

Global Environmental Policy (and Energy Policy Making on Technology)

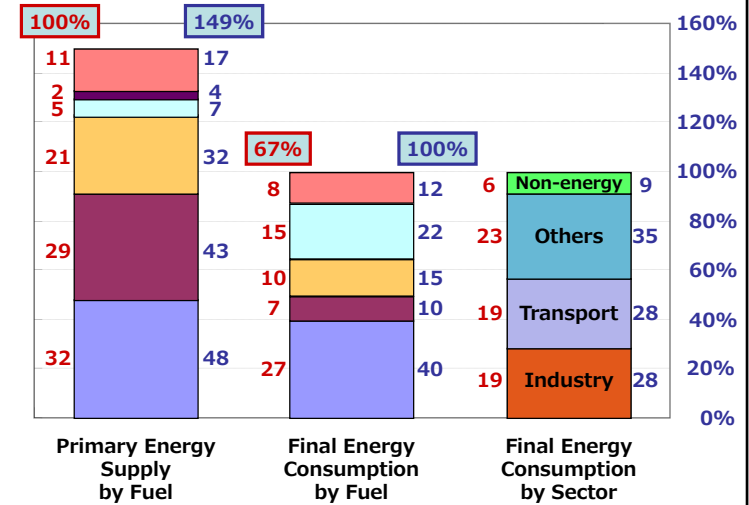
環境・エネルギー技術政策

Nov. 22 and 29, 2016

Jun TAKAHASHI

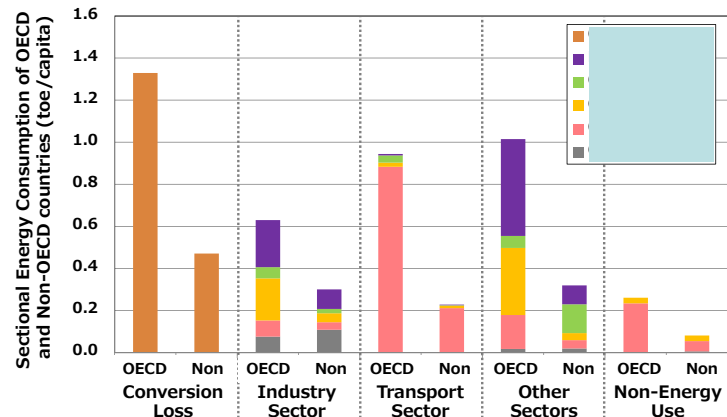
- ✓ Global energy balance
- ✓ How to read statistics data ?
 - ✓ Long-term viewpoint
 - ✓ Suspect an interpretation and the data itself !
- ✓ How to make a policy ?
- ✓ Quiz

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



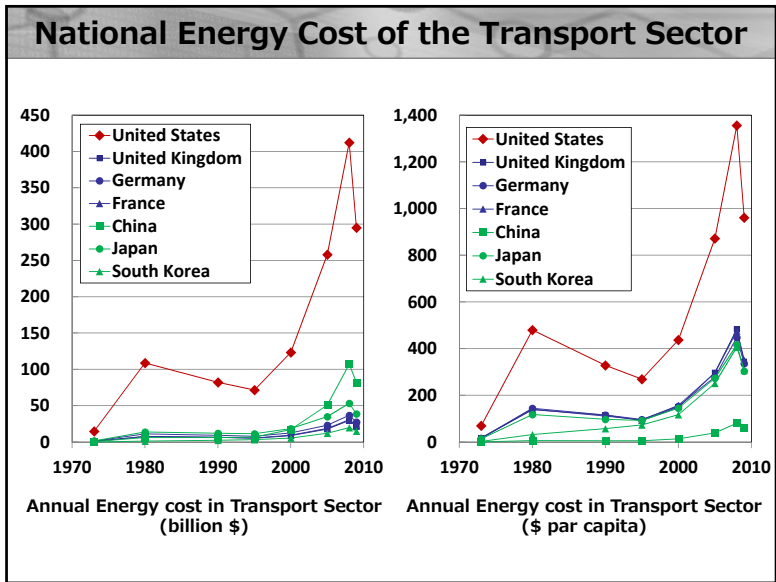
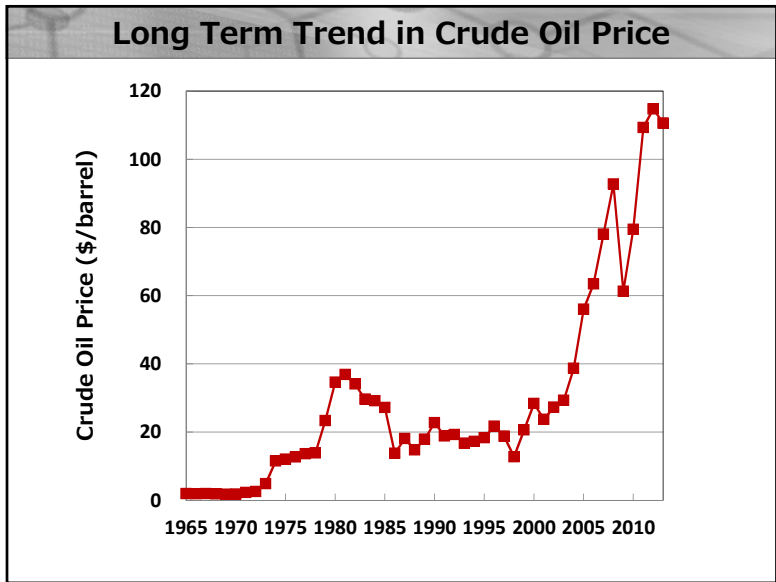
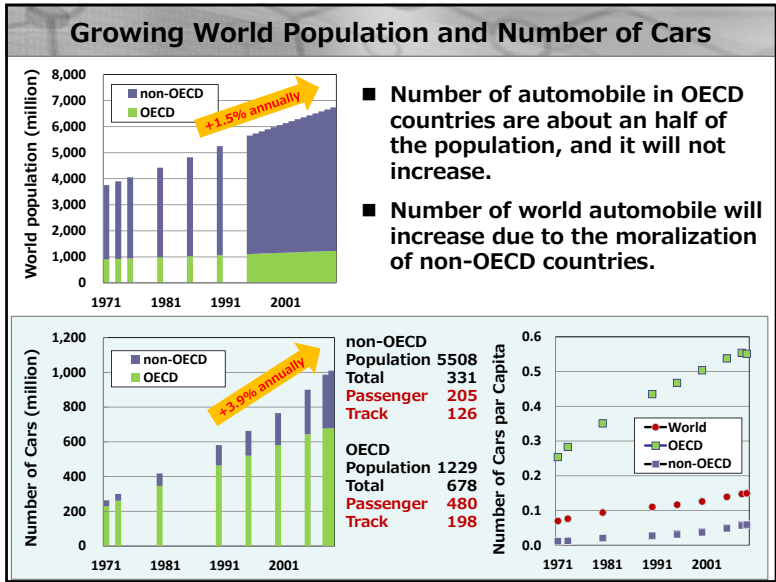
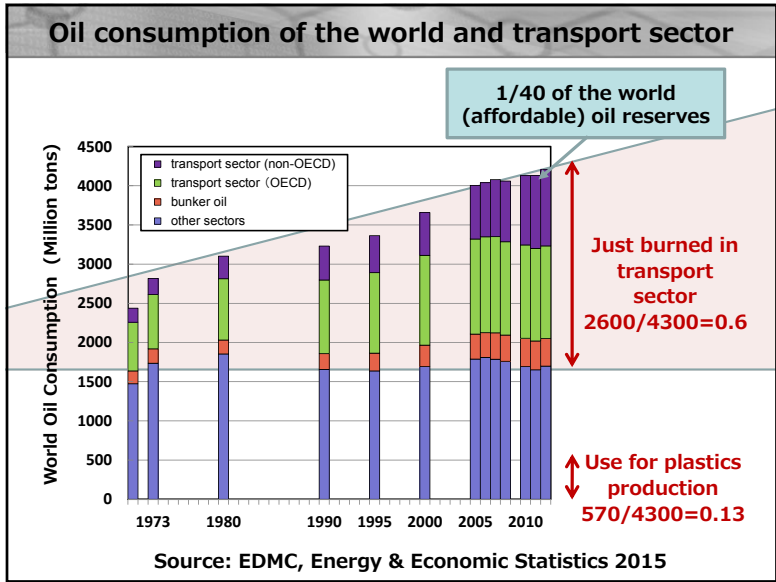
Fossil Resource and Material Production

