

Energy Efficiency Supporting Policy and Heat Pumping Technology in Japan

IEA Heat Pump Programme WORKSHOP

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Heat Pump & Thermal Storage Technology Center of Japan (HPTCJ)

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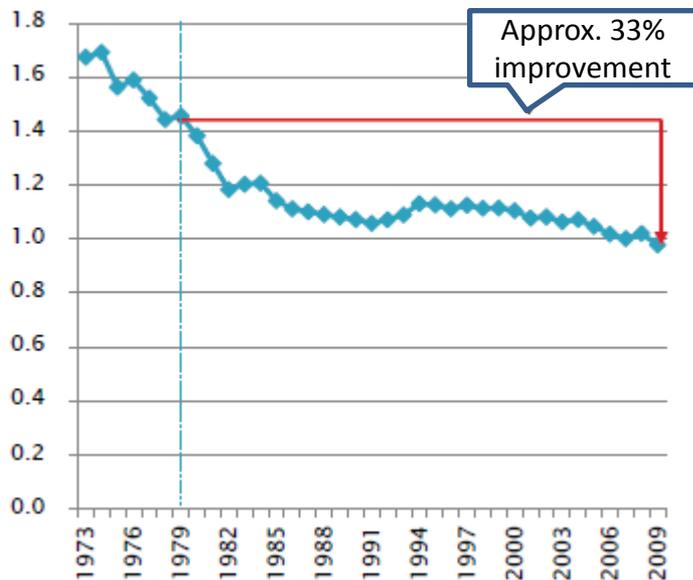
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1 Overview of Energy Conservation Trend until 2010

- Energetic effort brought approx. 33% improvement in energy efficiency after oil crisis.
- Japan achieved the highest energy efficiency in the world, which results from taking various countermeasures for energy conservation.

<Primary energy consumption per real GDP of Japan>

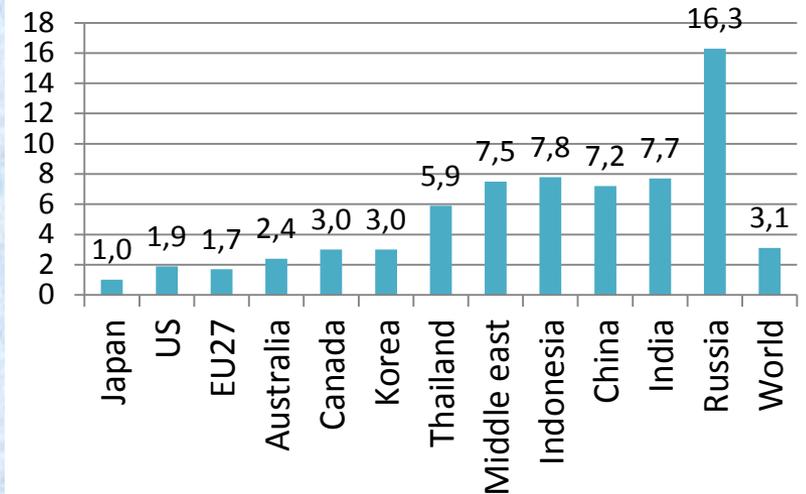
1 million tone of oil equivalent /JPY 1 trillion



Ref: METI/ Energy Data Modeling Centre, comprehensive energy statistics

<Primary energy supply per GDP in 2009>

Index: Japan=1



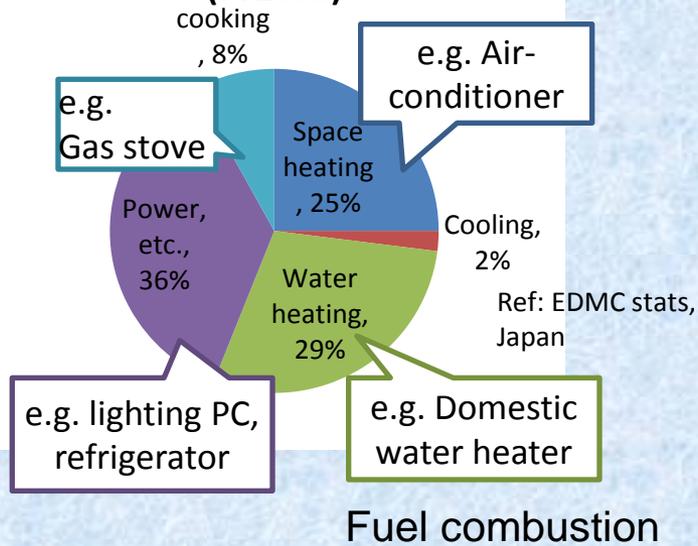
Ref: IEA statistics

*Total consumption of primary energy (tons in crude oil equivalent) / real GDP (U.S. dollars) is calculated with Japan = 1.

