Japan's Strategy for Mitigating Global Warming

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Contents

What is RITE

1. Established in 1990
2. Employees about 190
3. Main sponsor government of Japan
4. Size of annual budget 4 – 5 billion Yen
3. Objective

   Study on measures for mitigating climate change and related technologies

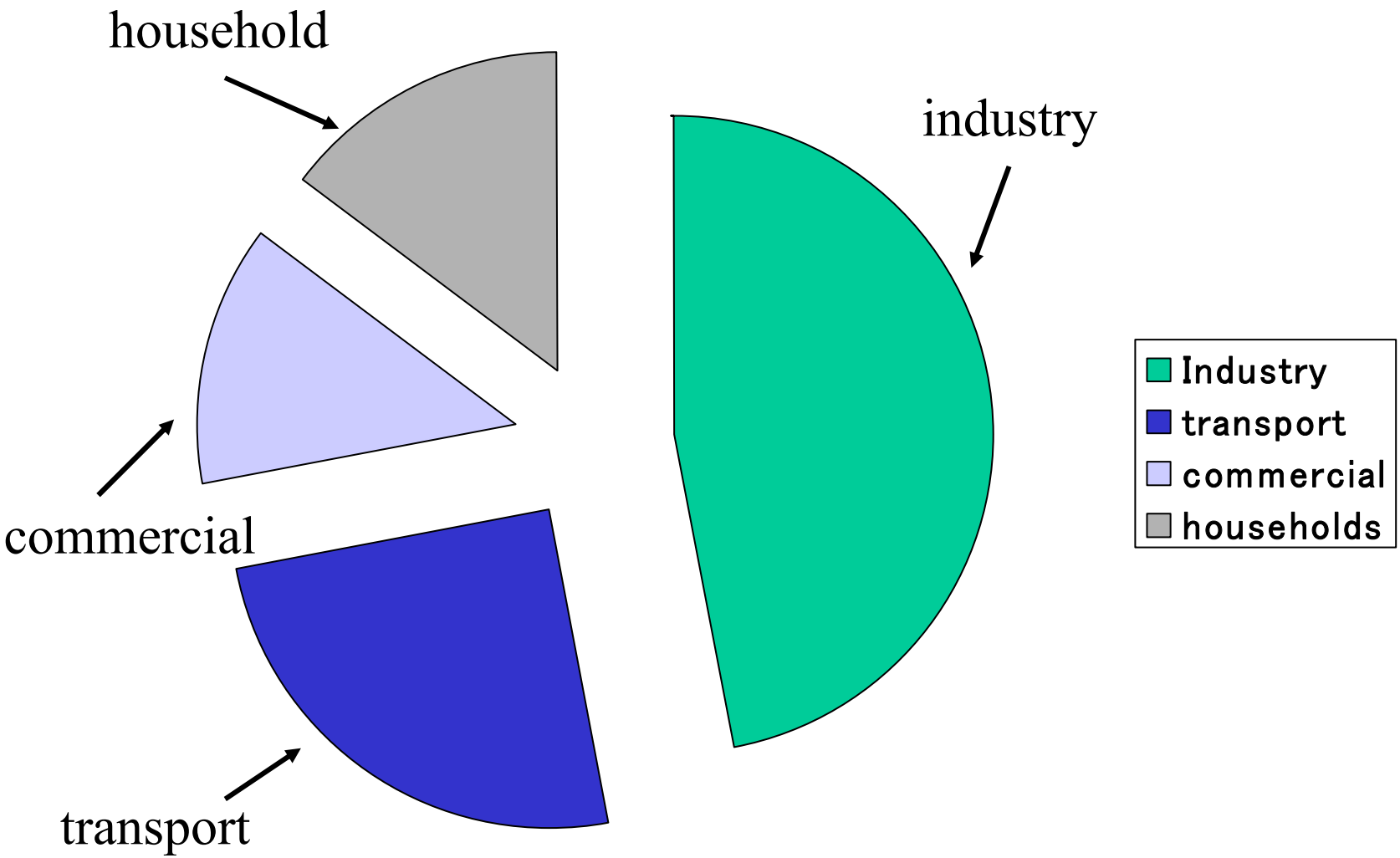


Fig. Demand structure of Japan:2004

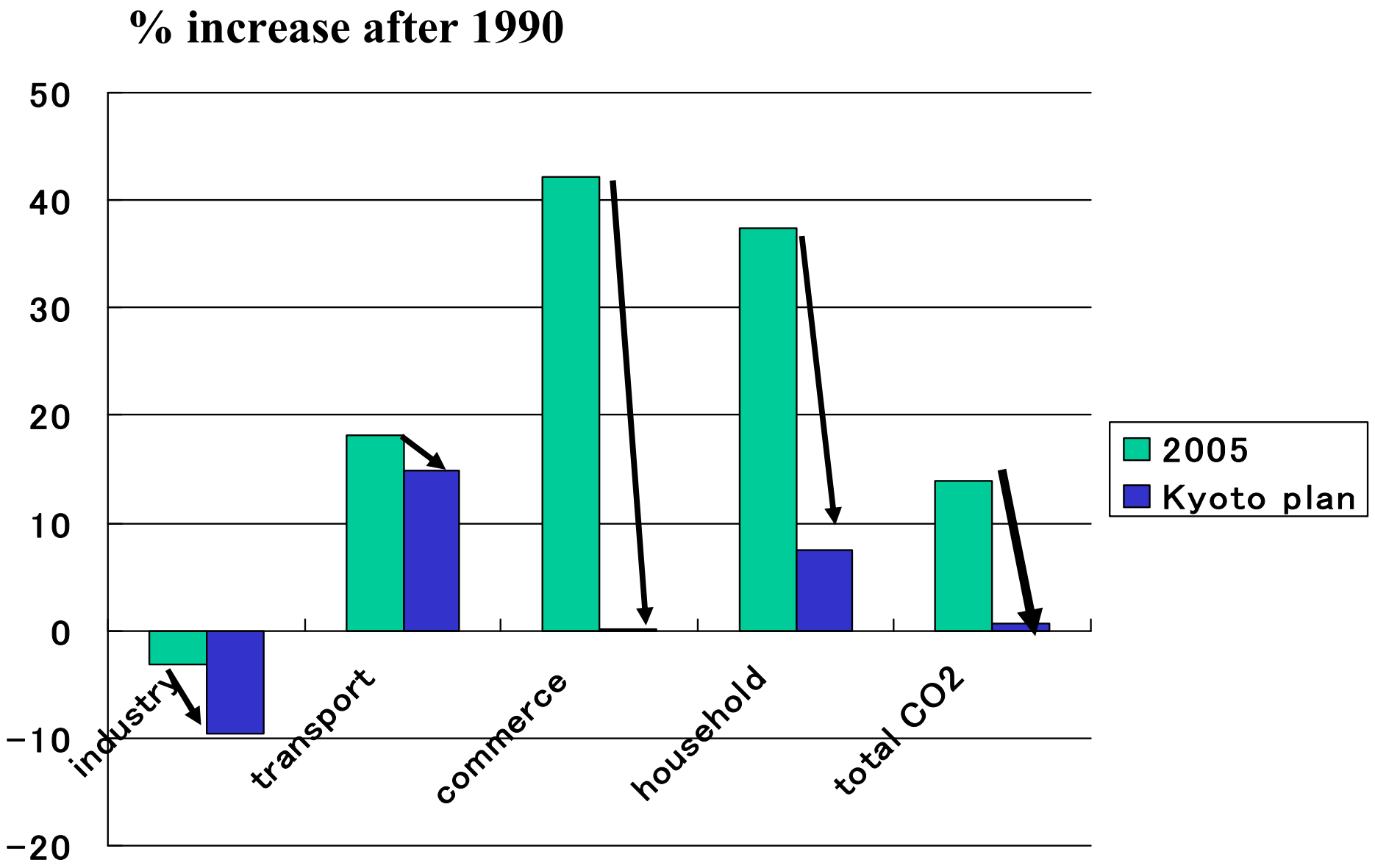


Fig.1.1 CO2 in Japan: Present status and 2010 target

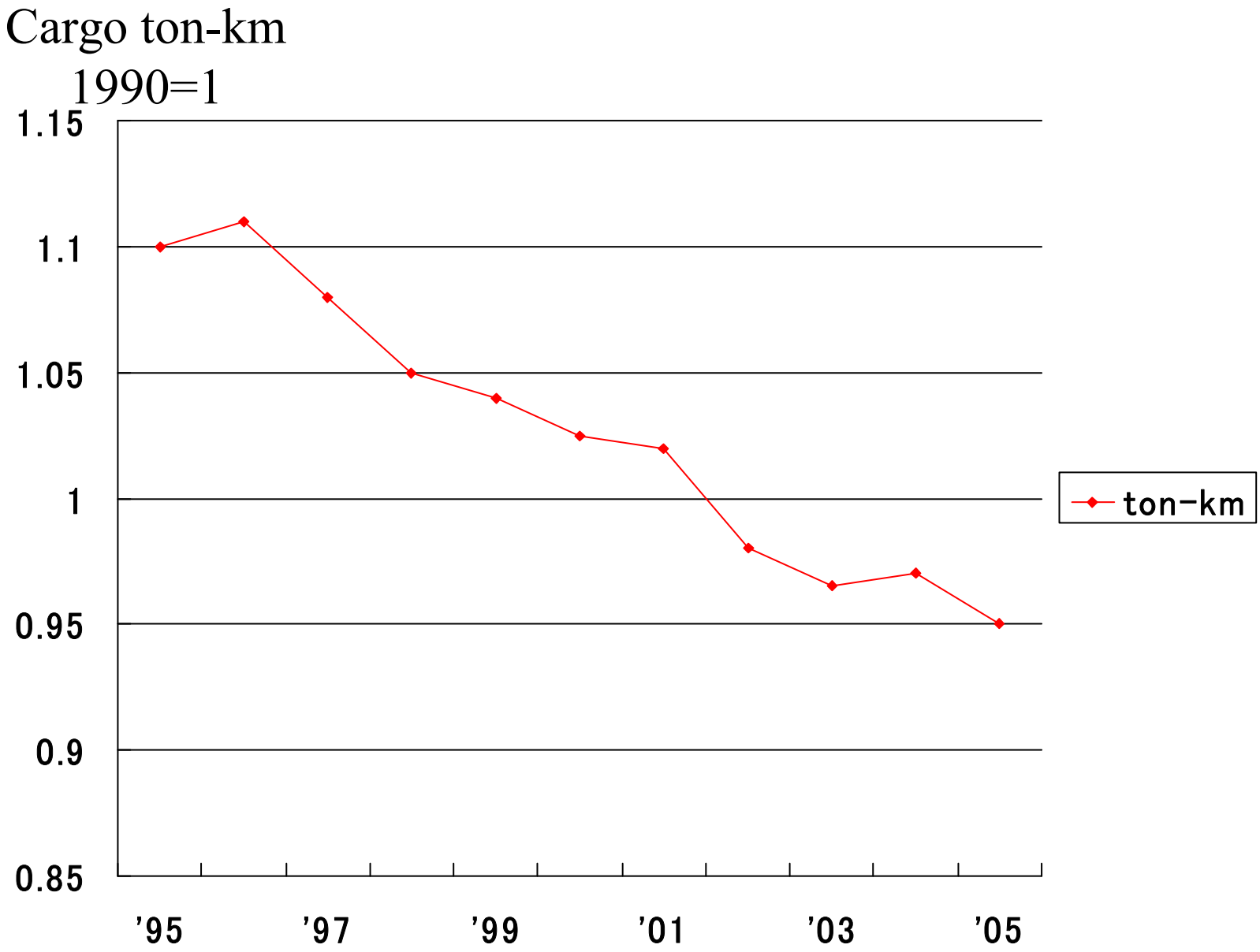
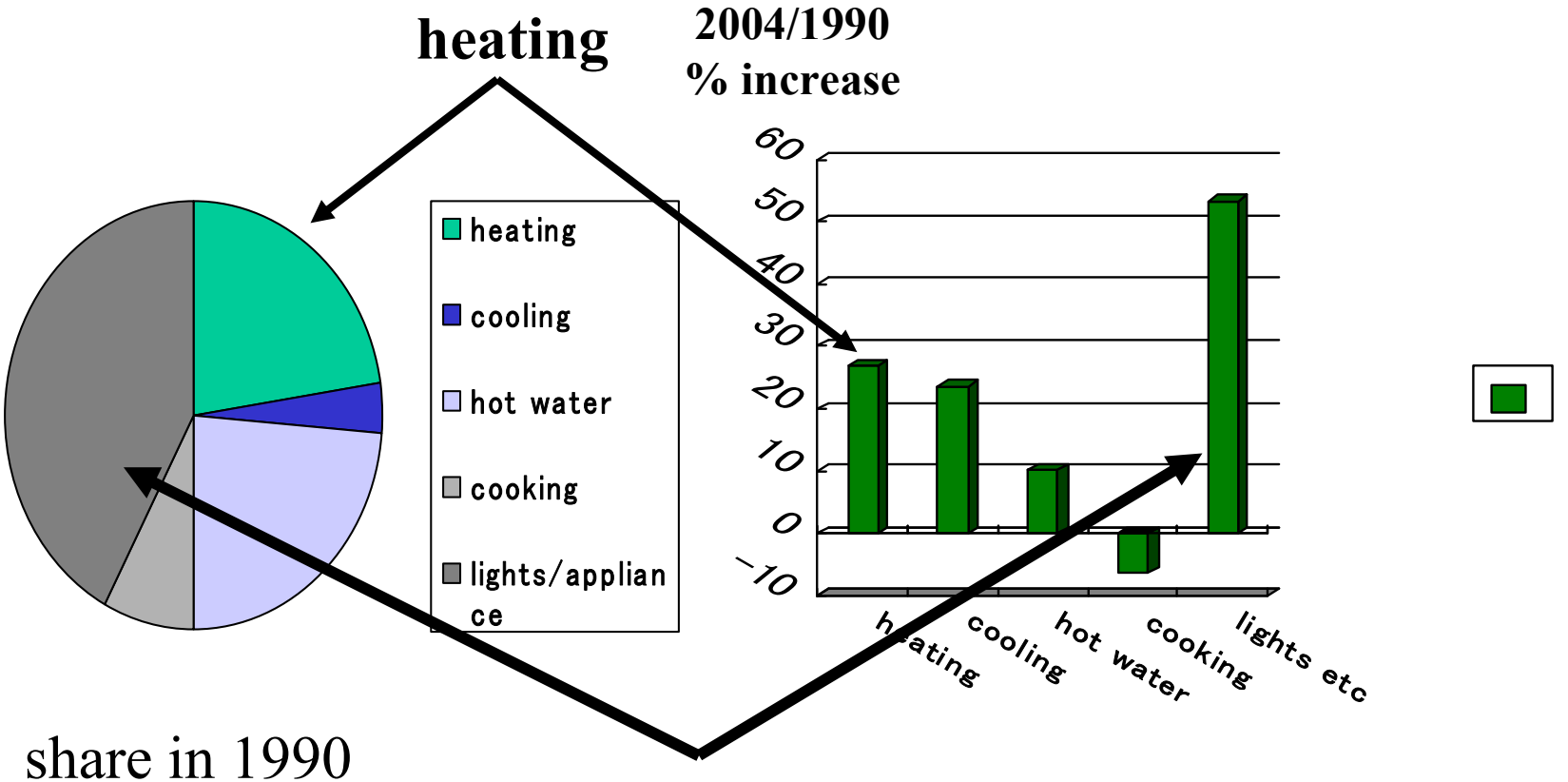


Fig. Trends of Cargo transport in Japan – 1995-2005 -