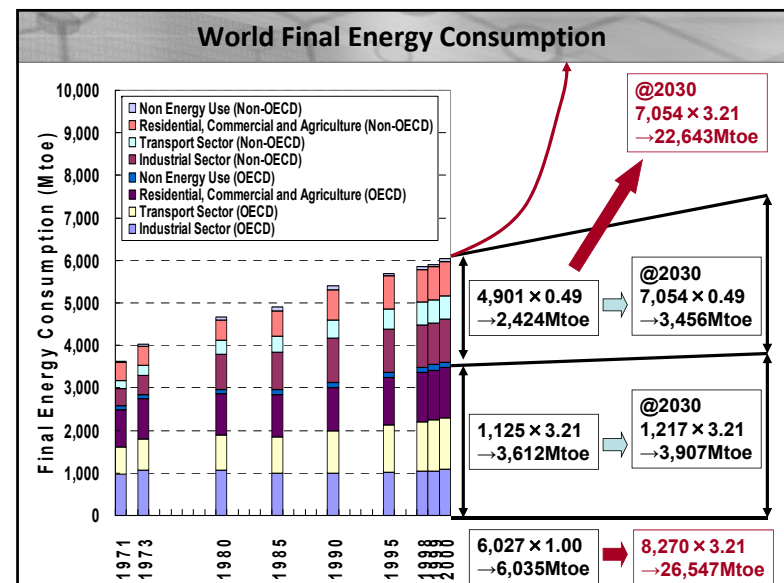
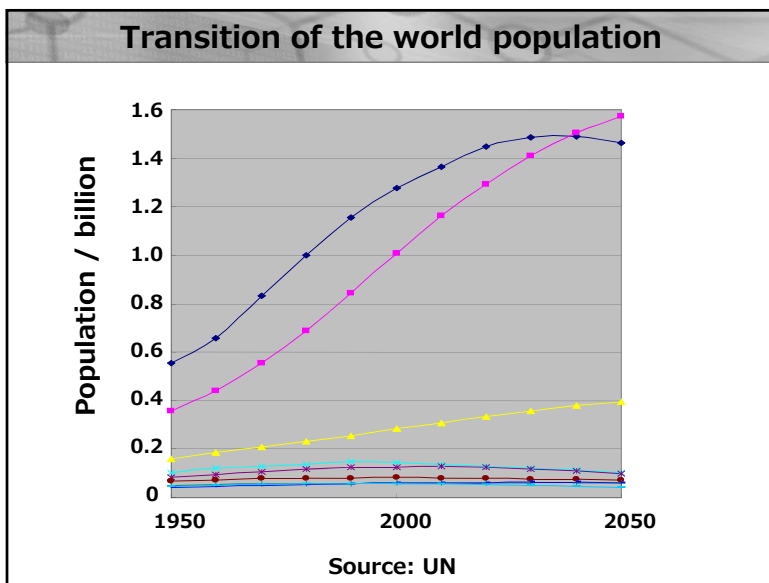
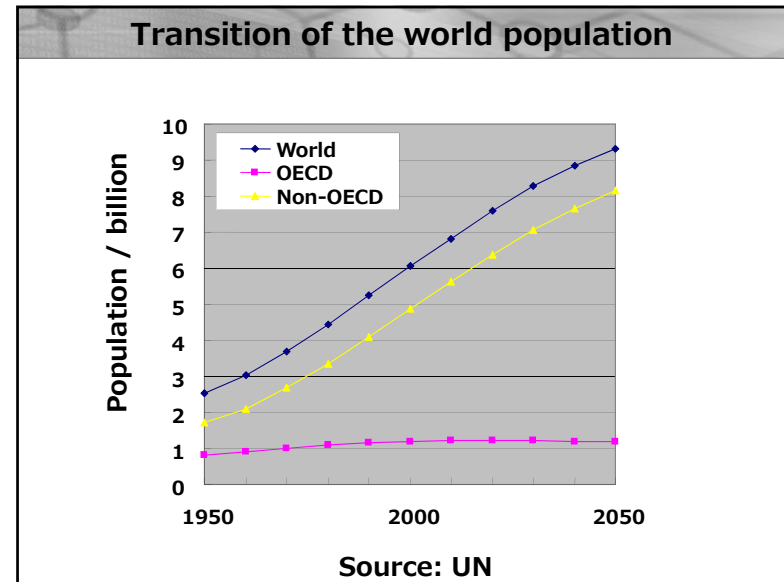
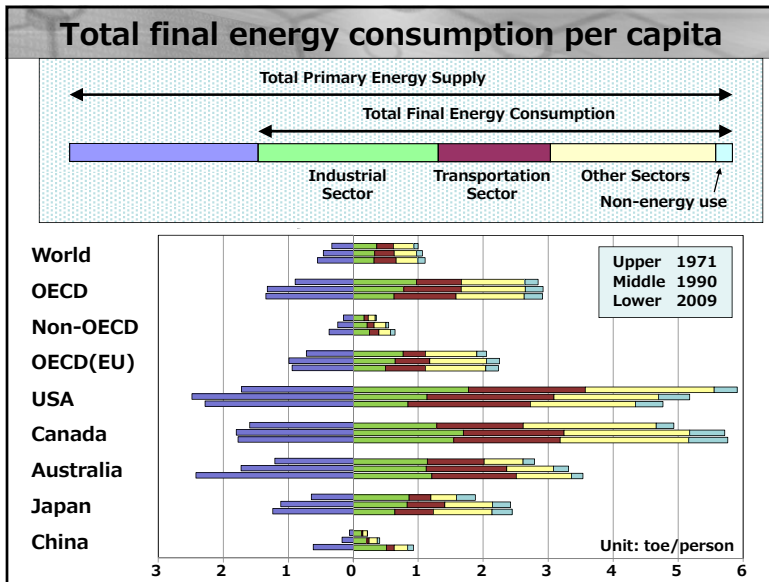
World coal consumption: 3.9 billion tons

- > 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

$$\begin{aligned}
 & 0.7 \times \pi R^2 [\text{m}^2] \times 1367 [\text{J/m}^2\text{s}] \\
 & = 0.7 \times 1.286 \times 10^{14} [\text{m}^2] \times 1367 [\text{J/m}^2\text{s}] \\
 & = 1.23 \times 10^{17} [\text{J/s}] \\
 & = 2.94 \times 10^{13} [\text{kcal/s}] \quad (= 40000 \times 10^4 [\text{kcal/day par capita}]) \\
 & = 2.94 [\text{Mtoe/s}] \quad (= 1.5 \times 10^4 [\text{toe/year par capita}])
 \end{aligned}$$

We have not used it since fossil fuels were cheap!

