

Global Environmental and Energy Policy

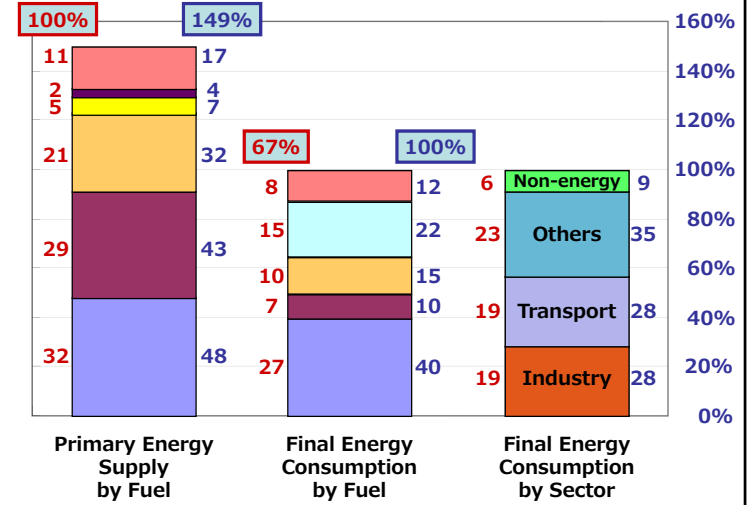
環境・エネルギー技術政策

Dec. 4 and 11, 2018

Jun TAKAHASHI

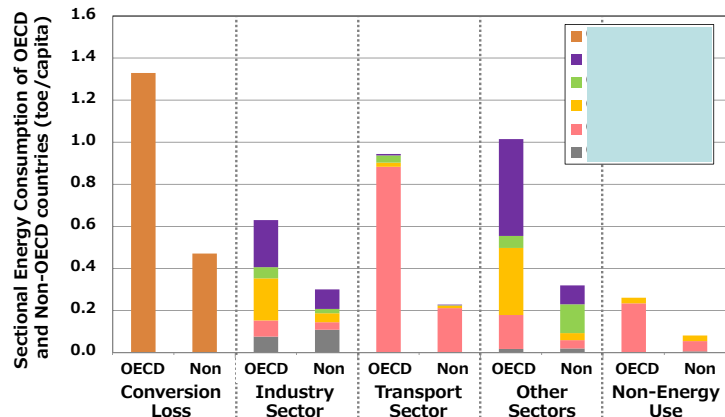
- ✓ Global energy balance
- ✓ How to read statistics data ?
 - ✓ Long-term viewpoint
 - ✓ Suspect an interpretation and the data itself !
- ✓ How to make a policy ?
- ✓ Quiz

World Energy Balance (Source IEA statistics)



Sectional Energy Consumption of OECD and Non-OECD countries

2012	Population	Total Primary Energy Supply	Total Final Energy Consumption
OECD	1254 million	4.19 toe/capita	2.86 toe/capita
Non-OECD	5783 million	1.40 toe/capita	0.93 toe/capita



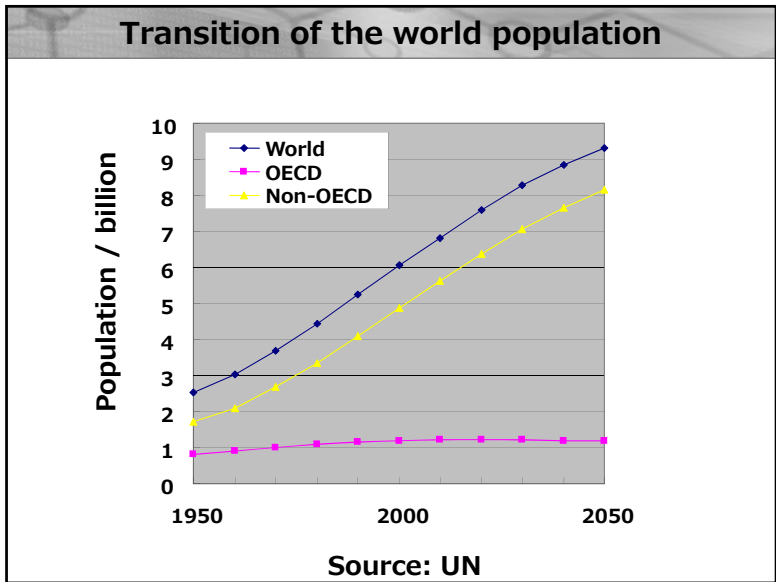
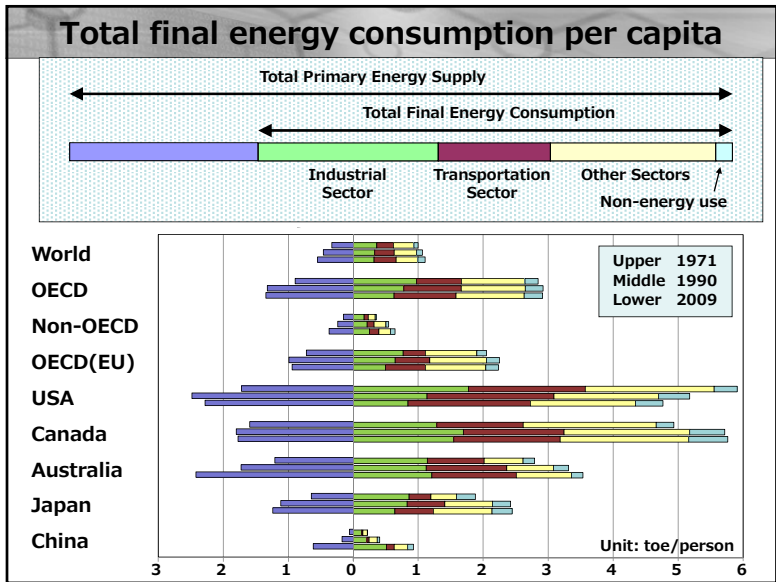
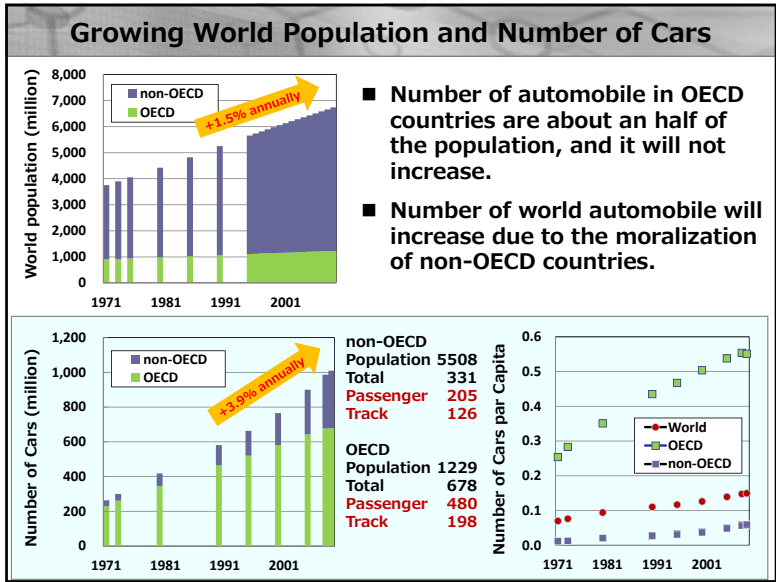
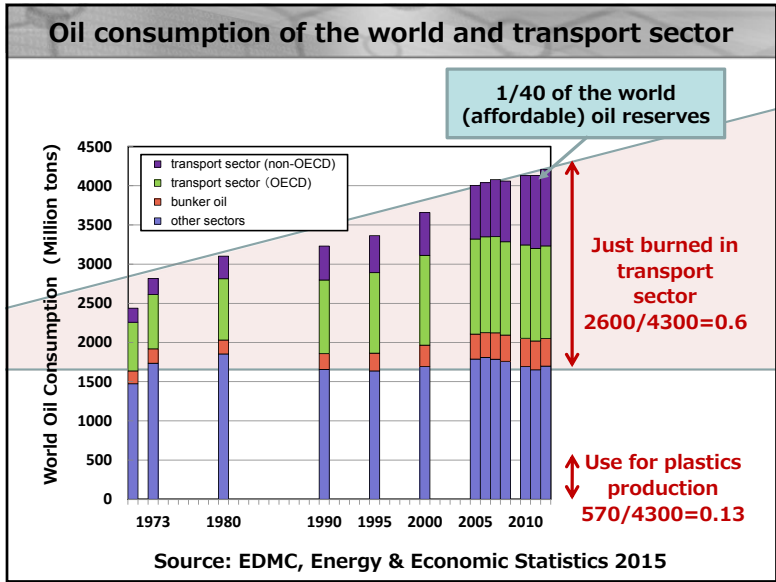
Fossil Resource and Material Production

