

Global Environmental Policy Making on Technology

環境・エネルギー技術政策

15th and 22th, October, 2012

Jun TAKAHASHI

- ✓ Global energy balance
- ✓ How to read statistics data ?
 - ✓ Long-term viewpoint
 - ✓ Suspect an interpretation and the data itself !
- ✓ How to make a policy ?
- ✓ Quiz

Calculation of the amount of solar energy

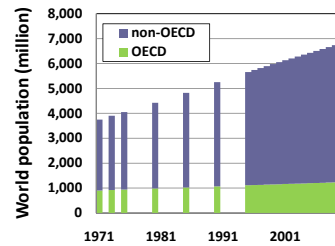
Reference

- World primary energy supply is about 1.5 toe/ year par capita
 - 1.5 [toe/ year par capita] = 40000 [kcal/day par capita]
- Human need energy of 2000 [kcal/day par capita] to live.

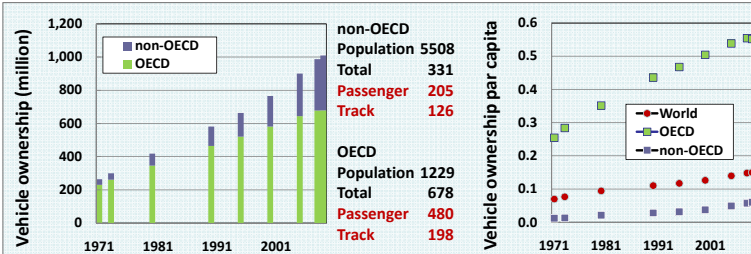
Solar energy flowing into the earth

$$\begin{aligned}
 &0.7 \times \pi R^2 [\text{m}^2] \times 1367 [\text{J}/\text{m}^2\text{s}] \\
 &= 0.7 \times 1.286 \times 10^{14} [\text{m}^2] \times 1367 [\text{J}/\text{m}^2\text{s}] \\
 &= 1.23 \times 10^{17} [\text{J}/\text{s}] \\
 &= 2.94 \times 10^{13} [\text{kcal}/\text{s}] \quad (= 40000 \times 10^4 [\text{kcal}/\text{day par capita}]) \\
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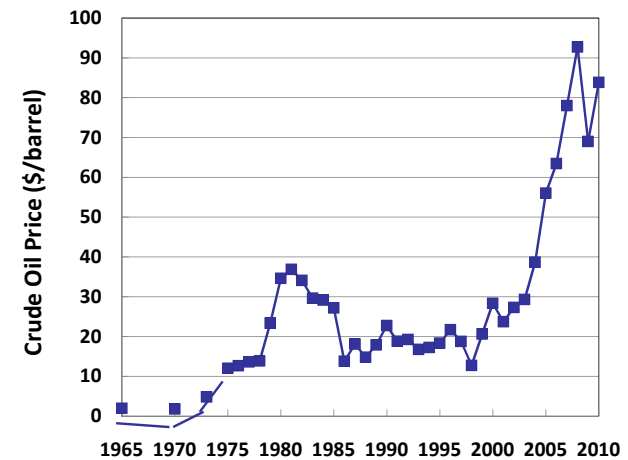
The world population and car ownership



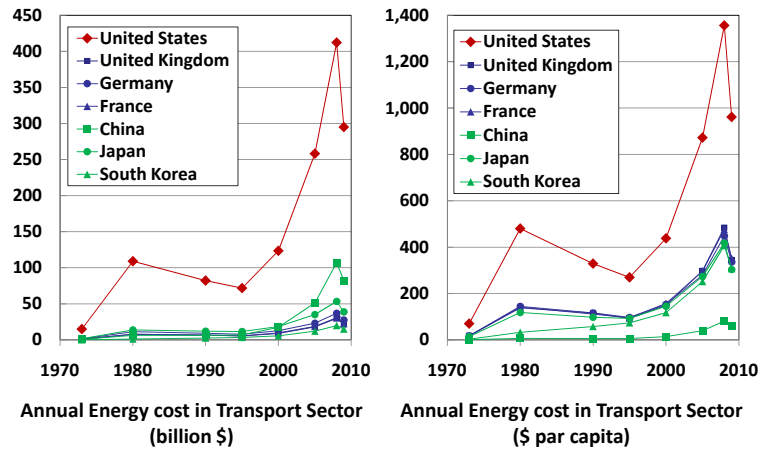
- Number of automobile in OECD countries are about an half of the population, and it will not increase.
- Number of world automobile will increase due to the moralization of non-OECD countries.



Long Term Trend in Crude Oil Price

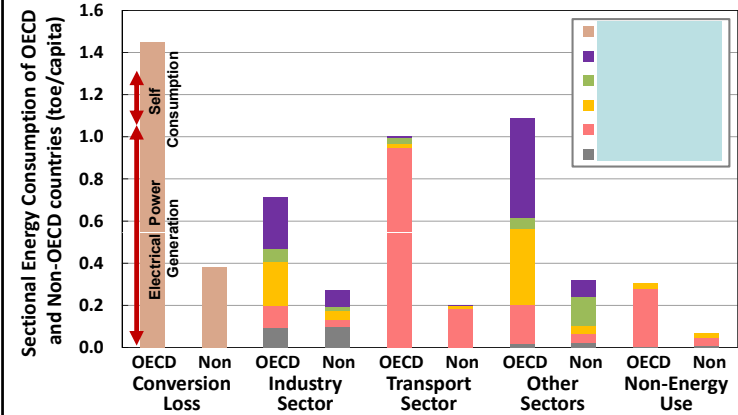


National Energy Cost of the Transport Sector



Sectional Energy Consumption of OECD and Non-OECD countries

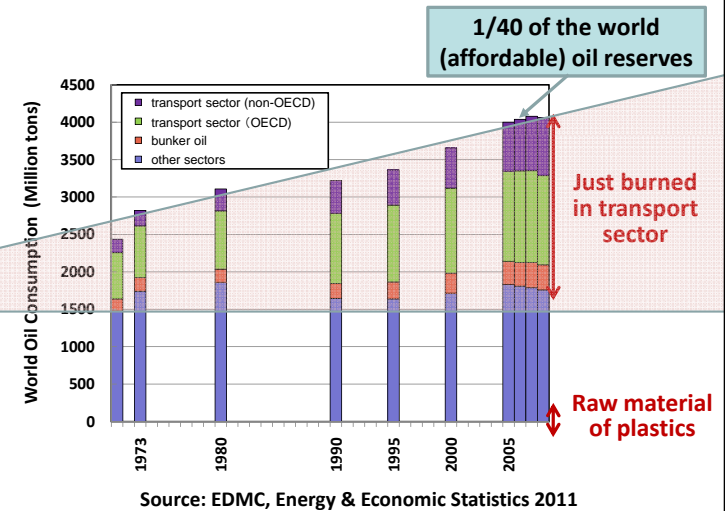
2008	Population	Total Primary Energy Supply	Total Final Energy Consumption
OECD	1190 million	4.56 toe/capita	3.11 toe/capita
Non-OECD	5498 million	1.24 toe/capita	0.86 toe/capita