Student's Presentation at Nov. 29

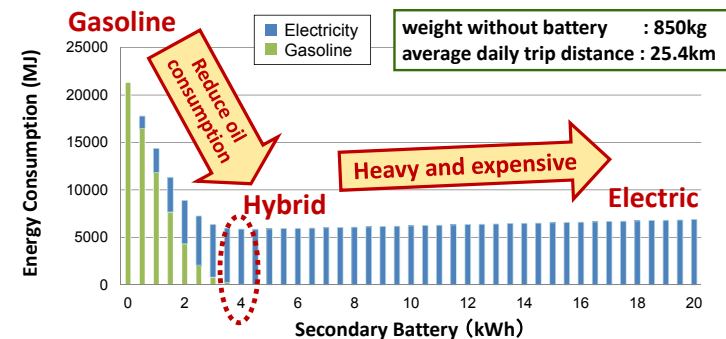
- Consider effective policy **to reduce world's fossil fuel consumption** by using statistics like today's lecture or following website first.
 - <http://www.iea.org/>
- Then, **show your assumption** about technological development such as electric vehicle, and introducing schedule of the technologies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

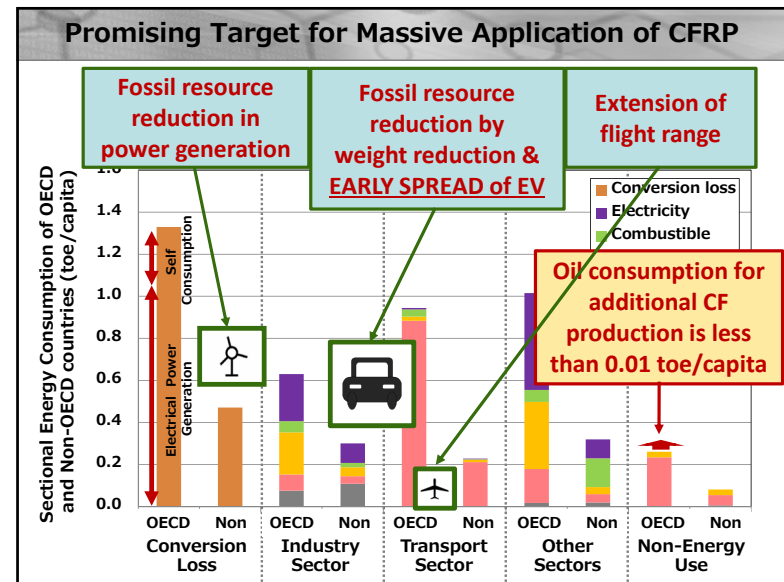
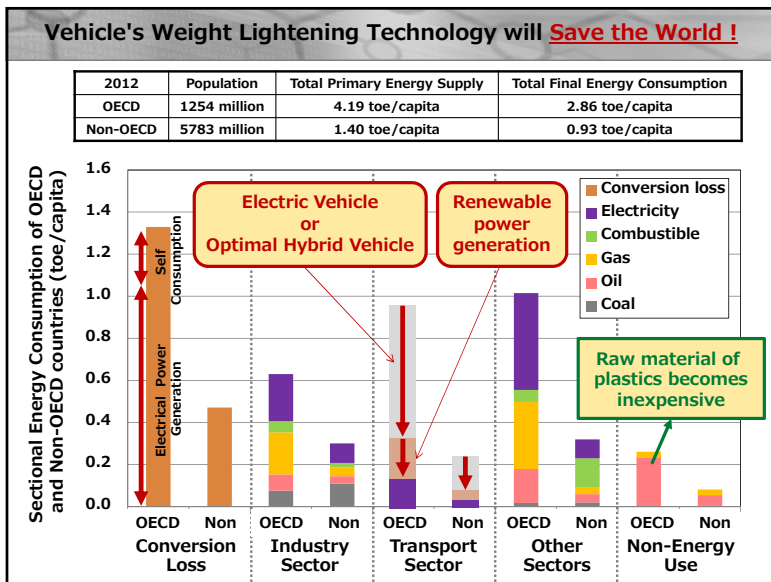
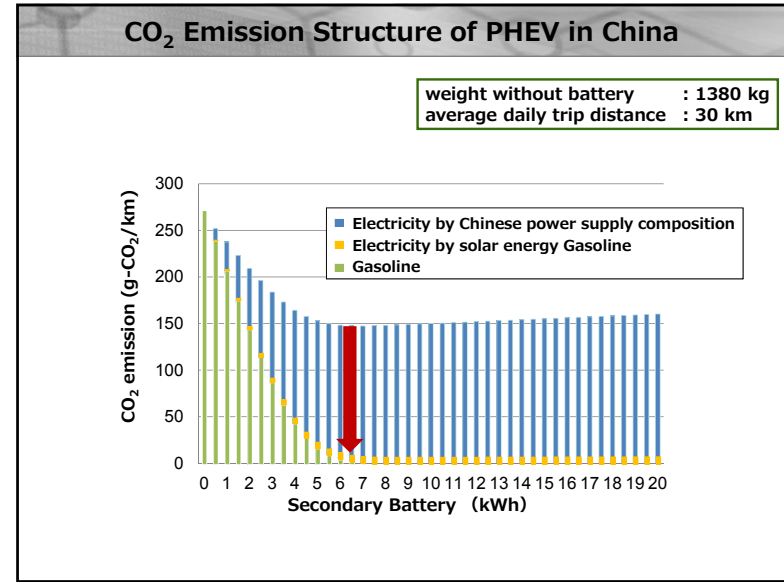
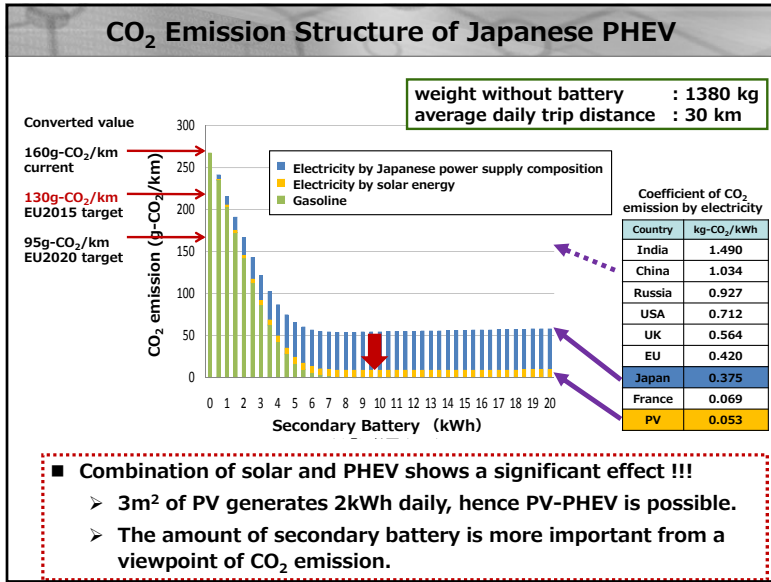
$$\begin{aligned}
 \Sigma F_w &= \underbrace{(m_g \cdot g \cdot f_R)}_{\text{Rolling}} + \underbrace{\rho_L \cdot A \cdot c_w \cdot v^2 / 2}_{\text{Air}} + \underbrace{b \cdot (m_g + \Sigma m_{\text{rot}})}_{\text{Acceleration}} + \underbrace{(m_g \cdot g \cdot \sin \alpha)}_{\text{Gradient}} \\
 \Sigma F_w &= \underbrace{F_R}_{\sim 35\%} + \underbrace{F_L}_{\sim 25\%} + \underbrace{F_B}_{\sim 40\%} + F_{St} \\
 &\quad \sim 75\% = F(m)
 \end{aligned}$$

