

5

MERITS 10

# Ten Merits of Heat Pump as an Energy Supply System to Simultaneously Achieve Both Improvement in Energy Security and Measures Against Global Warming

--- To realize an energy conservative world to support sustainable development ---

## Recent developments in energy situation

- Global warming issues
- Ensuring of energy security
- Measures to avoid a steep rise in crude oil prices

**Increase in problems that must be urgently resolved**

## Measures

- Strategy for resources and energy
- Measures for prevention of global warming

**Approaches taken at national level**

## Desirable future to be pursued

- Development and diffusion of energy conservation technologies
- Carbon-free society
- Resource diplomacy

**Setting of strategic targets**

- Technological innovation is not necessarily confined to cutting-edge fields.
- Technological innovation is rapidly under way in existing technologies.

**Promotion of widespread use of heat pumps**

Epoch-making and cutting-edge technology for measures against global warming on the demand side

What is heat pump?

- Technology to utilize inexhaustible heat of solar energy origin in the air for air-conditioning, hot water supply, cooling etc. without involving any combustion.
- Technology that has been already established in the field of heat utilization where positive effects will be immediately and significantly realized.
- If air-conditioning, hot water supply and humidification equipment are replaced with heat pump-based equipment, there is a potential of reducing emissions of CO<sub>2</sub> as a greenhouse gas by as much as about 130 million t-CO<sub>2</sub> only in Japan.

## MERITS 10



Viewpoint of Environmental Protection

- #1 It is highly worthwhile for the world at large to make efforts for promotion of widespread use of heat pump technology as a "technology to cope with global warming."
- #2 Ambient heats, such as heat in the air or heat in the ground are "renewable energy."
- #3 Reduction in artificial waste heat and recycling of heat ease "heat island" phenomena.



Viewpoint of Energy Security

- #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.



Viewpoint of Technological Contribution

- #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.

Overall Viewpoint

- #10 "High feasibility" that allows anyone to immediately address practical application of heat pump technology.

## Viewpoint of Environmental Protection

## Reduction of Environmental Load Will Be Realized by Variety of Global Warming Control Measures by Utilizing Inexhaustible Ambient Heat Energy

## MERIT #1 Technology to Cope with Global Warming

**It is highly worthwhile for the world at large to make efforts for promotion of widespread use of heat pump technology as a "technology to cope with global warming."**

- There is a potential of reducing CO<sub>2</sub> emissions by 130 million tons (100 million tons in the commercial sector + 30 million tons in the industrial sector) in Japan.
- This figure exceeds the Japanese government's target to reduce CO<sub>2</sub> emissions in the commercial sector by about 60 million tons.

**Potential is large → Diffusion is not enough by now**

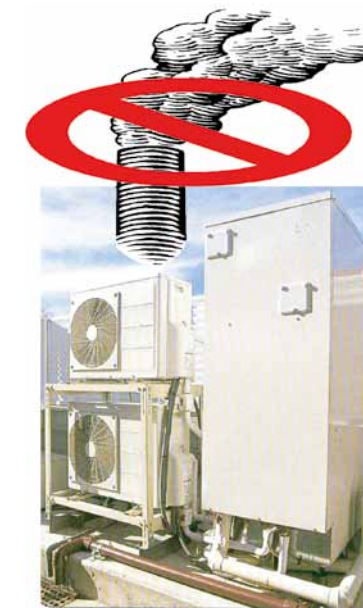
- Highly efficient appliances that utilize heat pump technology are already developed. If efforts to disseminate heat pumps are made, heat pumps are products of the most realistic technology to cope with global warming, which immediately yields the effect of reducing CO<sub>2</sub> emissions.