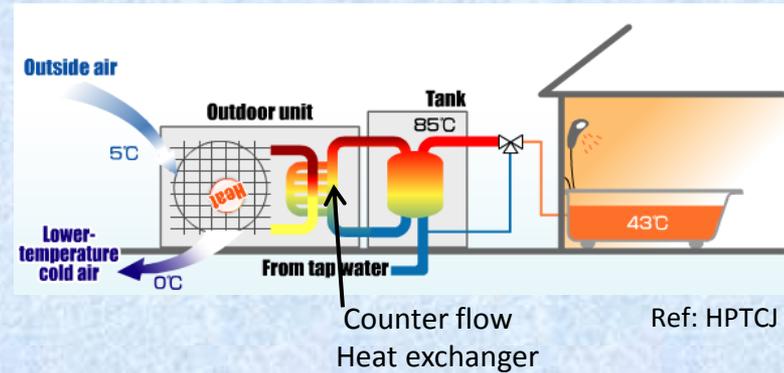
2-1. Eco Cute : example of countermeasure for energy conservation

Analysis of Energy Consumption

Energy consumption by end-use in Residential sector (FY2009)



Eco Cute Apparatus



Heat pump unit

Storage tank

Ref: TEPCO Website

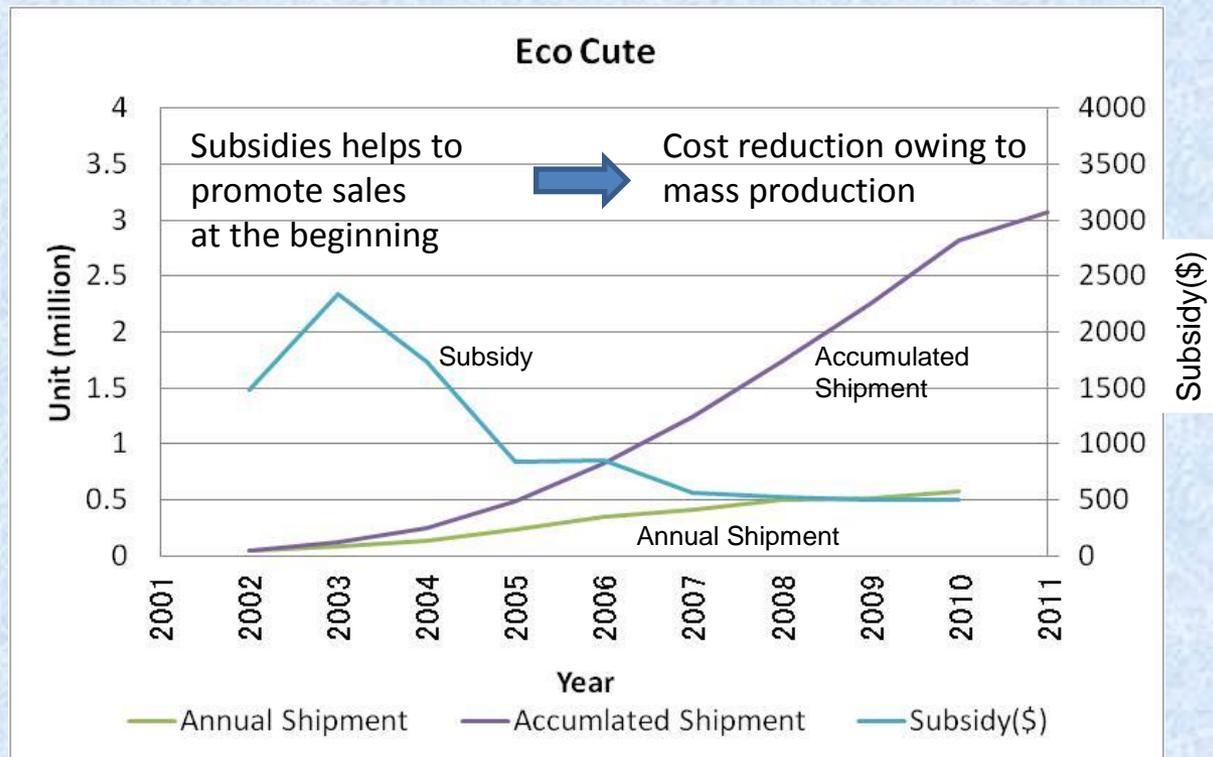
Feature (Newly developed)
Design for CO₂ refrigerant
Compressor for high pressure
Counter flow Heat exchanger