- 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.



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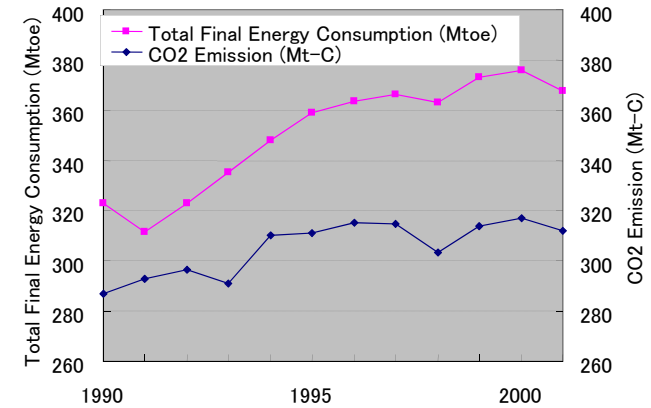
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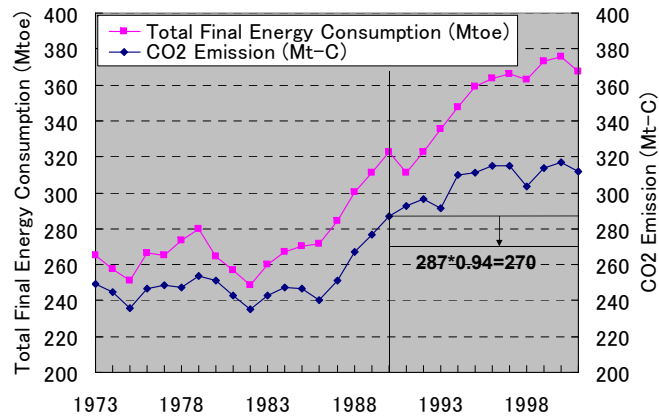
Jun TAKAHASHI

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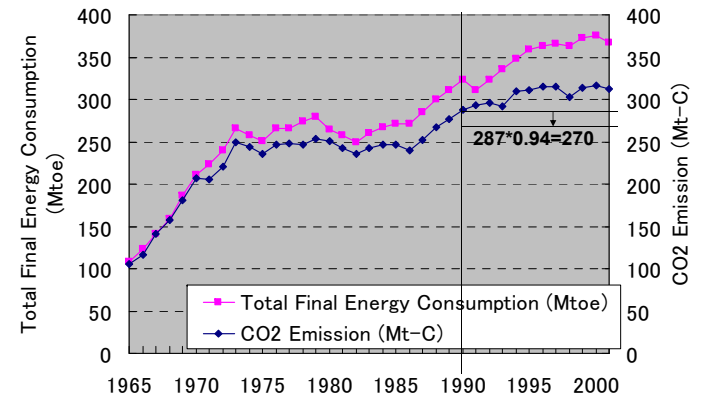
Japanese TFC and CO2 Emission (1990-2001)

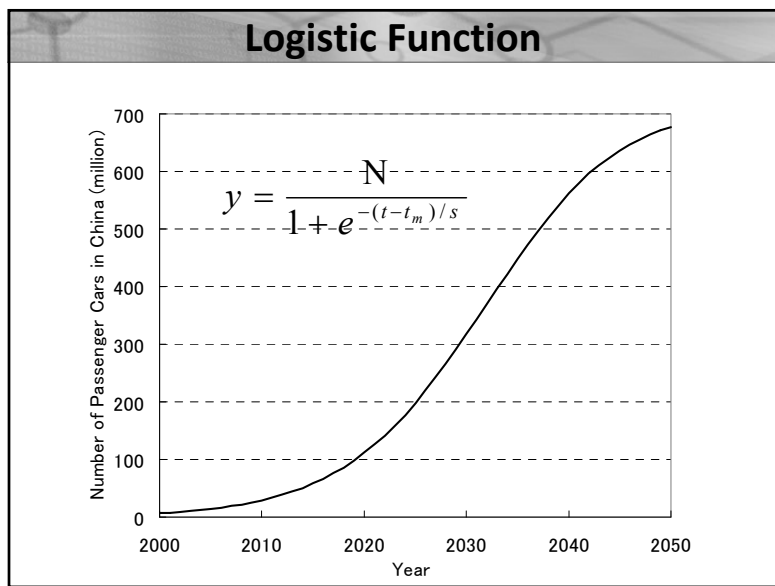
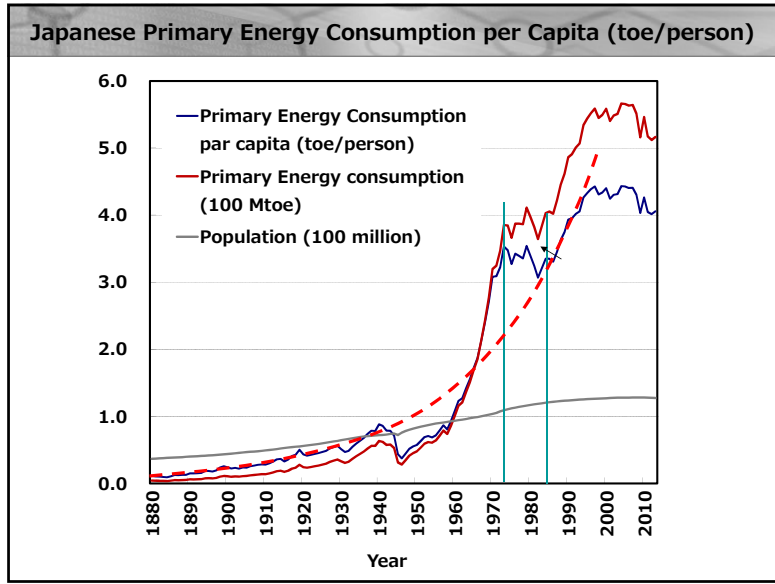
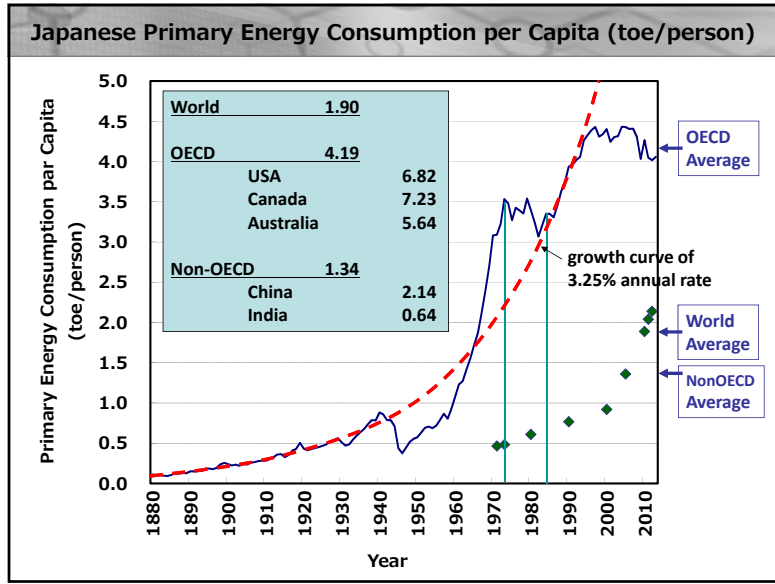