Fig. CO2 emission in households
- 2004 trends, Japan -



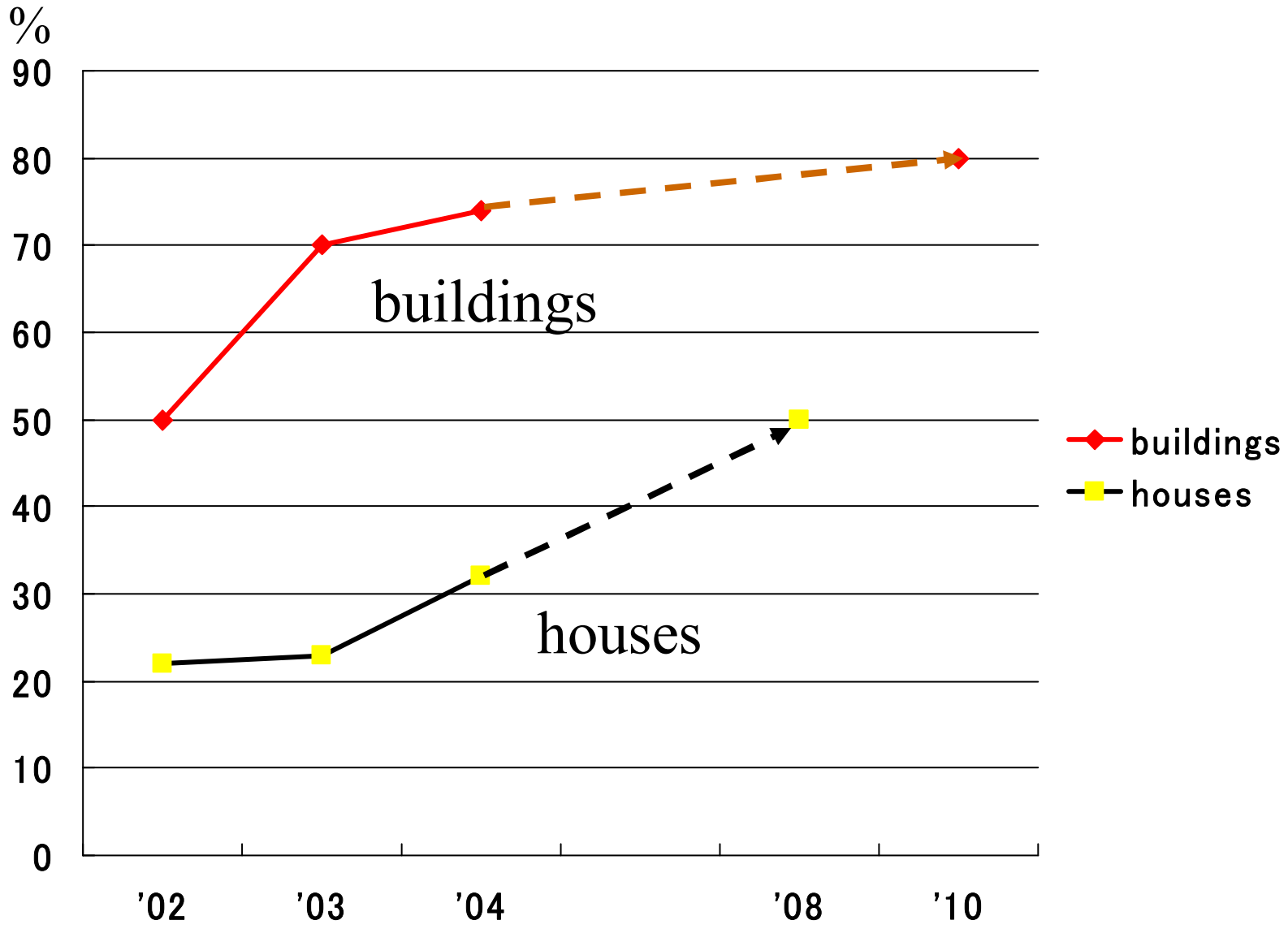
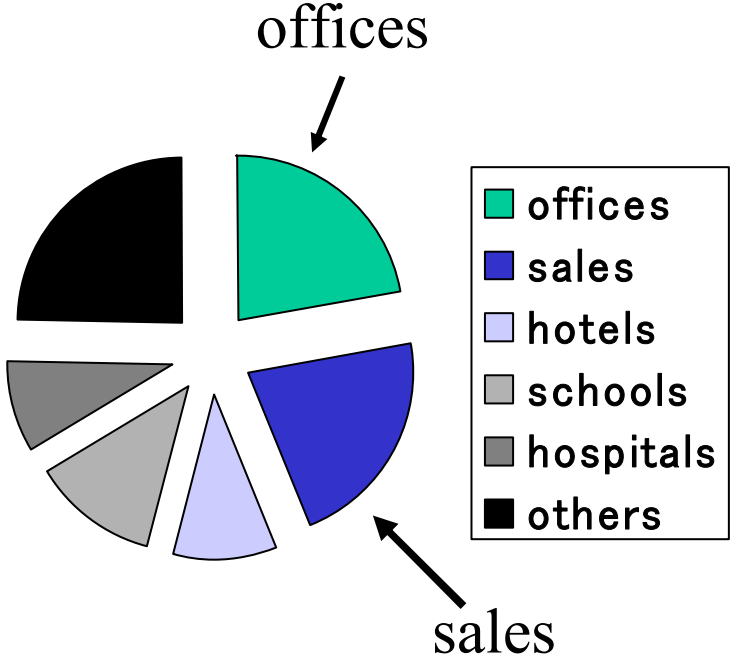
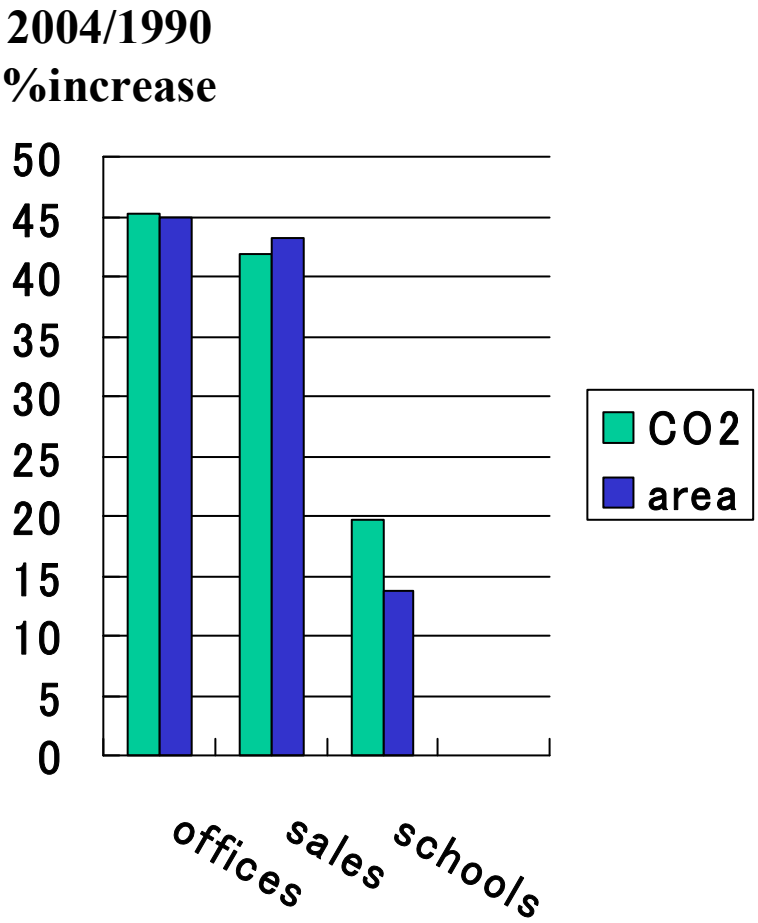


Fig. percentage of those satisfying insulation standard
- Buildings and houses newly built since 002 in Japan -

CO2 emission in commercial sector -2004 trends, Japan -



share in 1990



Issues in the government plan for achieving Kyoto target

1. **How to limit energy consumption in household and commercial sectors?**

   household / wholesale and retail sales

   only regulartory measures ?

   then what measures ?