Since more than half was covered by fuel combustion, Drastic energy saving can be achieved by adoption of heat pump for water heating. Eco Cute was developed for this reason

Over 15 manufactures have taken part in the markets ever since.
Owing to newly developed technology by the manufactures,
Now, Rated COP reaches 5! taking advantage of the CO₂ refrigerant cycle feature

2-2. Eco Cute : Government Subsidy & Market Trend

- Besides manufacturers effort, government subsidies also push the sales. Consequently the market has grown to a 500 thousands units business a year with accumulated shipment number of over 3 million units.

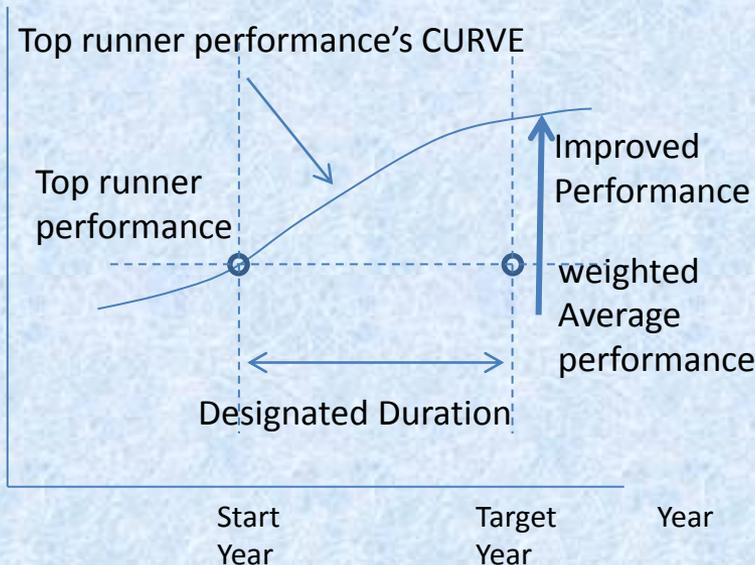


Ref: HPTCJ

Japan's support strategy successfully increase steadily the number of annual shipment of this high COP product.

3-1. Measures toward High Efficiency (Top Runner Program)

- ◆ **Top Runner Program started in 1998**
- **The Top runner performance (COP or APF) of each targeted item was set as a standard value in the Top Runner Program in 1998.**
- **The weighted average of COP or APF of each item must reach the standard COP or APF set in the Top Runner Program by the target year.**
- **The top runner program encouraged to develop high efficient HPs.**
- **Top runner program successfully carried out twice, as a result, the performance improved significantly.**



	Start year		Target year
Primary Act (COP is used as index)	1997	➔	2004
	3.01*		5.05*
Secondary Act (APF is used as index)	2006	➔	2010
	4.9**		5.7**