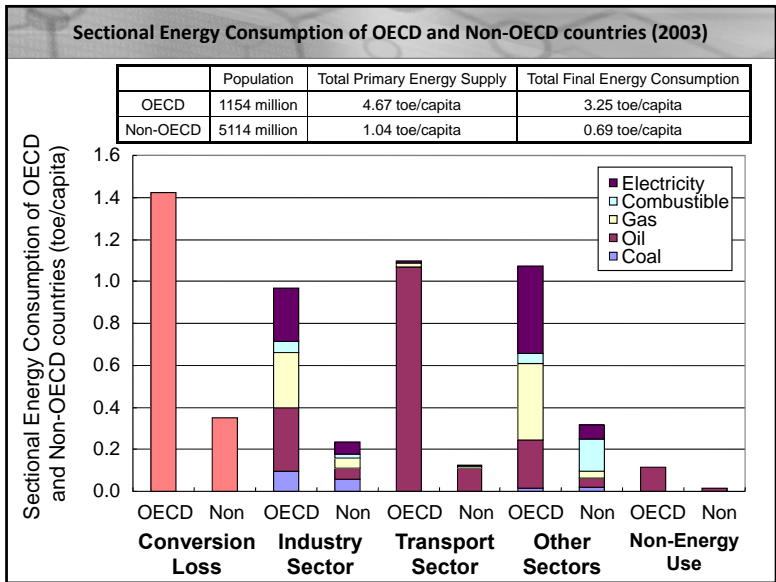
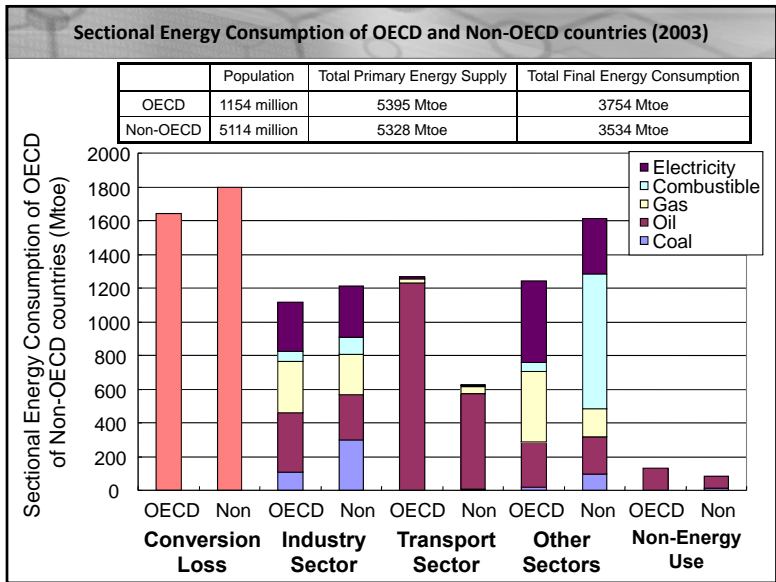
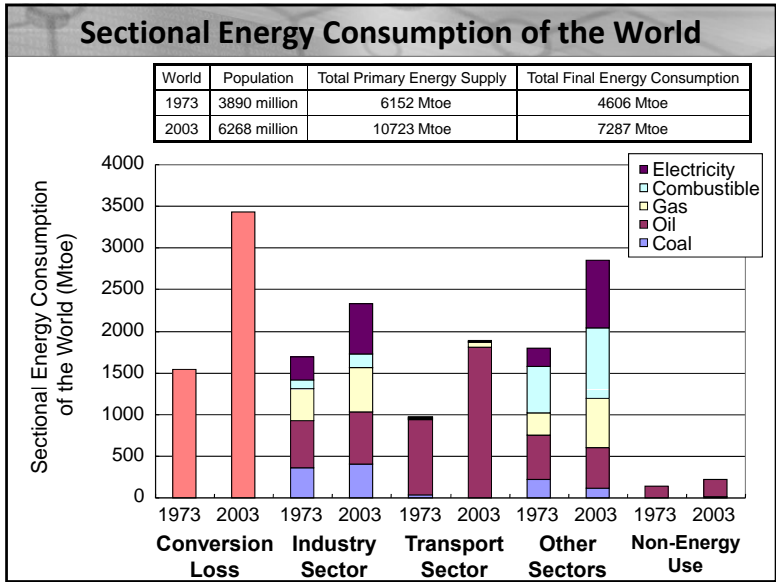
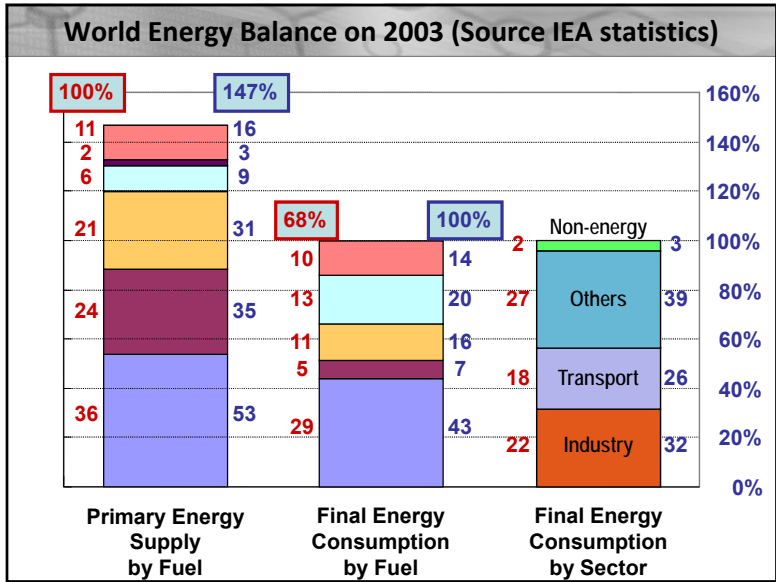