2. **How to reduce CO2/ energy in power sector?**

   improvement in operation rates of nuclear power ?

   reduction in use of coal fired plants ?

Limits of Kyoto protocol

1. Participation

   limiting GHG emission:

   only one third of the world

2. Character of the target

   macroscopic numerical target of a country

   --- government can regulate small energy consumers' behavior?

Energy conservation

1. Most effective

   In 20th century : rates of change

   C/E : - 0.3% / y < E/G: - 0.9% / y

   decarbonization energy conservation

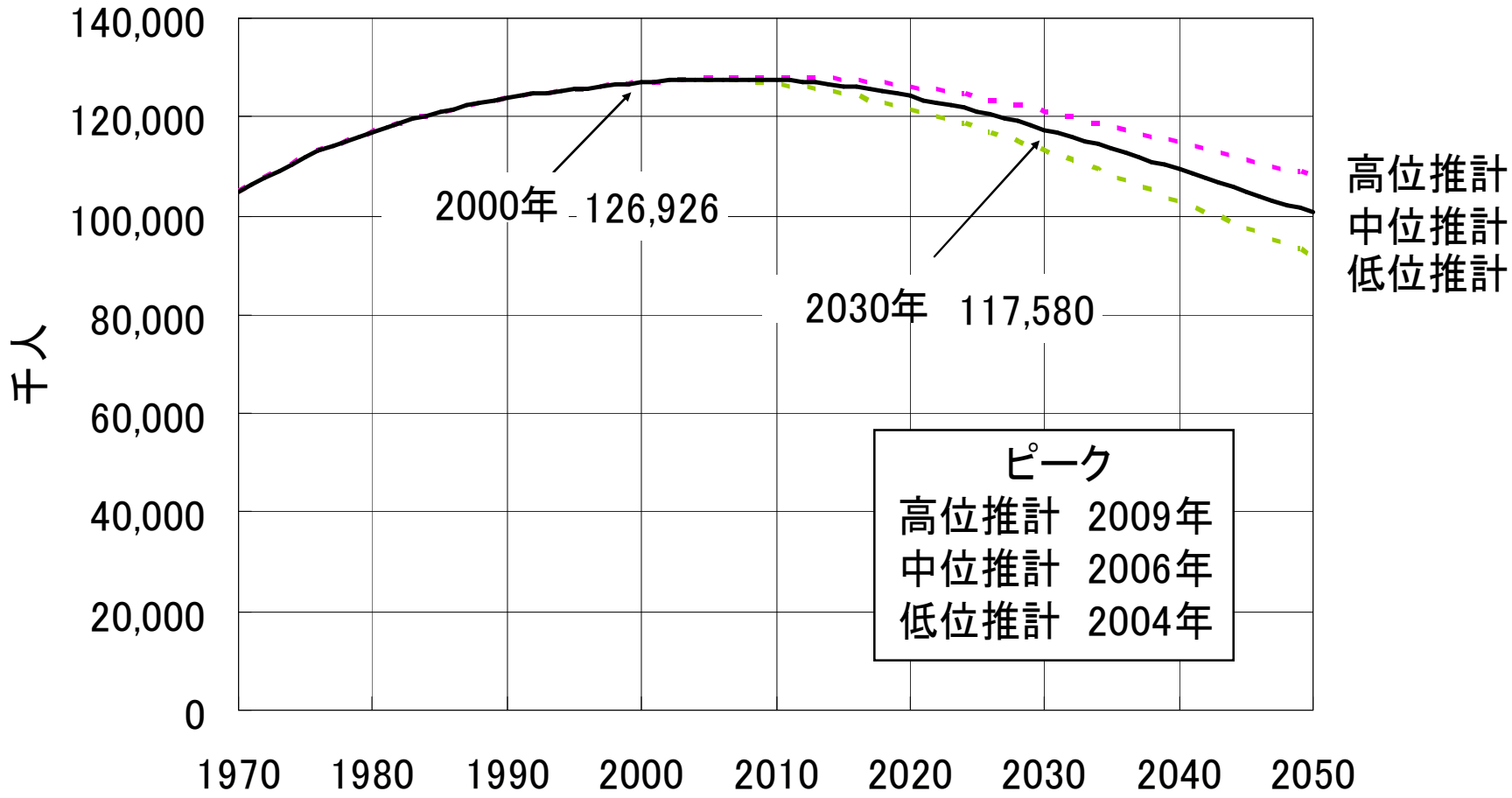
2. Applicable to all countries : beneficial in costs

3. Ways of energy conservation
   1) improvement in efficiencies of processes / machines
   2) cascade use of energy in various systems

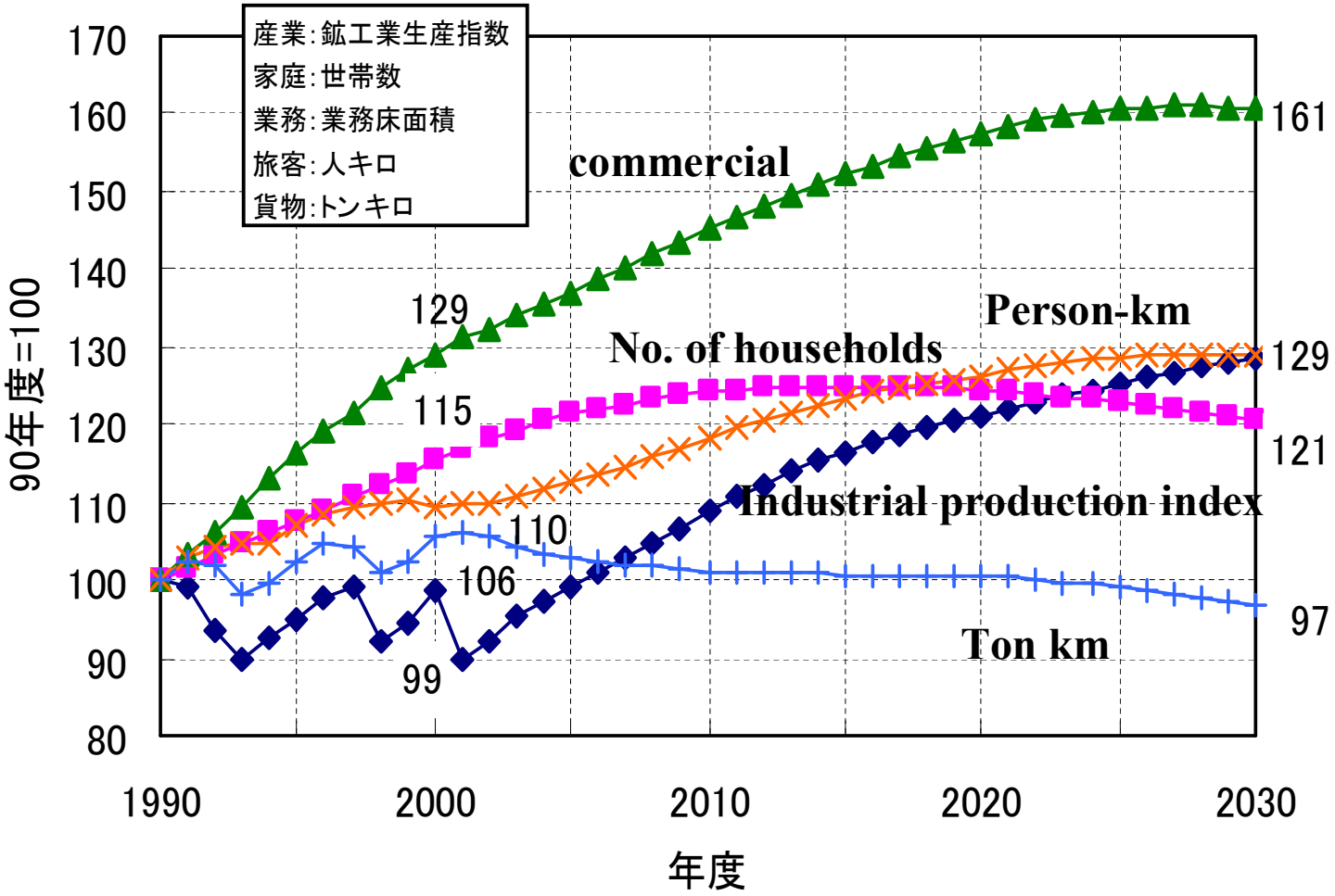
METI's long term forecast in 2004

1. Energy demand will peak between 2020 and 2030 mainly due to decrease in population.
2. Energy conservation will advance and give rise to further reduction in CO2 emission.
3. Further expansion of nuclear power is expected.