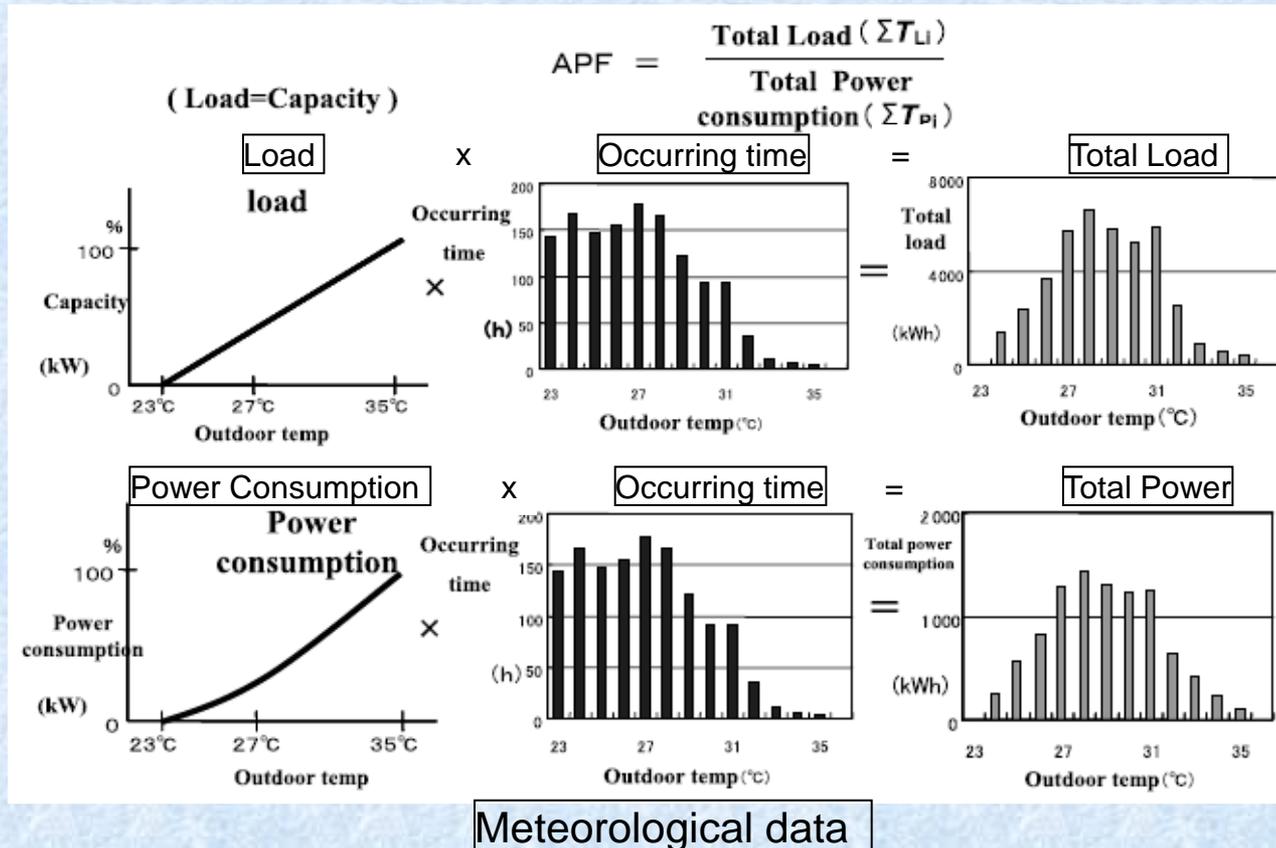
Ref "Efficiency improvement situation regarding the appliance of the target year 2010"
Agency for Natural Sources and Energy

*: Manufactures weighted average COP
 **: Manufactures weighted average APF
 APF is Annual performance factor

3-2. Measures toward High Efficiency (Concept of APF)

Concept of APF(Annual Performance Factor)

APF is calculated to evaluate the energy efficiency in accordance with the actual conditions, taking into consideration the load conditions of buildings, load hours, heat-pump performance changes along with outside temp etc.



“The Current State and View for the Testing and Rating for Performance of Air Conditioner” JSRAE 2009 Feb

APF calculation is very difficult, since this requires duplicating year round use of air conditioner in the experiment room.

3-3. Measures toward High Efficiency (Features of Japanese APF)

[Calculation method]

Japan applies practical and empirical estimation method which allows to calculate APF with the 5 points measurements (cooling 2points, heating 3 points) above intermediate capacity. The performance estimation at low capacity is derived from lots of experiment data from manufacturers.

[Test method]

Japan seriously pays attention to maintain its accuracy;

Sampling inspection from a market is conducted to maintain products quality.

Total combined standard uncertainty are determined by the uncertain analysis and indicates possible maximum error.

Mutual calibration between the inspecting facility and each manufacturer is carried out.

[Contribution to energy conservation policy]

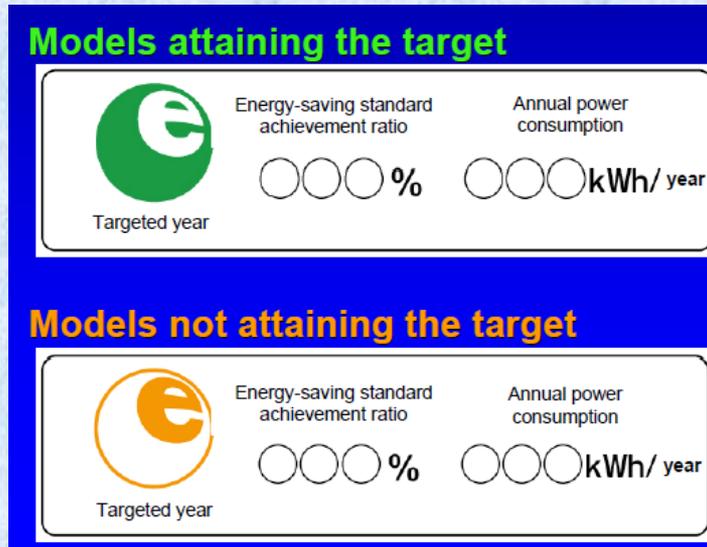
Thanks to the precisely established calculation method and testing method, APF index is recognized as a reliable and fair one, and widely used in Japan, contributing as an index of labeling as well as the top runner program implemented by Japanese government to promote energy conservation efforts.