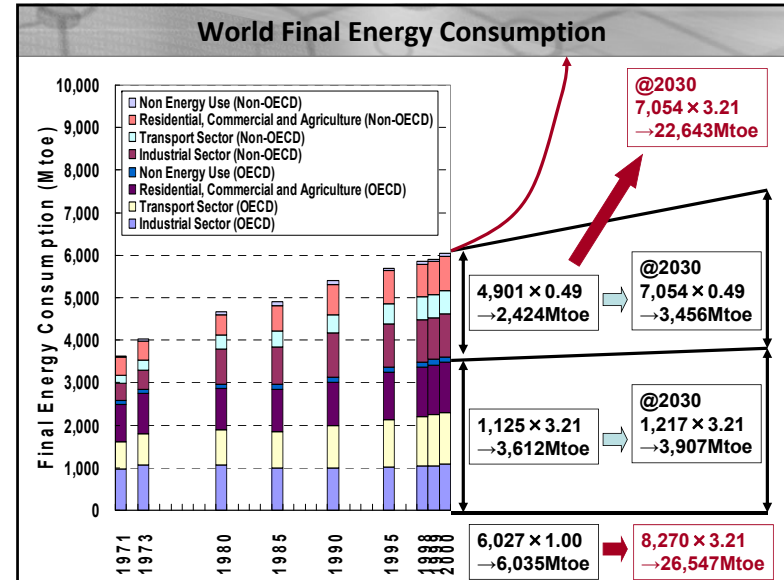
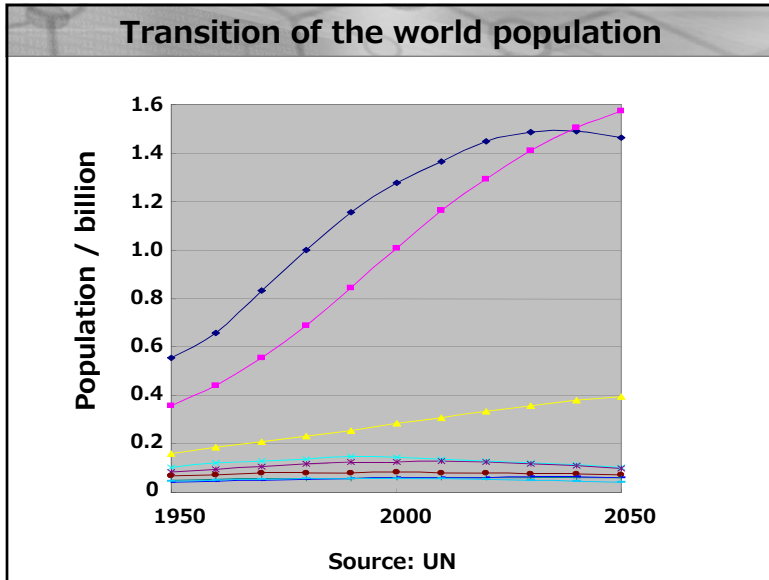
World coal consumption: 3.9 billion tons

- > 3.2 billion tons (82%) is used as fuel
- > 2.1 billion tons (54%) is used for electricity
- > 0.7 billion tons (18%) is used to product steel
- > Crude steel production: 1.7 billion tons

World oil consumption: 4.3 billion tons

- > 2.6 billion tons (60%) is used for transportation
- > 0.3 billion tons (6%) is used for electricity
- > 0.6 billion tons (13%) is used to product plastics
- > Plastics production: 0.29 billion tons





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

$$0.7 \times \pi R^2 [m^2] \times 1367 [J/m^2s]$$

$$= 0.7 \times 1.286 \times 10^{14} [m^2] \times 1367 [J/m^2s]$$

$$= 1.23 \times 10^{17} [J/s]$$

$$= 2.94 \times 10^{13} [kcal/s] \quad (= 40000 \times 10^4 [kcal/day par capita])$$

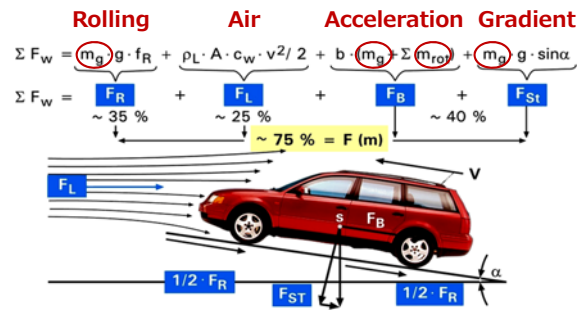
$$= 2.94 [Mtoe/s] \quad (= 1.5 \times 10^4 [toe/year par capita])$$

We have not used it since fossil fuels were cheap!