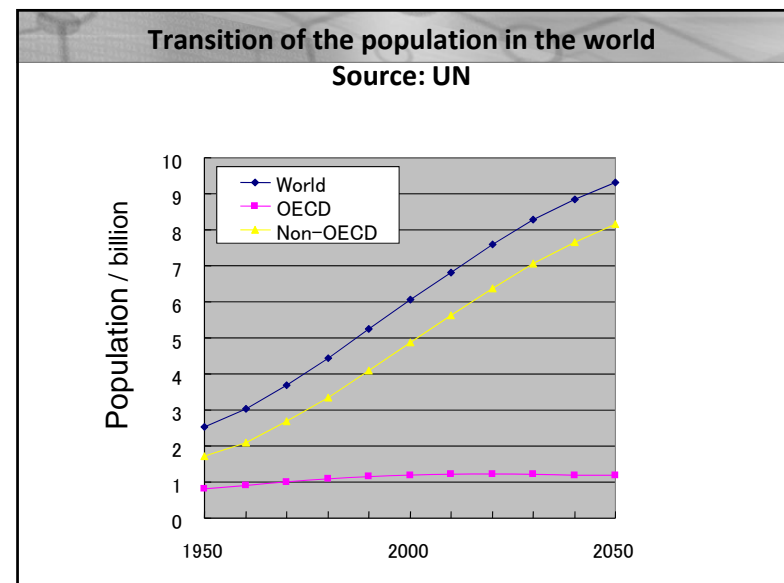
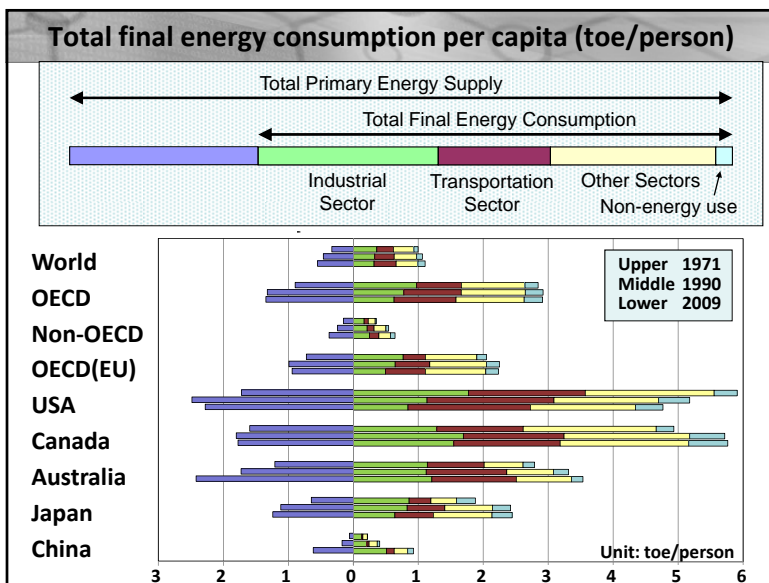
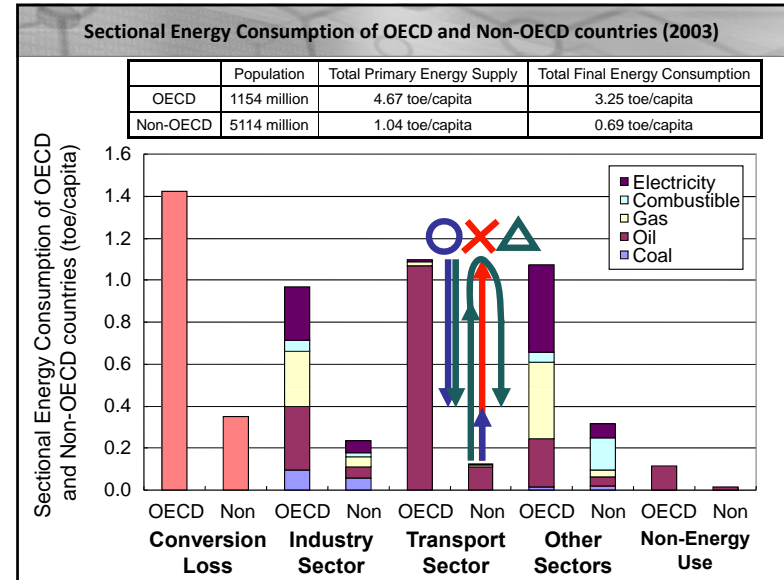
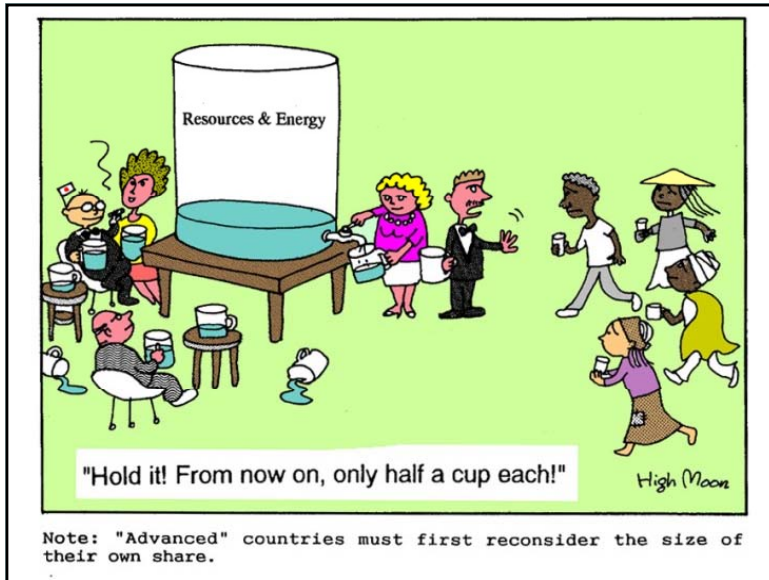
Annual World Material Production

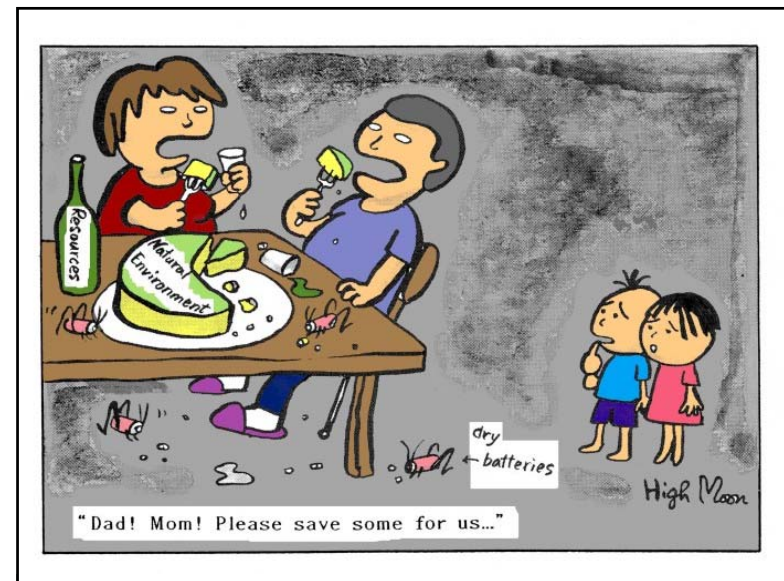
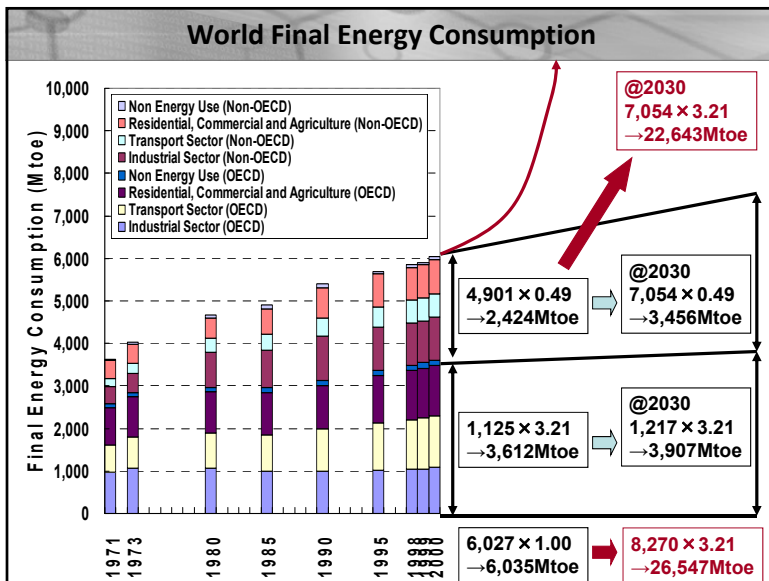
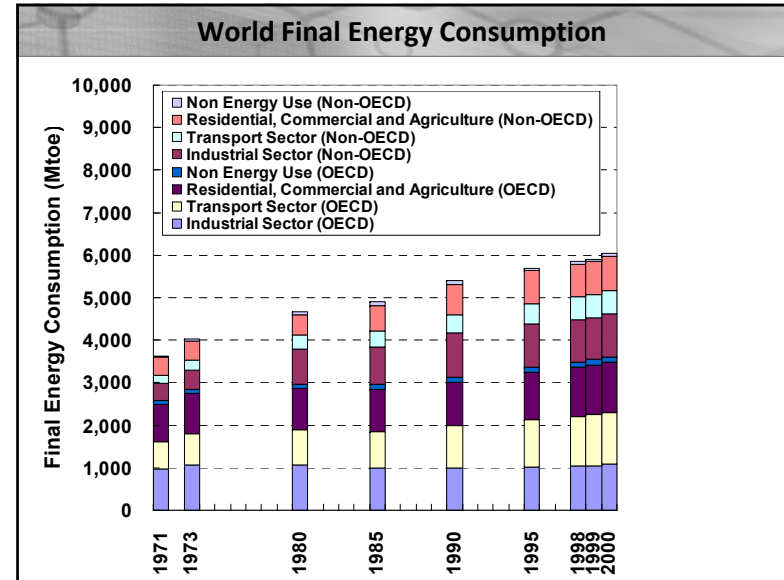
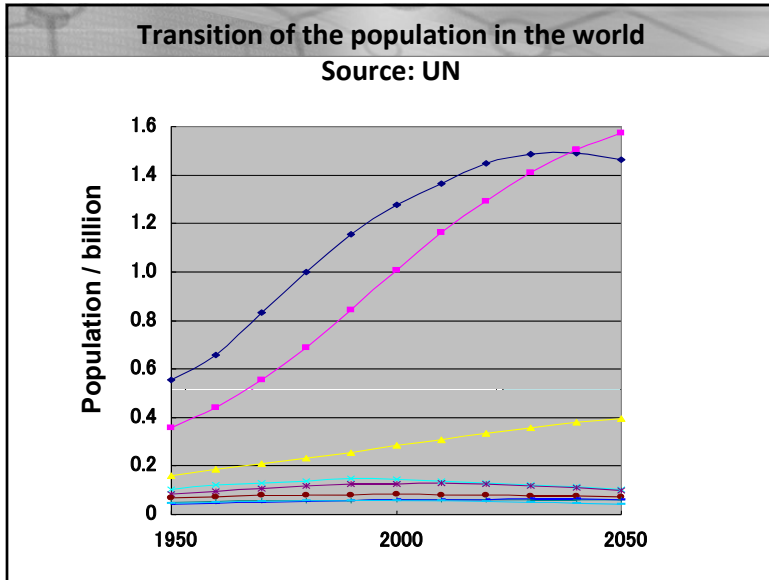
- **Crude steel production: 1.4 billion tons**
 - Coking coal for steel production: 0.7 billion tons (= 0.1 tons per capita)
 - World coal consumption: 3.3 billion tons (2.5 billion tons for fuel)
- **Plastics production: 0.25 billion tons**
 - Oil consumption for plastic production: 0.5 billion tons
 - World oil consumption: 4 billion tons (2.1 billion tons for transport)