**Feasible right now and its effect is large**

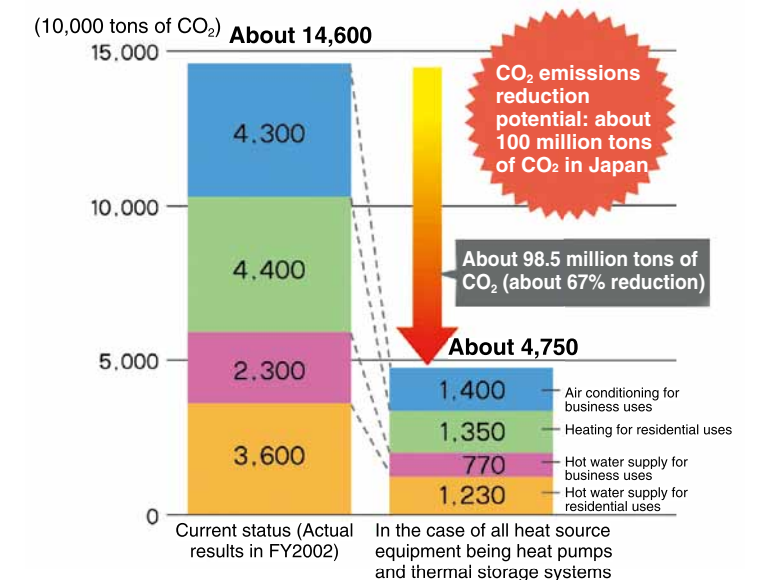
- As no combustion is involved, there are no emissions of not only CO<sub>2</sub> but also NO<sub>x</sub>, SO<sub>x</sub> and other air-polluting substances at places of demand.

**Also effective to prevent air pollution**

No CO<sub>2</sub> emissions at places of demand



CO<sub>2</sub> Emissions Reduction Potentials of Heat Pumps and Thermal Storage Systems in Japan (Residential & Business Sectors)



## MERIT #2 Renewable Ambient Heat Energy

**To increase the amount of renewable energy to be introduced by utilizing ambient heat energy**

- Heat pumps are internationally classified into renewable energy (together with geothermal energy utilization) in thermal energy area, and many European countries include heat pumps in international statistics.
- In Japan, there are 830,000 heat pump water heaters (Eco Cute) now in use and 100 million heat pump air-conditioners in use.

The photovoltaic and wind power energy supplied in Japan amounts to 654,000 kiloliters (oil equivalent)

About three times as much

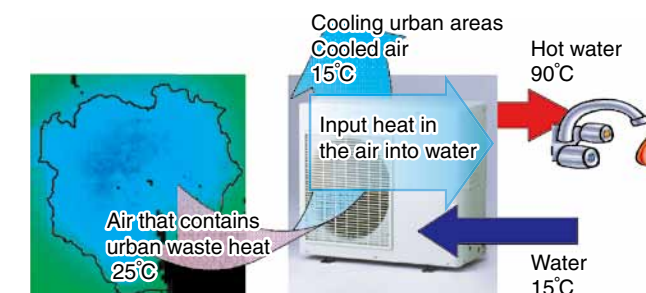
Heat energy in the air utilized by heat pumps amounts to 1,725,000 kiloliters (oil equivalent)



## MERIT #3 Heat Island Phenomenon Problem in Urban Areas

**To ease heat island phenomena through reduction in artificial waste heat and recycling of heat**

- Reduction of artificial waste heat generated by air-conditioners: Highly efficient heat pump air-conditioners are effective to reduce waste heat from cooling and heat of combustion at places of demand.
- Recycling of urban waste heat: Eco Cute that heats water by using atmospheric heat also has an effect of recovering urban waste heat and cool urban areas.



If heat pump equipment are installed at all households in Tokyo (about 4 million units)

there is an effect of lowering the temperature by about 0.5°C



Viewpoint of Energy Security

## Improvement in "Energy Security" by Heat Pumps Utilizing Ambient Heat and Highly Efficient Power Sources

## MERIT #4 Energy Strategy

## Decarbonization in energy supply

- Improvement in self-sufficiency through expansion of utilization of nuclear energy and renewable energy, efficient utilization of fossil fuels, etc.
- Combination of various energy sources in consideration of their characteristics to reinforce energy security.