3-4. Measures toward High Efficiency (Labeling Program)

- ◆ Labeling program started in 2000

This labeling system shows an energy efficiency category.

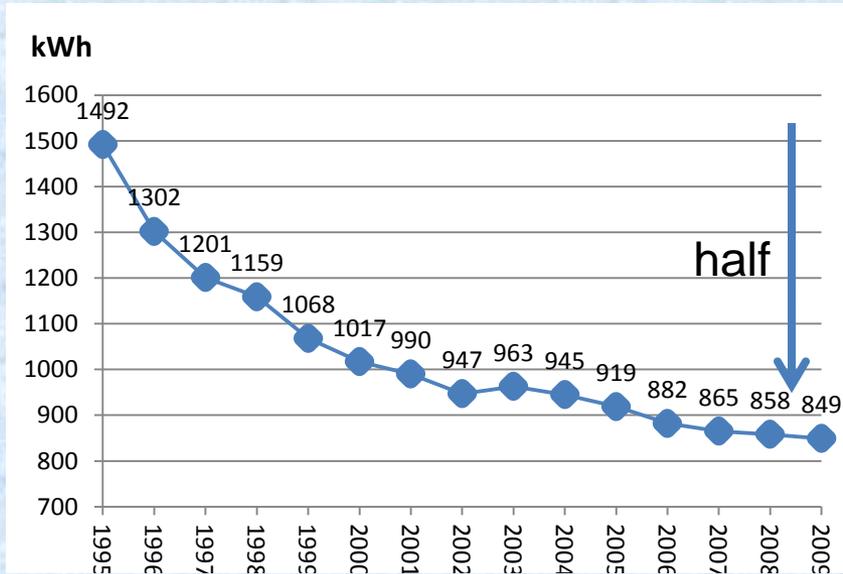
Manufacturers are required to put a label on the product to show how efficient it is.



Ref: ECCJ

The labeling promoted environmentally friendly consciousness nationwide.

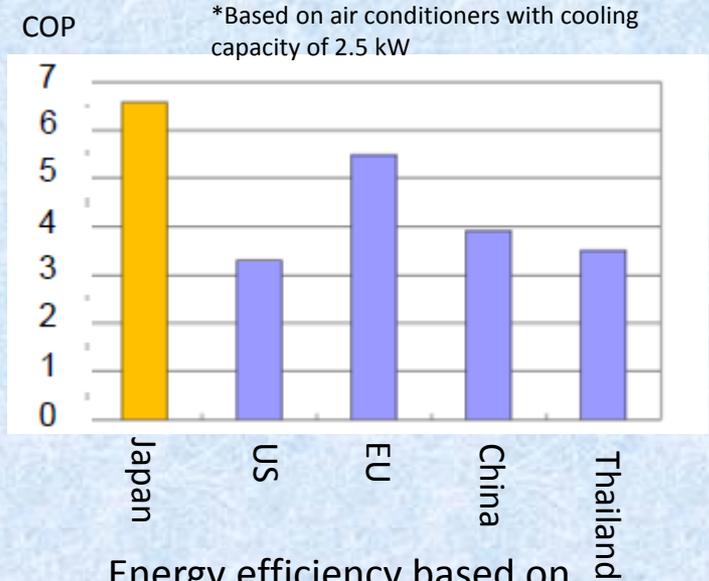
3-5. Measures toward High Efficiency (Efficiency Trend)



Annual electricity consumption on wall mount type of 2.8kW

*Based on an average of wall mounted, typical energy conserving type air conditioners with 2.8 kW