Oil consumption of the world and transport sector









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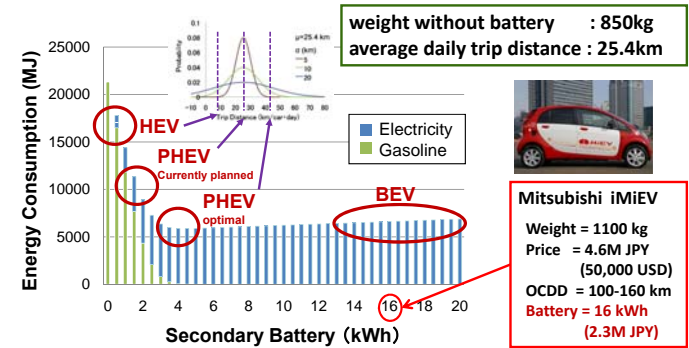
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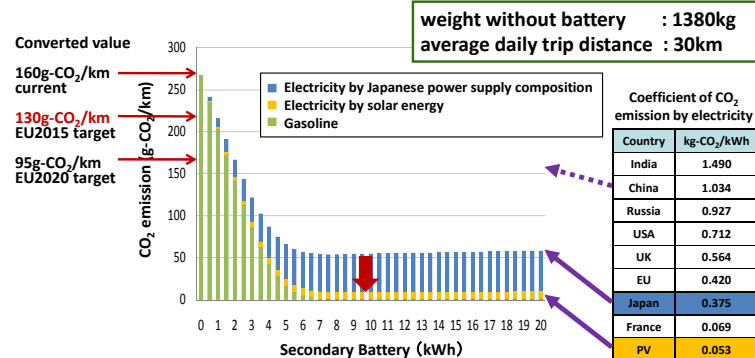
$$= 2.94 [\text{Mtoe}/\text{s}] \quad (= 1.5 \times 10^4 [\text{toe}/\text{year par capita}])$$

Energy Consumption Structure of mini-PHEV



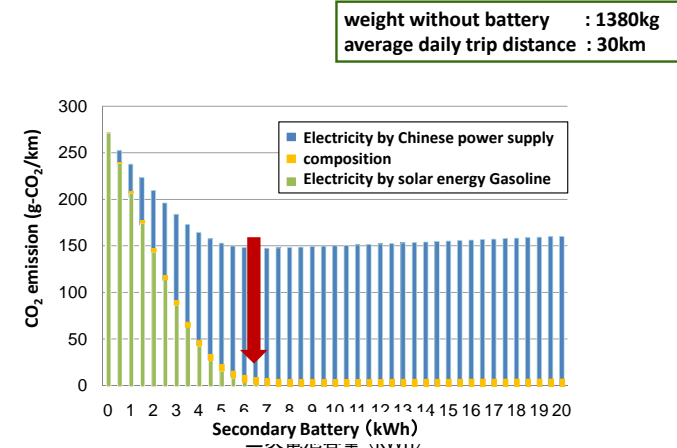
- There is an optimal amount of secondary battery depends on the weight of vehicle and average daily trip distance.
- Hence, the spread of such an optimal PHEV must be difficult in case of heavier cars and countryside.

CO₂ Emission Structure of Japanese PHEV



- Combination of solar and PHEV shows a significant effect !!!
 - 3m² of PV generates 2kWh daily, hence PV-PHEV is possible.
 - The amount of secondary battery is more important from a viewpoint of CO₂ emission.

CO₂ Emission Structure of PHEV in China



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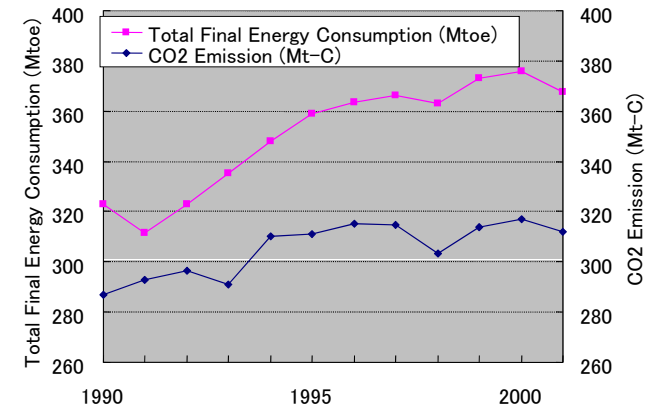
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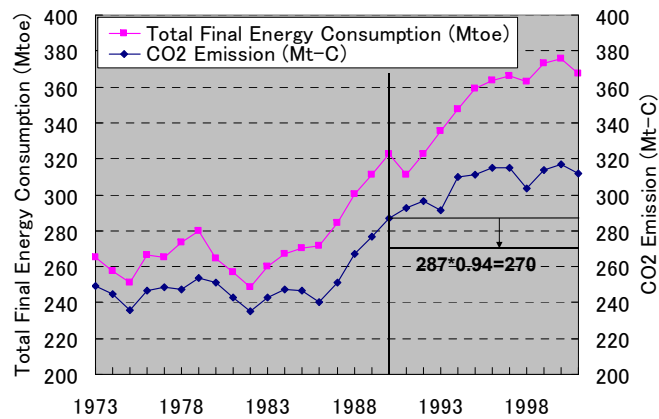
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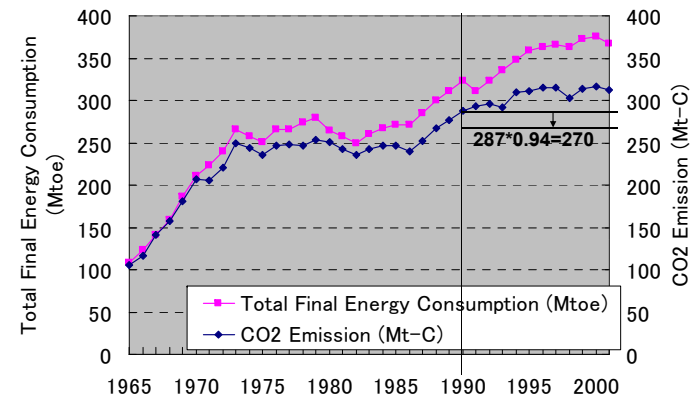
Japanese TFC and CO2 Emission (1990-2001)