Next week's student's presentation

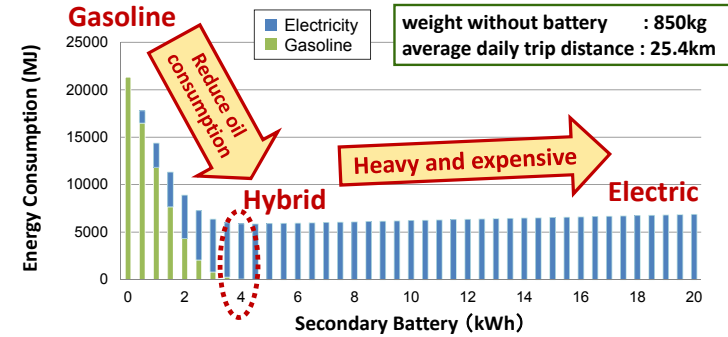
- Consider effective policy **to reduce world's fossil fuel consumption** by using statistics like today's lecture or following website first.
 - <http://www.iea.org/>
- Then, **show your assumption** about technological development such as electric vehicle, and introducing schedule of the technologies 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.

Running Resistance of the Automobile



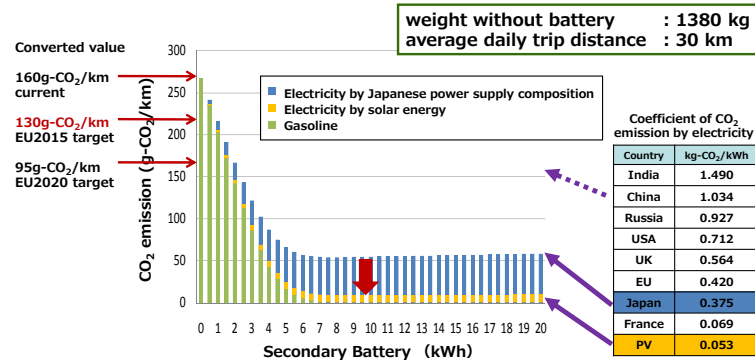
- About 75% of the running resistance is proportional to vehicle weight
 - 30% improvement in fuel efficiency is expected by 40% weight reduction
- In the case of electric vehicles, the heavy and expensive battery can be reduced in proportion to the weight reduction of vehicle body

EV reduces oil consumption drastically, but ...



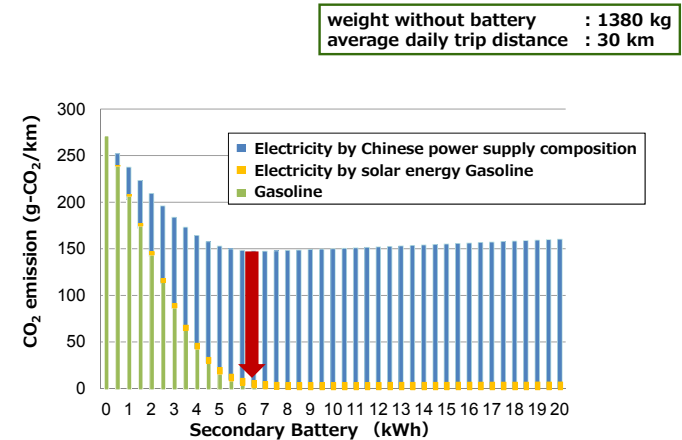
- There is an optimal amount of secondary battery depends on the **weight of vehicle** and **average daily trip distance**.
- Hence, weight lightening of HEV (Hybrid-EV) is effective to reduce **cost of the optimal HEV**, accordingly, its **early spread**.
- In addition, the daily demand of 4kWh, which is generated by 6m² of photovoltaic, can also be reduced by vehicle's weight reduction.

CO₂ Emission Structure of Japanese PHEV



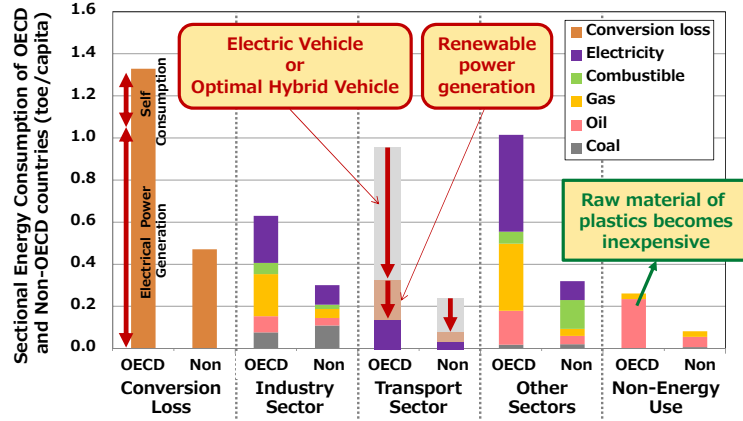
- **Combination of solar and PHEV shows a significant effect !!!**
 - 3m² of PV generates 2kWh daily, hence PV-PHEV is possible.
 - The amount of secondary battery is more important from a viewpoint of CO₂ emission.

CO₂ Emission Structure of PHEV in China



Vehicle's Weight Lightening Technology will Save the World !

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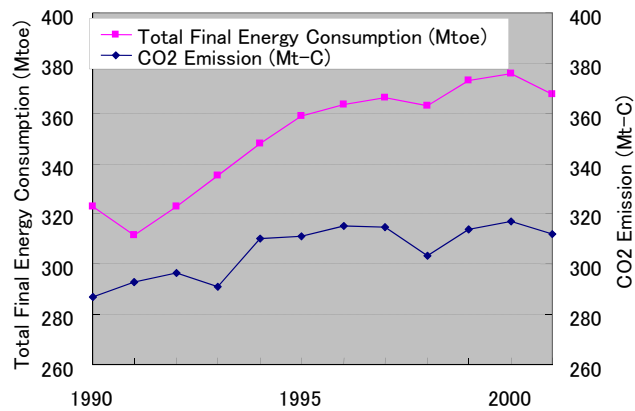
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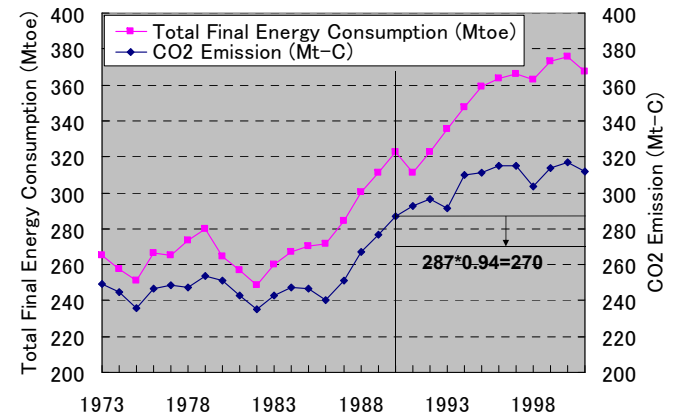
Jun TAKAHASHI

