Advanced Energy Conservation Technologies for Sustainable Global Development

National Institute of Advanced Industrial Science and Technology (AIST)

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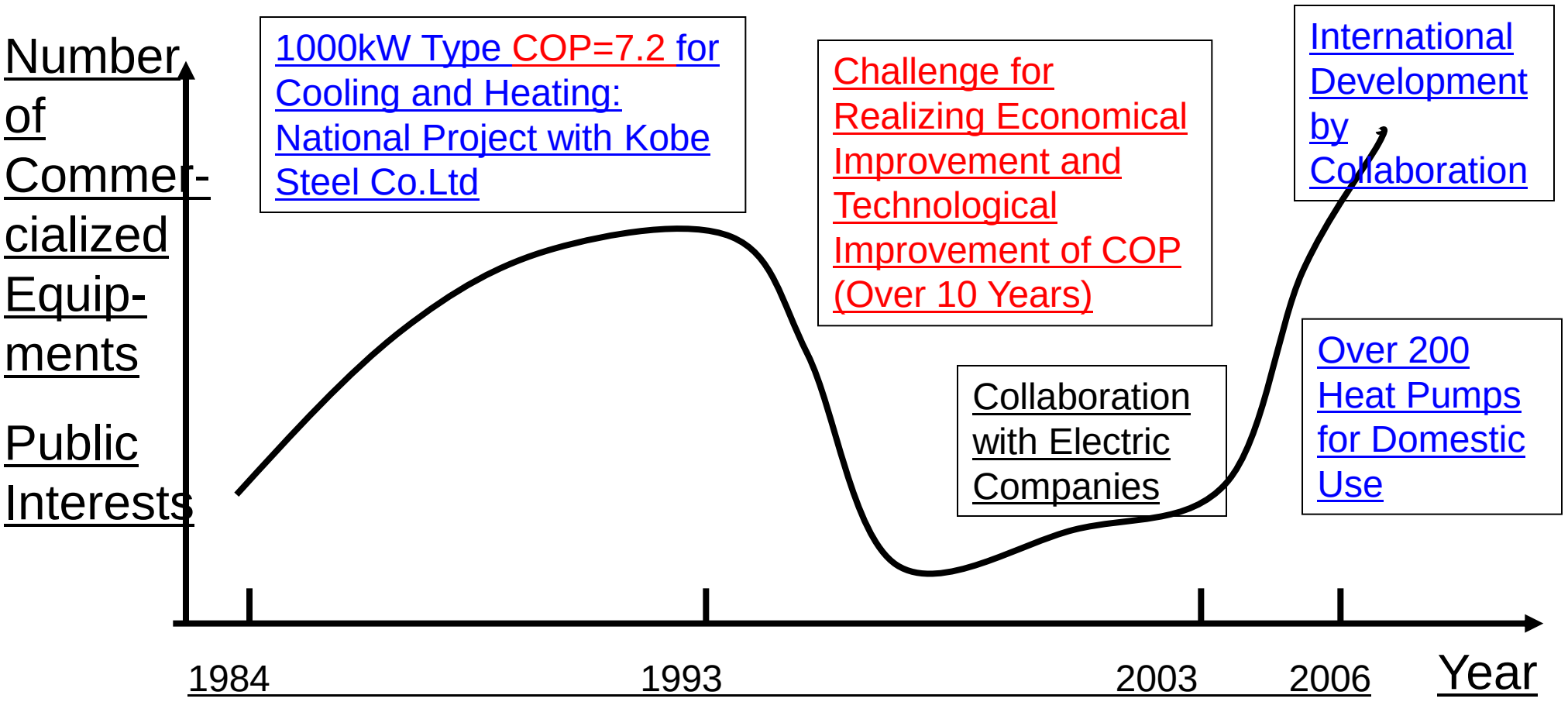
AIST(one of the largest Japanese National Laboratories)
Collaborates with DOE Laboratories
(Los Alamos National Laboratory, Lowrence Berkeley NL, Lowrence Livermore NL, Sandia NL, NREL)
& DOC, NIST from May 2009
for Energy and Environment (Solar Energy, Hydrogen Energy, Standardization & etc)

Result of National Research and Development Project of Advanced High Efficiency Heat Pump System（Air-Conditioning of Buildings）



9 Years National Project (New Sunshine Project)

COP=5 Developed with Electric Company

COP=5.5 Developed with 3 Electric Companies

What are Environmentally Friendly Technologies?

