

## Global Environmental and Energy Policy

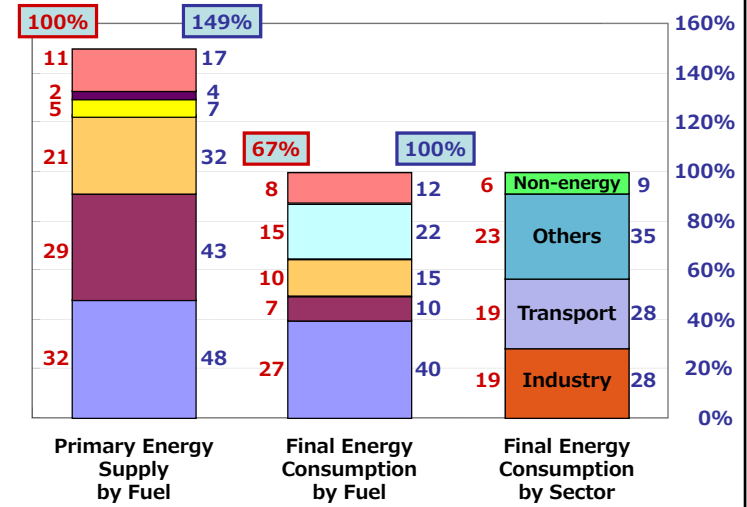
環境・エネルギー技術政策

Nov. 19 and 26, 2019

Jun TAKAHASHI

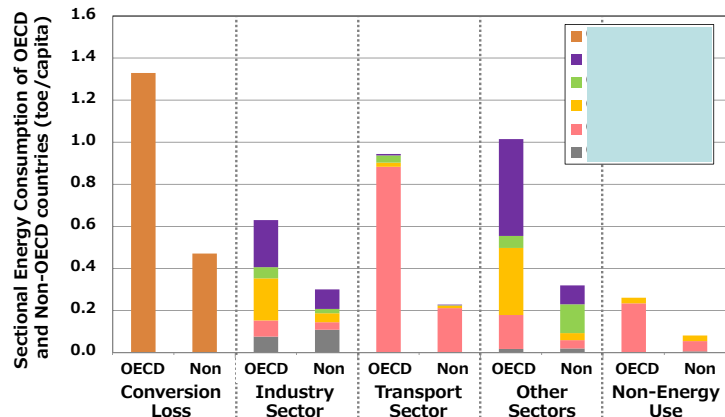
- ✓ Global energy balance
- ✓ How to read statistics data ?
  - ✓ Long-term viewpoint
  - ✓ Suspect an interpretation and the data itself !
- ✓ How to make a policy ?
- ✓ Quiz

## 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                |



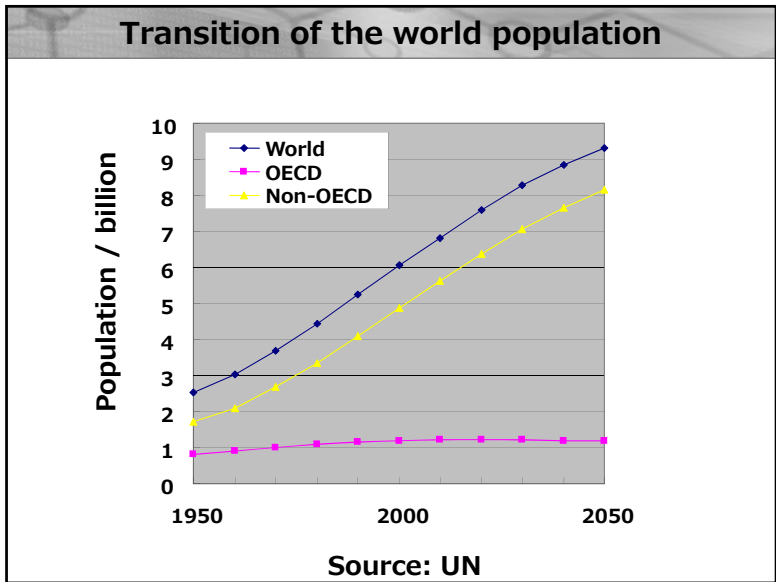
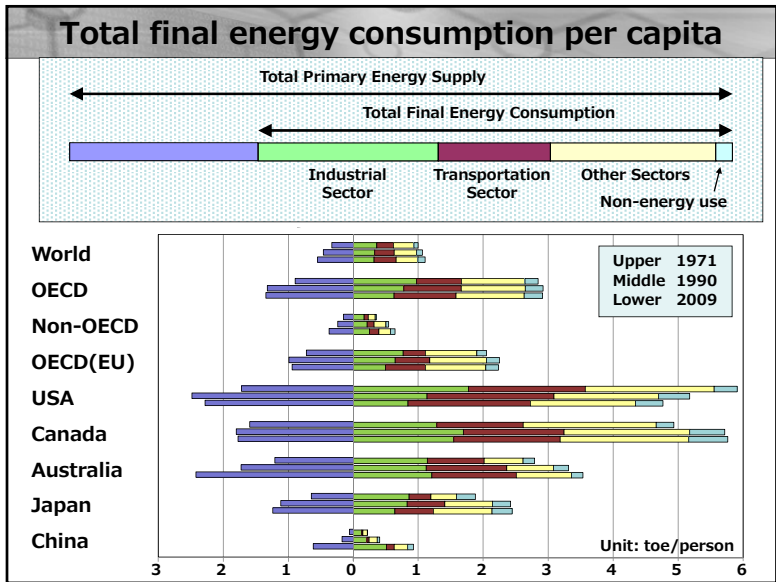
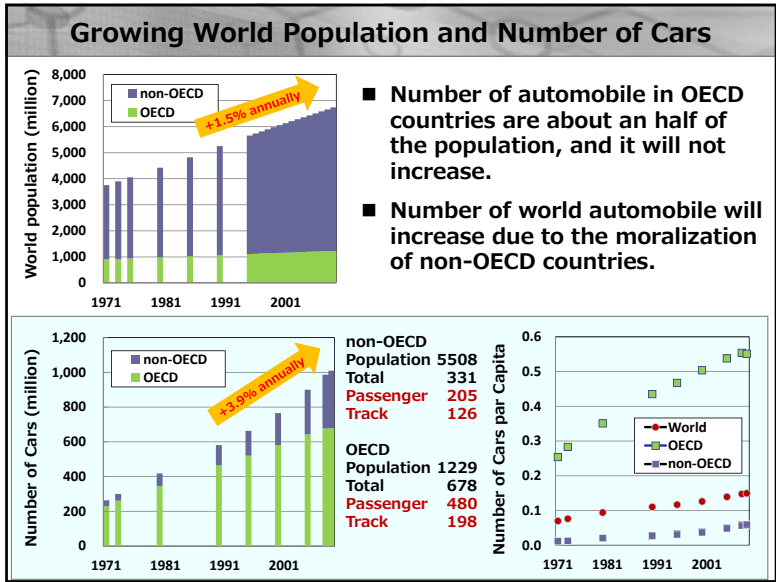
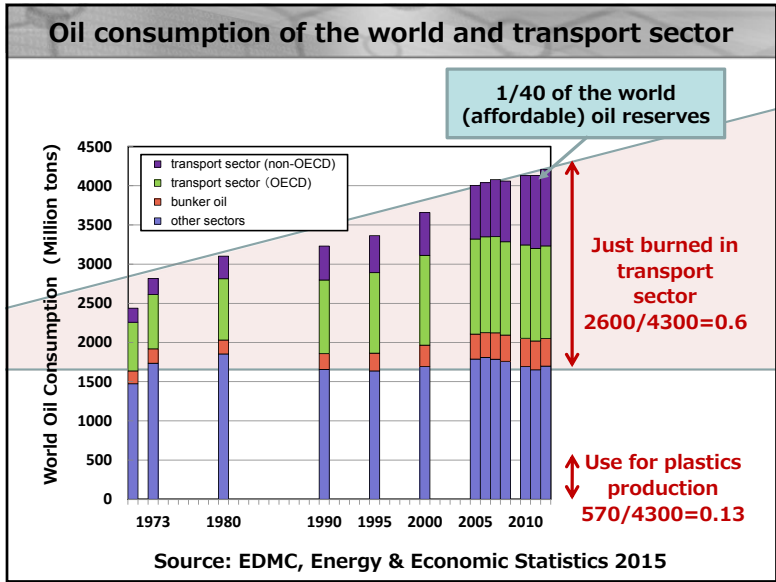
## Fossil Resource and Material Production