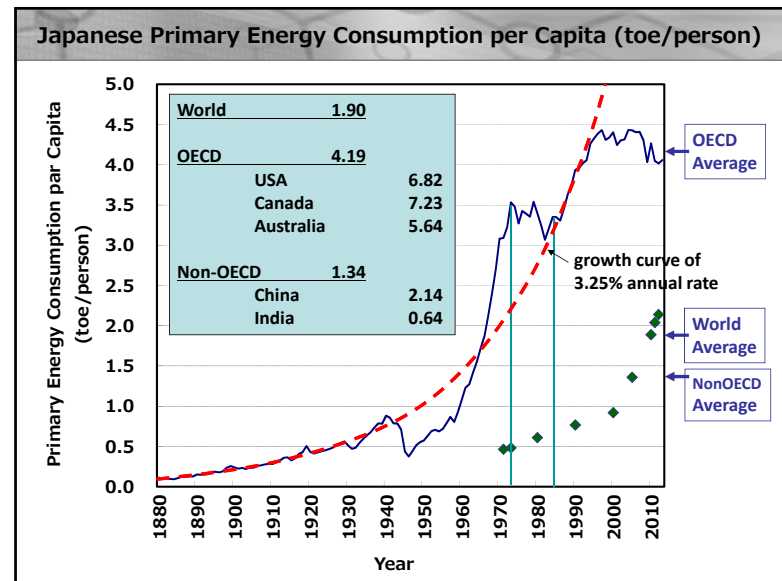
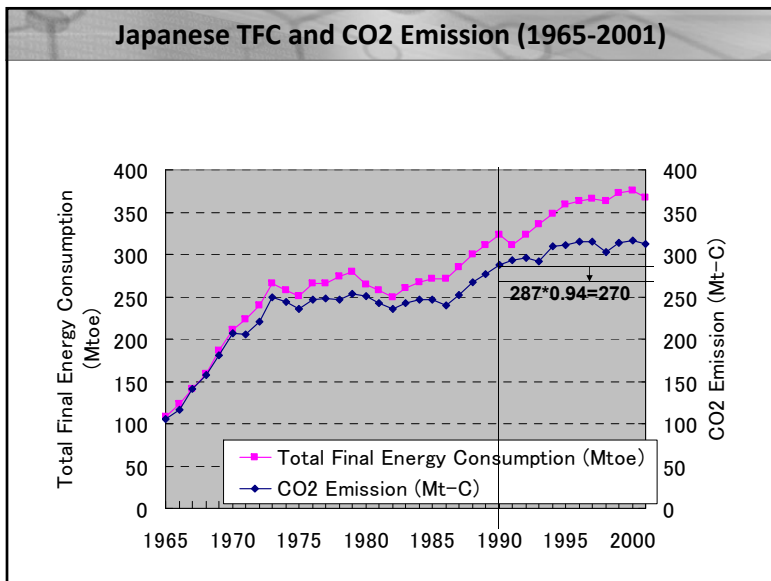
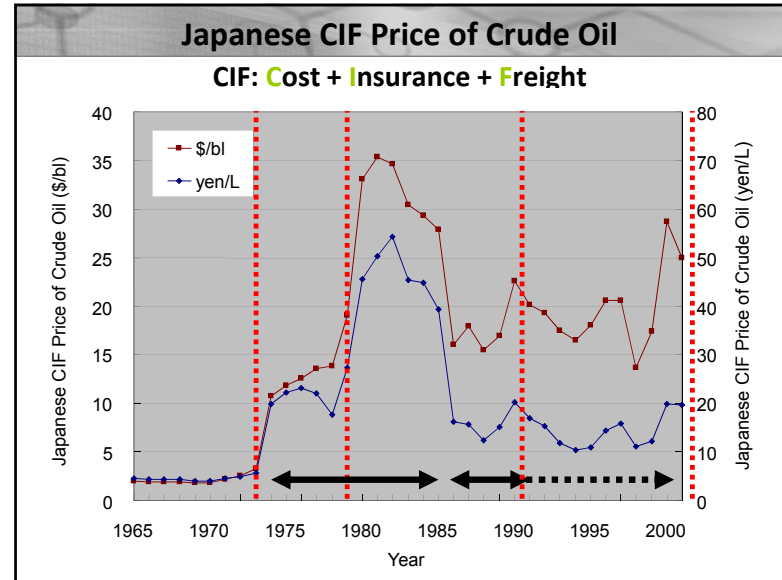
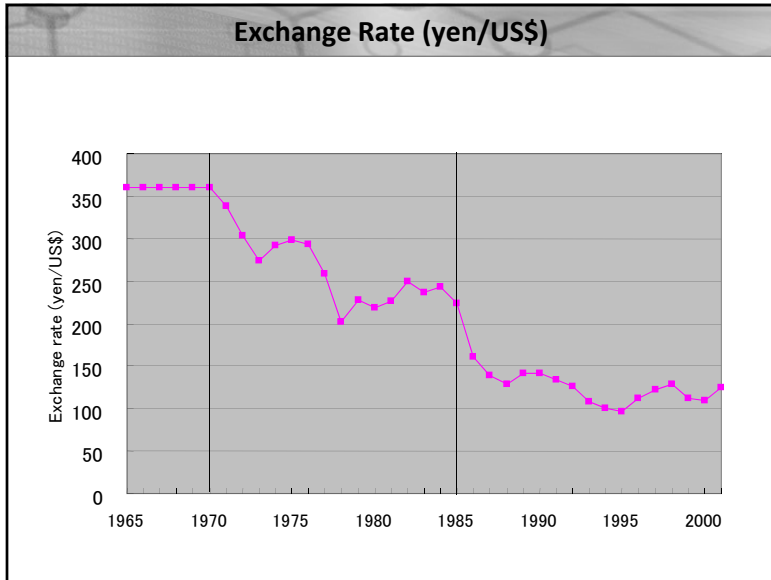
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- ✓ **How to read statistics data ?**
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Japanese TFC and CO2 Emission (1990-2001)