Air-Conditioning & Hot Water Supply System with Minimum Energy Consumption

For Hot Water Supply(Heating): Electric Heater, Gas Heater, Heat pump System(Eco-Cute)

Energy Flow

Electric Heater **Gas Heater (with Heat Exchanger)**

1000W means 1000W of Heating 1100W means 1000W of Heating

Electric Heat Pump System（COP=5）

200W of using Electricity means1000W of Heating（Utilizing the Heat from the Environment , that means the Renewable Energy from the Natural Air)

Heat Pump System has been recognized as the renewable energy in EU & Japan, since it utilizes the much amount of heat from the ambient nature.

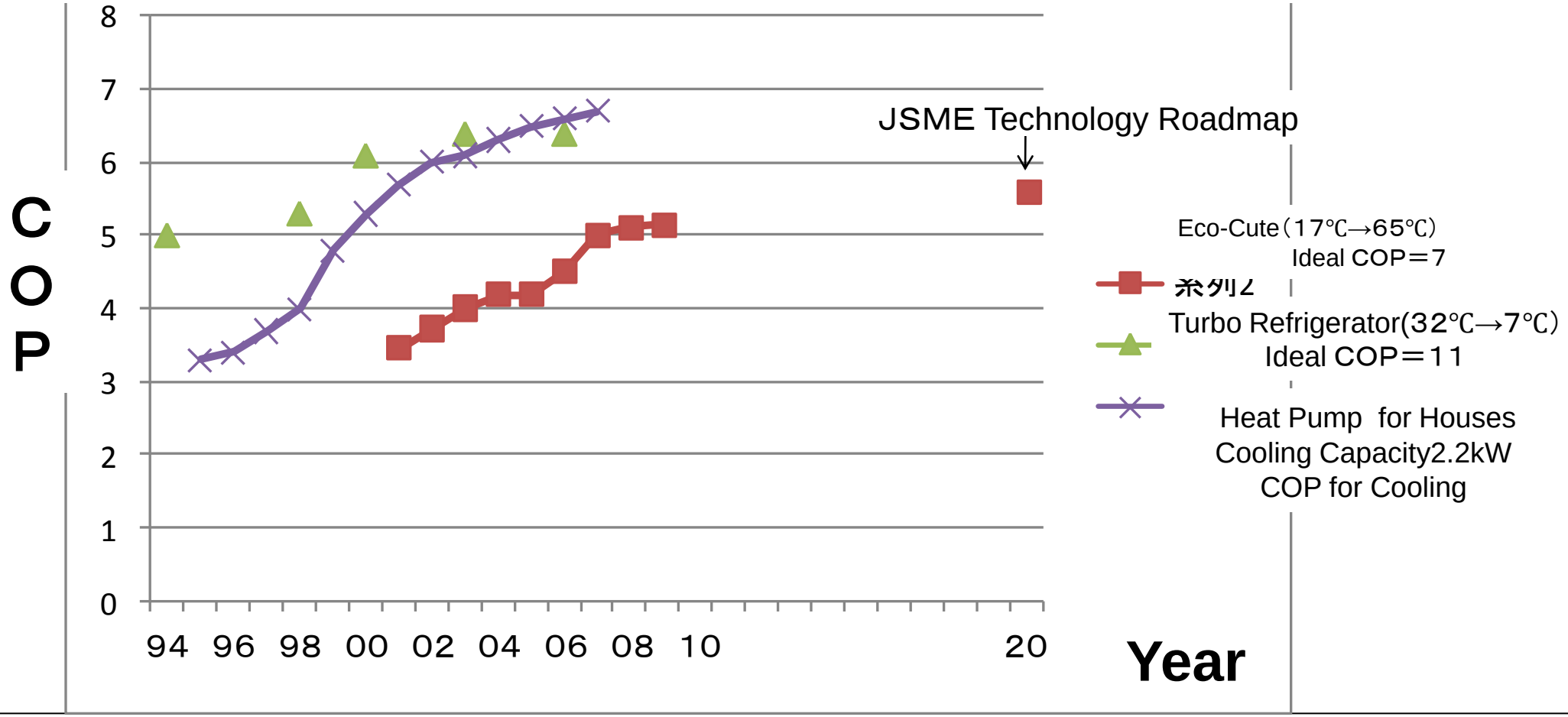
Effective Energy Flow (Exergy Flow)