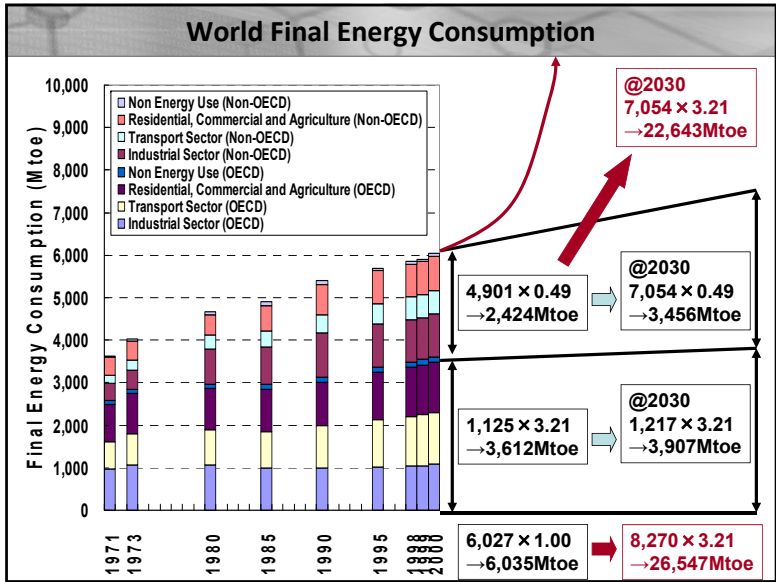
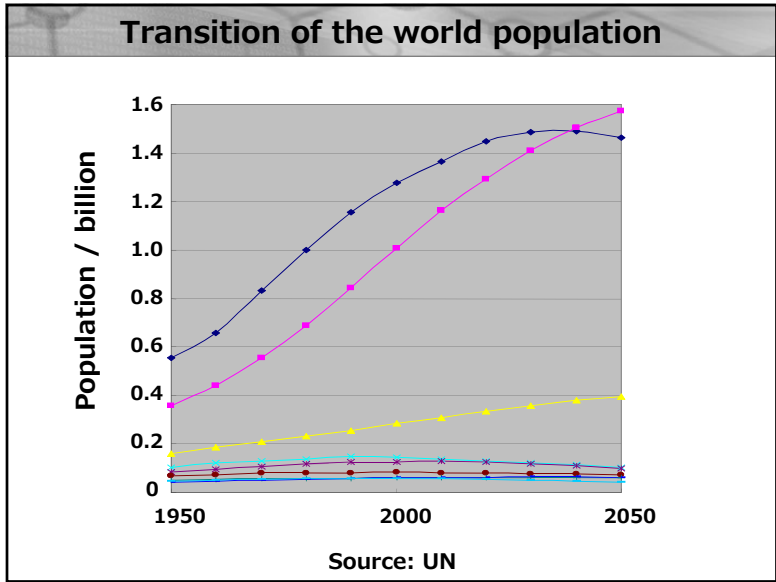
### World coal consumption: 3.9 billion tons

- > 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

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

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

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

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

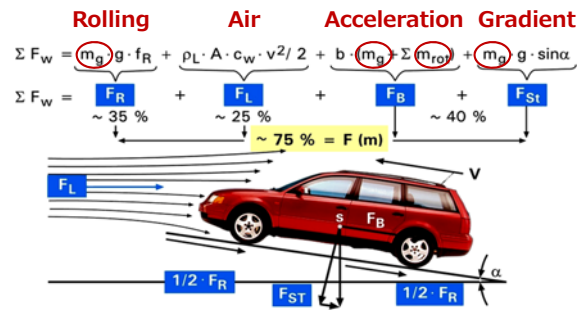
$$= 2.94 [Mtoe/s] \quad (= 1.5 \times 10^4 [toe/year par capita])$$

**We have not used it since fossil fuels were cheap!**

### Next week's student's presentation

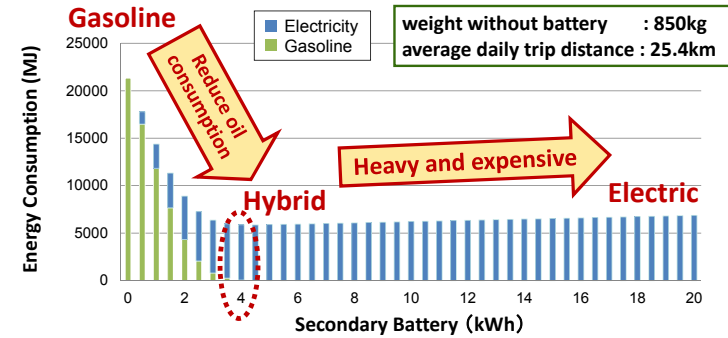
- Consider effective policy **to reduce world's fossil fuel consumption** by using statistics like today's lecture or following website first.
  - <http://www.iea.org/>
- Then, **show your assumption** about technological development such as ICT and AI, and introducing schedule of the technologies to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