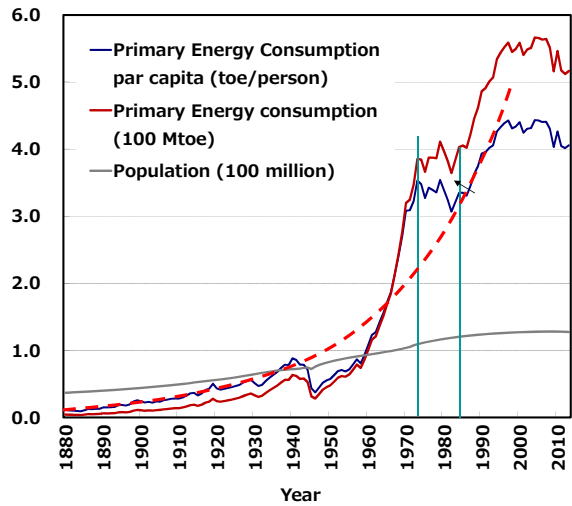


Japanese TFC and CO2 Emission (1973-2001)

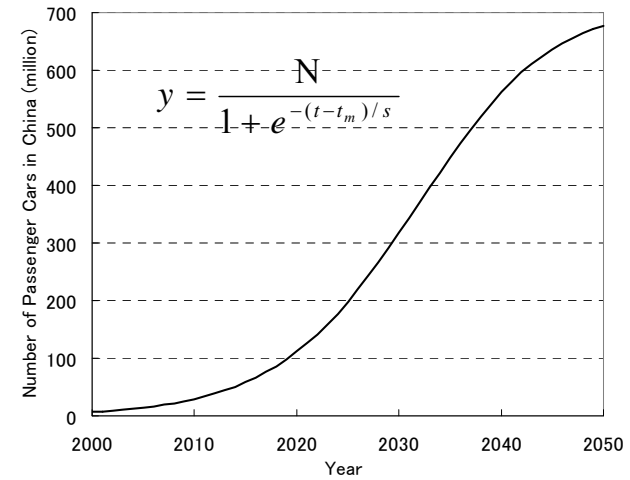




Japanese Primary Energy Consumption per Capita (toe/person)



Logistic Function



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

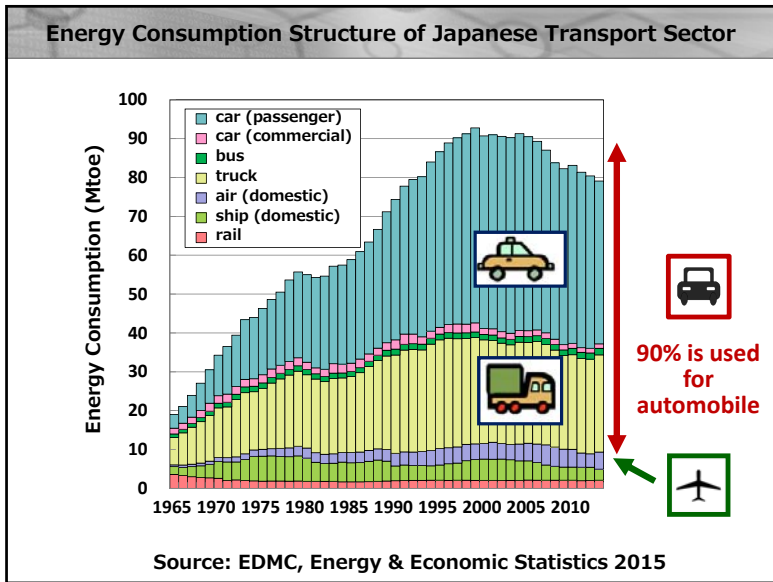
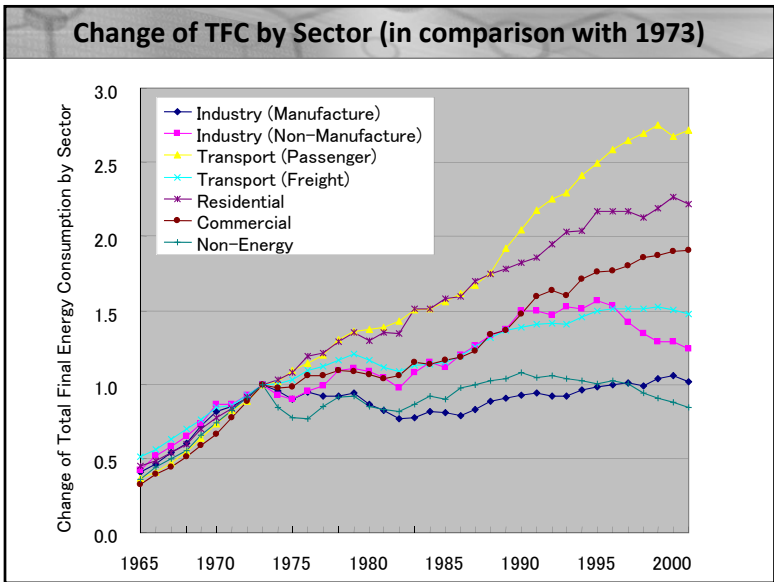
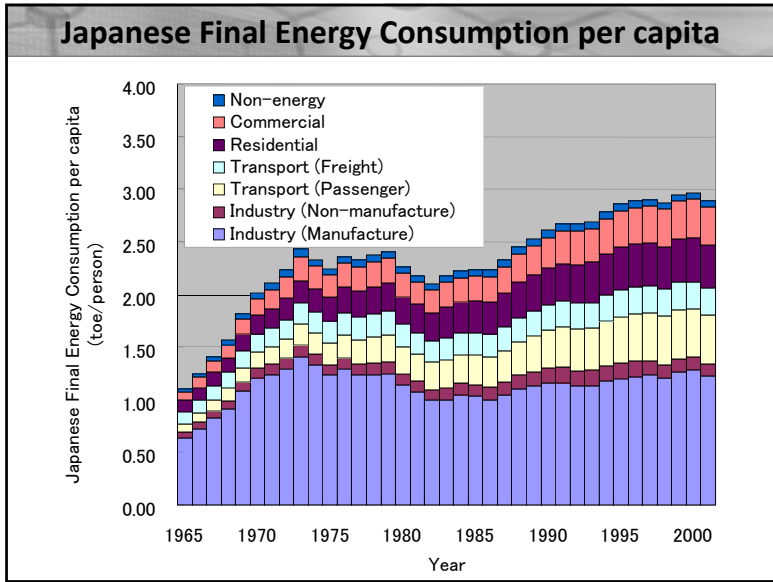
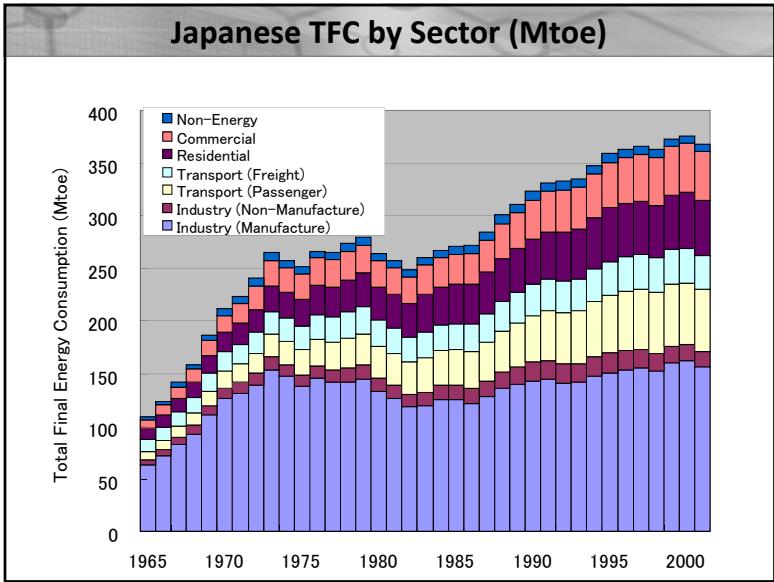
業務部門