Ref "Saving energy of Japan" Agency for Natural Sources and Energy 2011 November



Energy efficiency based on the top efficient model of each country

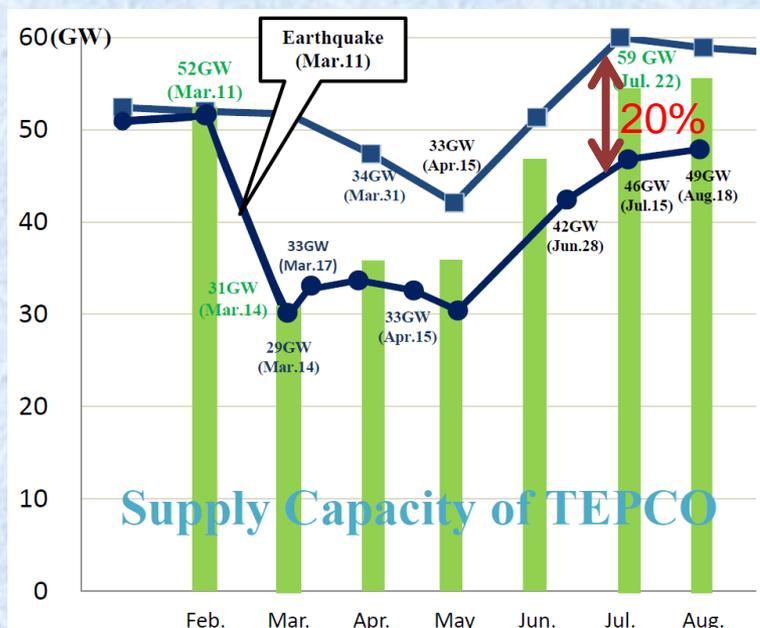
Top runner program & Labeling push the performance high

➤ Thanks to the Top Runner & Labeling Programs, Japan successfully shows excellent performance of air conditioners in the world.

4-1. Energy Conservation Challenges (after the Earthquake and Tsunami Disaster)

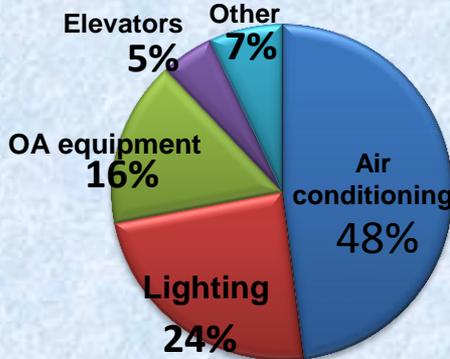
- After an earthquake disaster of 2011, electric power consumption reduce by 20% even more, through the nation-wide “Saving Energy“ effort, confronting extremely tight Supply-Demand situation.

Electric capacity of TEPCO



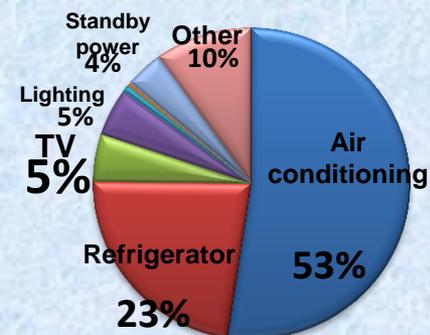
Ref: IEA 4E EXCO 10-17 October 2011

Office Building Electricity Consumption



Ref: Agency for Natural Resources and Energy statistics
Numerical values for day representing record (highest recorded) demand

Electricity Consumption on a Summer Day (2 p.m., average for all households)



Ref: Agency for Natural Resources and Energy statistics
Numerical values for day representing record (highest recorded) demand

Obviously, Air conditioning accounts for majority of consumption at the highest demand time.

[Countermeasure]

- Demand side must be aware of the saving energy more.
- Proceed saving conservation technology which has promising prospect of long lasting effect .

5-1. Government Support Technology (Important Technology Fields)

NEDO: Incorporated administrative agency New Energy and Industrial Technology Development Organization

- Below are five R&Ds specified by NEDO as an very important and promising technology fields, which subsidies and R&D financial support will be prioritized.