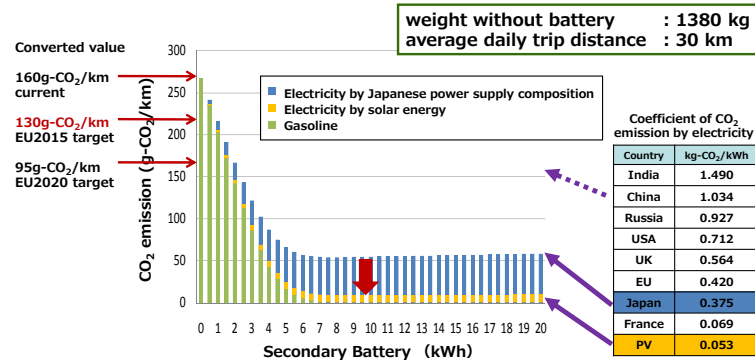
- About 75% of the running resistance is proportional to vehicle weight
  - 30% improvement in fuel efficiency is expected by 40% weight reduction
- In the case of electric vehicles, the heavy and expensive battery can be reduced in proportion to the weight reduction of vehicle body

## EV reduces oil consumption drastically, but ...



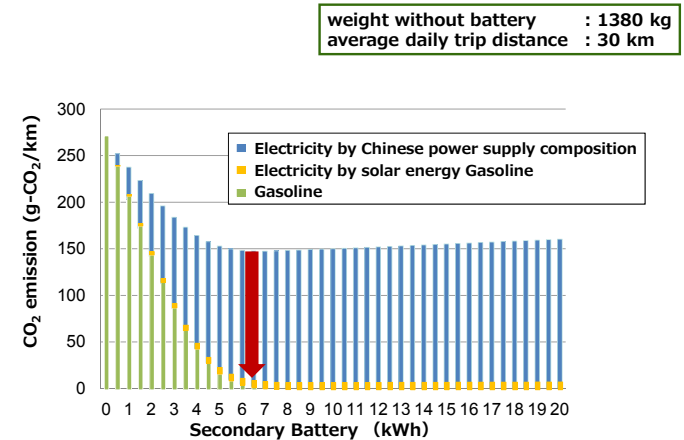
- There is an optimal amount of secondary battery depends on the **weight of vehicle** and **average daily trip distance**.
- Hence, weight lightening of HEV (Hybrid-EV) is effective to reduce **cost of the optimal HEV**, accordingly, its **early spread**.
- In addition, the daily demand of 4kWh, which is generated by 6m<sup>2</sup> of photovoltaic, can also be reduced by vehicle's weight reduction.

## CO<sub>2</sub> Emission Structure of Japanese PHEV



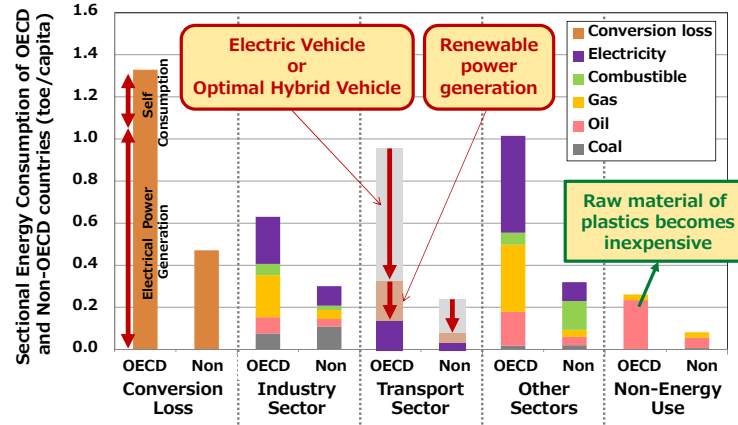
- **Combination of solar and PHEV shows a significant effect !!!**
  - 3m<sup>2</sup> of PV generates 2kWh daily, hence PV-PHEV is possible.
  - The amount of secondary battery is more important from a viewpoint of CO<sub>2</sub> emission.

## CO<sub>2</sub> Emission Structure of PHEV in China



**Vehicle's Weight Lightening Technology will Save the World !**

|          | 2012         | Population      | Total Primary Energy Supply | Total Final Energy Consumption |
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**Global Environmental and Energy Policy**

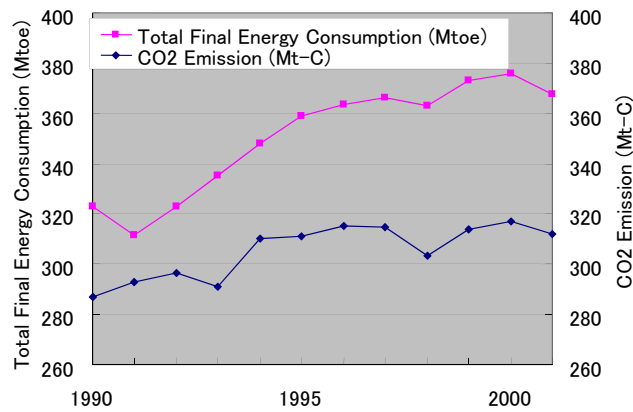
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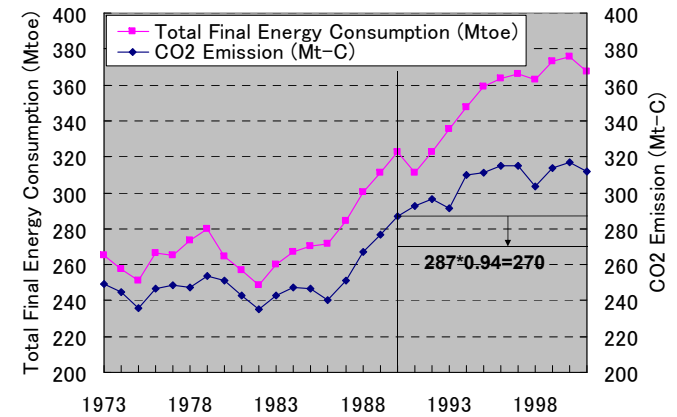
Jun TAKAHASHI