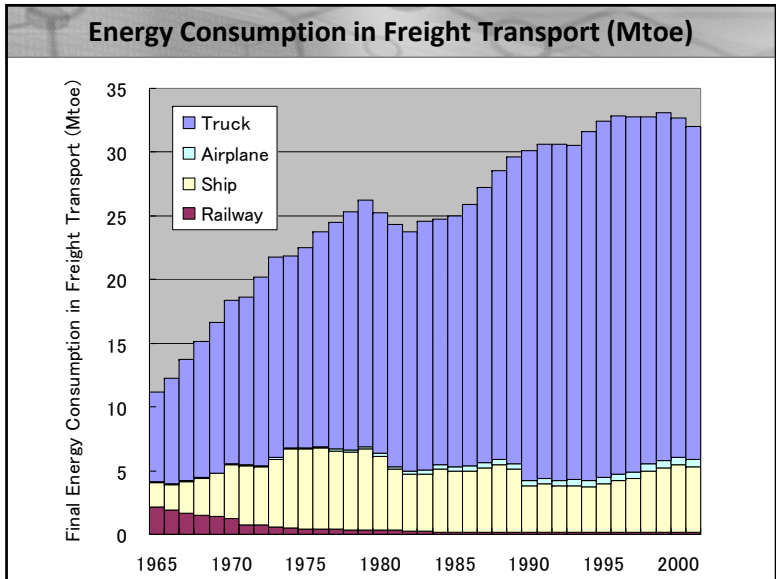
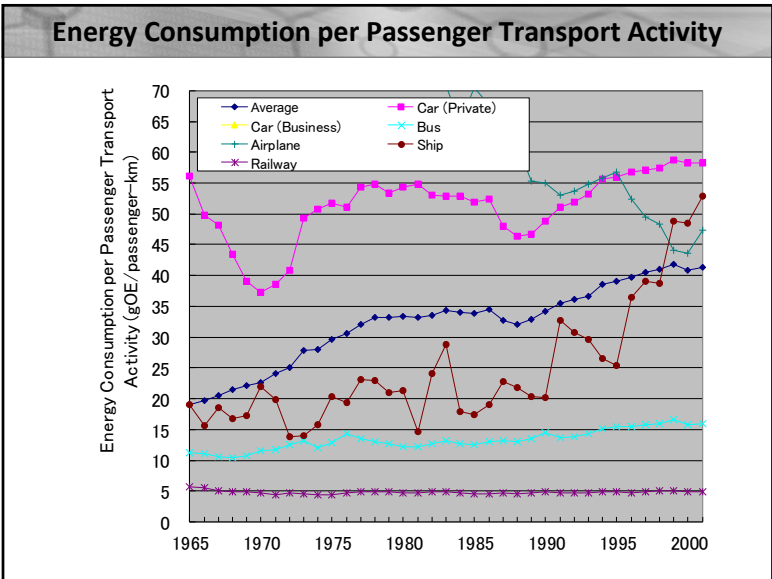
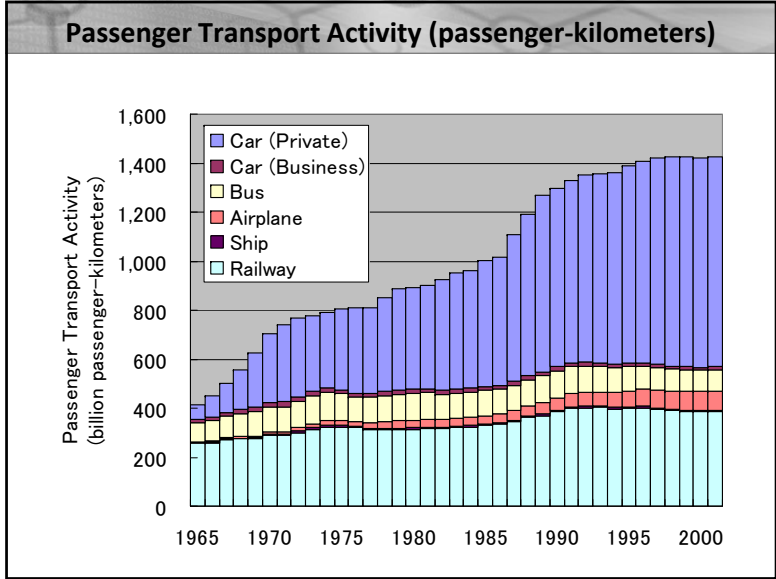
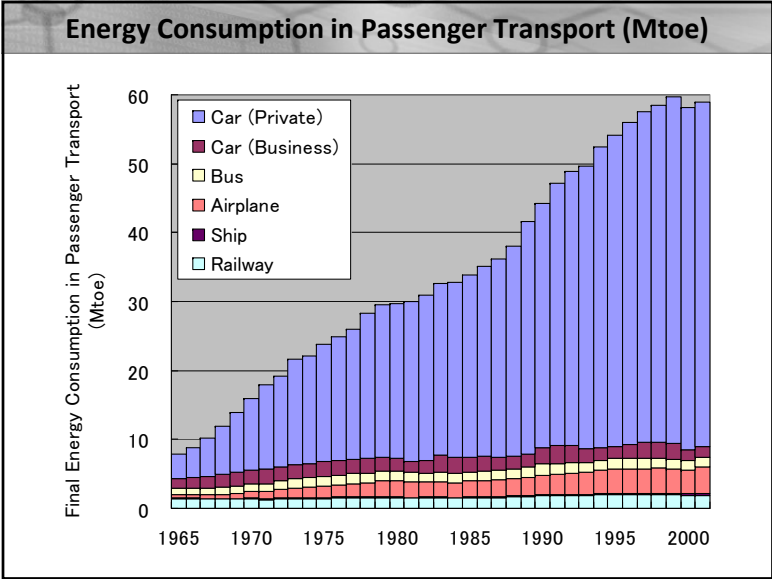
非エネルギー