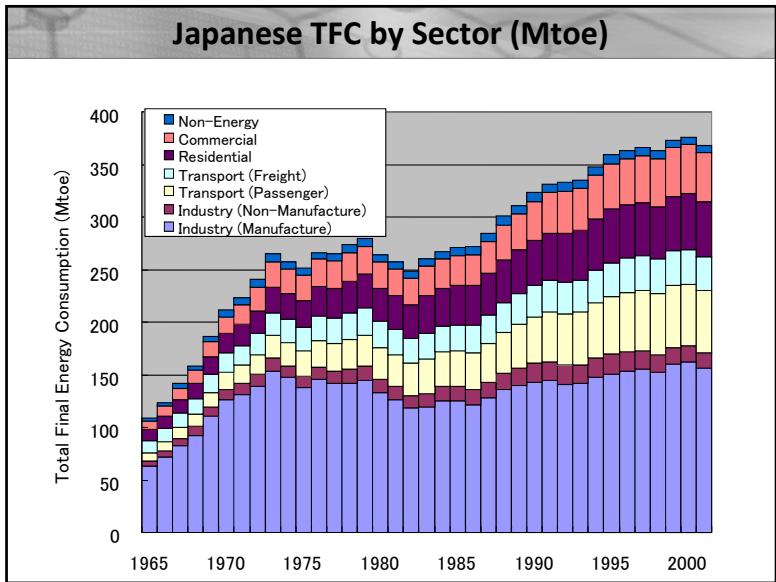
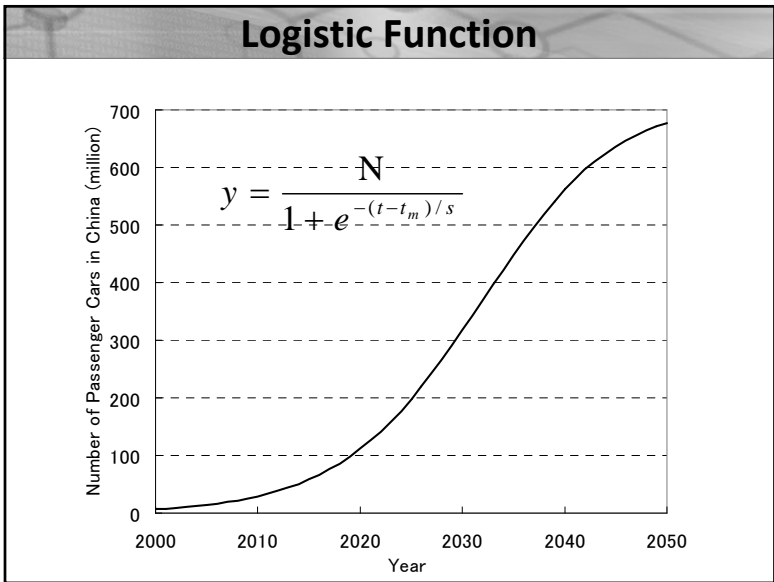
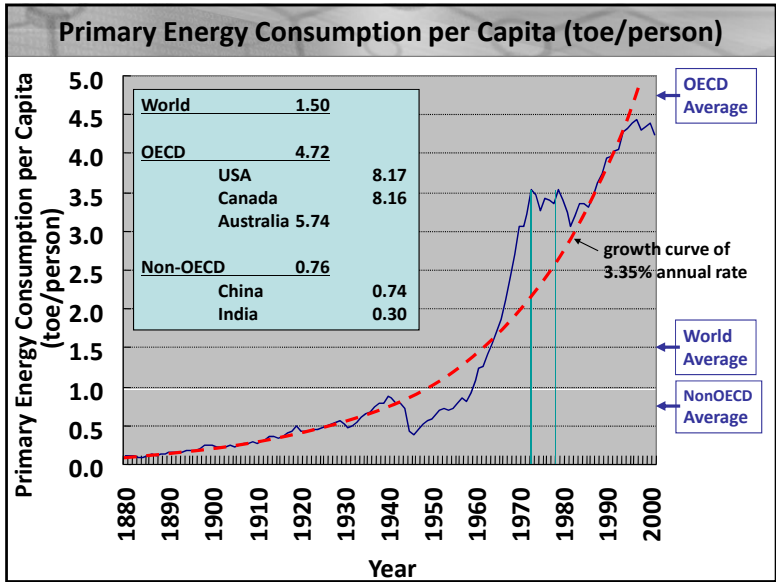
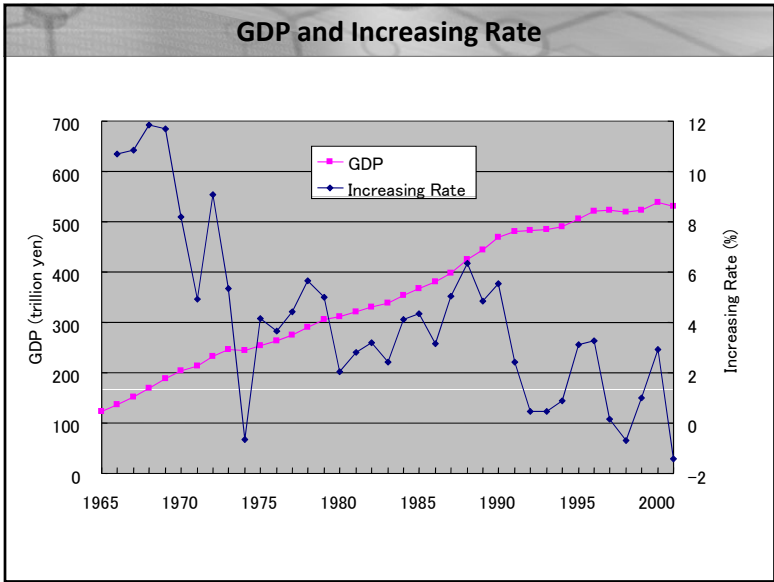


Japanese TFC and CO2 Emission (1973-2001)