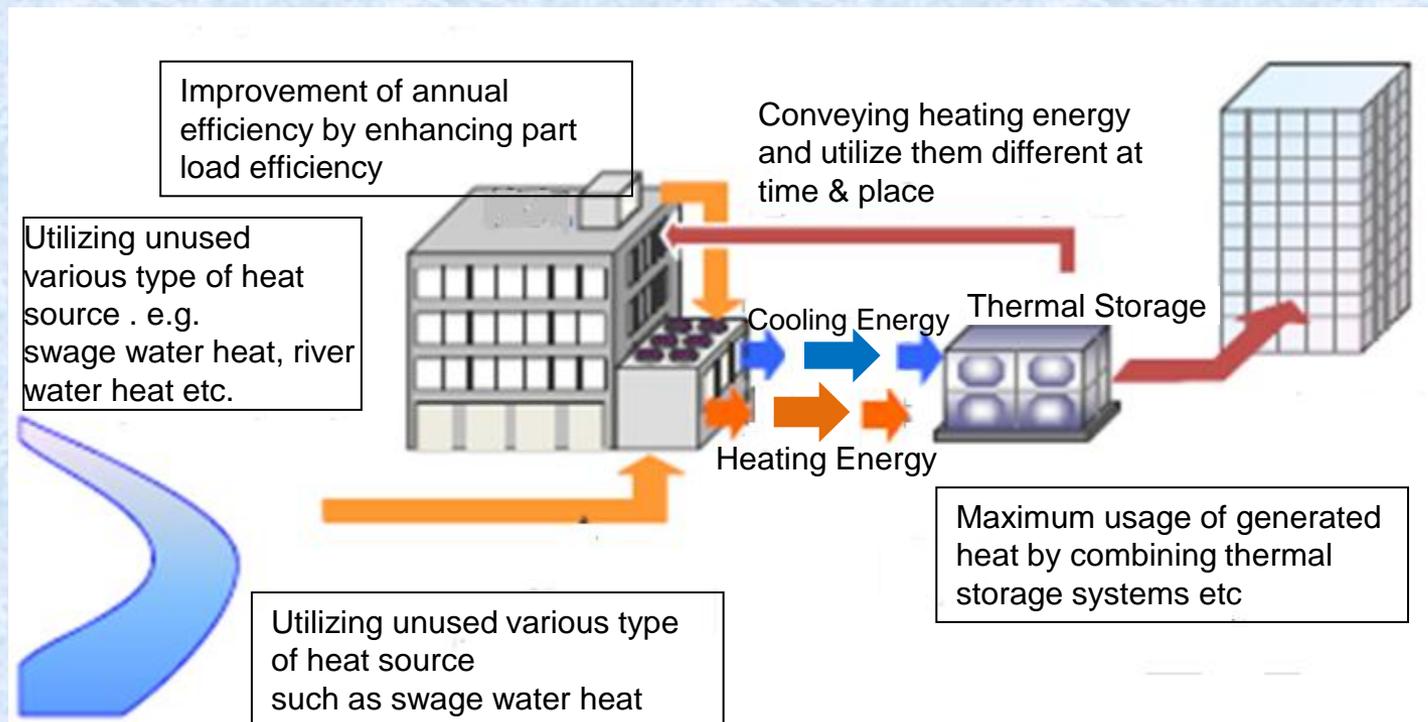
Item	contents
Industry Heat Pump	Industry Heat pump which is alternative to boiler, to reduce primary energy. High temperature heat pump utilizing waste heat High temperature heat pump which simultaneously use cooling and heating energy.
Air Conditioning for Commercial Building	Heat Pump for space and hot water supply which utilize waste energy from factory, swage water, underground water as heat source.
Air Conditioning for Commercial Building	Air conditioning system which enhance part load performance to save primary energy
Car Air Conditioner	High performance heat pump for electric vehicle
Hot water Supply HP for Domestic & Small Commercial Building	High performance hot water supply HP for domestic & small commercial building

5-2. Government Support Technology (Next Generation HP Project)

R&D grant : US\$11,000,000 1US\$=80JPY

Next Generation Heat Pump Research & Development Project

Besides continuous improvement of heat pump efficiency, comprehensive energy conservation technology approach is adopted, where the large potential of raising efficiency left untouched.



Ref: NEDO Next Generation Heat pump Research & Development Project

[Heat pump system technology]