Electric Heater：1000W of Electric Energy Changes 77W of Effective Energy, that is the Effective Energy of the Hot Water of 50 deg. C

Performance of Compression Heat Pump System

COP (Coefficients of Performance) increased to 5～6

By Inverter System for Compression, Increasing the Efficiency of Compressor, Heat Exchanger)



Energy-Saving Performance of Heat Pump

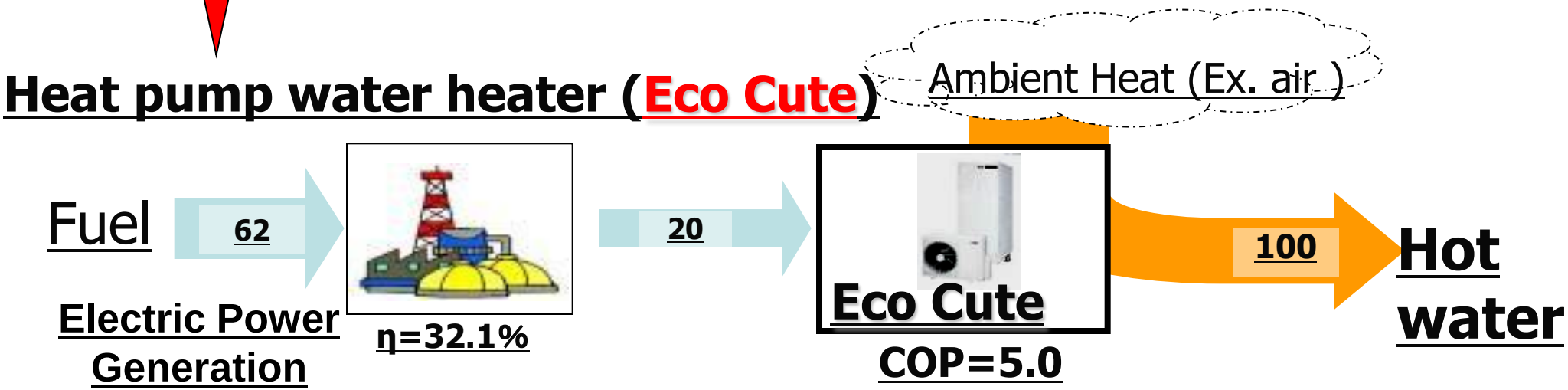
Combustion-type water heater

44% Energy Saving

LNG:2.36kg-CO2/m2

Electricity:0.56kg-CO2/kWh

Heat pump water heater (Eco Cute)



Source:2009 Energy Data Book

Advanced Heat Pump System for Heating and Hot Water Supply

Advanced Heat Pump System

High Efficient Compression-Type Heat Pump System for Cooling, Heating and Hot Water Supply