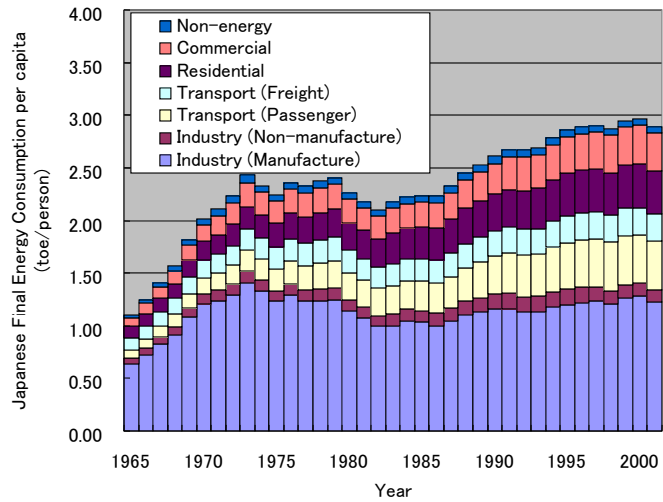


Japanese TFC and CO2 Emission (1965-2001)

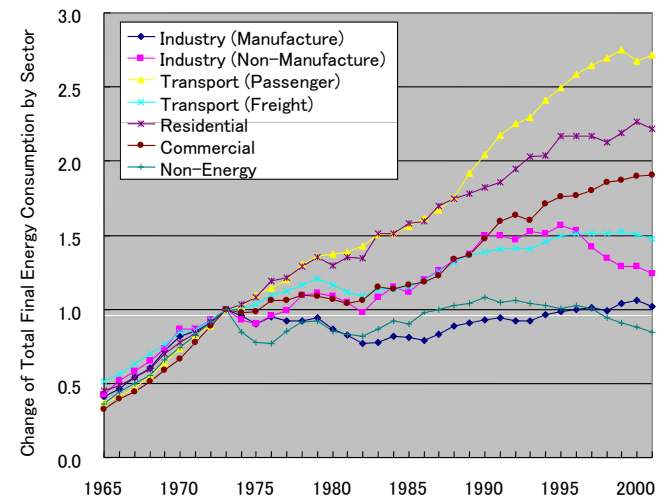




Japanese Final Energy Consumption per capita



Change of TFC by Sector (in comparison with 1973)



The Items of Final Energy Consumption

Industrial Sector

- Manufacturing
 - Material
 - Steel
 - Chemicals
 - Cement
 - Paper and Pulp
 - Processing/assembly
 - Foods
 - Textile
 - Nonferrous metal
 - Machines
 - Others
- Non-manufacturing
 - Agriculture, Forestry & Fishery
 - Mining
 - Construction

Residential Sector

- Heating
- Cooling
- Hot Water Supply
- Cooking
- Power & etc.

Commercial Sector

Non Energy Use

- Asphalt, grease, paraffin, lubricating oil, etc.

Transport Sector

- Passenger
 - Car (Private)
 - Car (Commercial)
 - Bus
 - Airplane
 - Ship
 - Railway
- Freight
 - Truck
 - Airplane
 - Ship
 - Railway

最終エネルギー消費部門の分類

産業部門

- 製造業
 - 素材系
 - 鉄鋼
 - 化学
 - 窯業土石
 - 紙・パルプ
 - 非素材系
 - 食品煙草
 - 繊維
 - 非鉄金属
 - 金属機械
 - その他
- 非製造業
 - 農林水産業
 - 鉱業
 - 建設業

家庭部門

- 暖房
- 冷房
- 給湯
- 厨房
- 動力・照明他

業務部門

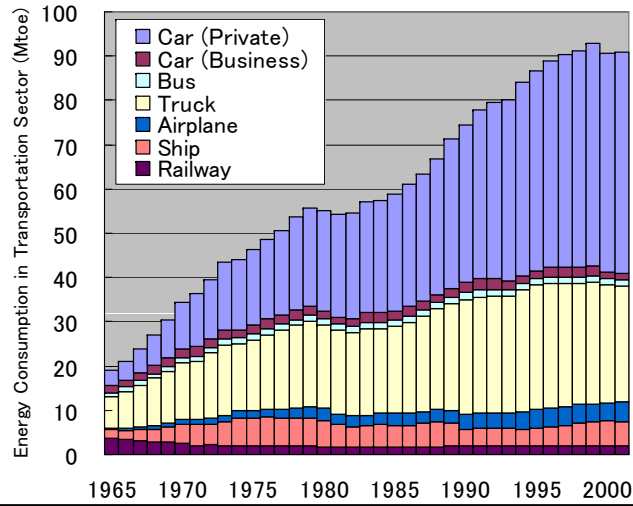
非エネルギー

- アスファルト、グリース、パラフィン、潤滑油等

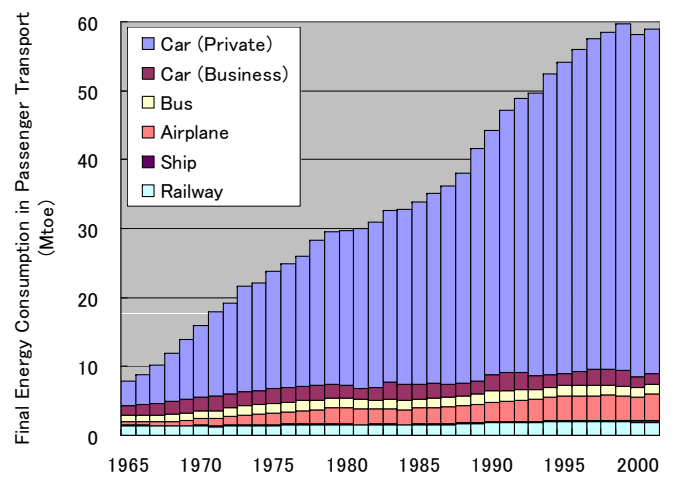
運輸部門

- 旅客
 - 自家用乗用車
 - 営業用乗用車
 - バス
 - 旅客航空
 - 旅客海運
 - 旅客鉄道
- 貨物
 - 貨物自動車
 - 貨物航空
 - 貨物海運
 - 貨物鉄道

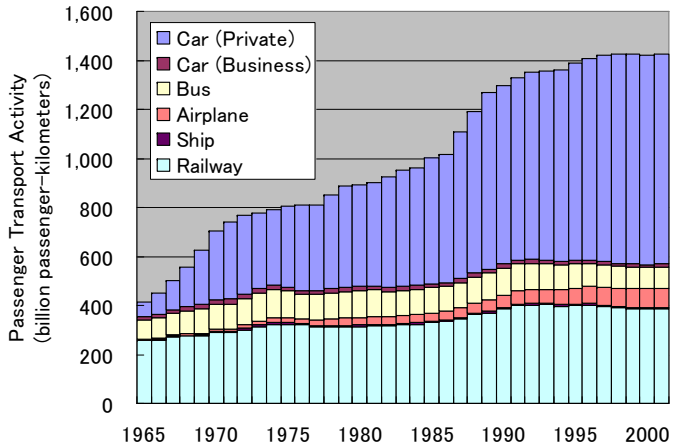
Energy Consumption in Transportation Sector (Mtoe)



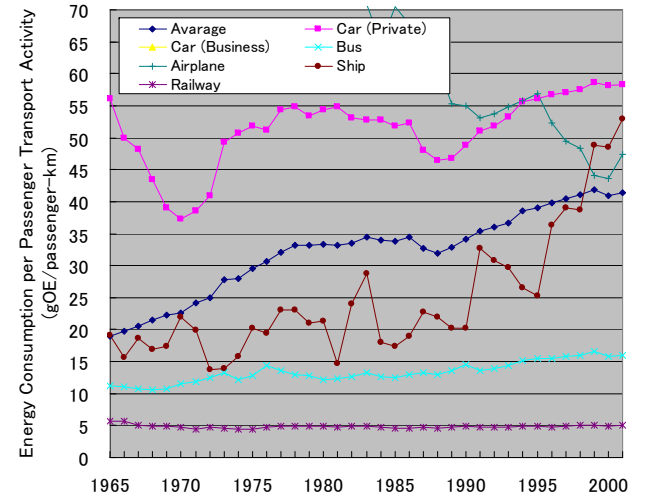
Energy Consumption in Passenger Transport (Mtoe)