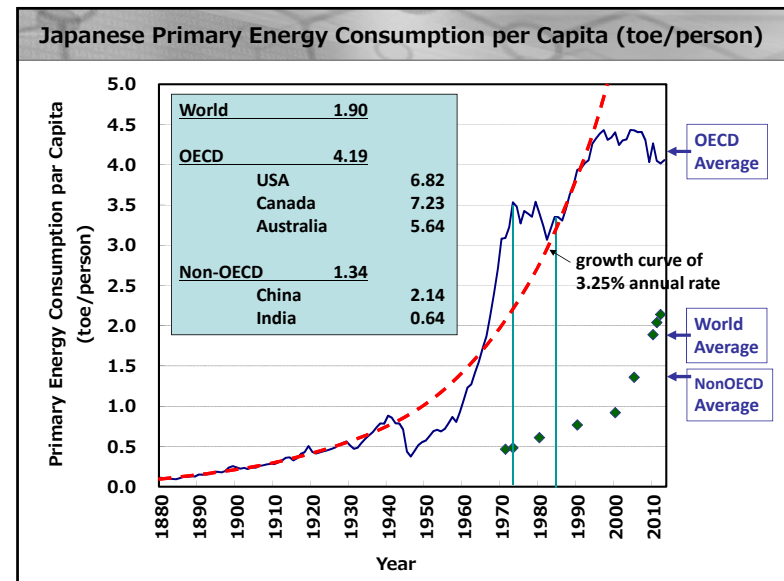
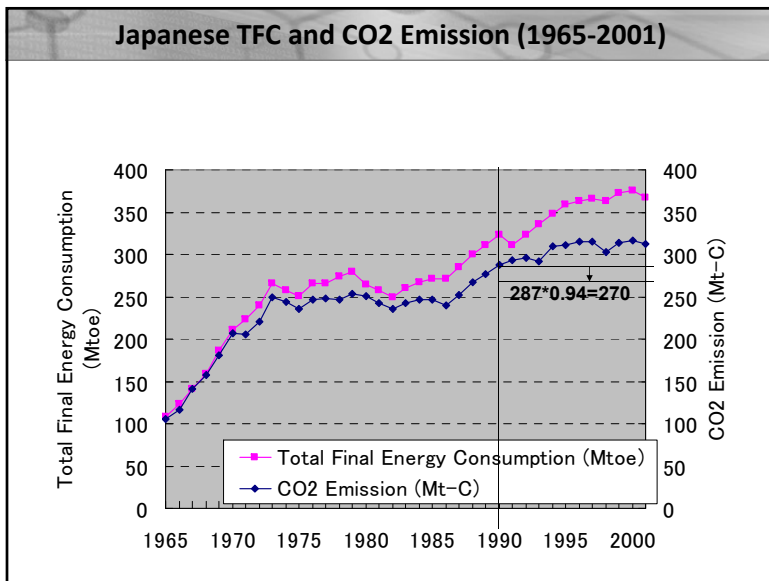
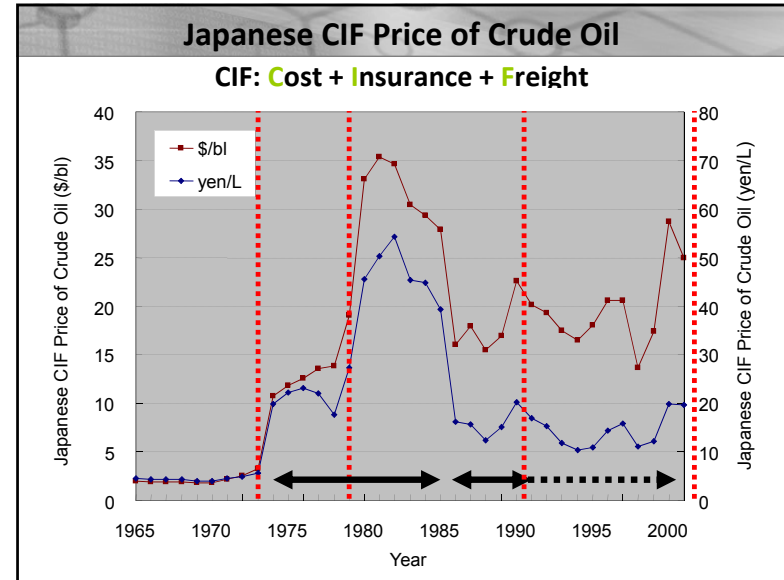
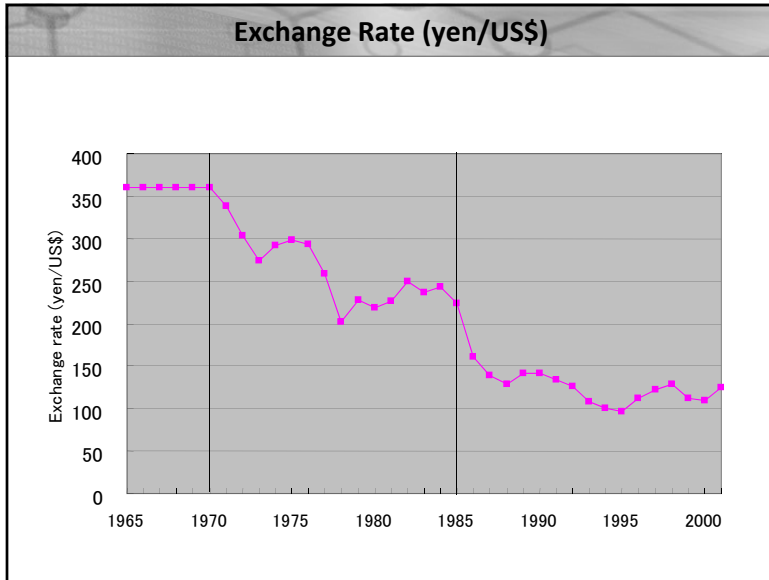
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**Japanese TFC and CO2 Emission (1990-2001)**