Future of Population in Japan



Future activities in Japan: METI's forecast



METI forecast: CO2 emission in Japan

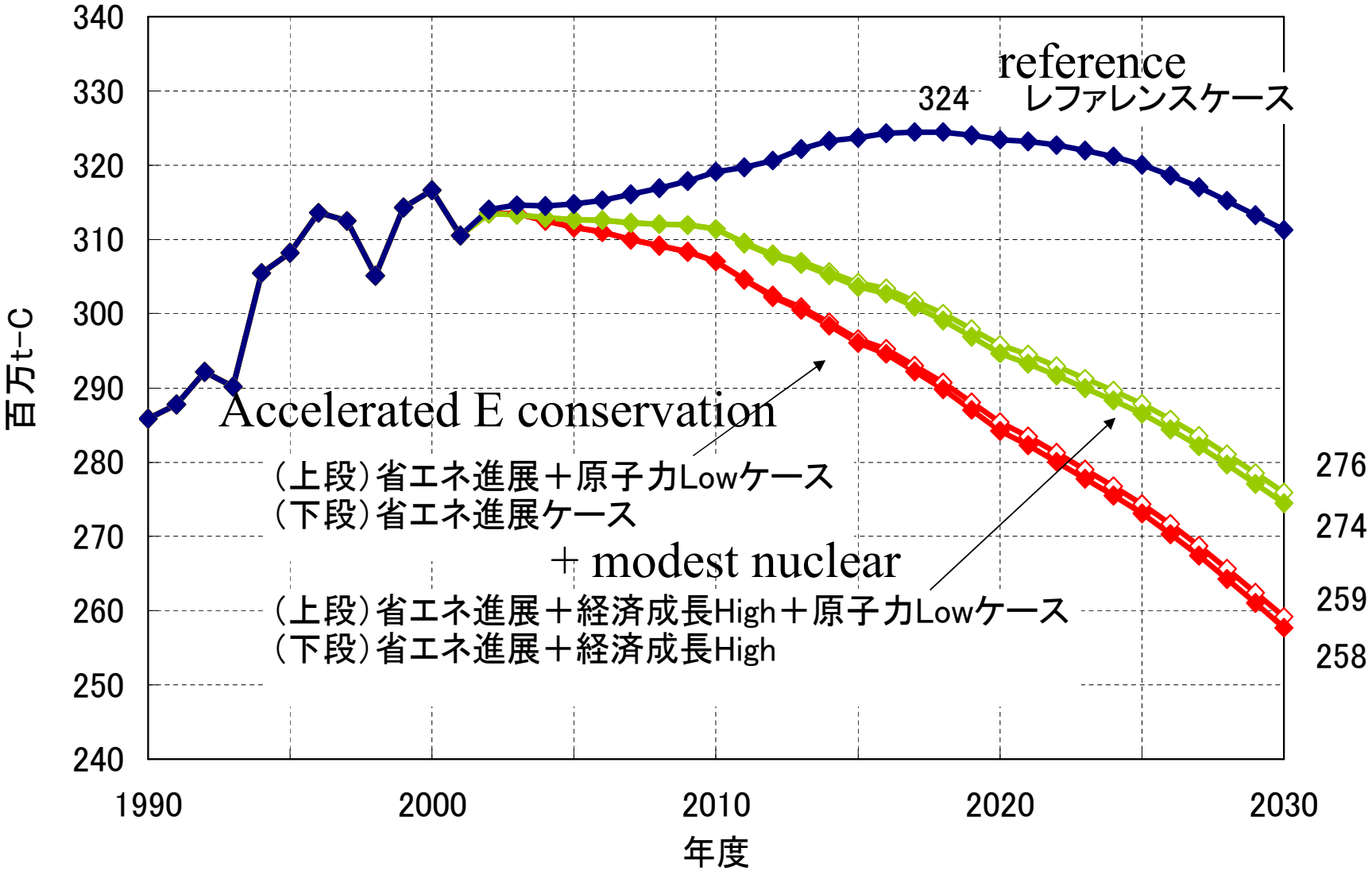
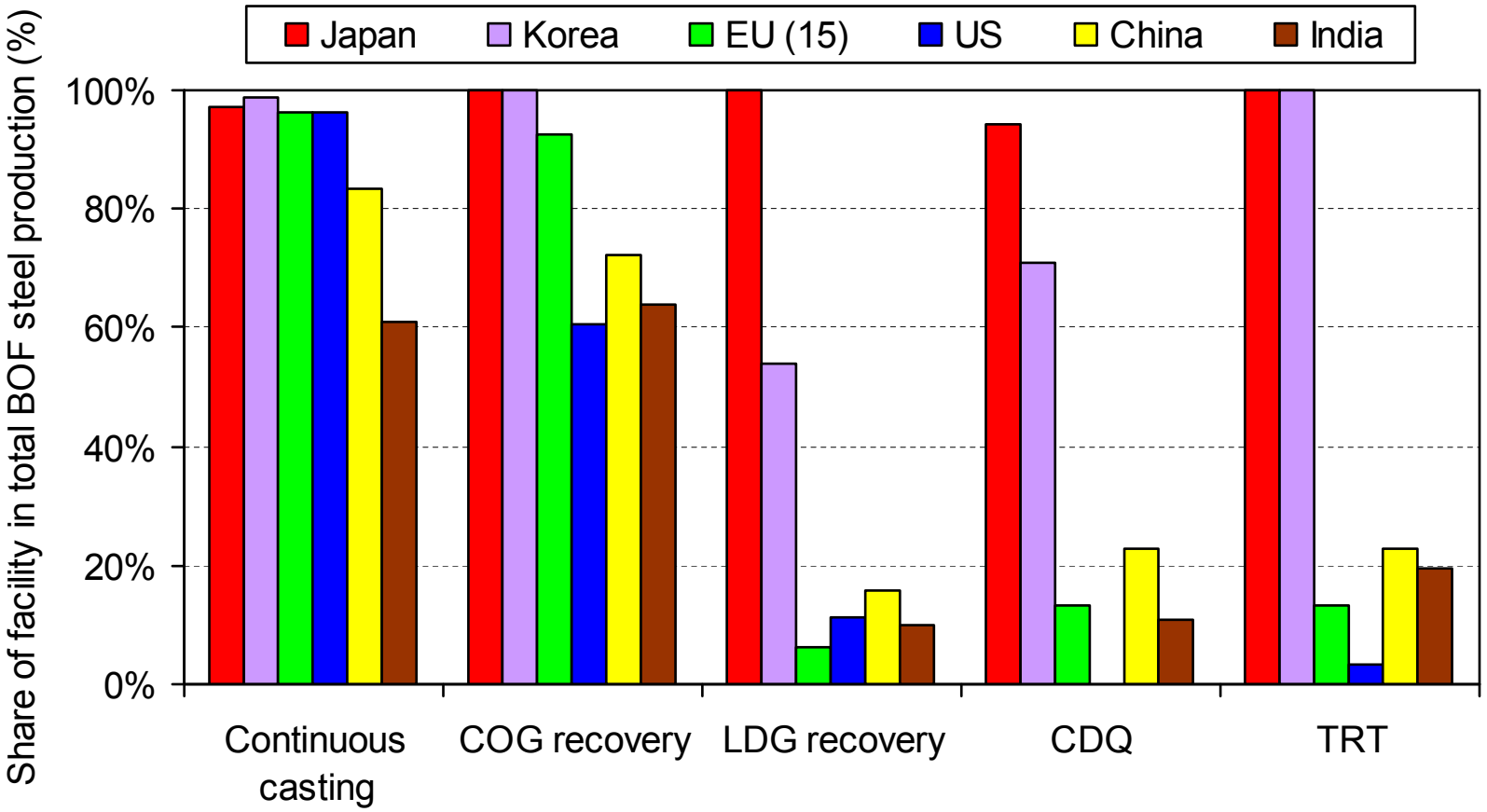


Fig.2.1 Penetration Share of Energy Efficient Technologies in Iron & Steel Industry in 2000



Source: Estimates by RITE from data of reports from IISI, NEDO, etc.

When the installation capacities of energy efficient technologies are estimated from various literatures, the installation shares are large in Japan.

Detailed bottom-up modeling is needed to evaluate the effects of technology diffusions.