COP becomes larger than 5 or 6

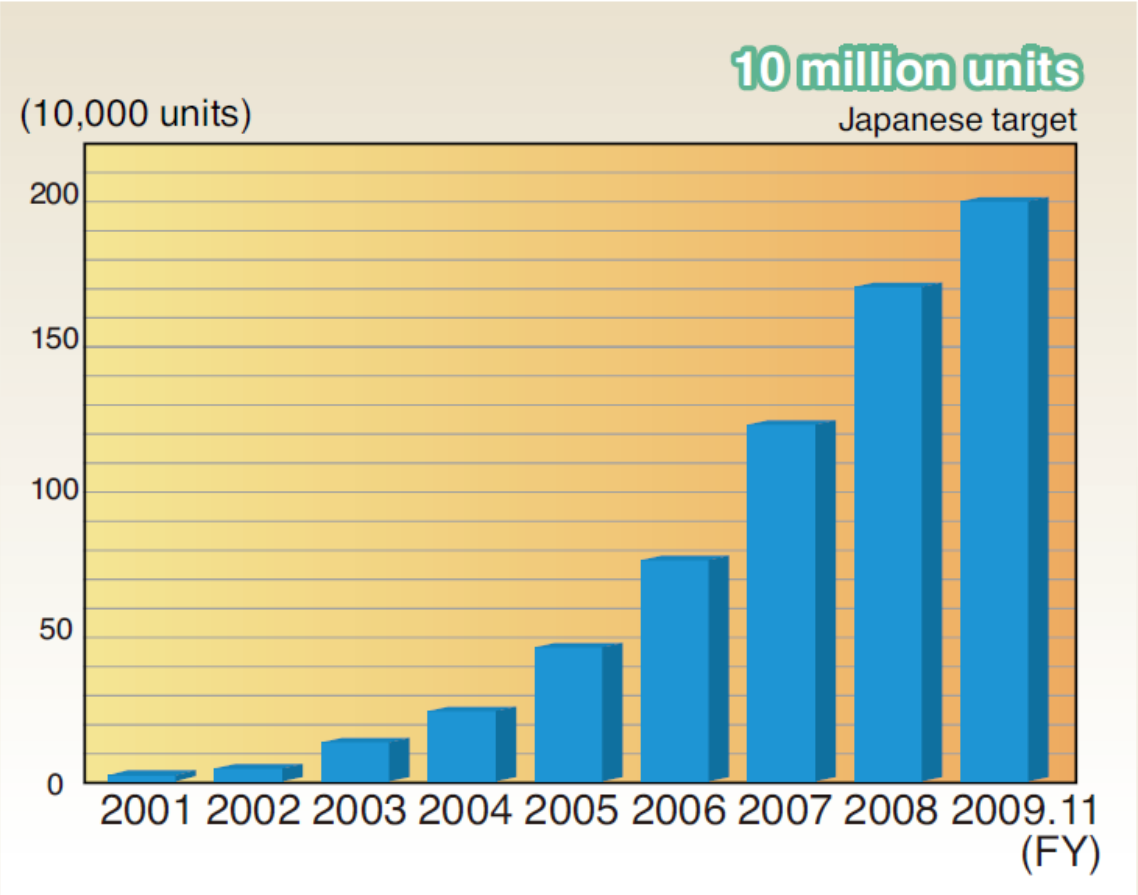
Electricity Generation Efficiency= Larger than 40%

Total Necessary Amount of Energy (5-6)X 0.4= 2-2.4

About 2 times more Effective than the Combustion Process of Hot Water Supply or Absorption Heat Pump Systems of Cooling

By Utilizing Advanced Heat Pump System, the Electricity Demand for Air-conditioning would be decreased to 50%.

Innovation of Electric Heat Pump System has been Generated for Heating &Hot water Supply



Actual Diffusion Results of Eco Cute in Japan (Installed Base)

Merits of Introducing High Performance Electric Heat Pump Systems for Heating, Cooling & Hot Water Supply in U.S.A.