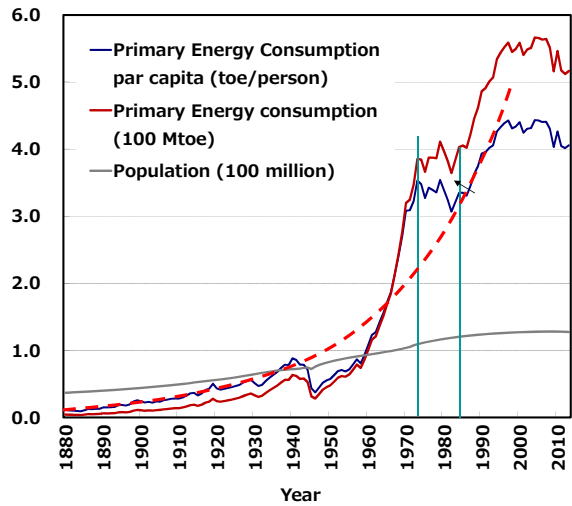


**Japanese TFC and CO2 Emission (1973-2001)**

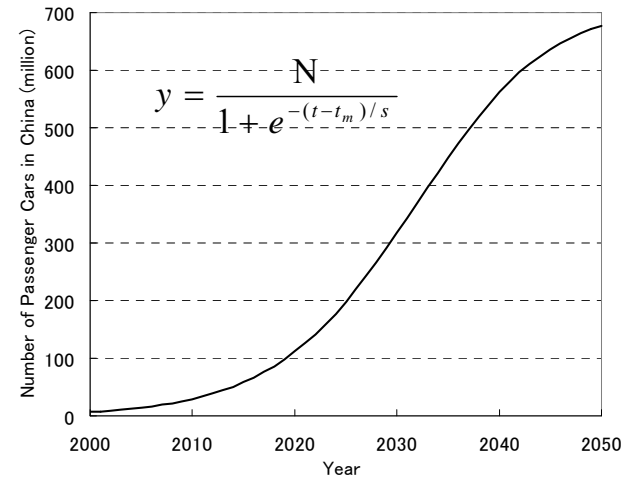




### Japanese Primary Energy Consumption per Capita (toe/person)



### 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

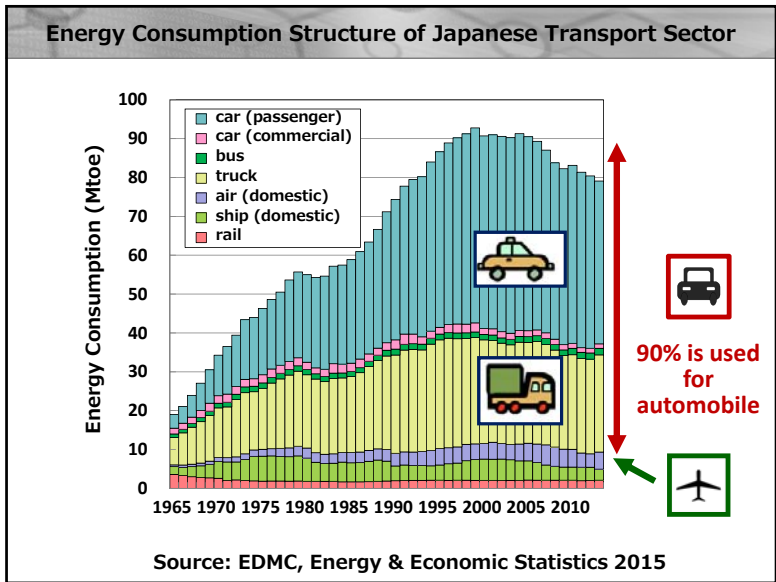
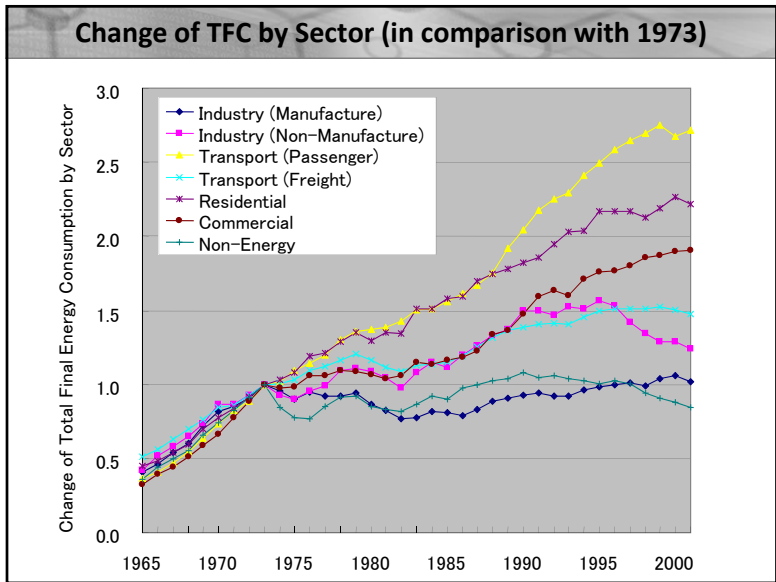
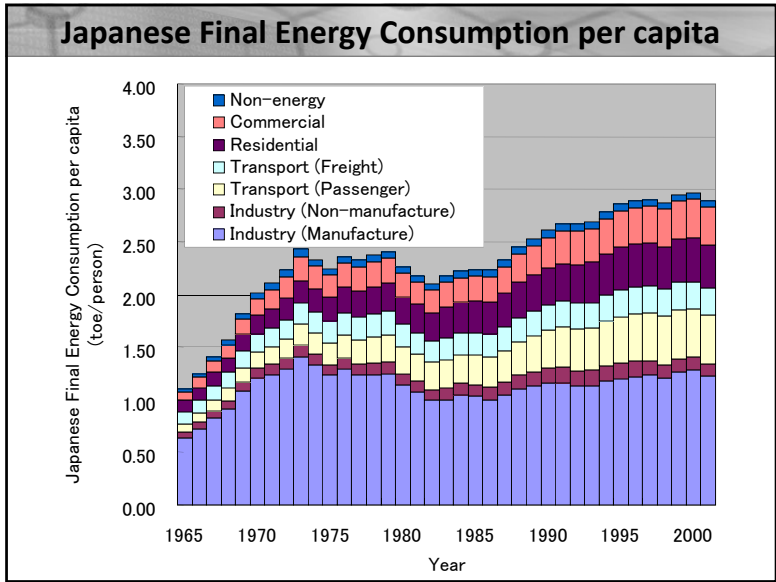
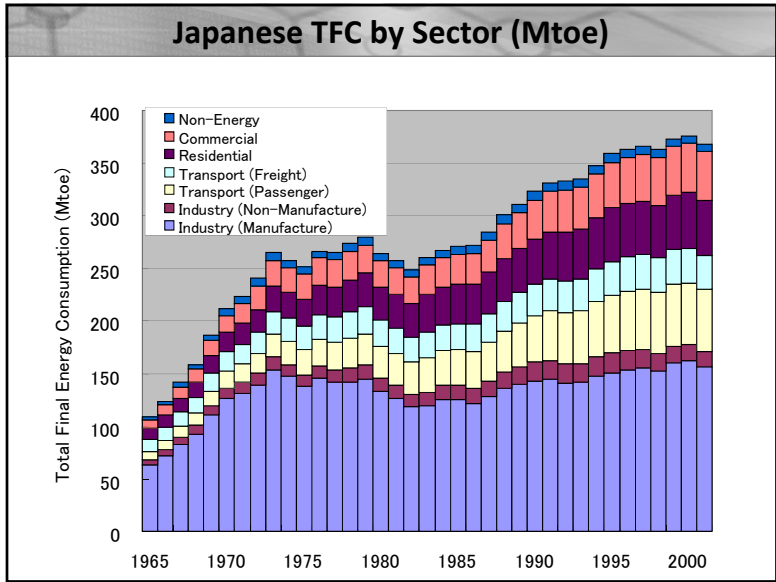
#### 業務部門