Japanese TFC and CO2 Emission (1973-2001)

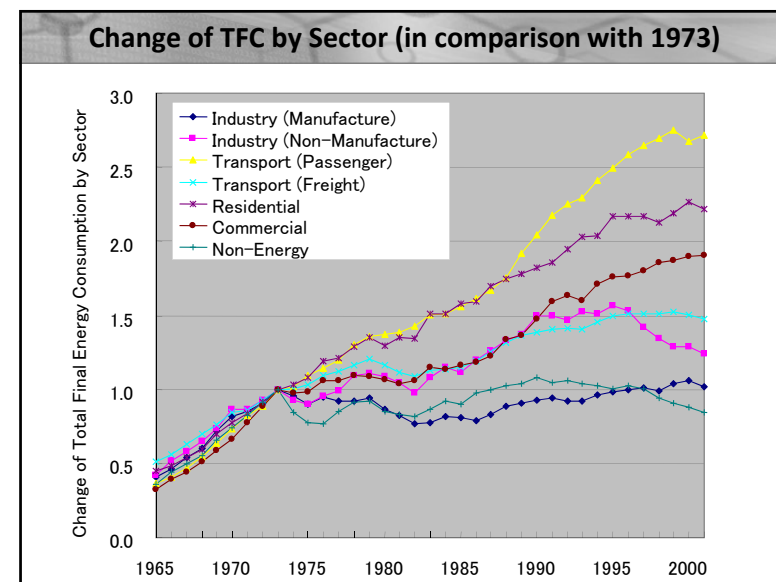
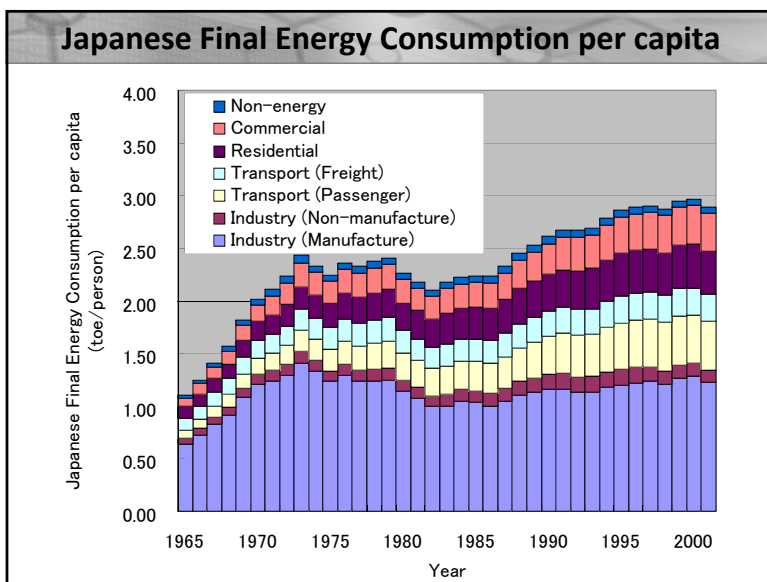
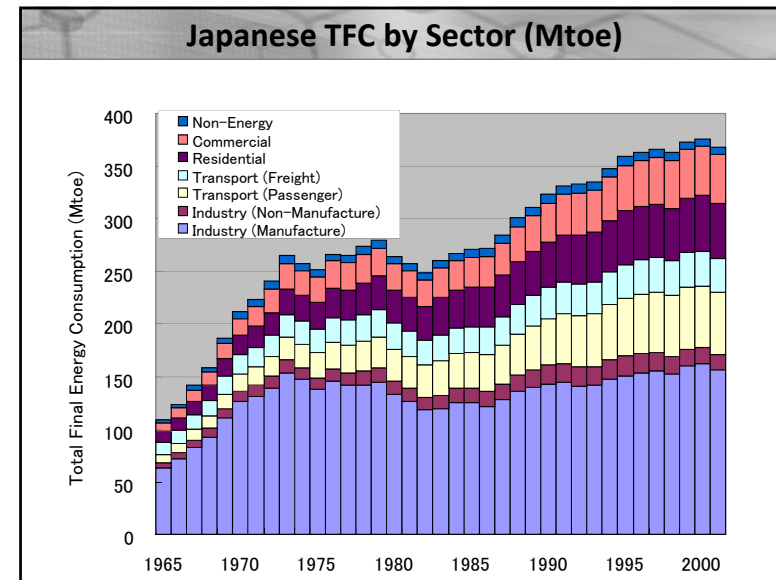
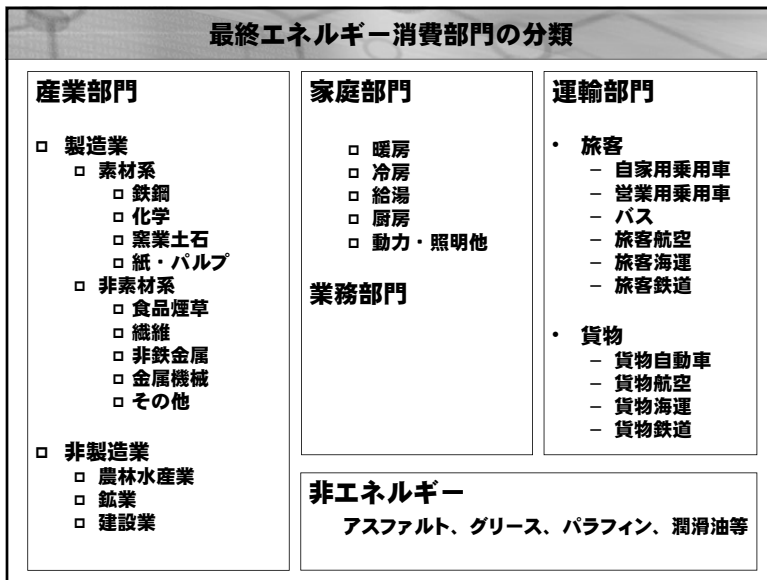