Alternative idea about the future action for mitigating climate change

1. **Multi-nation oriented**

   NOT UN oriented

   voluntary consortium of large countries

   ex. Asia Pacific Partnership, G-8

2. **Action oriented**

   energy conservation for developing countries

   renewables in the long term

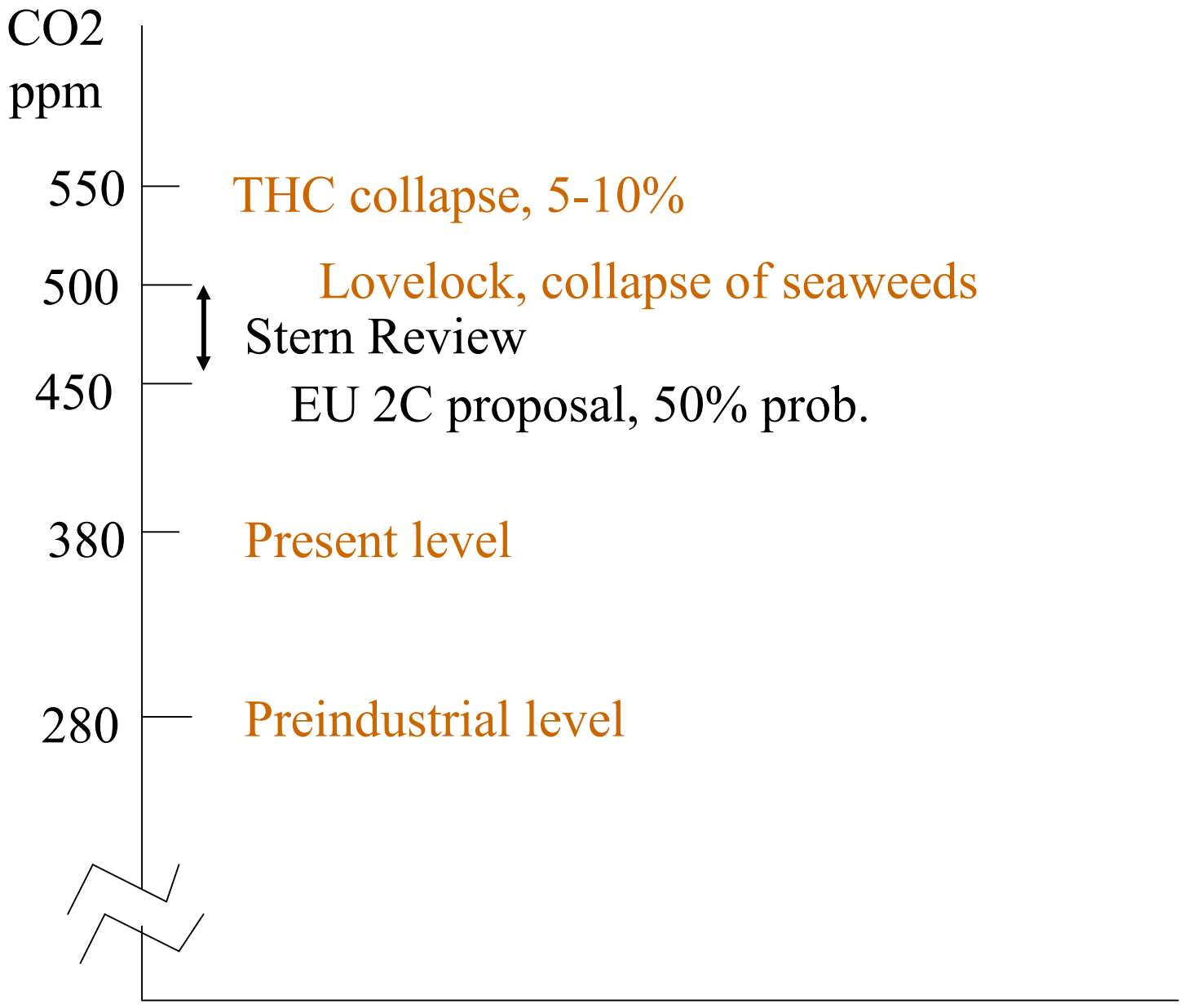


Fig.CO2 concentration in the atmosphere

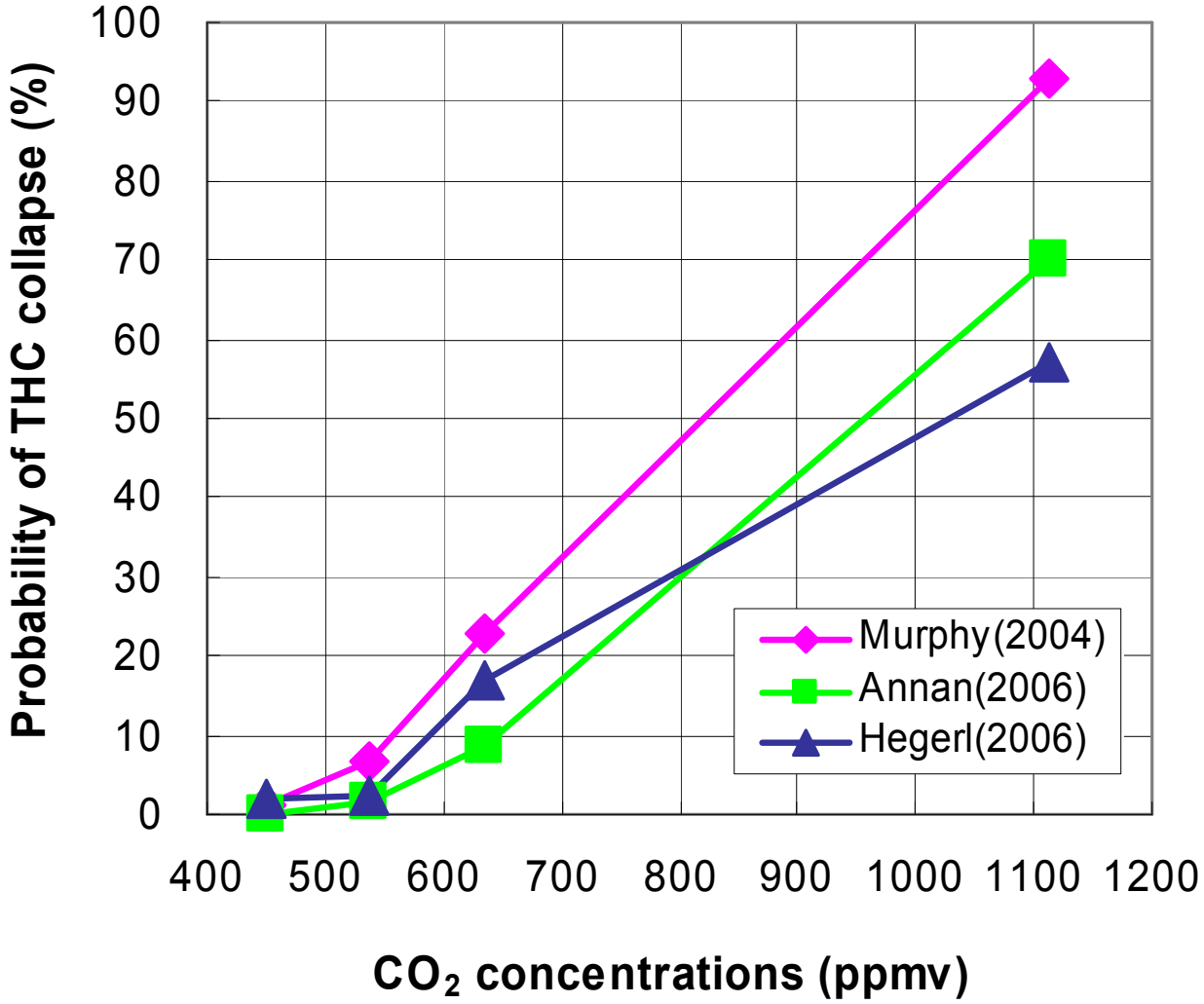


Fig. Possibility of the Collapse of Thermohaline Circulation (THC)

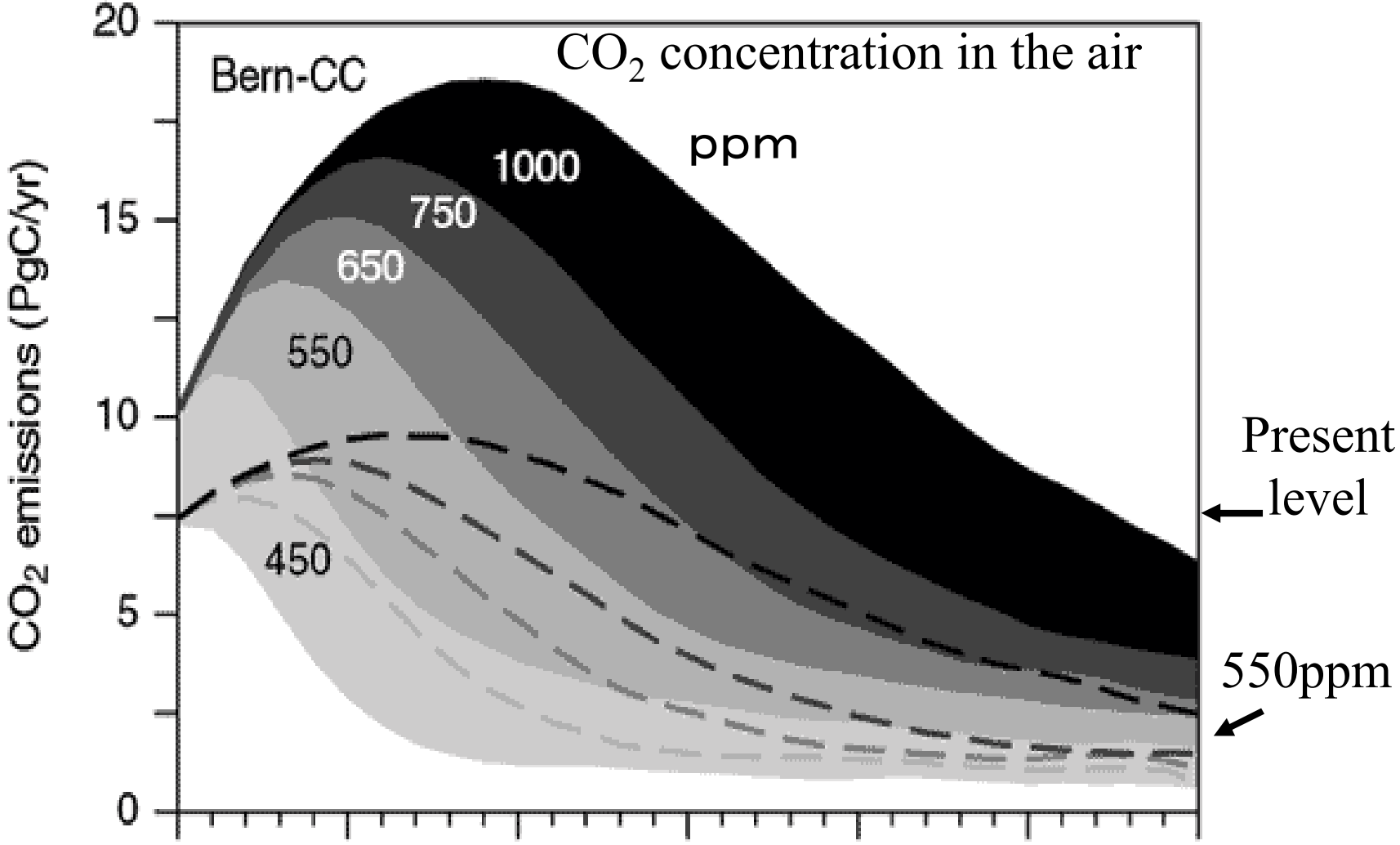
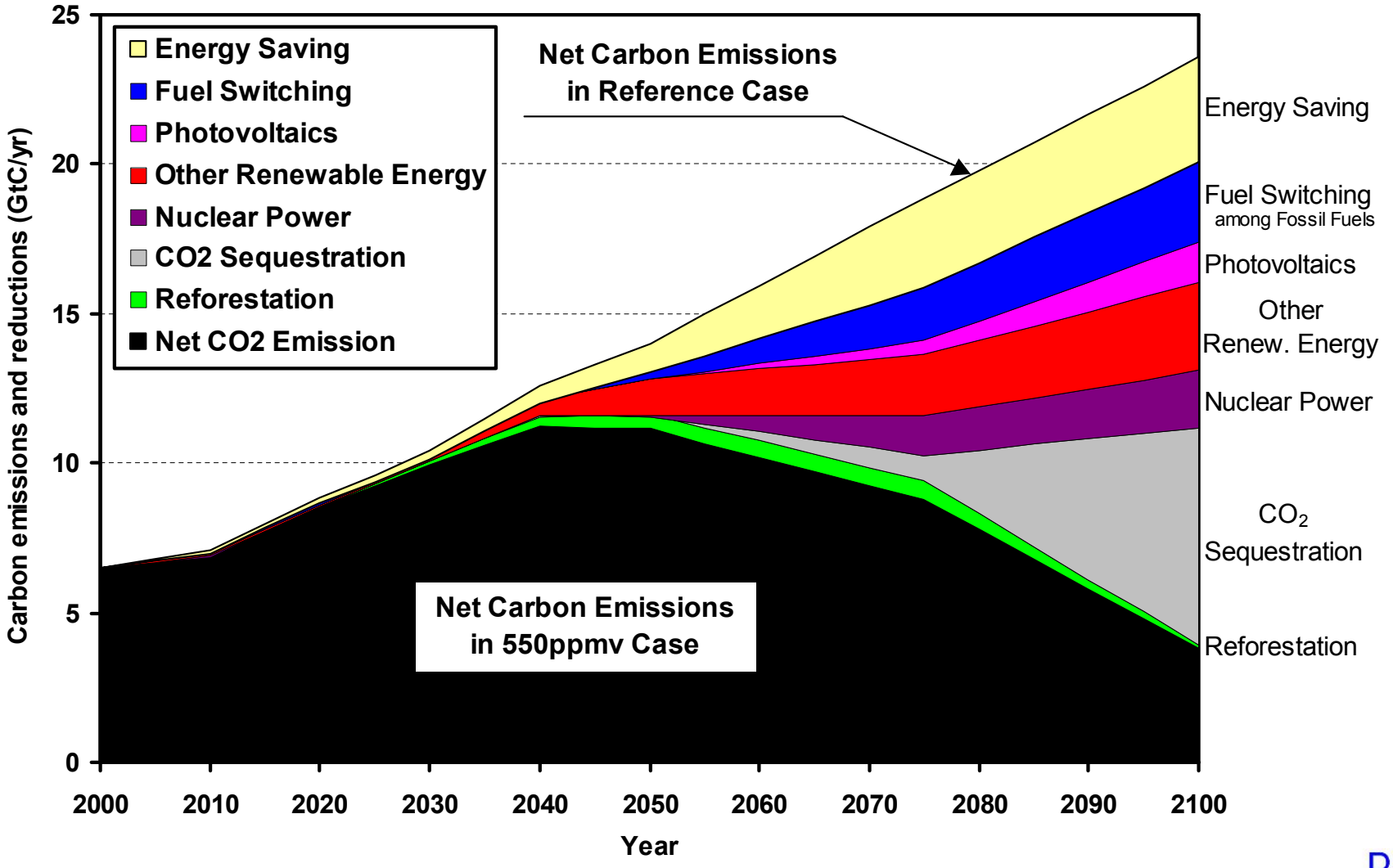


Fig. CO_2 emission for stabilizing its concentration in the air

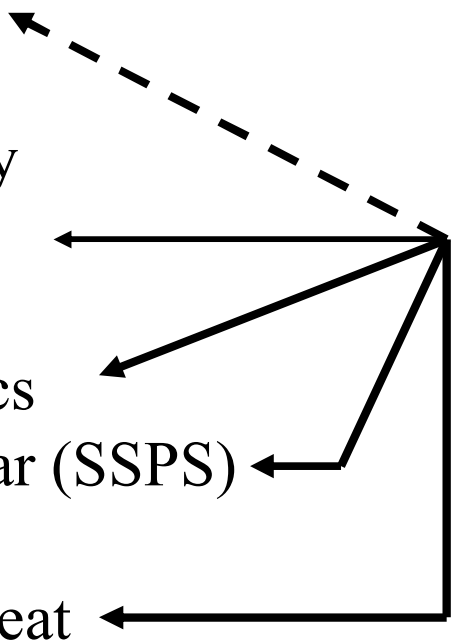
Source: IPCC TAR technical summary

Technological Options for 550 ppmv Stabilization



Efforts for decarbonization

1. Energy conservation
   industries / transportation
   houses and buildings
2. Non carbon primary energy
   1) nuclear power
   2) renewables
      a. wind power / photovoltaics
      b. remote hydro - space solar (SSPS)
      c. **biomass**
      d. ambient resources – geoheat
3. **CO2 capture and storage (CCS)**



Future key issues on nuclear power

Basis: Nuclear is almost indispensable in decarbonized future.