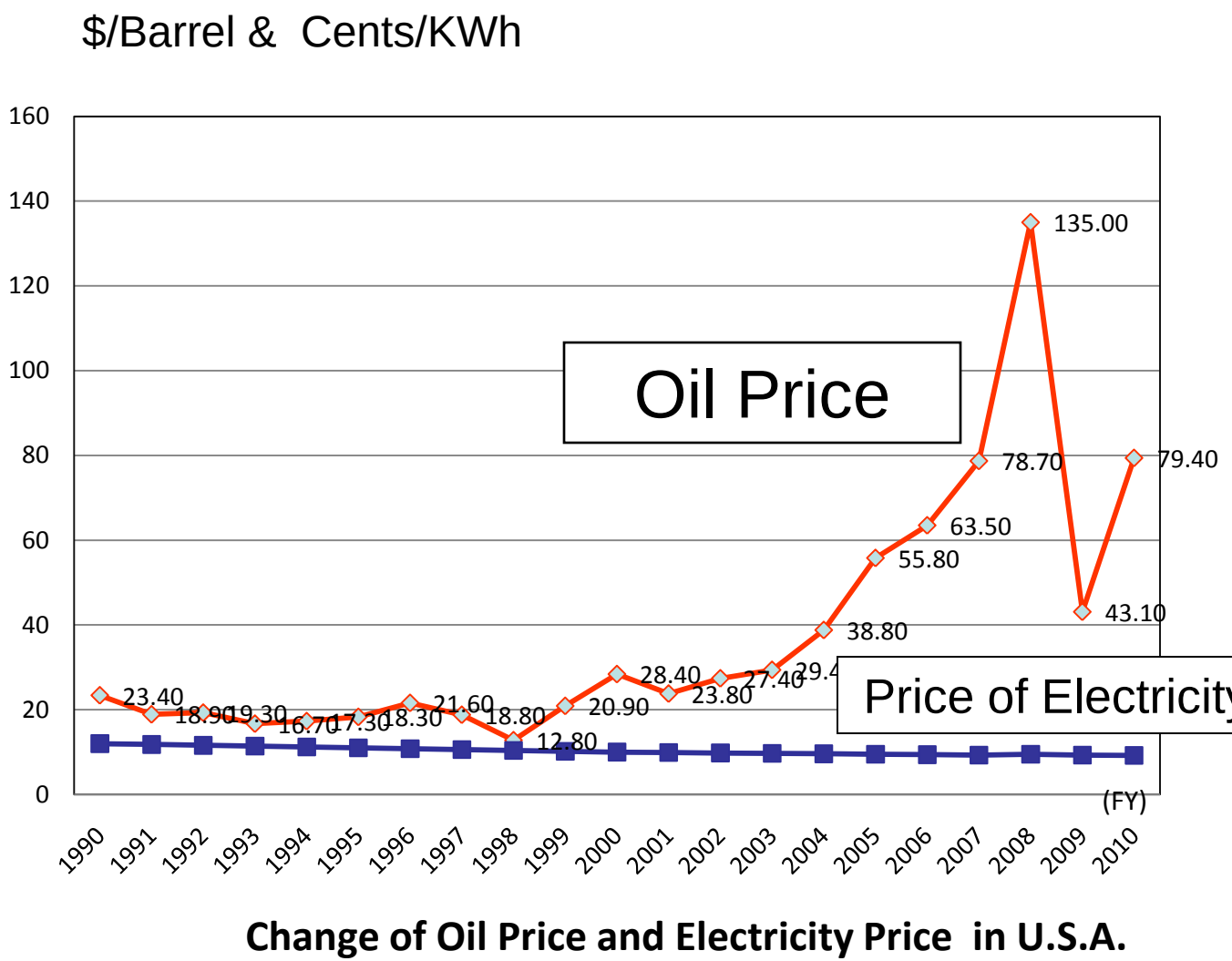
To Make the Energy Consumption Structure in U.S. A. Not Sensitive for the Oil Price

By use of Electricity as much as possible, Energy System in U.S. A. becomes Not Sensitive for the Change of Oil Price.

To Make the Total Amount of Energy Consumption & CO2 Emission in U.S.A. Reduce Largely

Advanced Heat Pump decreased Energy Consumption to about 50% Compared to the Combustion Process

To Make the Energy Consumption Structure in U.S. A. Not Sensitive for the Oil Price



Change of Oil Price and Electricity Price in U.S.A.

By Use of Electricity as much as possible Instead of Using Oil for Heating and Hot Water Supply, Society becomes Strong for the Change of Oil Price.