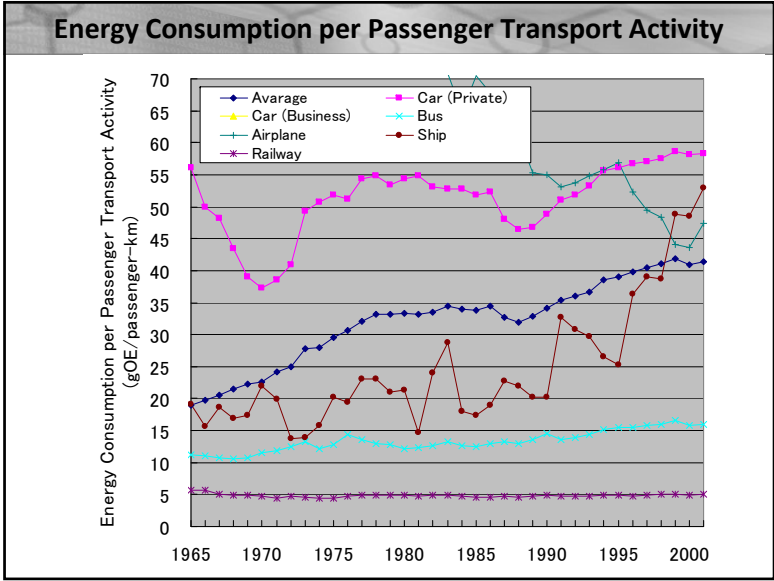
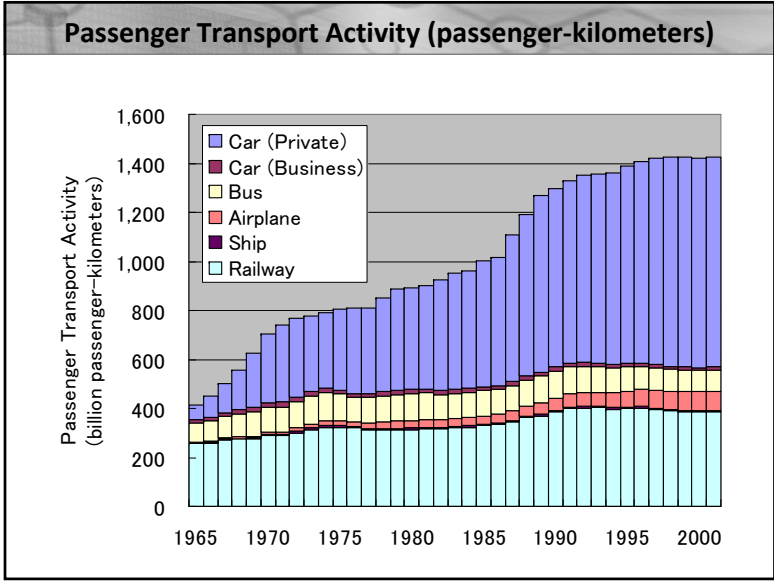
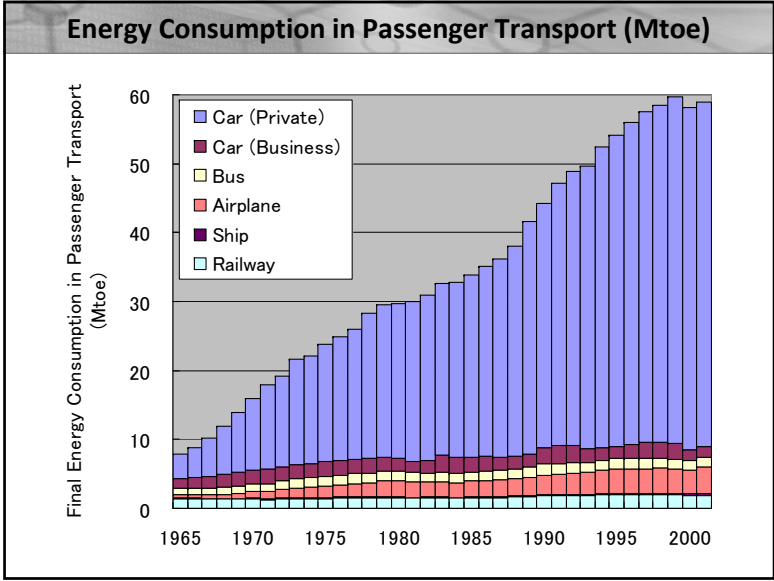
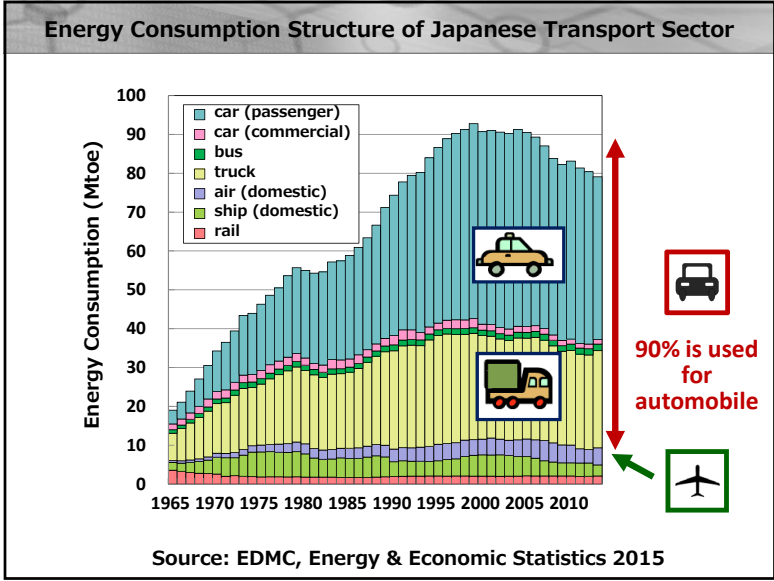
Japanese TFC and CO2 Emission (1965-2001)