#### 非エネルギー

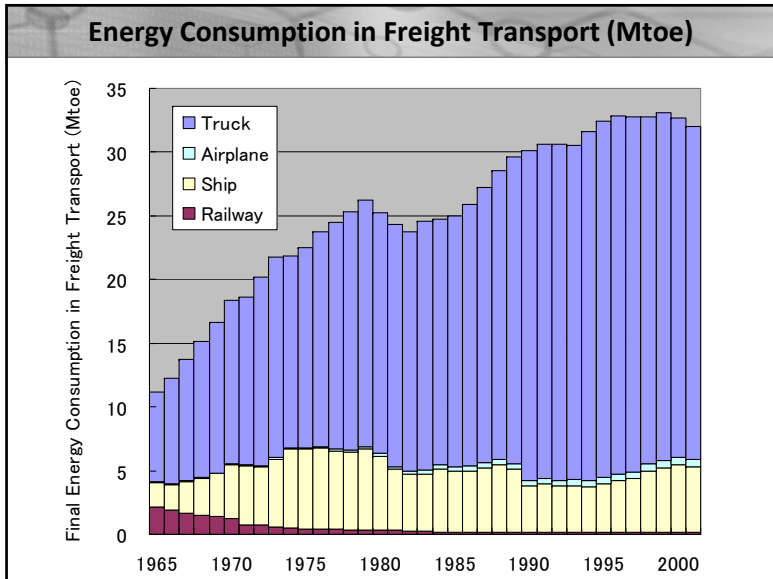
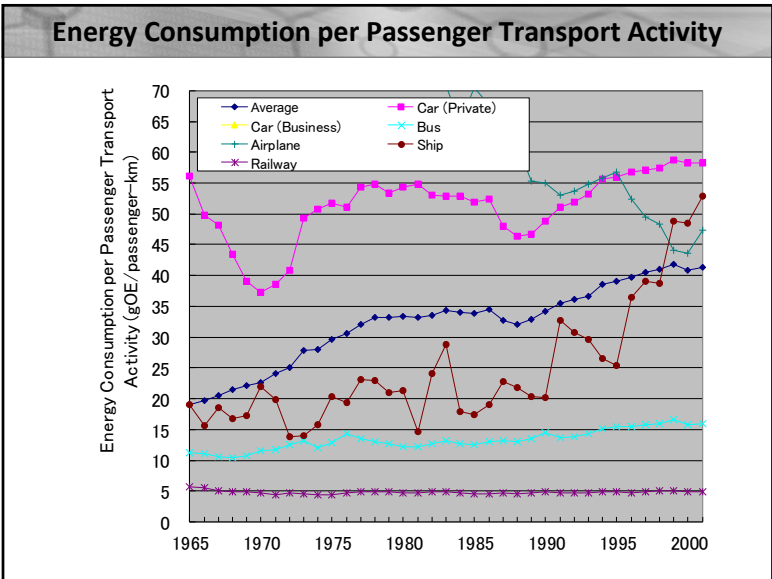
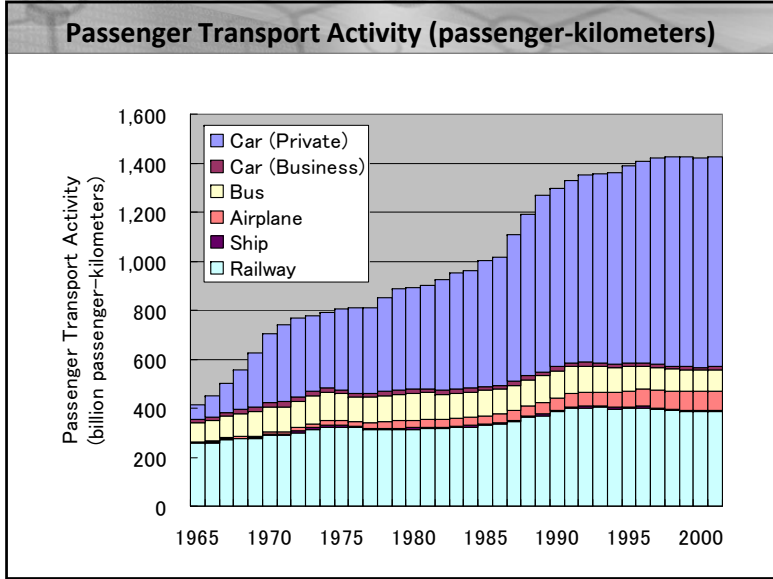
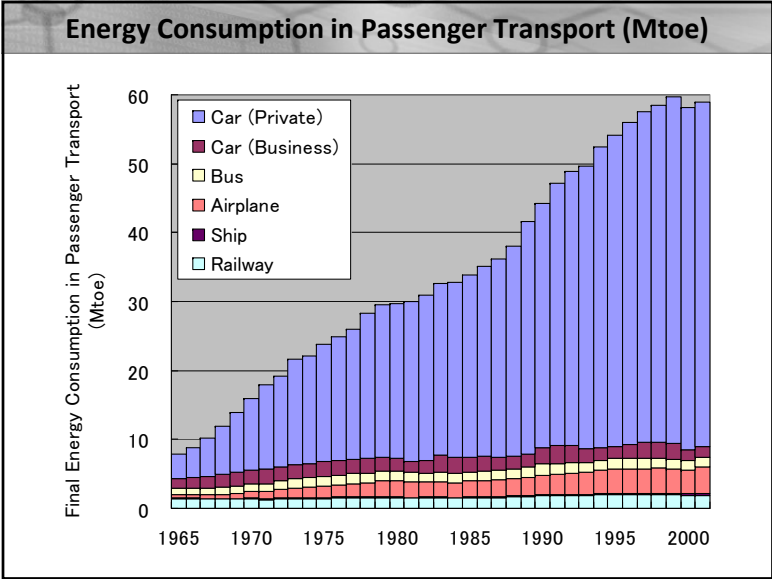
- アスファルト、グリース、パラフィン、潤滑油等