To Make the Total Amount of Energy Consumption & CO2 Emission in U.S.A. Reduce Largely

Advanced Electric Heat Pump (COP=5) decreased Energy Consumption to about 50% Compared to the Combustion Process

Energy Usage of U.S.A.:
22%: Residential Use
18%:Commercial Use
32%:Industrial Use
28%:Transportational Use

About 40% is for Houses and Buildings

For Residential Use:
41% is for Heating, Cooling & Hot Water Supply

For Commercial Use: (Buildings)
52% is for Heating, Cooling & Hot Water Supply

Energy Consumption of Various Countries for One Person

Global Warming means Too Much Amount of Energy Consumption？

We are not sensitive for the amount of energy usage.

Japanese People is using energy of 5.2kW for one person constantly

World Average about 2kW （1993）

U.S.A. 9.8kW,

Germany & France 5.3kW

India 0.22kW (1/24 of Japan)

China 0.65kW

As the Country the Total Energy Consumption,

Japan	**506 Mtoe(5.7% of the World)**
U.S.A	**2205 Mtoe(25%)**
Germany & France	**579 Mtoe(6.5%)**
India	**261 Mtoe (2.9%)**
China	**961 Mtoe(10.8%)**

(1997)

Amount of Energy Usage from the Viewpoints of Our Daily Life （Japanese Case)

Contents from Viewpoints of Our Daily Life

（Total 5150W, LCA Analysis including Materials）

Clothes：137W（Clothes & Bed 86W, Washing：51W）

Eating ：296W（Green House128W, Cooking59W, Refrigerator50W, Restaurant 59W）

Living ：1576W（House Construction 148W, Autobobiles for Personal Use 527W,Air-conditioning195W, Bath &Hot Water Supply 198W,Lightening 49W, TV& Electronics 301W)

Business & School：869W（Building & Construction 652W,Public Transportation122W,Hotel 95W)

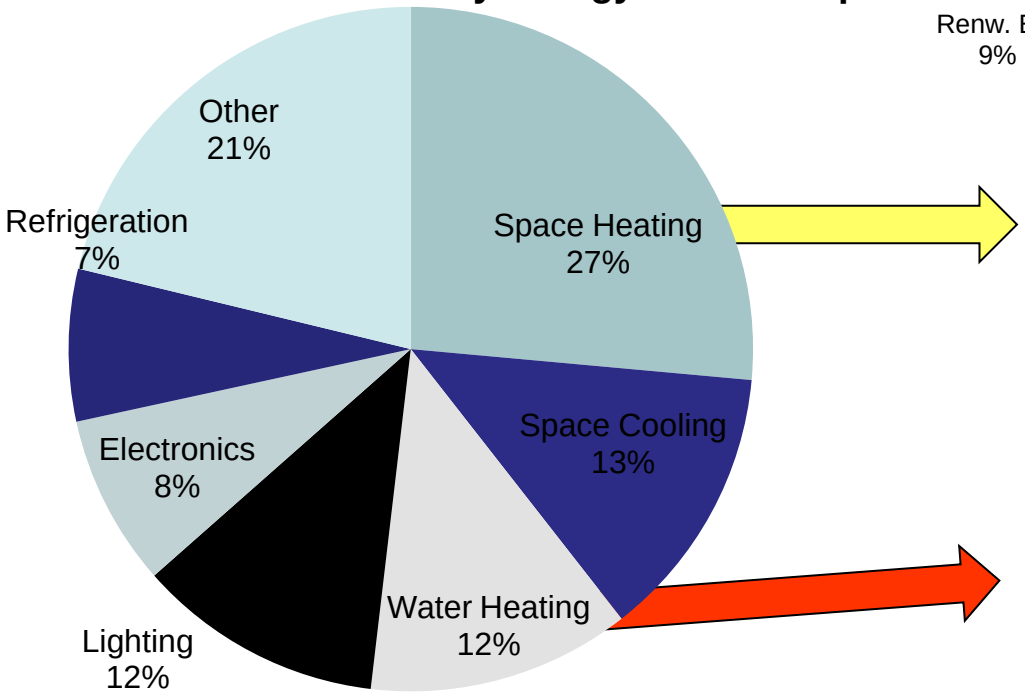
Society：918W（Carriage 324W, Store 155W, Hospital 81W, Road Construction 103W, River 92W, Movie 27W)