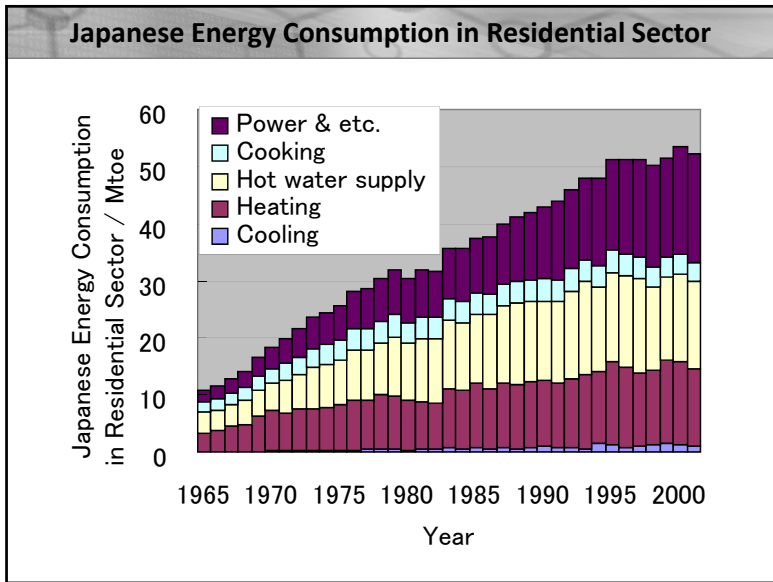
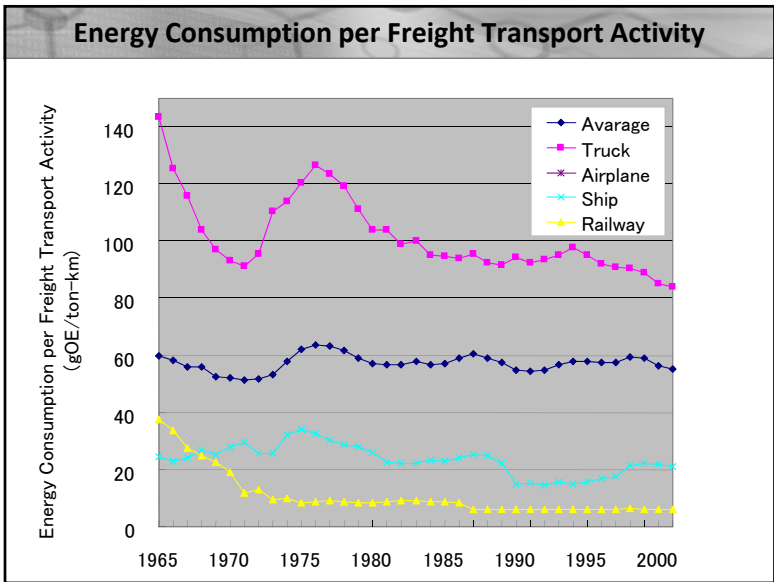
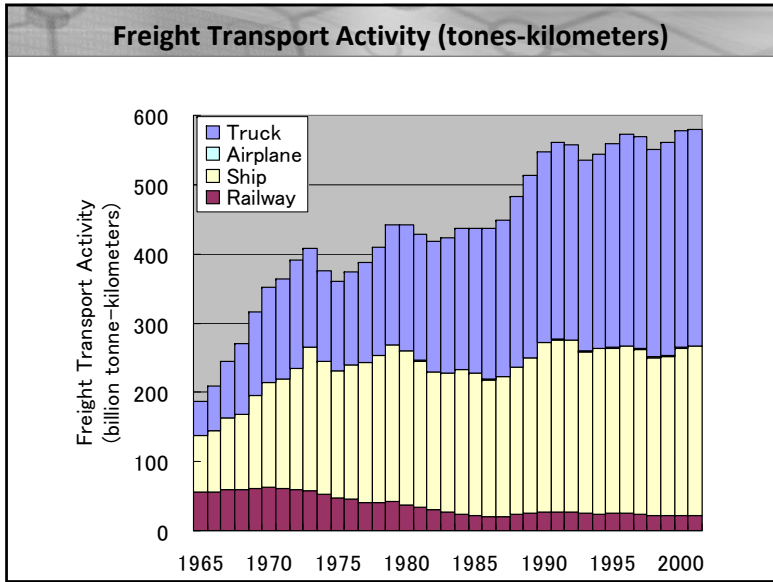
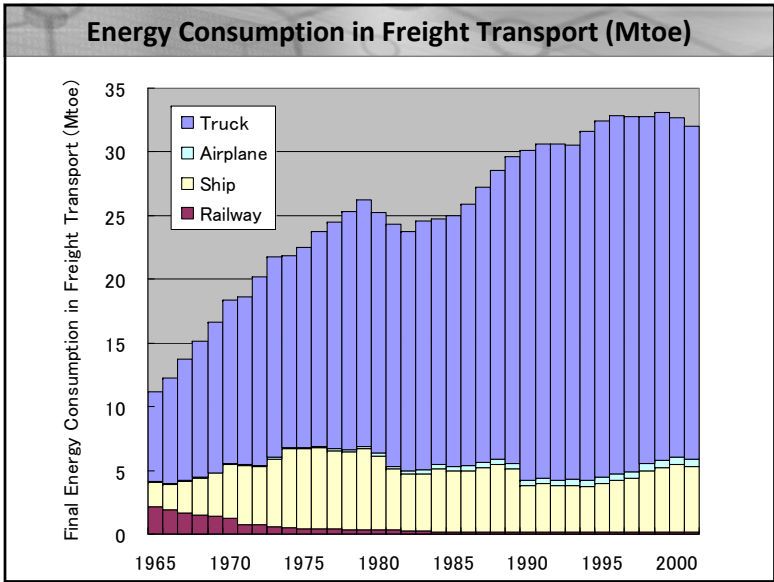