1. How to scrap and build present reactors?

ex. Japanese case (see the figure)

2. How and where to dispose nuclear wastes?

3. How to improve public acceptance?

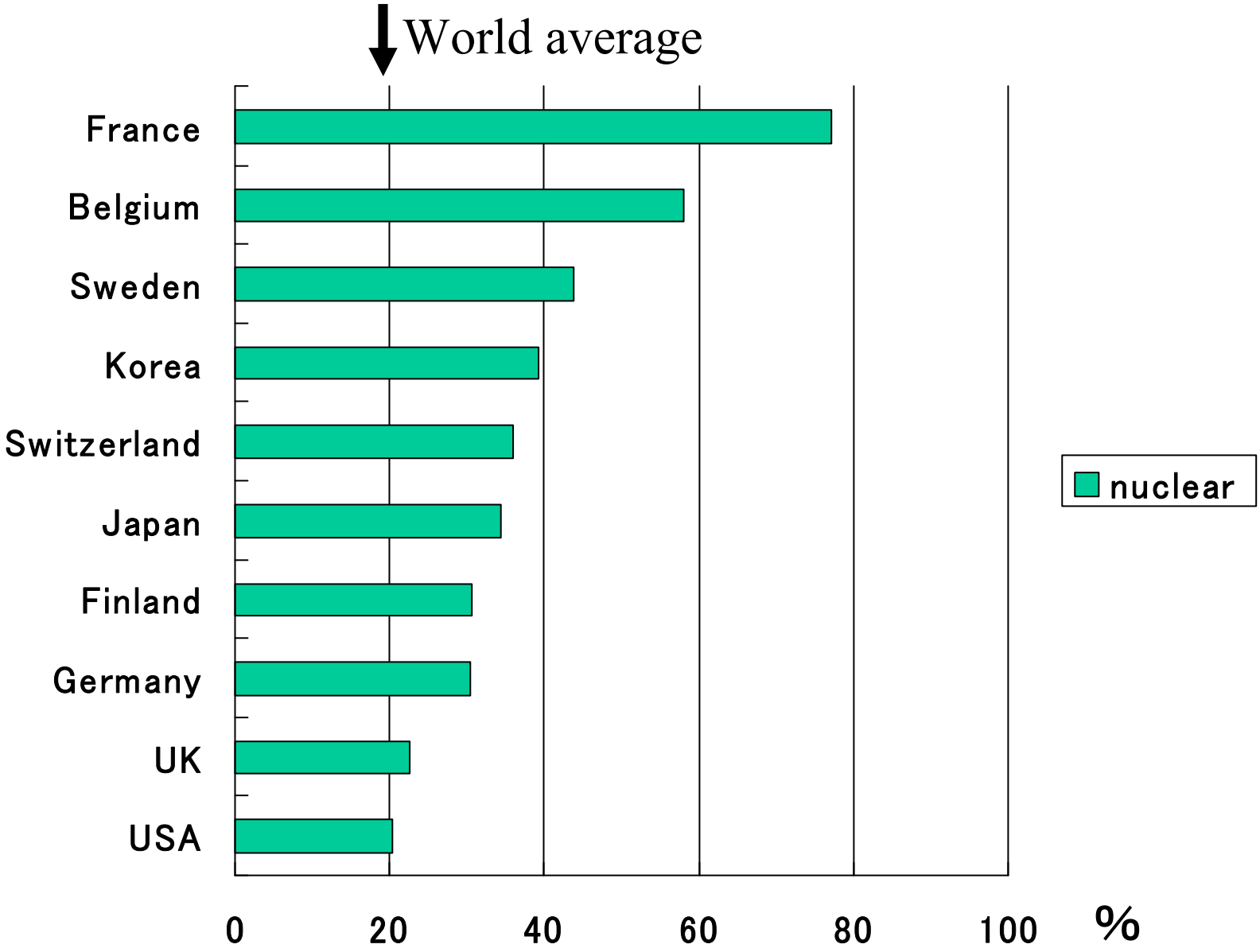


Fig. Share of nuclear in power supply (kwh、2001)

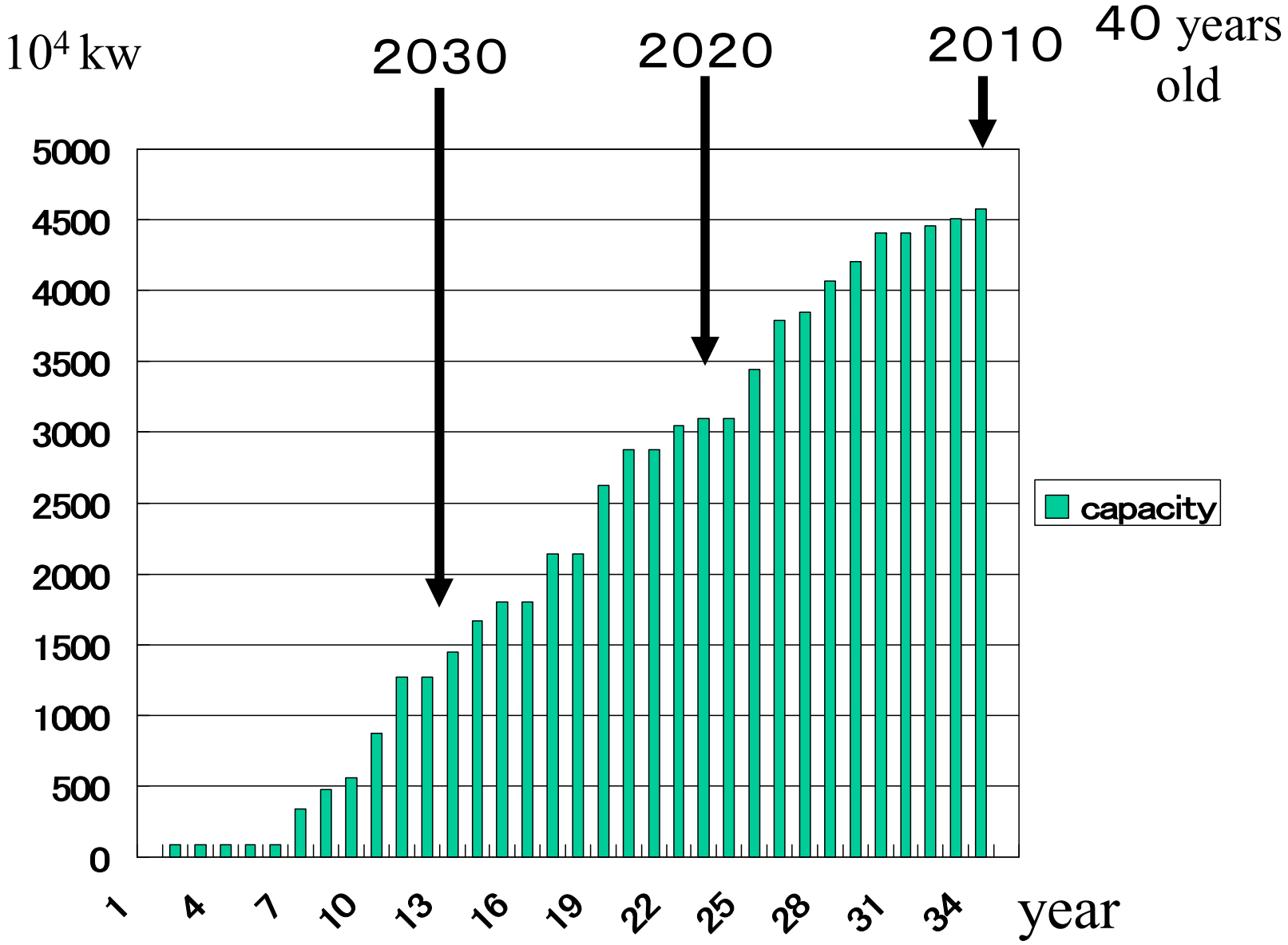


Fig. Age structure of Japanese nuclear power plants

Future of Renewables

1. Wind power / photovoltaics (WP/PV)
   recent trends and limits
   SSPS: future dream
2. Biomass
3. Other renewables: ambient energy sources

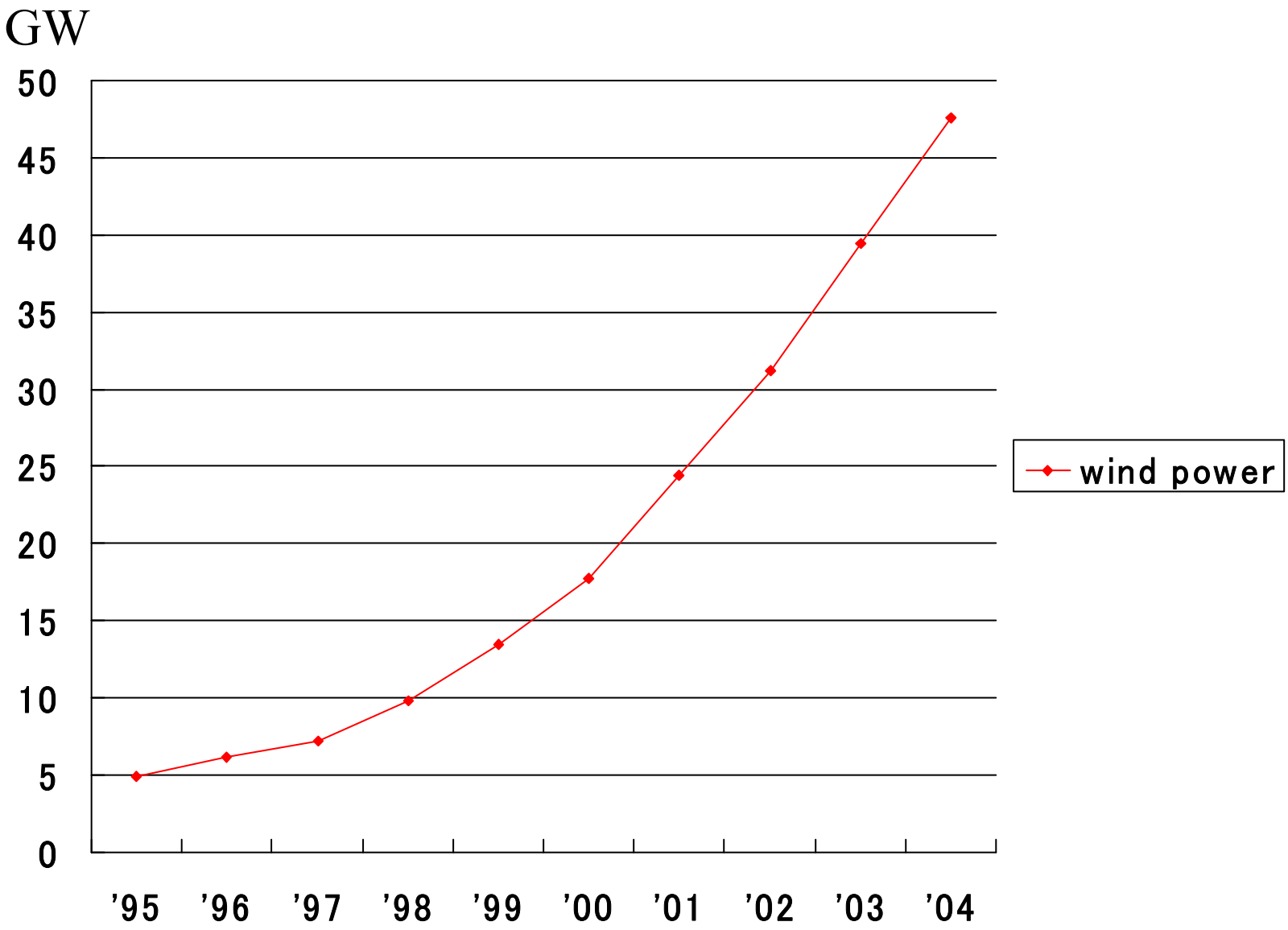


Fig. 3.1a Total capacity of wind power (World)

