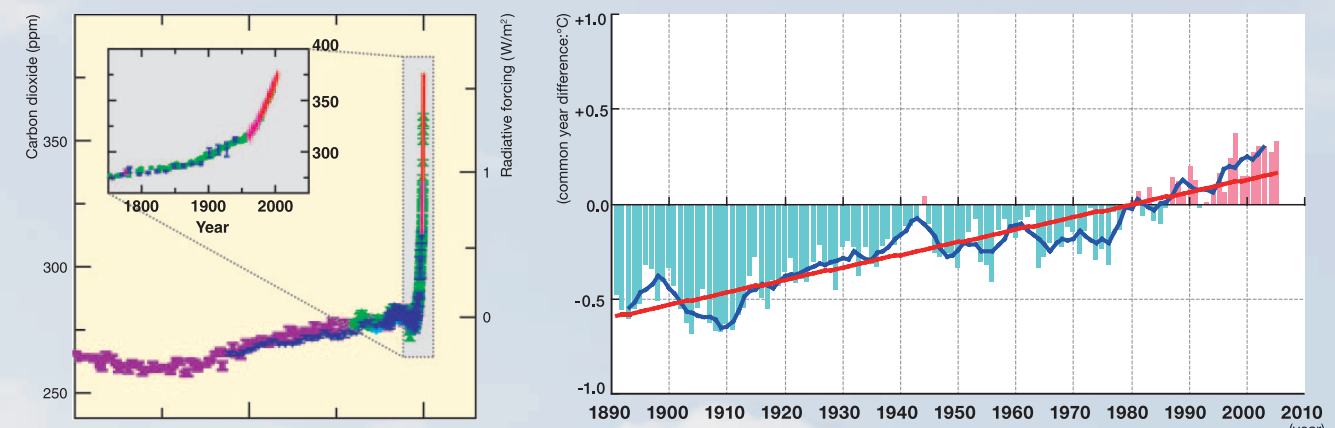


2005

Comparison of Arctic ice in September when sea ice in the Arctic Circle decreases most. Amount of ice observed in recent years has decreased by about 20% from the average amount observed from 1979 to 2005.

Source: NASA

Rapidly increasing CO₂ concentration



Changes in concentration of carbon dioxide

Changes over the common years in differences of yearly average temperature (from 1891 thru 2005)

CO₂ concentration in the atmosphere has been rapidly increasing in recent years. Compared with the level before the Industrial Revolution and that of 2005, the concentration has become greater by about 1.5 times as much. The decisive conclusion is that the cause is the increase in anthropogenic greenhouse gas emissions.

Source: Data obtained from website of Japan Meteorological Agency



Eco-friendly Appliances with Use of Advanced Technology Are Making Their Debut One after Another!

A two-times improvement of energy consumption efficiency in the past ten years

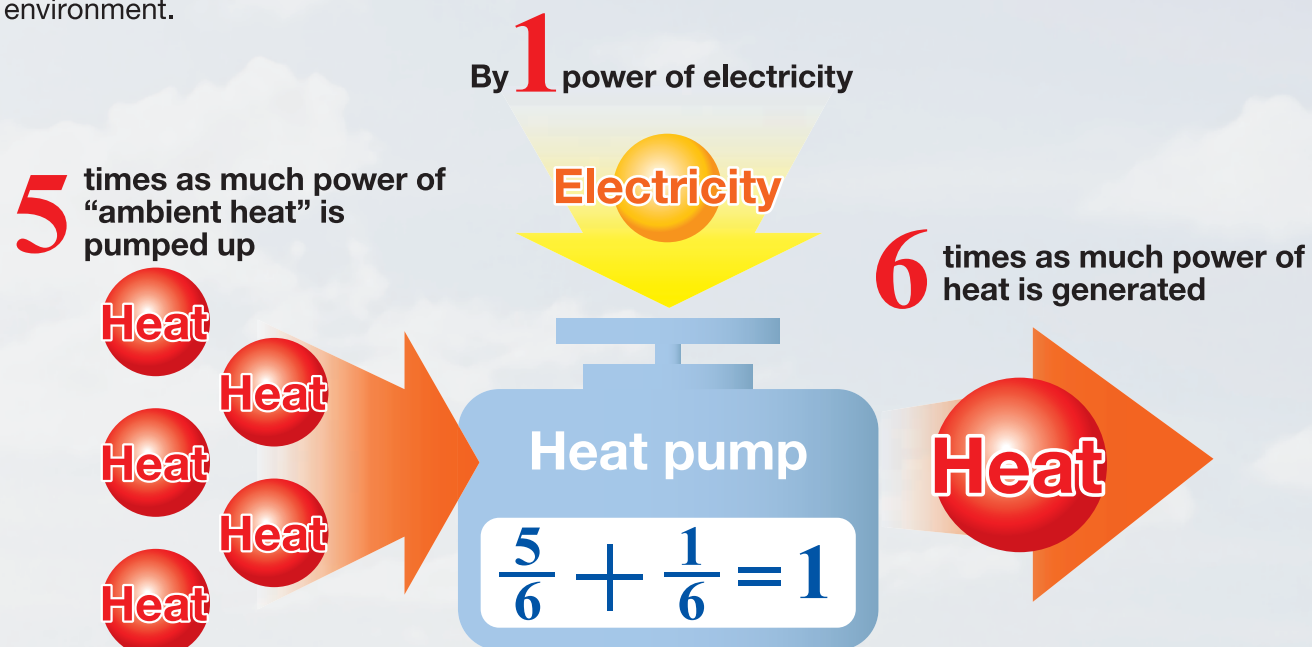
Temperature of gas rises when it is compressed and falls when it is expanded. Heat transfers from a point of higher temperature to a point of lower temperature. By utilizing such properties of gas and heat, heat pumps efficiently convey heat. They can take out heat even in cold climate areas such as in Northern Europe, for example, and successfully take out a large amount of energy by using a small amount of power.