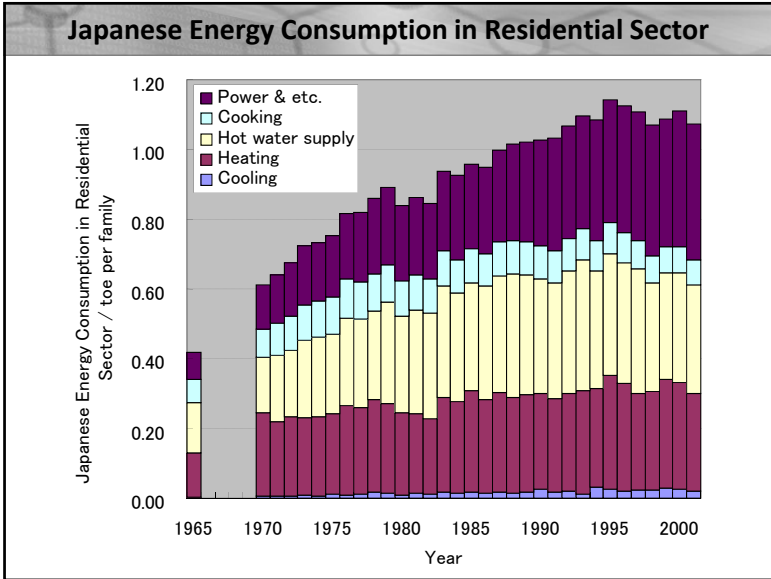
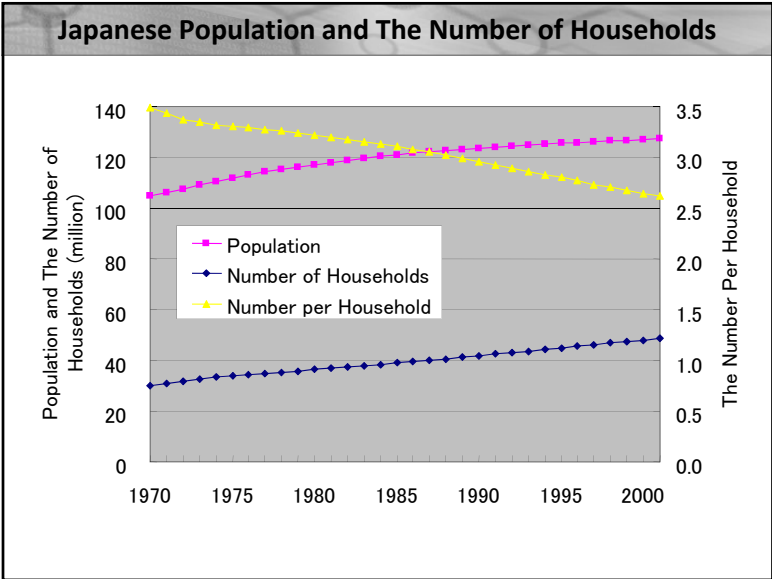
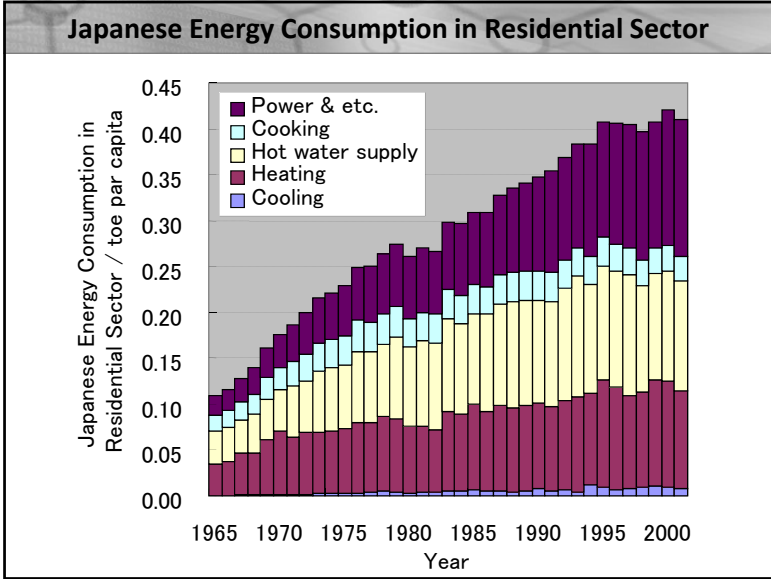
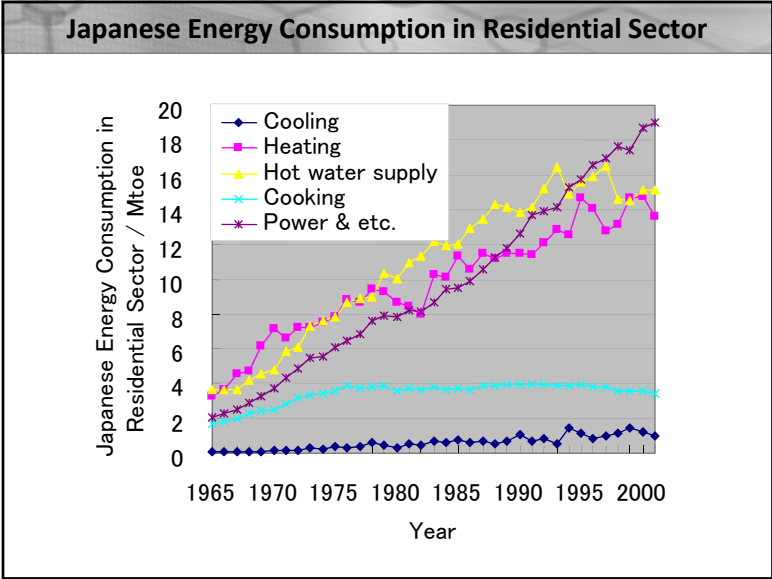


- ### The Items of Final Energy Consumption
- | | | |
|---|---|---|
| Industrial Sector <ul style="list-style-type: none"> □ Manufacturing <ul style="list-style-type: none"> □ Material <ul style="list-style-type: none"> □ Steel □ Chemicals □ Cement □ Paper and Pulp □ Processing/assembly <ul style="list-style-type: none"> □ Foods □ Textile □ Nonferrous metal □ Machines □ Others □ Non-manufacturing <ul style="list-style-type: none"> □ Agriculture, Forestry & Fishery □ Mining □ Construction | Residential Sector <ul style="list-style-type: none"> □ Heating □ Cooling □ Hot Water Supply □ Cooking □ Power & etc. | Transport Sector <ul style="list-style-type: none"> • Passenger <ul style="list-style-type: none"> - Car (Private) - Car (Commercial) - Bus - Airplane - Ship - Railway • Freight <ul style="list-style-type: none"> - Truck - Airplane - Ship - Railway |
| Non Energy Use <ul style="list-style-type: none"> - Asphalt, grease, paraffin, lubricating oil, etc. | | |

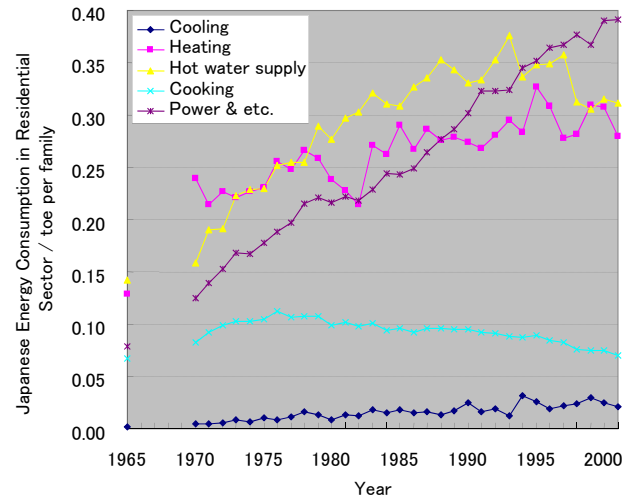




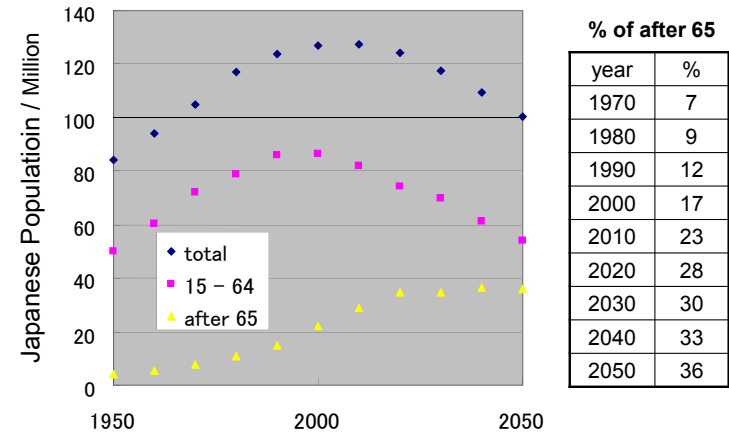




Japanese Energy Consumption in Residential Sector



Transition of population composition of Japan



Student's Presentation at Nov. 29

- ✓ **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 Nov. 29**
 - ✓ 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 15:10**
 - ✓ 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. 29.