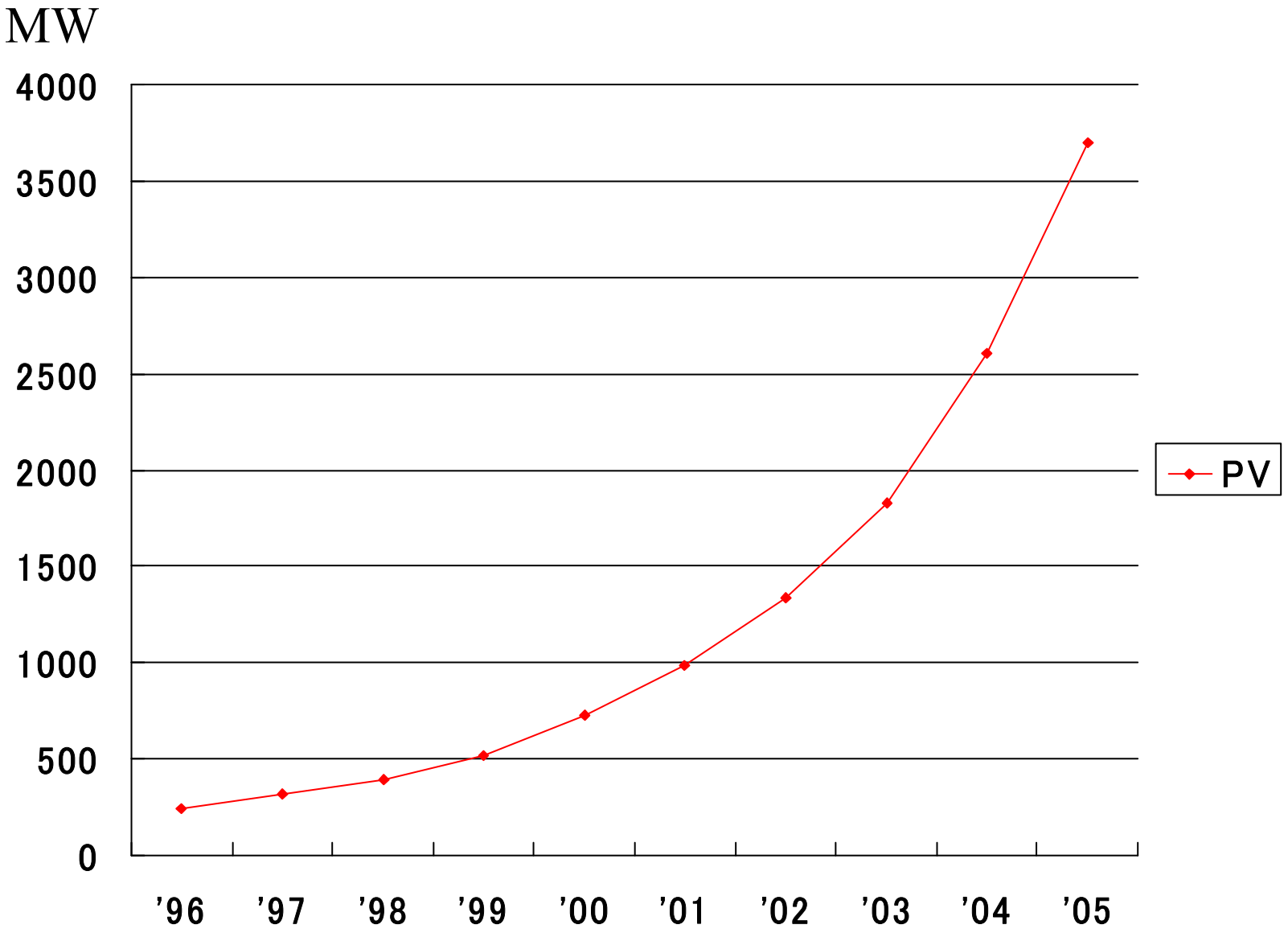


Fig.3.1 b: Recent trends of photovoltaics in the world (capacity)
Source: Trends in photovoltaics applications, IEA

	Capacity (2004)	Future target (% of elec.power)
Germany	16.6 GW	25% (2025)
Spain	8.3 GW	---------
USA	6.8 GW	6 % (2020)
Denmark	3.1 GW	20% (2030)
Japan	0.9 GW	3.4 % (2030)

Table. Present and future target of wind power

Fig. time variability of outputs of wind power(Germany)

1 plant

1,500 plants

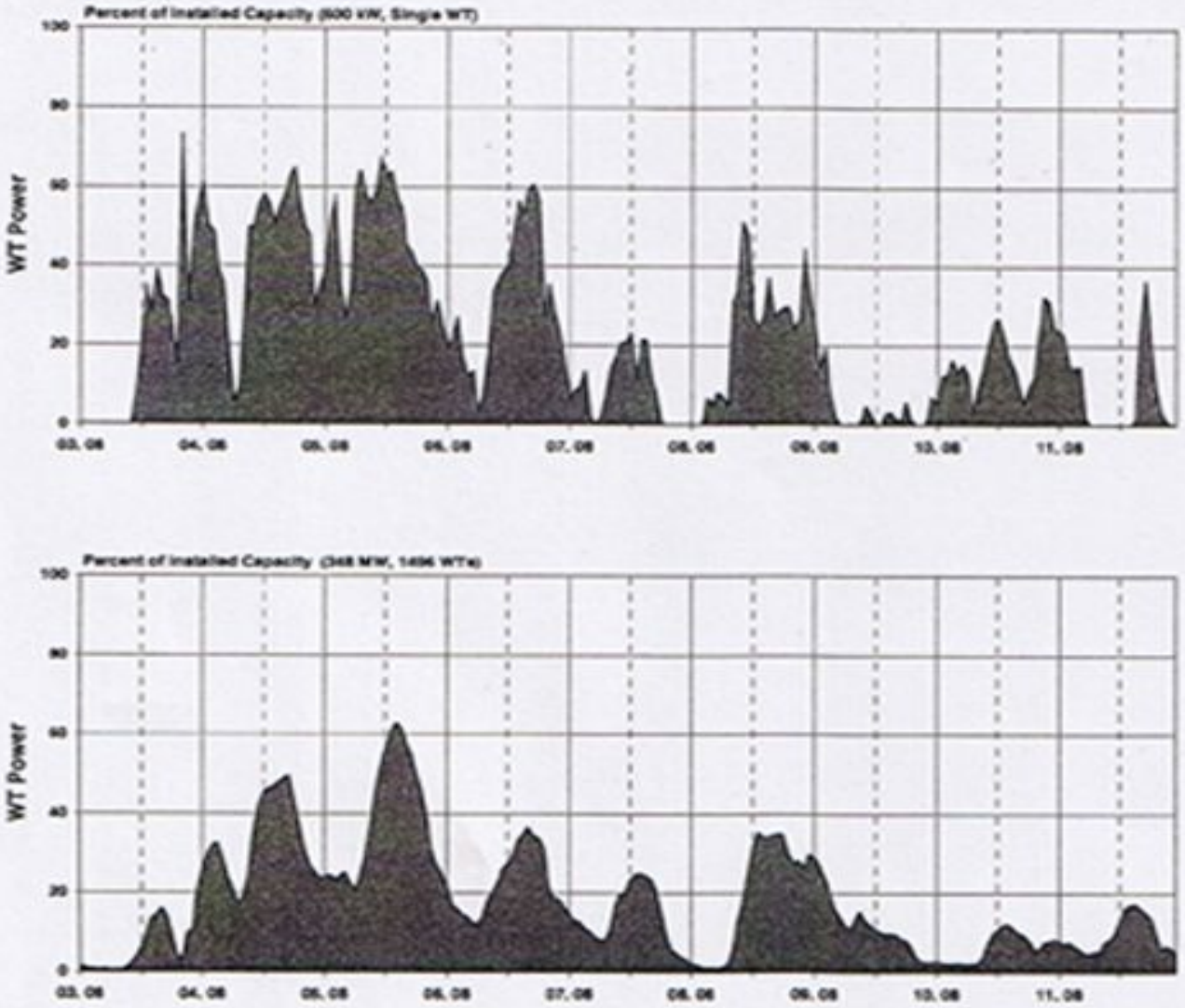


Fig. 9: Comparison of WT Individual and Cumulative Power [3]

Limits of WP / PV due to output changeability

1. Their output changeability innevitably requires installation of those **power plants which adjust their outputs so as to satisfy the condition**

   total supply = total demand

2. **Facility costs of these power plants are additional costs of the grid** solely due to introduction of WP/PV. **= too heavy burden**

   → capacity of WP/PV << grid capacity

Novel renewables in the long term

1. Requirements
   1) large scale
   2) outputs are stable in time
2. Future candidates
   1) remote large scale hydro
   2) space solar power system (SSPS)