Utilization of unused various type of heat source

Improvement of efficiency by enhancing part load efficiency

Maximum usage of generated heat by combining thermal storage systems etc

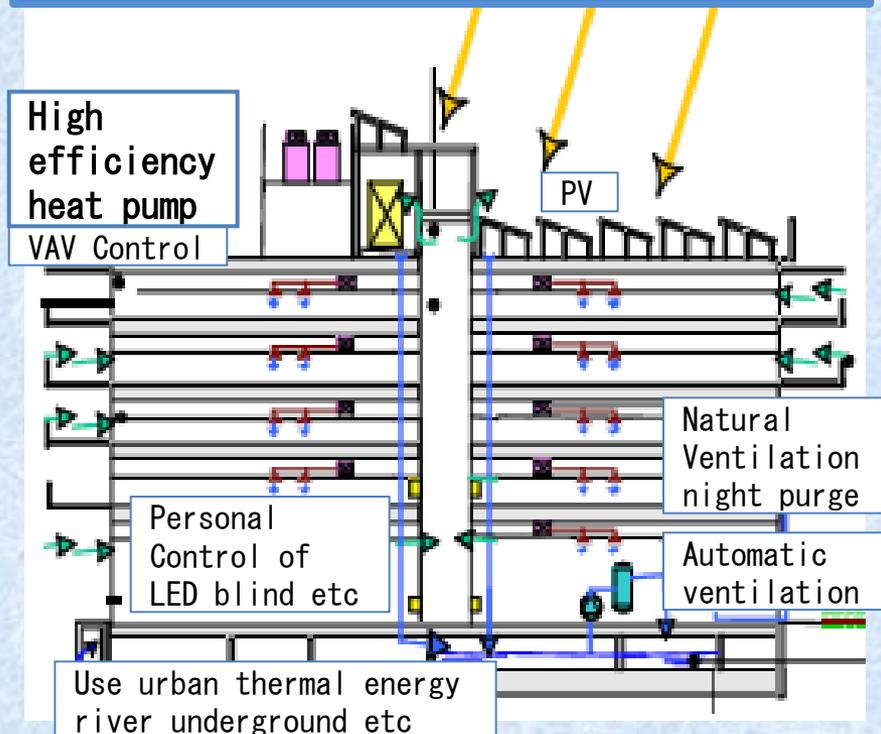
5-3. Government Support Technology (nZEB & nZEH)

Subsidy : US\$87,500,000 1US\$=80JPY

- Improving energy-saving efficiency and comprehensively designed systems such as load controls and integrated controls would reduce energy consumption amounts in residential and commercial buildings toward net zero.

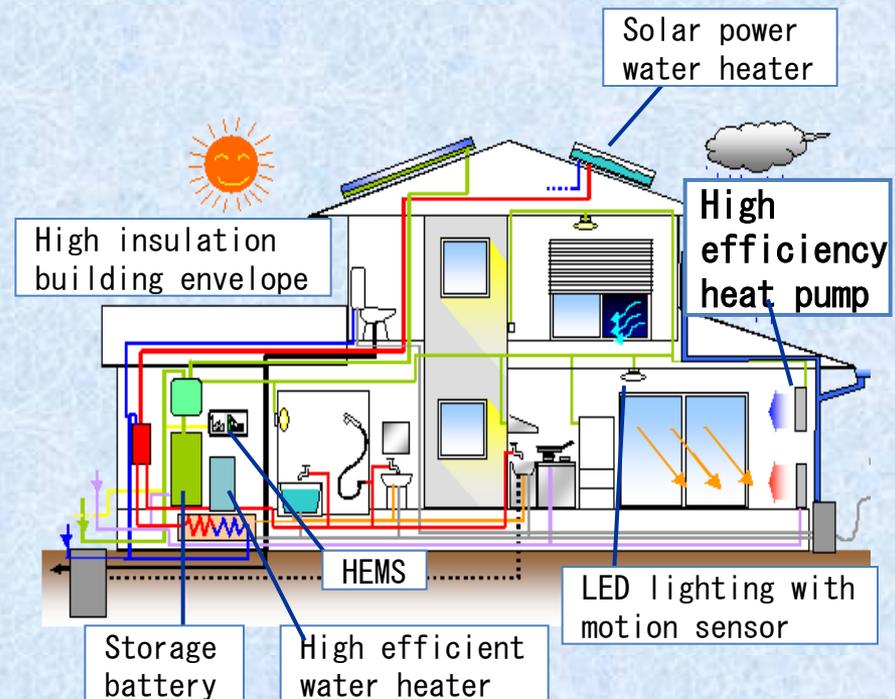
Net Zero Energy Building Project

Subsidy for building which can reduce over 30 % for new ones and over 25% for existing ones of annual energy consumption by installing highly efficient equipment.



Net Zero Energy House Support

Support project for a net zero house of installing high insulation, efficient and highly performing equipment together with control system.



6. Summary

- **Eco Cute has expanded its market share solidly owing to manufacturers effort & government support.**
- **The top runner program encouraged to develop high efficient HPs and the labeling system promoted environmentally friendly consciousness.**
- **APF was used as index of Top runner program 2006, since Japanese APF is recognized as reliable and fair one nation-wide.**
- **After an earthquake disaster of 2011, electric power consumption reduce by 20% even more, through the nation-wide “Saving Energy” effort, confronting extremely tight Supply-Demand situation.**
- **Besides improvement of heat pump efficiency, Comprehensive energy conservation technology is adopted, where large potential of raising efficiency left untouched.**

Thank you for your attention!