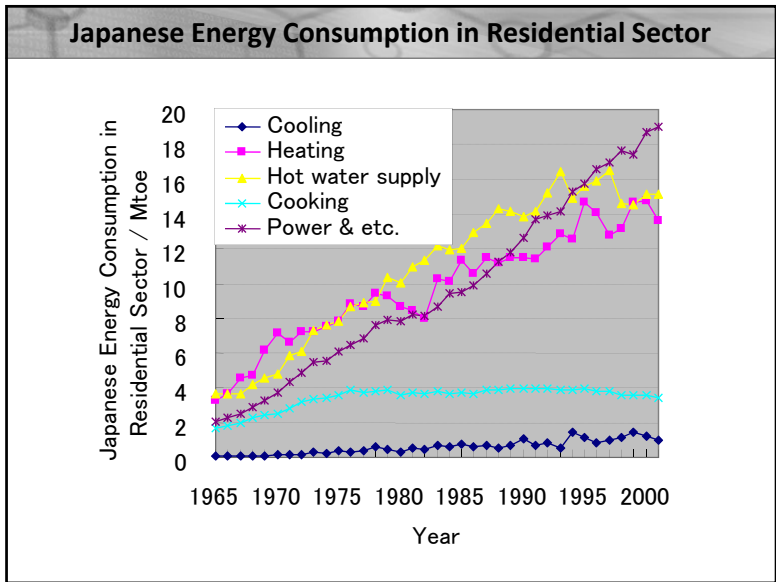
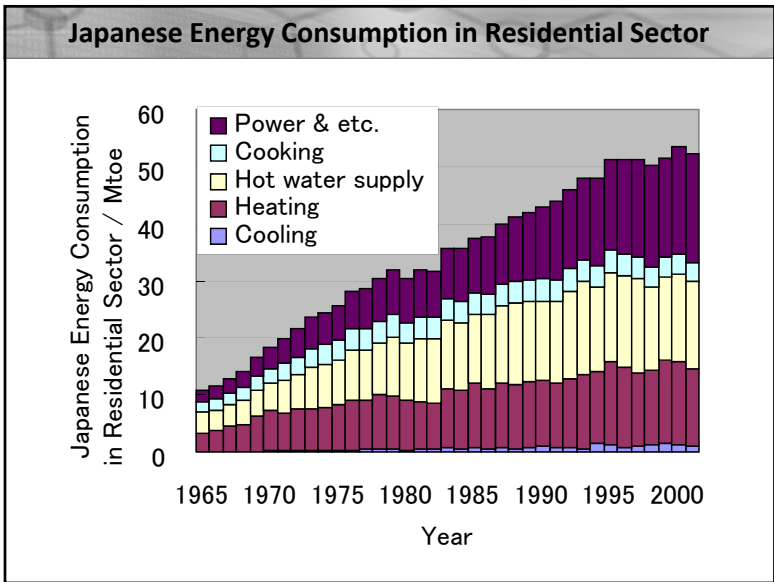
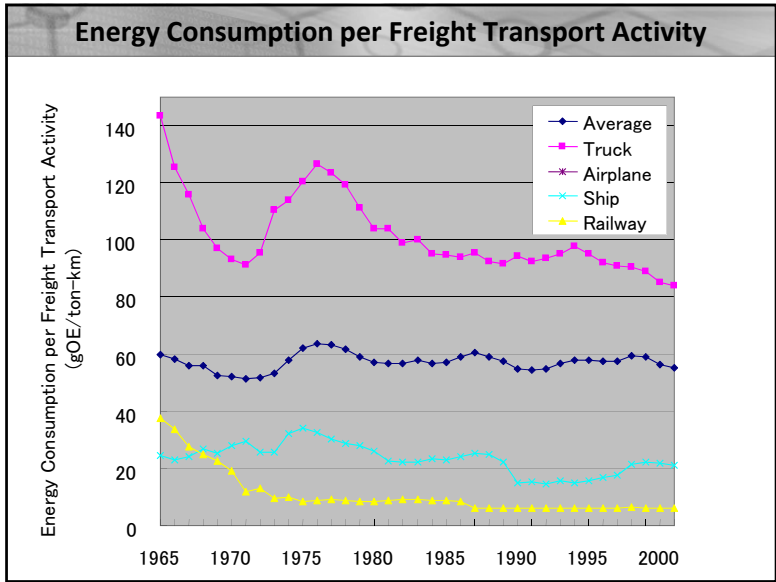
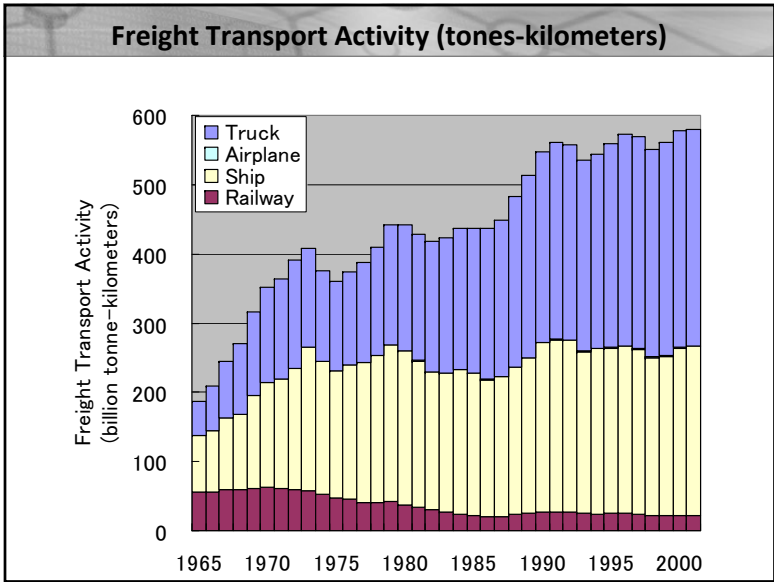
#### 運輸部門