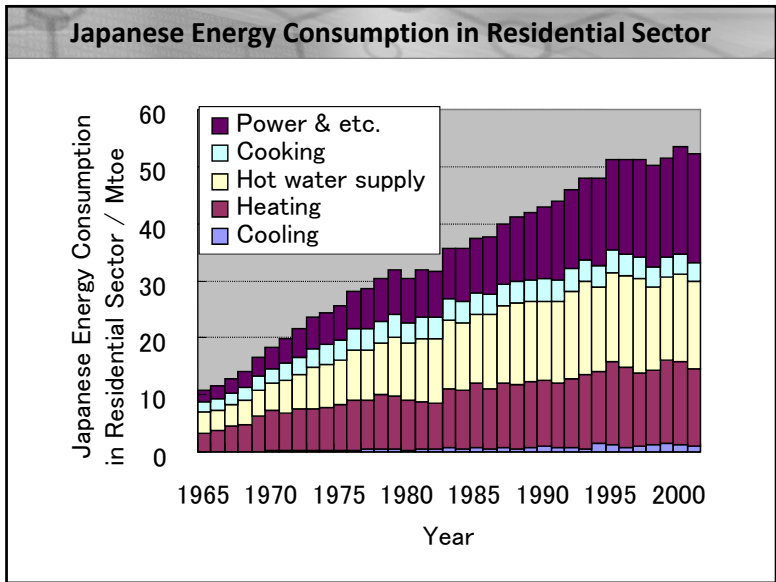
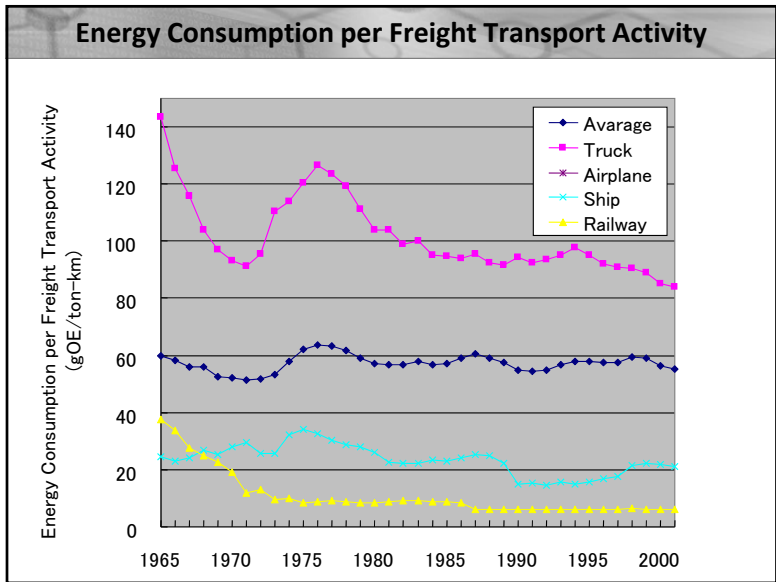
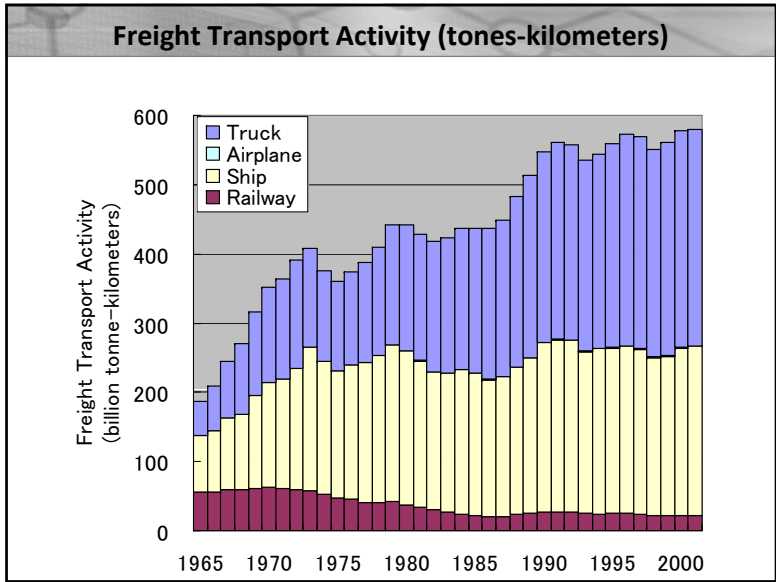
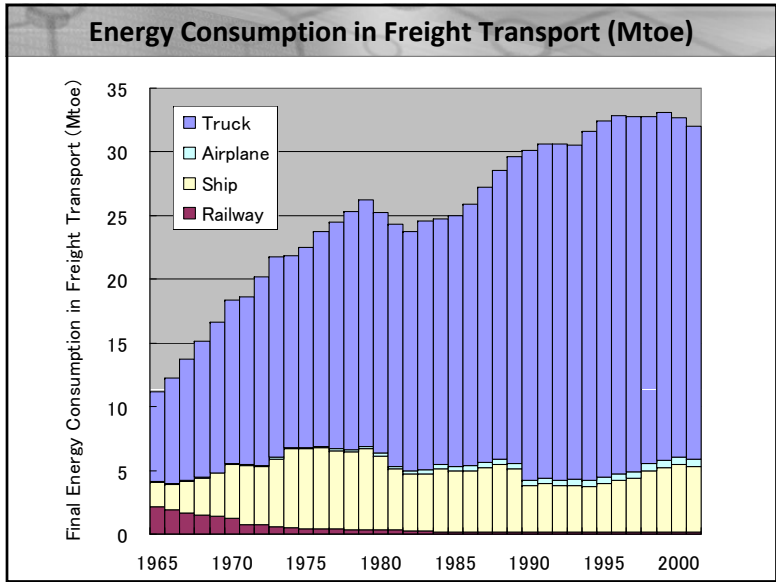


Passenger Transport Activity (passenger-kilometers)