## Aiming at the cutting-edge energy supply and demand structure

- Diversification and decentralization of energy sources
- Maintenance of appropriate surplus energy supply capacity to cope with tight supply and demand
- Promotion of carbon-free nuclear energy

## MERIT #6

## Heat Pumps also Contribute to Stabilization of Supply Systems.

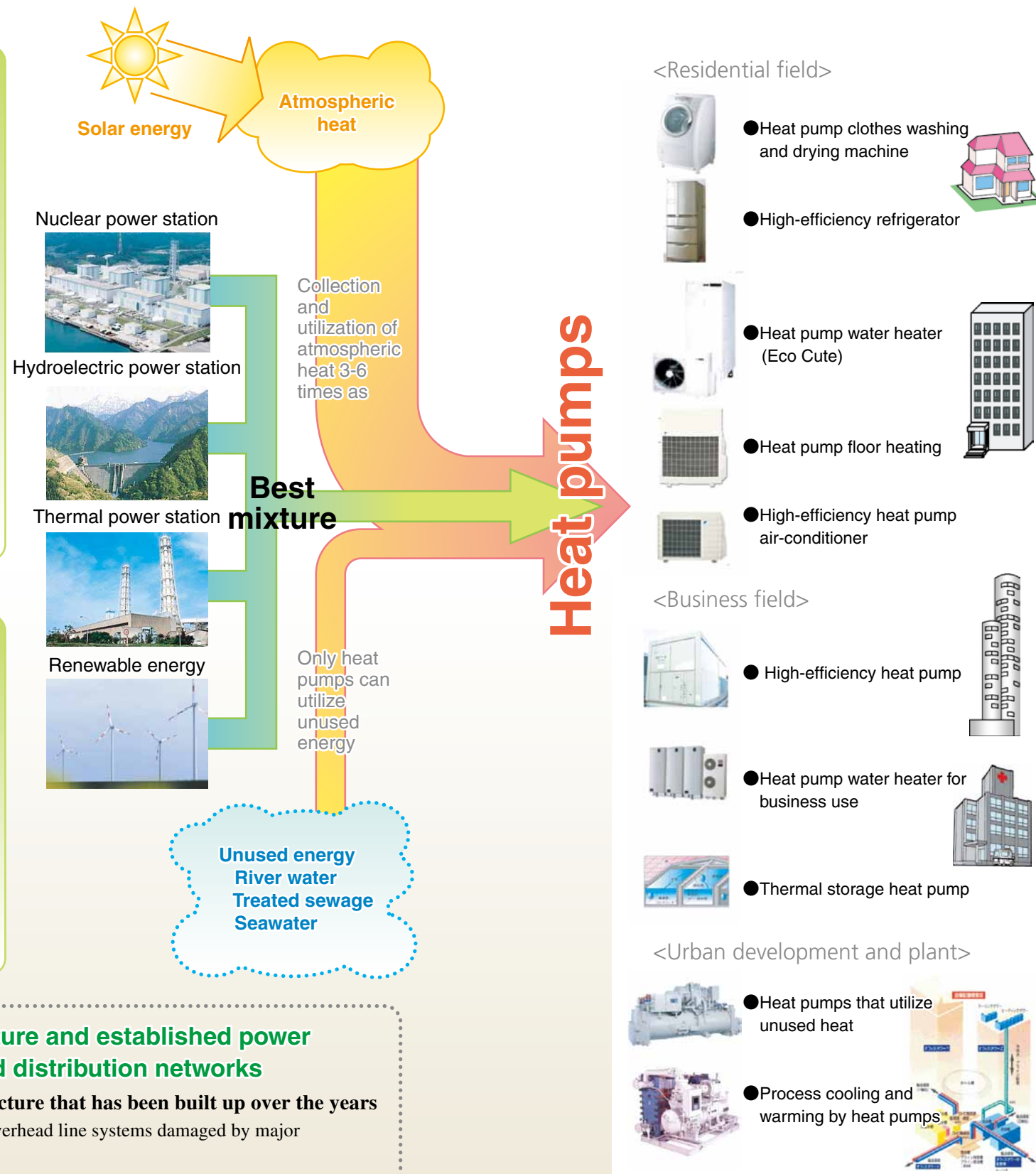
- Wider use of highly efficient heat pumps constrains the peak of energy consumption.
  - Increased use of thermal storage systems contributes to the progress in terms of load leveling.
- Surplus energy supply capacity increases (In the case of Japan, if 20 million units of Eco Cute are installed (one out of every two households), the share of nuclear energy exceeds 50%.)