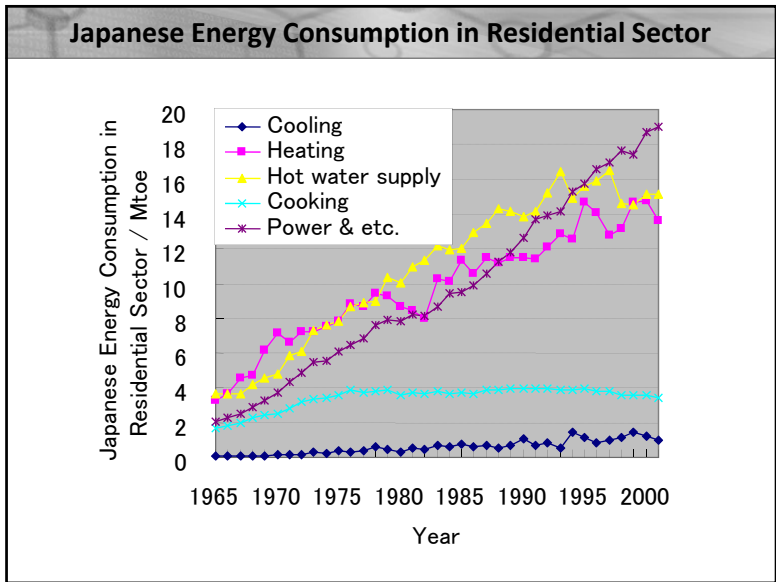
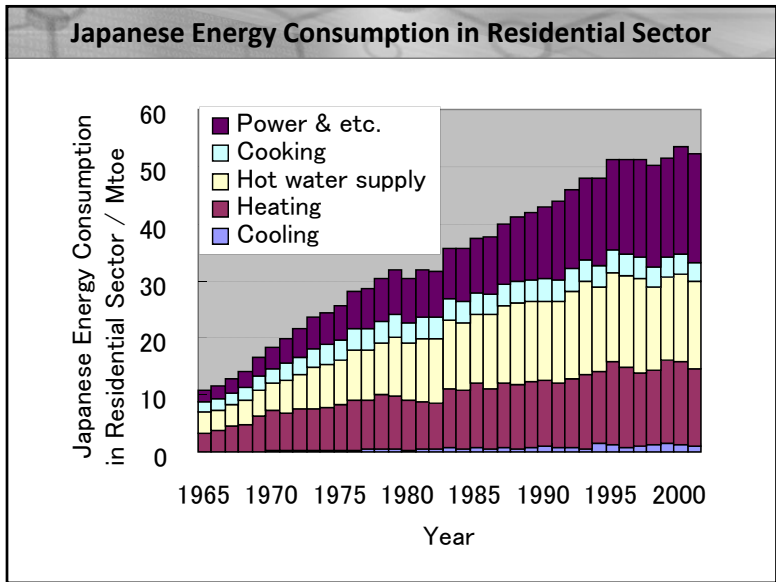
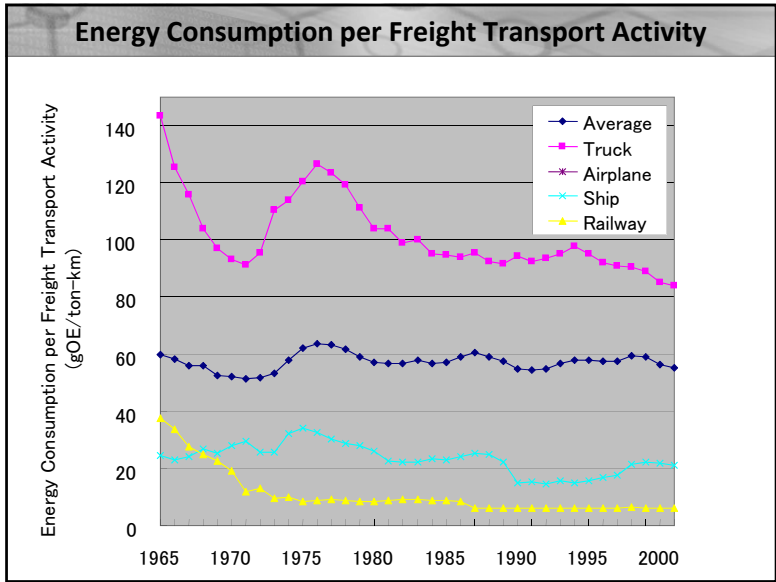
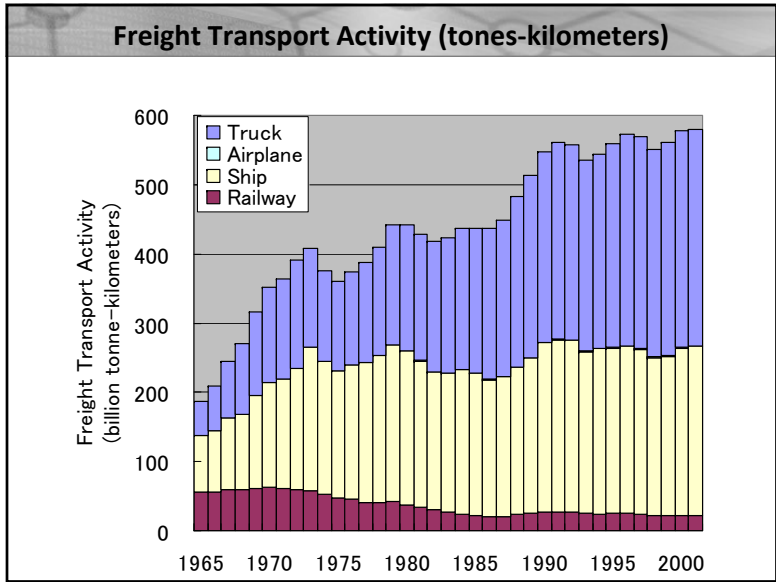
- アスファルト、グリース、パラフィン、潤滑油等