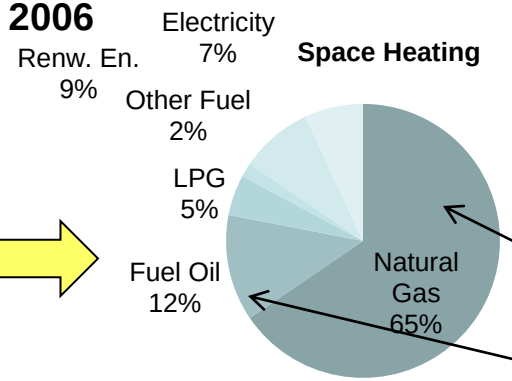
not cleared：1354W

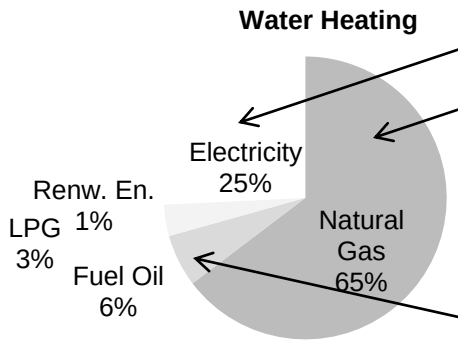
Utilization of Advanced Heat Pumps for Houses