Space Power Generation System

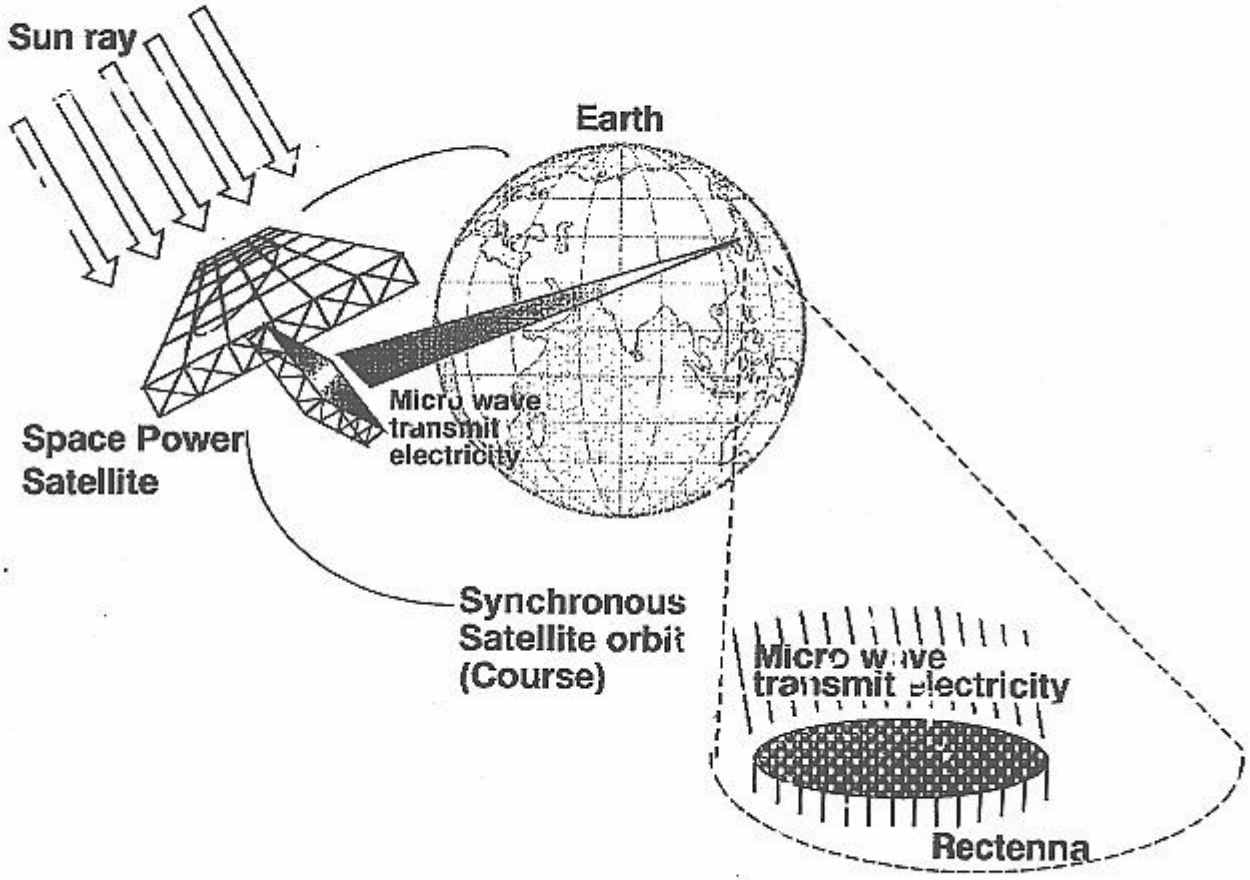


Table: Outline of SSPS

Location of the orbit	Geostational earth orbit (36,000km high)
Power generator	Solar cell- magnetron 1GW, 2.6km × 2.4km
Power transmission	microwave
Earth surface facility	Rectenna 12.5 km2
Costs	Space facilities 5,800M$ Transportation 6,800 Other 20,100
Power cost	11.6 cents / kwh
Source	Inst. for unmanned Space Experiment Free Flyer, Japan 2003

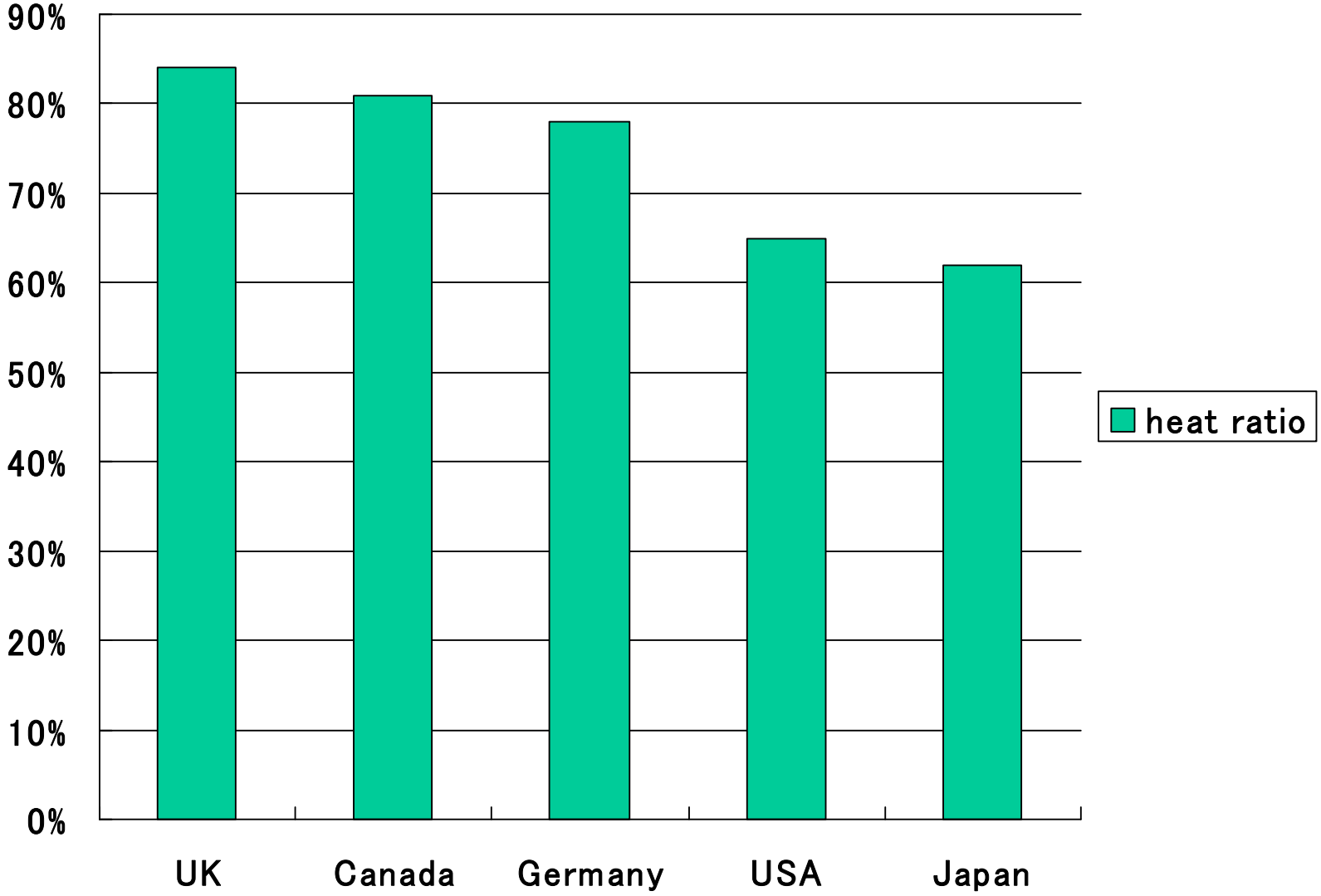
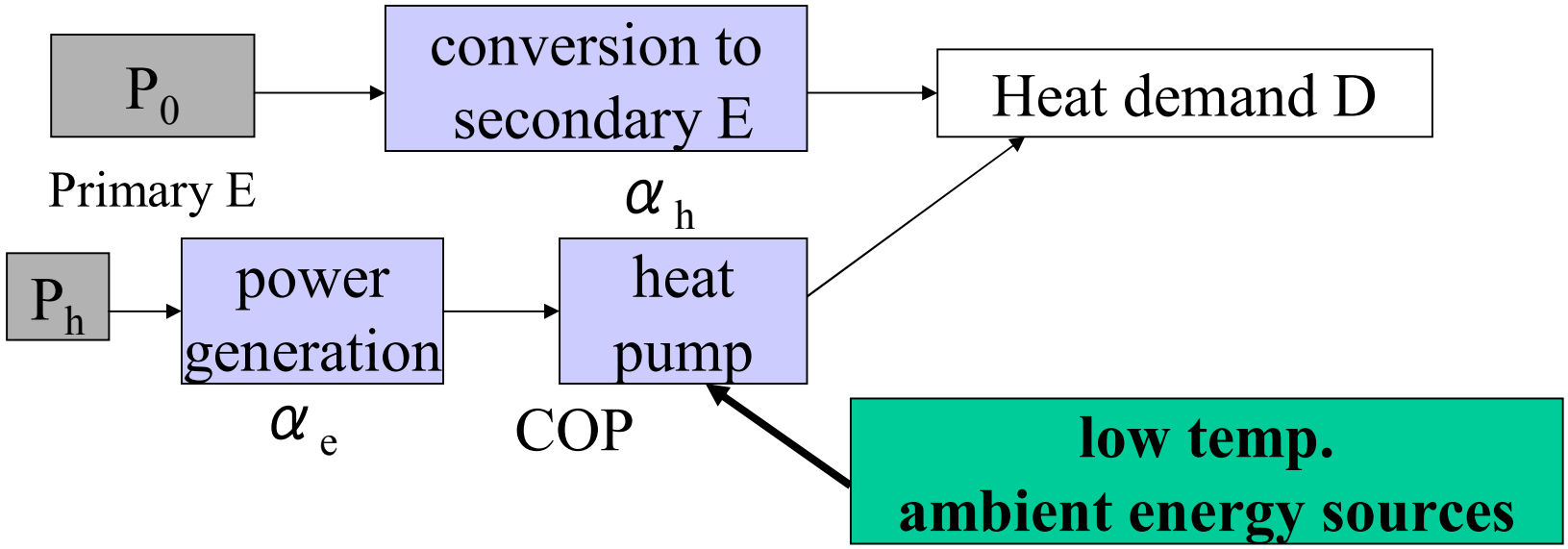


Fig. Share of heat in residential energy demand

How to satisfy residential heat demand

1. Passive use of solar power
   ex. Passive house in Germany
2. Active use of solar power
   introduction of solar heater,etc.
3. **Utilization of ambient energy resources as low temp. heat source of heat pump**

Utilization of low temp. geoheat in residential sector



$$D = \alpha \cdot COP \cdot P \qquad (1)$$

Energy gain from ambient energy sources

$$F = P_o - P_h = (1/\alpha_h - 1/ \alpha e \cdot COP) \qquad (2)$$

	Number of houses utilizing Geoheat
USA	500, 000
Germany	50, 000
Switzerland	42. 000
France	9. 000
Japan	200

Table: Distribution of Houses utilizing Geoheat

Potential of low temp. geothermal E
- share in residential E, Japan -

1. COP of heat pump
   geothermal: 10 degrees in Celsium (Sapporo, 10m deep)

supply temp.	Theoretical	real
30 deg. (room?)	15	8 ?
50 deg. (water?)	8	6 ?

2. Availability of low temp. geothermal (potential)

Share in primary energy in Japan

	residential	commercial	total
COP=5	3.7 %	2.5 %	**6.2 %**
COP=10(heating)	4.3	3.0	**7.3**

Concluding remarks (1)

1. **Achievement of Kyoto target is not an easy task** for Japan, and desperate efforts particularly in commercial and household sectors are required.
2. **Multi-country action oriented approach should be promoted for long term GHG reduction, in parallel with Kyoto protocol .**
3. **Energy conservation** is always **one of the most effective measures** for reducing CO2 emission.

Concluding remarks (2)

4. **The role of nuclear power** will be much larger, not only in Japan but also all over the world.
5. Present **renewable technologies** are important but we should notice that **their capacity when connected to the grid is limited** due to their output changeability.
6. **Novel large scale renewables** such as SSPS should be developed in the long term.
7. **CCS is a useful but technology bridging** the age of fossil fuel use and decarbonized society.