## Supply System not Dependent on Fossil Fuels

## Utilization of mature and established power transmission and distribution networks

## Universal infrastructure that has been built up over the years

- Quick restoration of overhead line systems damaged by major earthquakes, etc.
- No need to invest in new infrastructure



The synergistic effect of promotion of decarbonization on the demand side through utilization of atmospheric heat energy and an increase in shares of non-fossil fuels on the supply side contributes to the improvement in energy security.

## MERIT #5 Carbon-free Society on the Demand Side

Creation of CO<sub>2</sub>-free society

- Efforts not to emit CO<sub>2</sub> at places of demand are necessary.
- Reduction in dependence on primary energy (direct combustion of fossil fuels)
- Shift to utilization of secondary energy (electric power) and renewable energy (wind power and atmospheric heat)
- Heat energy in the air (energy conservation) is homemade energy.

## Heat pump technology as a carbon-free technology

- Heat energy produced by combustion is replaced with atmospheric heat energy.
- Heat pump technology that can produce heat energy without combustion is a carbon-free technology.

## Achievement of energy load leveling

- Promotion of load leveling of energy is effective for efficient operation of equipment. Energy cost is also reduced.
- It is possible to shift daytime energy demand for air-conditioning to nighttime, and create energy demand for hot water supply during nighttime by combining heat pumps with thermal storage systems as the "energy utilization technology that goes beyond time and space."
- The use of heat pumps in combination with electricity storage systems is also effective.

## Toward a Demand System not Dependent on Fossil Fuels

## Viewpoint of Technological Contribution

## "International Contribution" by Heat Pumps Through the Use of Energy Conservation Technology

## MERIT #7 "International Contribution" Through the Use of Energy Conservation Technology

- Heat pumps were born in Europe and have come into wide use in Japan.
- Japan has made efforts to improve the efficiency of heat pumps to date. Now is the time to contribute to mitigation of global environmental and resource issues by disseminating heat pumps in the world.
- In cold climate areas in Europe and North America, a lot of energy is consumed for heating, and most of which is based on combustion.
- Heat demand for heating, cooling, hot water supply, etc. is increasing in developing countries because of an increase in commercial demand.

**Heat pumps can contribute to significant energy conservation in heating, cooling and hot water supply that consume a lot of energy in both developed and developing countries.**

Potential of CO<sub>2</sub> reduction (Examples of estimation)

- France: 70 million t-CO<sub>2</sub> a year
- China: 200 million t-CO<sub>2</sub> a year



## MERIT #9 Heat Pump Technology Can Evolve as an "Advanced Environmental Technology" Because They Are Expected to Find out Other Large Fields of Application in the Future.

- Heat pumps increased the efficiency of air-conditioners for heating and cooling by about twice as much and that of refrigerators by five times as much or more over the past ten years in Japan.
- CO<sub>2</sub> refrigerant heat pump water heaters were introduced in the market in 2001. During the six years since then, their efficiency has increased further by about 50%.
- Heat pumps were also applied to clothes washing and drying machines for residential use in 2005.
- Heat pumps has started being used for road heating to melt natural snow by heat in the air, which is introduced to prevent road from being frozen for traffic safety in winter.



- The advent of natural refrigerant heat pump water heaters for hot water supply and heating
- The advent of heat pump air-conditioners for not only cooling but also for both heating and cooling
- The COP of high-efficiency heat pump air-conditioners is now 6.0 or higher.

Heat pumps for use in conventional heaters, coolers and refrigerators are the top runner models of energy conservation, and are the "leading-edge environmental technology" as represented by the advent of new environmental products in the heat utilization equipment and field such as water heaters, clothes washing and drying machines, etc.