In USA, about 20% of the Total Energy Usage is used in Residential Area

U.S. Residential Primary Energy End-Use Splits 2006





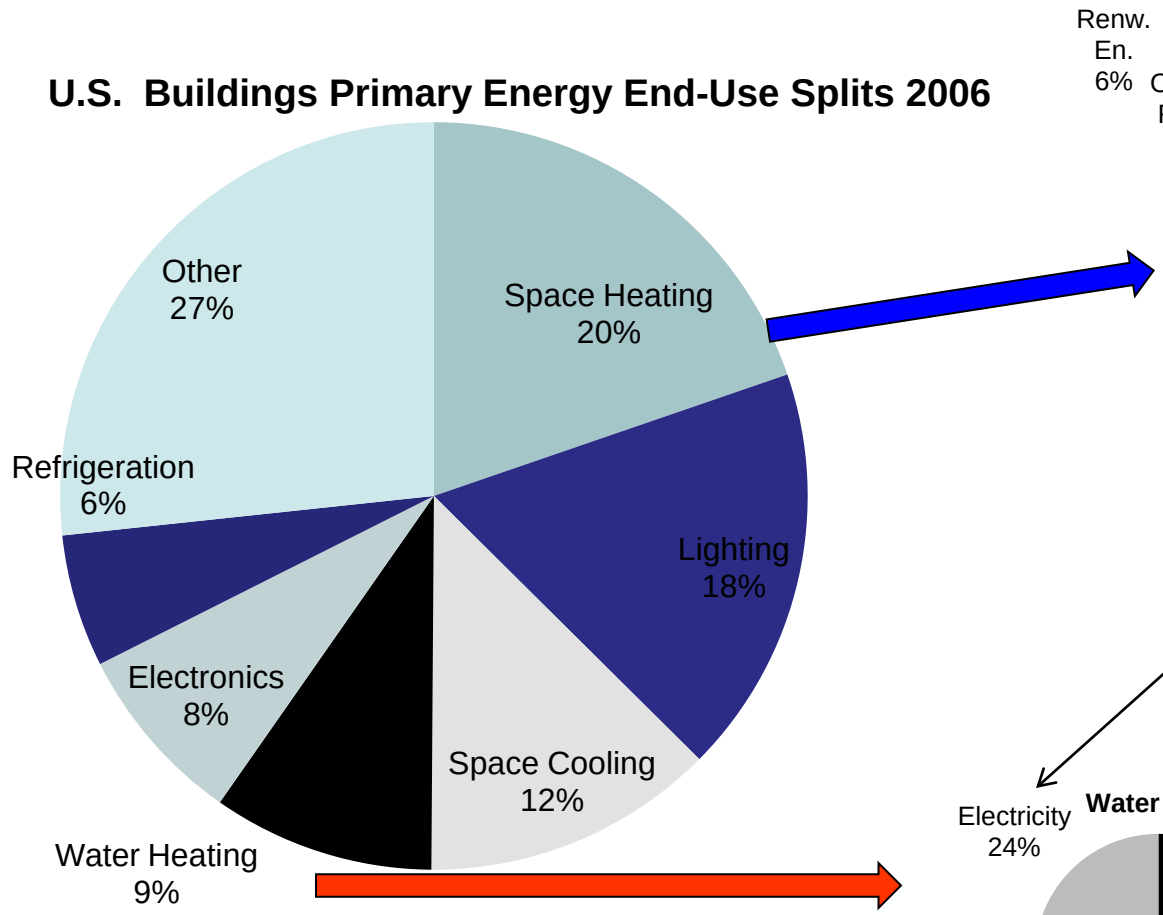


Replacing Combustion Process by Electric Advanced Heat Pump Systems

Source:U.S. Department of Energy Buildings Energy Data Book 2009

Heating & Hot Water Supply reach 39%, 85%-99% of which have been supplied by Combustion Process. Energy Consumption decreases over 50% by Applying Electric Heat Pump System

Utilization of Advanced Heat Pumps for Buildings



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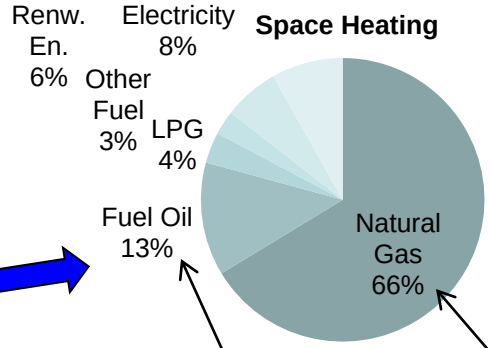

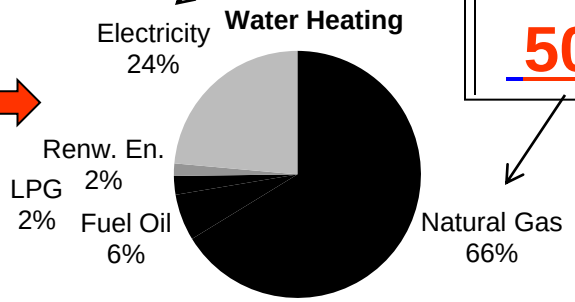

Replacing the Combustion Process by Advanced Electric Compression-type Heat Pump

50% Energy Saving

Replacement Effect of Electrically Driven Advanced Compression-type Heat Pump Systems：

Estimated Energy Saving Potential

USA Total Primary Energy Supply

Houses（22%）：

Heating：22x0.27x0.82x0.5＝2.4%

Hot Water：22x0.12x0.99x0.5＝1.3%

Buildings（18%）：

Cooling：18x0.12x0.5x0.5＝0.5%

Heating：18x0.20x0.86x0.5＝1.5%

Hot Water：18x0.09x0.98x0.5＝0.8%

Energy Saving Potential of Advanced Heat Pump：

6.5% of Total Primary Energy Supply

Concluding Remarks

1. Over 10 Years of Research and Development would be necessary for establishing Advanced Energy Equipments after Realizing the Technology Seeds.
2. Advanced Electric Heat Pump Systems with COP of 5～6 has been Technological Innovation for Replacing Combustion Process and has been Utilized Rapidly
3. Merits of Introducing Advanced Electric Heat Pumps would be the contribution of the Energy Consumption Structure in U.S.A. not to be influenced by the change of Oil Price
4. In U.S.A, Utilizing Advanced Heat Pump Systems by Replacing Combustion Process has the Potential of Saves 6.5% of the Total Energy Usage.