Heat pump technology has made significant progress in the past ten years. Their energy consumption efficiency (Coefficient of Performance (COP)) has risen by about twice as much.

Mechanism of heat pump

In the field of heat utilization, heat pumps uniquely convert unused "ambient heat" into heat of utilizable temperatures, by inputting a very small amount of primary energy without burning fuels as a source of CO₂ emissions.

Moreover, heat pumps need electricity that is only about one-six in order to collect of "one unit of heat" to collect. Therefore, heat pumps produce heat energy that far exceeds the primary energy consumed at power stations, even if the loss in the process of generation of electricity is taken into consideration. For these reasons, heat pumps can dramatically reduce the damage to the environment.



Appliances that use heat pumps



Heat pump water heater (Eco Cute)

Eco Cute pumps up ambient heat to boil water. Chlorofluorocarbon is not able to efficiently produce high temperatures required for hot water supply. Using CO₂ as refrigerant has solved this bottleneck.

Compressed CO₂ up to 100 barometric pressures enabling heating water over 90 °C, necessary for hot water supply. In1998, Central Research Institute of Electric Power Industry in Japan, DENSO CORPORATION, and Tokyo Electric Power Company (TEPCO) started joint development of the world's first natural refrigerant heat pump water heater. Eco Cute was introduced to the market in 2001.

One-third of total household energy consumption is for hot water supply. Currently, combustion type water heaters have a majority market share. If such efficient Eco Cutes spread, significant energy-saving and reduction of CO₂ emissions would be possible.



Home air conditioner

By early 1990s, home air conditioners had reached a level of COP= 3 in performance efficiency, which is comparable to combustion type equipment. In addition, Top Runner Regulations under the revised Energy Conservation Law, which took into effect in 1999, has promoted competition among the manufacturers in efforts to develop highly efficient home appliances, resulting in achieving efficiency as high as nearly COP=7.

Thus, due to rapid changes, including cutting power consumption by half over the past ten years, a heat pump air conditioner is able to heat for a running cost about half of other heating equipment burning oil or gas, although it is a little known fact.



Heat pump washing and drying machine

In November 2005, the world's first washing machine that dries clothes by heat pump was introduced to the Japanese market.

Operating on the same principle as outdoor and indoor units of an air conditioner, the machine is so unique that it performs simultaneously drying and heating with warm air, with little consumption of energy.



Non-chlorofluorocarbon refrigerator

First freezing system, using a heat pump, was developed in 1834 in the U.S.

In 2002, non-chlorofluorocarbon refrigerators became available in the Japanese market. These models using natural refrigerant isobutene, has become rapidly widespread. Today almost all refrigerators in the market are based on non-chlorofluorocarbon specifications.