## MERIT #8

## Promotion of Energy Conservation Technology Invigorates "Design and Manufacturing Activities" of the Manufacturing Industry.

Sales of Eco Cute have amounted to 350,000 units a year (results in fiscal 2006) only in six years since it was put on the market and created a market of about 250 billion yen.

Conventional industries have grown by producing things that satisfy consumer needs. However, consumers' awareness has changed in these days of environmental issues. As a result, consumers have begun finding values in low-emission, low-impact products.

The increase in the value of energy conservation creates a new market where consumers willingly purchase equipment of higher energy-saving performance.

Contribution to both economy and environment in a sustainable manner

Amid the changing distribution of industrial productivity in the world, heat pump systems are expected to provide a new style of "industries and design and manufacturing" as well.

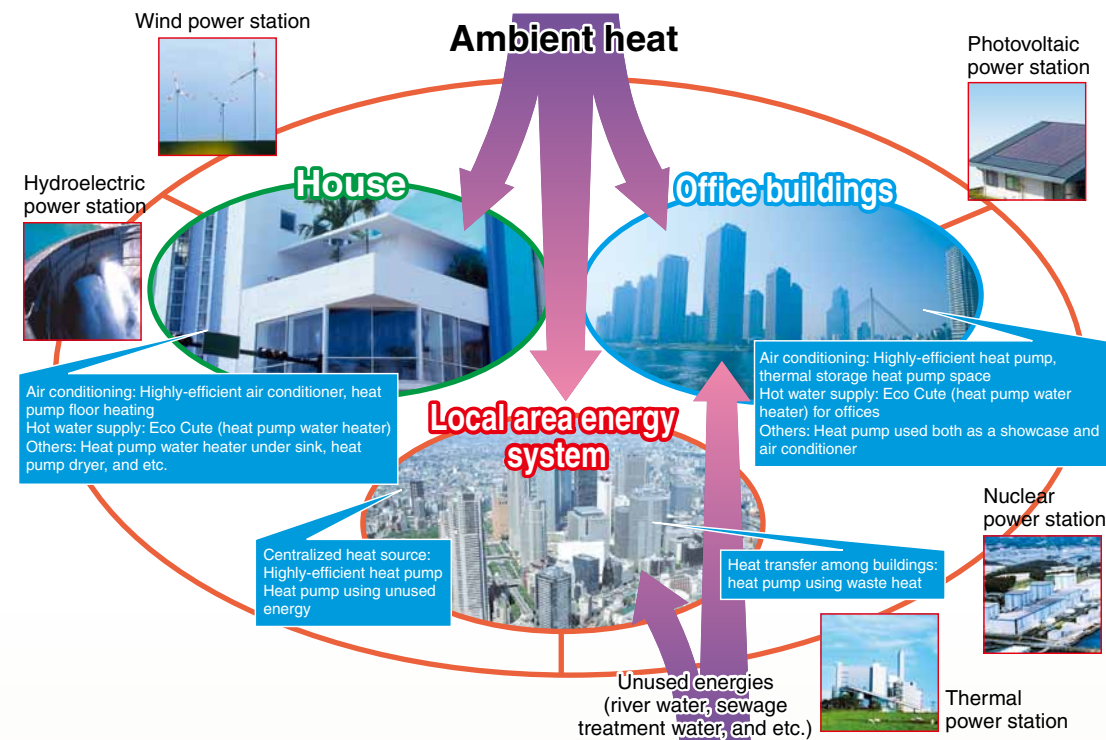




Overall Viewpoint

MERIT #10

## Energy Conservative World Where Heat Pumps Are Fully Utilized



Keys toward simultaneous achievement of both global warming prevention and stable energy supply are "to do without carbon," "to do without burning" and "to build a society using the highly efficient energy." The society in the 21st century should be the most promising and highly realizable, as long as "heat pumps" are fully utilized with the best possible use of clean and inexhaustible "ambient heat" and other various unused energies very efficiently.