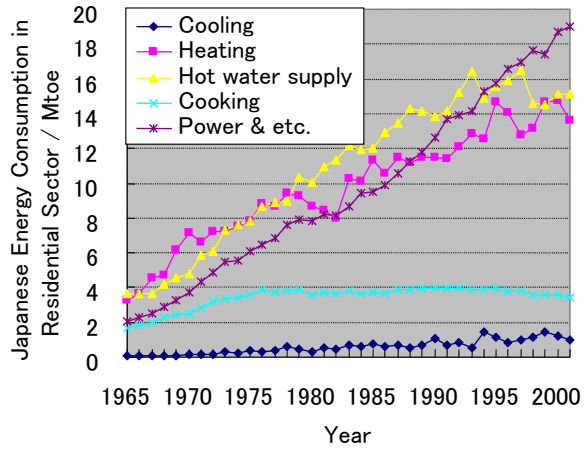


Energy Consumption per Passenger Transport Activity

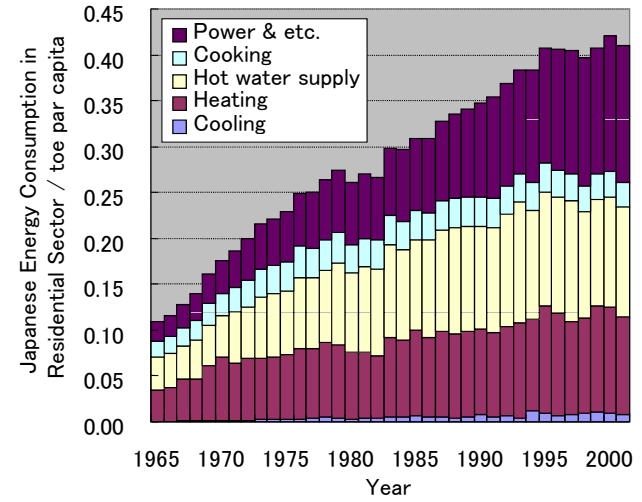




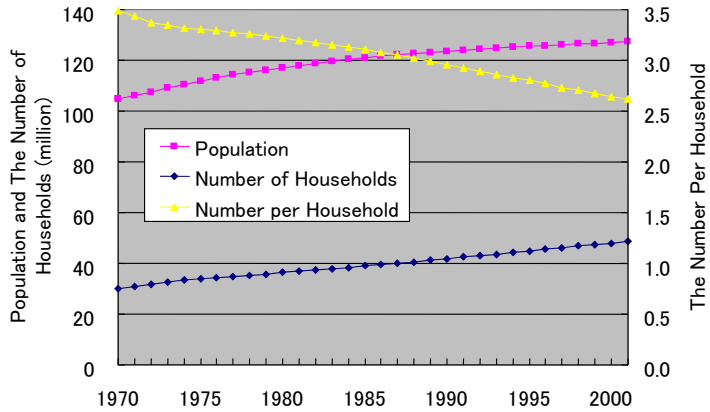
Japanese Energy Consumption in Residential Sector



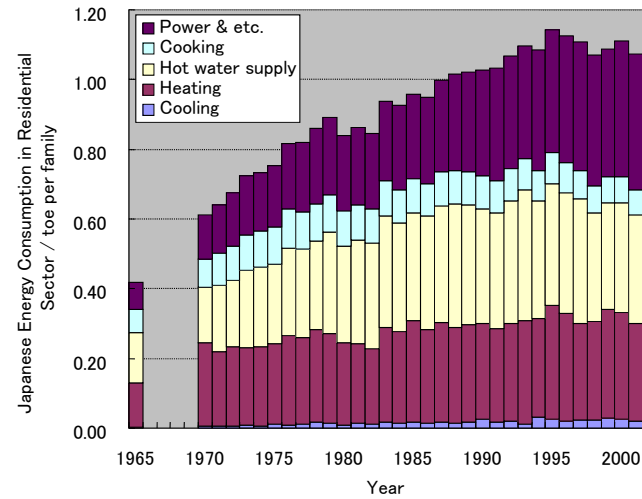
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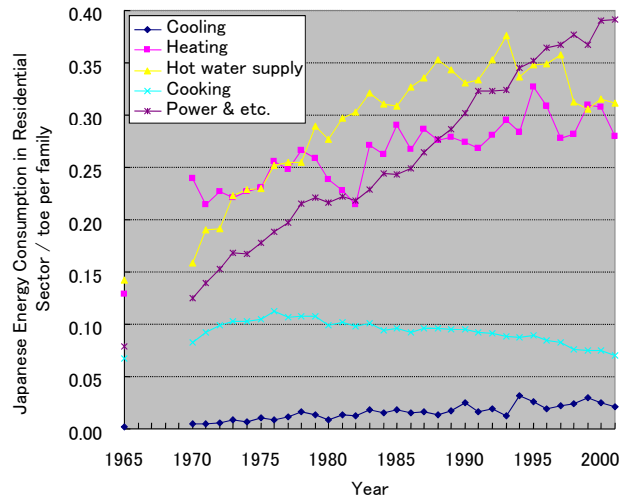
Japanese Population and The Number of Households



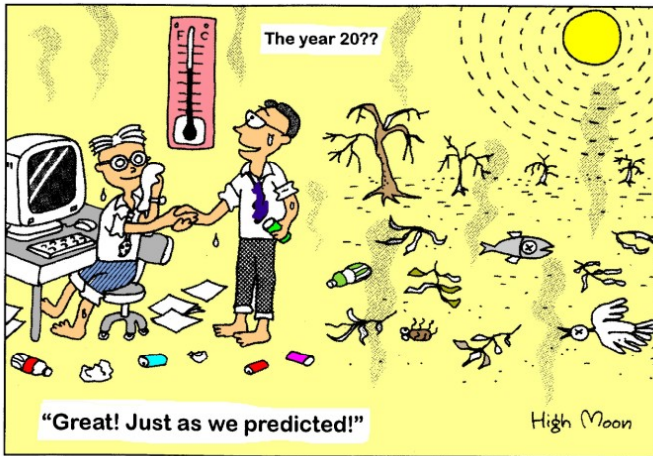
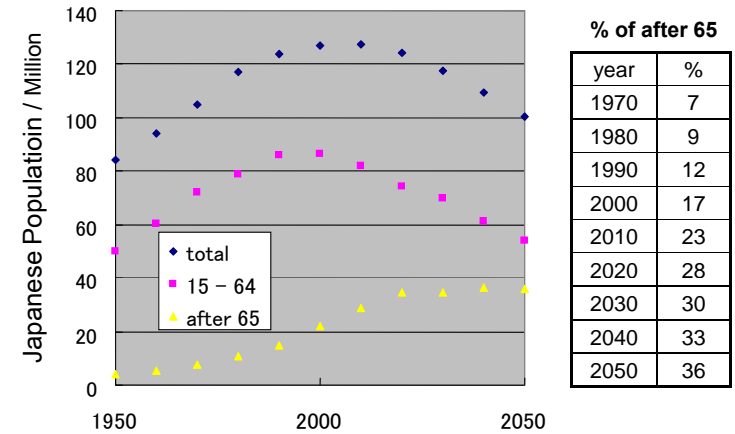
Japanese Energy Consumption in Residential Sector



Japanese Energy Consumption in Residential Sector



Transition of population composition of Japan



Note: In the case of global warming, countermeasures and implementation are more important than prediction.

Student's Presentation at 22nd October

- ✓ **Theme**
 - ✓ Consider effective policy **to reduce world's fossil fuel consumption** by using statistics shown in today's lecture or following website first.
 - ✓ <http://www.iea.org/>
 - ✓ Then, **show your assumption** about technological development, i.e. electric vehicle, and introducing schedule of the technologies to our society.
 - ✓ Evaluate the **long term effect** of the technologies on the reduction of fossil fuel consumption **till 2050** quantitatively based on your assumption.
- ✓ **Presentation and Submission at 22nd October**
 - ✓ You have to **make a group** which consists of 2 to 5 students.
 - ✓ Discuss well about your presentation in your group.
 - ✓ Presentation will start **from 15:20** at 22nd October
 - ✓ Every group have to make a **15 to 20 minutes presentation** by using Microsoft powerpoint.
 - ✓ After the class, the slide (if necessary modified) which includes names of the group member have to submit by e-mail to jun@sys.t.u-tokyo.ac.jp.
 - ✓ If you can't contribute any presentation, you should submit more than 10 pages PPT file by e-mail to jun@sys.t.u-tokyo.ac.jp by 22nd October.