4 How Much Potential to Reduce CO₂ Emissions Do Heat Pumps Have?

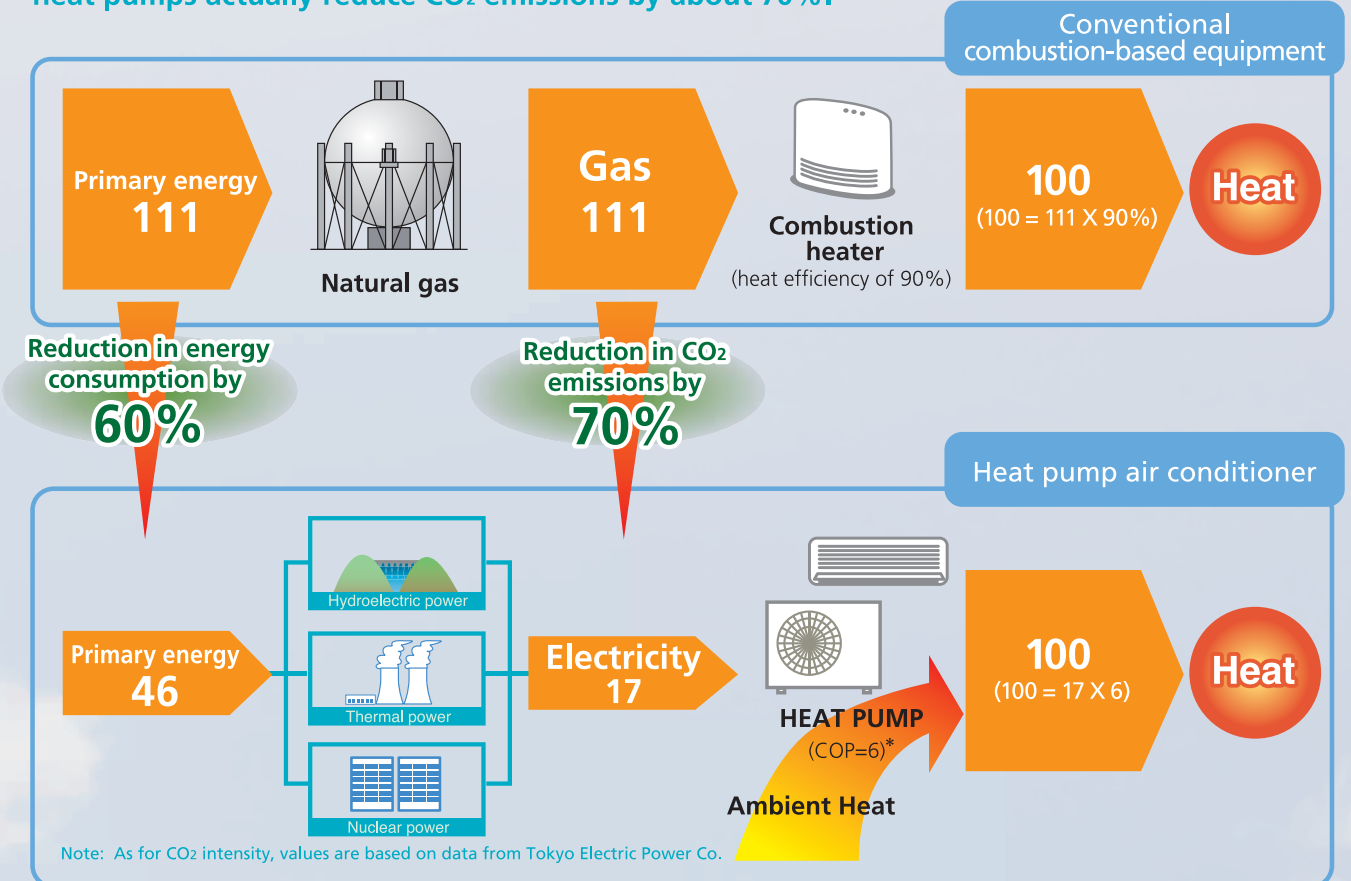
An effect to exceed the reduction target set by the Kyoto Protocol

Instead of using equipment that burn inefficiently CO₂-emitting fossil fuels, the utilization of ambient heat with heat pumps can be applied for cooling and heating and hot water supply in the commercial sector such as homes and buildings, and the applications of heating and drying in the industrial sector. If heat pumps come into wide use in these fields, the amount of CO₂ emissions to be reduced in Japan as a whole is estimated at about 100 million tons per year in the commercial sector and 30 million tons in the industrial sector. As a total of Japan's CO₂ emissions now amounts to total 1.3 billion tons, Japan's CO₂ emissions can be reduced by about 10%.

This means that heat pump is the technology that has not come into wide use yet and that is in the course of widespread use. However, air conditioners and water heaters that utilize heat pumps are already sold on the market. If such heat pumps are installed, they can immediately start exerting a large effect and realistic measure against global warming.