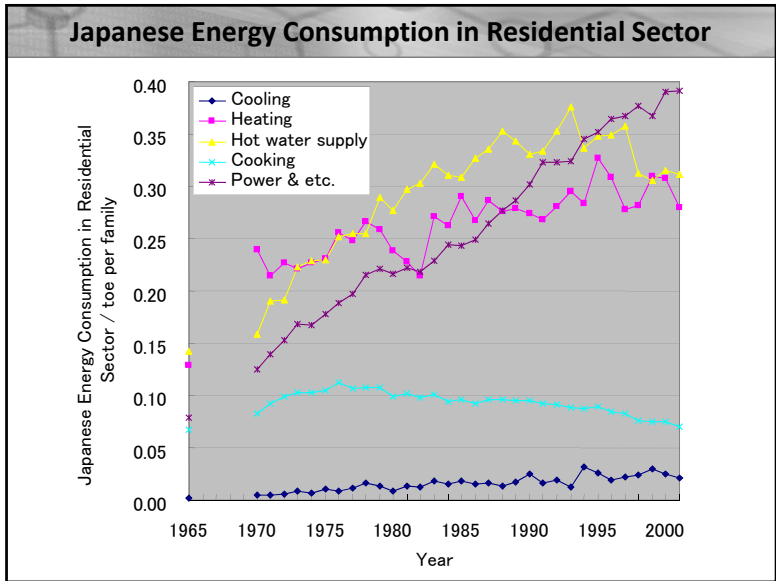
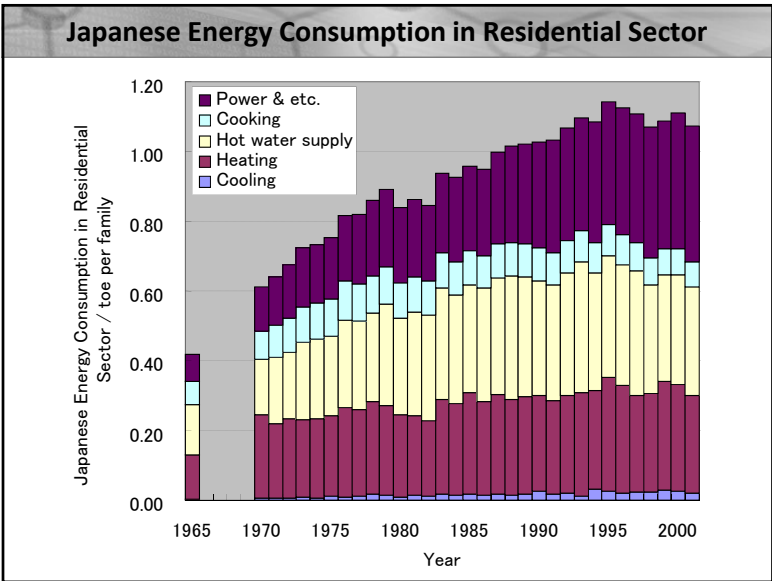
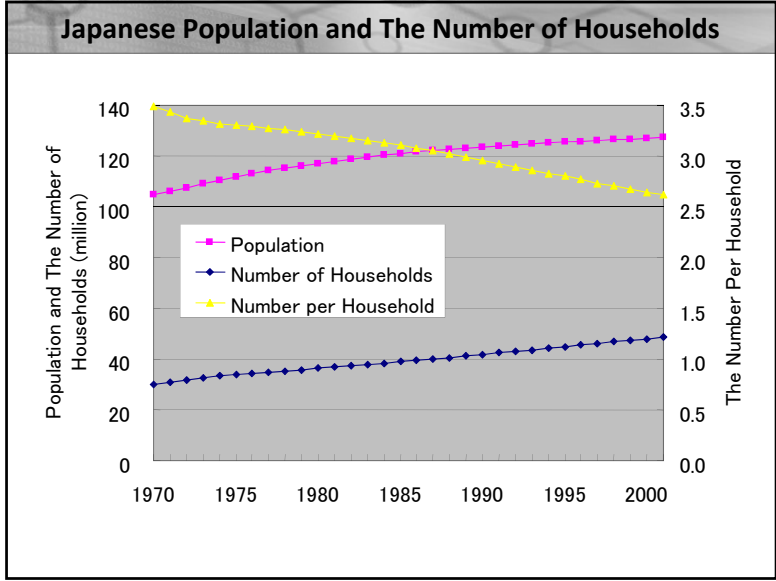
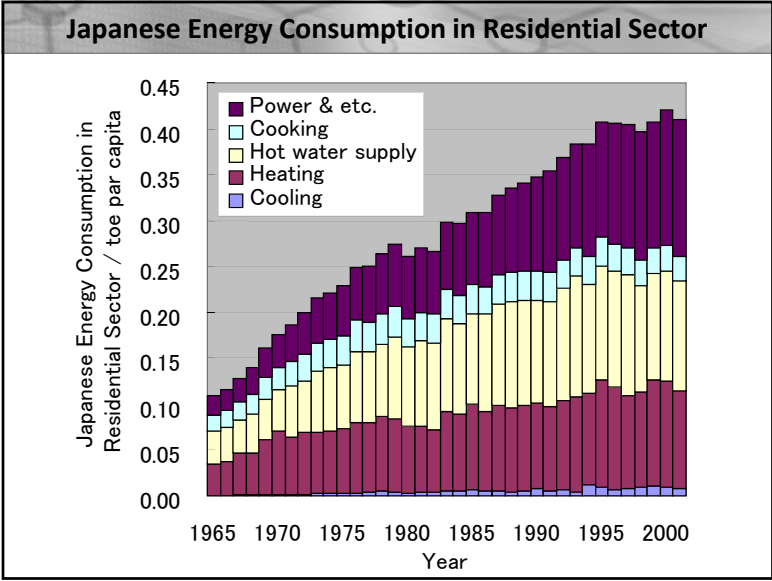
- 旅客
  - 自家用乗用車
  - 営業用乗用車
  - バス
  - 旅客航空
  - 旅客海運
  - 旅客鉄道
- 貨物
  - 貨物自動車
  - 貨物航空
  - 貨物海運
  - 貨物鉄道



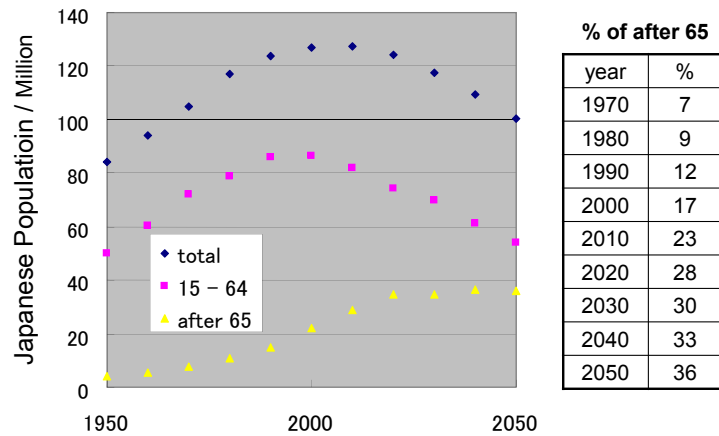








### Transition of population composition of Japan



% of after 65

| year | %  |
|------|----|
| 1970 | 7  |
| 1980 | 9  |
| 1990 | 12 |
| 2000 | 17 |
| 2010 | 23 |
| 2020 | 28 |
| 2030 | 30 |
| 2040 | 33 |
| 2050 | 36 |

### 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. ICT and AI, 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 Nov. 26**
  - ✓ 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 Nov. 25**.