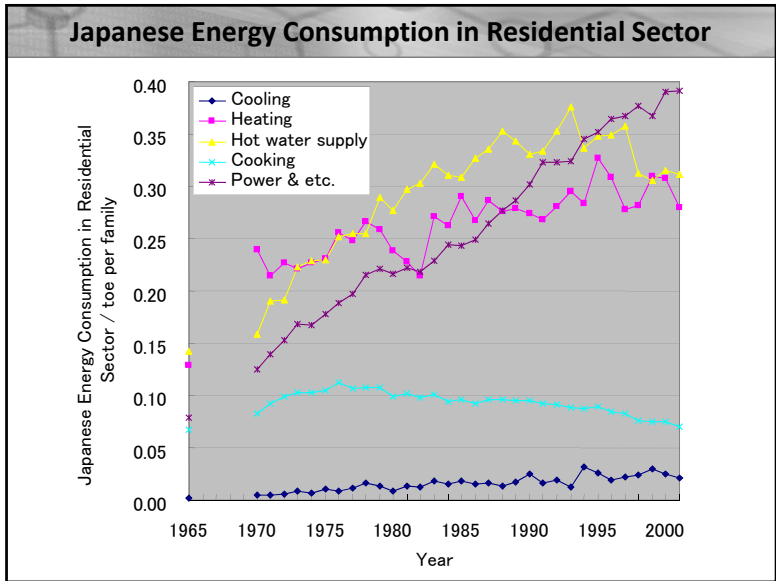
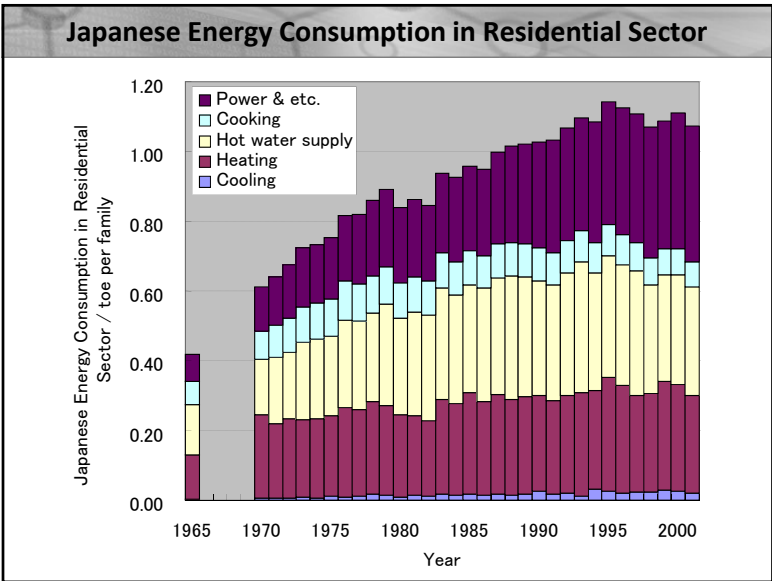
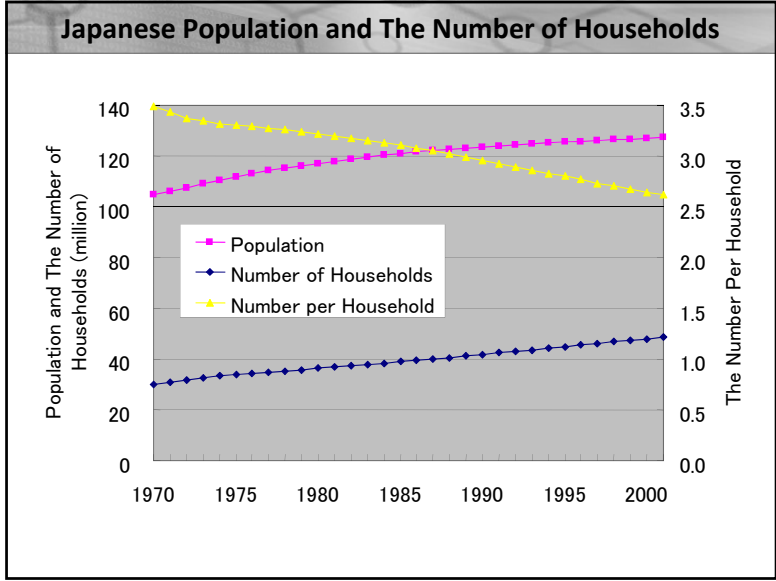
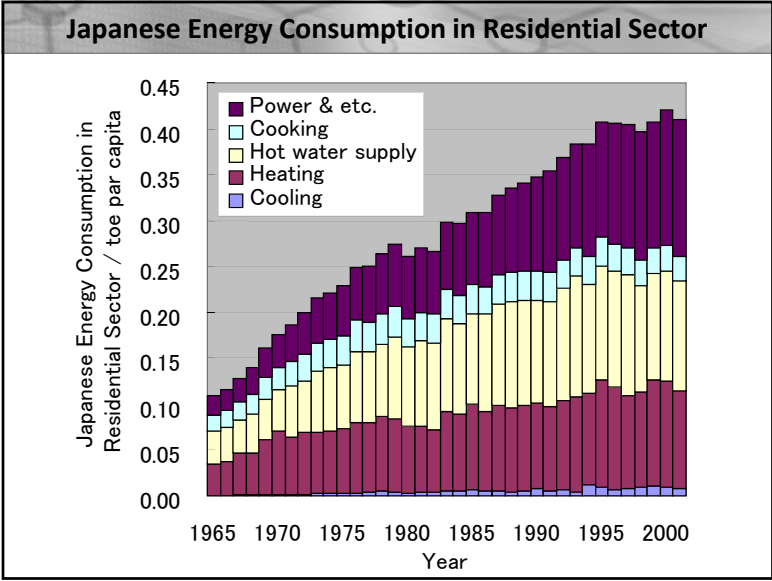
運輸部門

- 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

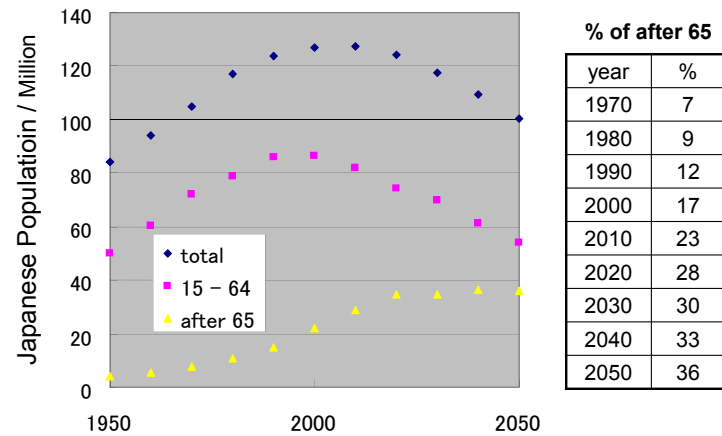








Transition of population composition of Japan



Next week's student's presentation

- ✓ **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 Dec. 11**
 - ✓ You have to **make a group** which consists of 3 to 5 students.
 - ✓ Discuss well about your presentation in your group.
 - ✓ Presentation will start **from 15:00**
 - ✓ 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 **TA student**.
 - ✓ If you can't contribute any presentation, you should submit more than 10 pages PPT file by e-mail to **TA student** by Dec. 11.