A key to save energy and reduce CO₂ emissions is the use of ambient heat by heat pumps

Compared with combustion heaters burning natural gas and fossil fuels, air conditioners with heat pumps actually reduce CO₂ emissions by about 70%.



* COP (Coefficient of Performance)
COP represents energy consumption efficiency. The ratio of heating (cooling) output divided by the energy inputted. COP=6 means that input of electricity of 1 is required to produce heat of 6. In other words, it shows the efficiency when heat energy of 1 is pumped up, electric energy of only one-sixth of the heat energy is required.

Current share of heat pumps

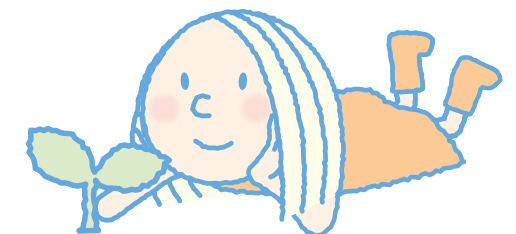
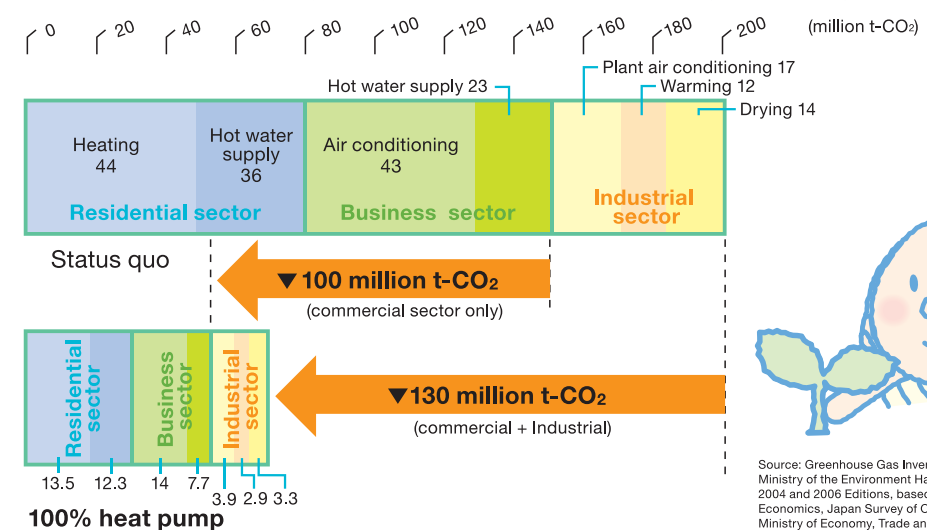
■ Share of heat pumps
■ Share of combustion-based heaters
■ Fields that cannot be replaced by heat pumps

Sector	Use of heat	Replacement by HP	Current ownership rate of heat pumps		
			25%	50%	75%
Industrial sector	Use of heat	Less than 100°C/°C	[Bar chart showing low ownership rate]		
	Power, lighting and others	x	[Bar chart showing 0% ownership]		
Residential sector	Cooling	○	[Bar chart showing high ownership rate]		
	Heating	○	[Bar chart showing low ownership rate]		
	Hot water supply	○	[Bar chart showing low ownership rate]		
Business sector	Power, lighting and others	x	[Bar chart showing 0% ownership]		
	Air conditioning	○	[Bar chart showing low ownership rate]		
	Hot water supply	○	[Bar chart showing low ownership rate]		

The share of heat pumps is not high either in the residential sector or the business sector. Conversely, drastic changes in these sectors can significantly reduce CO₂ emissions.

Source: Heat Pump & Thermal Storage Technology Center of Japan

Potential of CO₂ Reduction in Japan



Source: Greenhouse Gas Inventory, based on date quoted from CGER-Report 2004, Ministry of the Environment Handbook of Energy and Economic Statistics in Japan, 2004 and 2006 Editions, based on date of FYs 2002 & 2004. The Institute of Energy Economics, Japan Survey of Oil Consumption Structure by Sector, 2001 Edition, Ministry of Economy, Trade and Industry



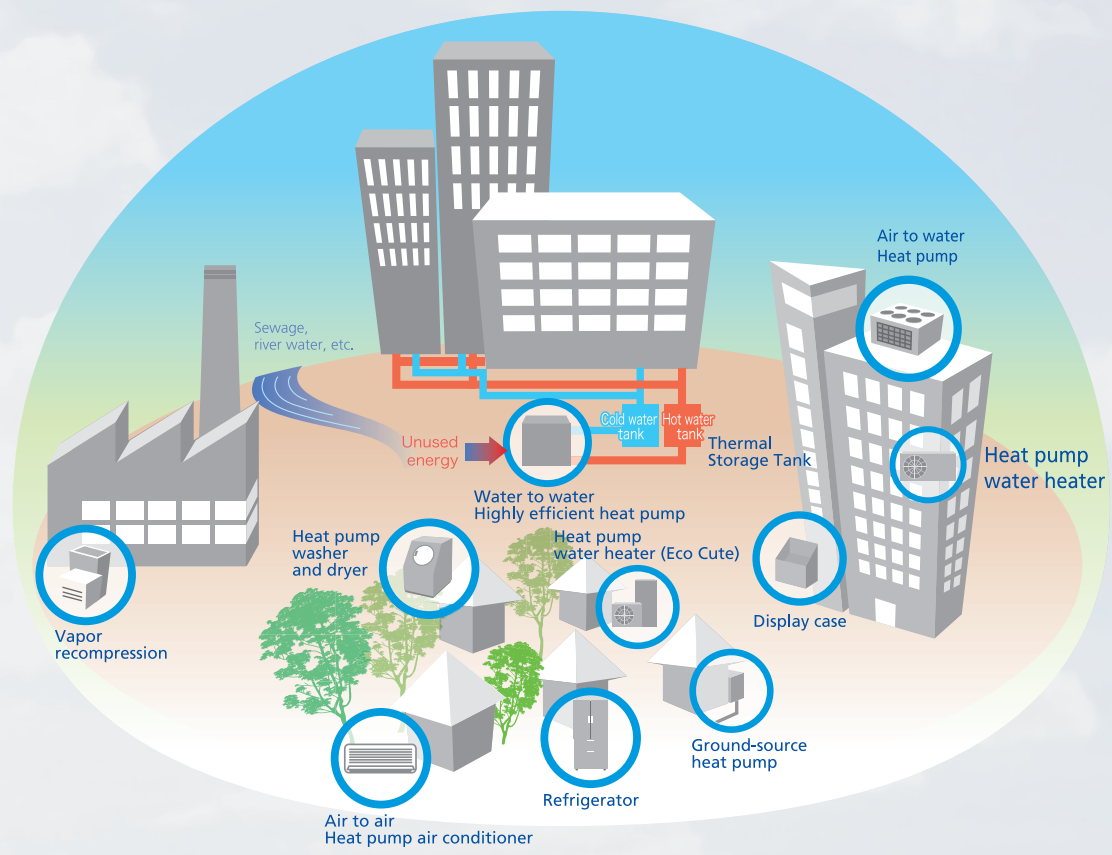
Leading-edge Heat Pump Technology Is the Focus of Attention in the World!

Advanced countries with eco-consciousness in Europe all recommend heat pumps

In EU, heat pumps are handled as renewable energy like solar and wind power. EU has set its target to increase the share of renewable energy to 20% by 2020, and heat pumps are included in this target.

Let's share the vision of ambient heat energy society all over the world!

Heat pump - using the power of technology to recycle the "heat" in the "air" and "ground" is supplies a recyclable, clean and inexhaustible energy. A solar energy recycling society, which recycles the blessing of the sun - the heat in the air, heat in the ground, heat in the lake water and heat in the river water - is the ultimate sustainable society. The time has come for people in the world to join in hands, with each individual citizen and business utilizing the technology and putting the achievements together toward building a sustainable society.



Proposal



Let's Save the Earth with Heat Pumps!

Now, our life built upon the heavy use of limited and precious natural resources such as gas and oil is reaching a turning point. For human beings to survive through the 21st century, technology that makes use of the inexhaustible ambient heat for air conditioning and for hot water supply, greatly reducing CO₂ emissions, is essential.

Can you believe that such technology already exists and has been widely used?
That is "Heat Pump" technology!

By spreading the use of Heat Pumps technology, a reduction of 130 million tons in annual CO₂ emissions can be expected in Japan.

That is equivalent to 10% of Japan's annual CO₂ emissions.

As the leading country of this highly efficient, revolutionary technology for energy conservation and CO₂ emission reduction, we entreat the world to widely utilize Heat Pumps.

Together we can save the Earth on the brink of a global warming crisis.

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- Kiyoshi Kurokawa** Special Advisor to the Cabinet and former president of Science Council of Japan
- Hiroshi Kato** Chairman, Heat Pump & Thermal Storage Technology Center of Japan, professor emeritus, Keio University



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