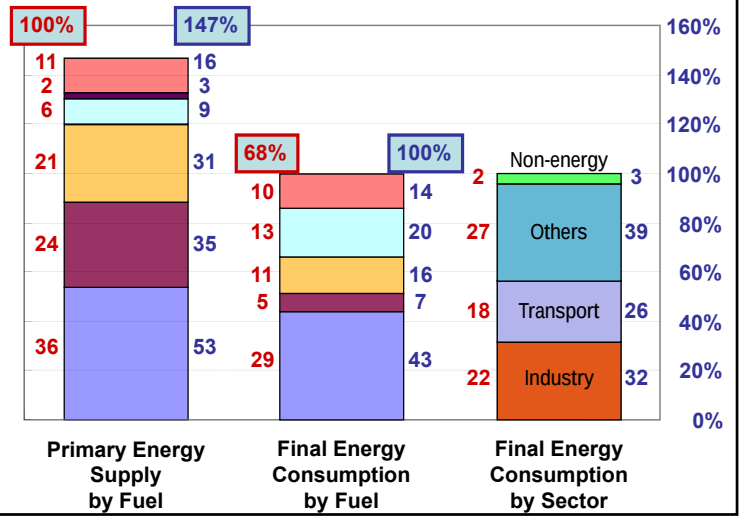
Global Environmental Policy Making on Technology

環境・エネルギー技術政策

7th and 21st, October, 2013
Jun TAKAHASHI

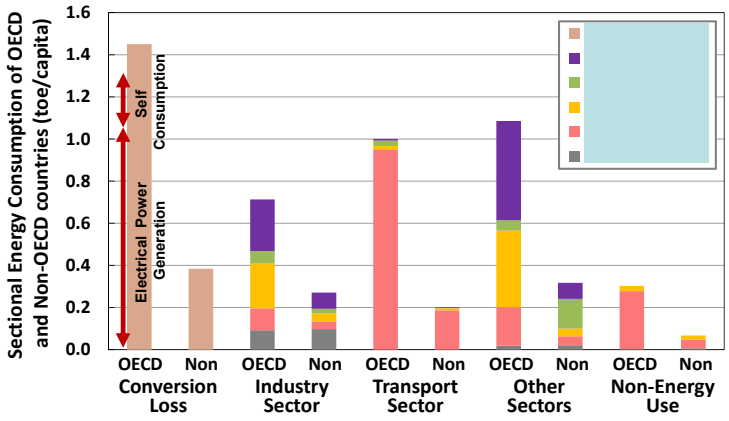
- ✓ Global energy balance
- ✓ How to read statistics data ?
  - ✓ Long-term viewpoint
  - ✓ Suspect an interpretation and the data itself !
- ✓ How to make a policy ?
- ✓ Quiz

World Energy Balance on 2003 (Source IEA statistics)



Sectional Energy Consumption of OECD and Non-OECD countries

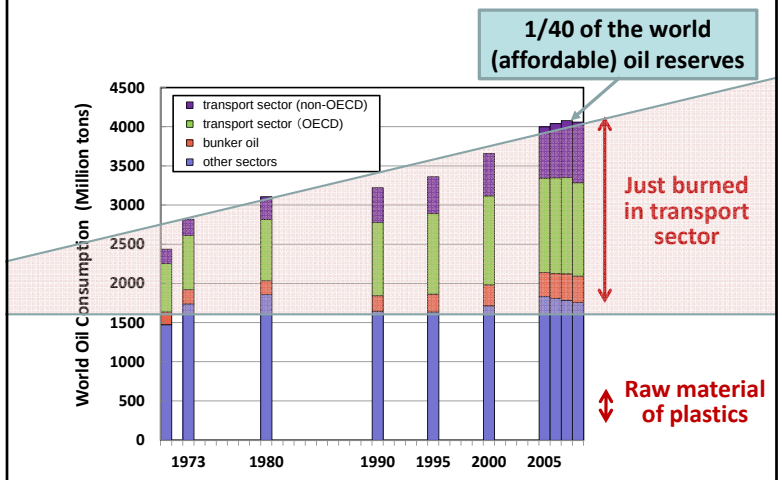
2008	Population	Total Primary Energy Supply	Total Final Energy Consumption
OECD	1190 million	4.56 toe/capita	3.11 toe/capita
Non-OECD	5498 million	1.24 toe/capita	0.86 toe/capita



Annual World Material Production

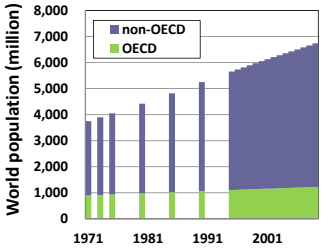
- ■ Crude steel production: 1.4 billion tons
  - ➢ Coking coal for steel production: 0.7 billion tons (= 0.1 tons per capita)
  - ➢ World coal consumption: 3.3 billion tons (2.5 billion tons for fuel)
- ■ Plastics production: 0.25 billion tons
  - ➢ Oil consumption for plastic production: 0.5 billion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

Oil consumption of the world and transport sector

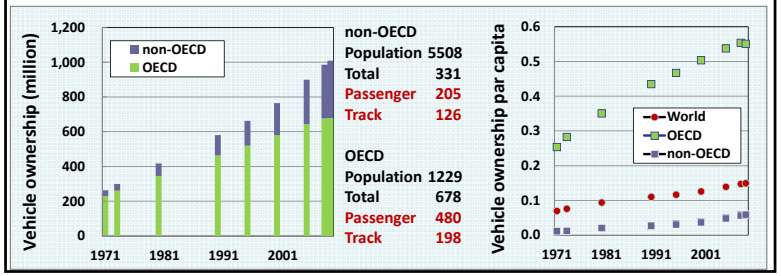


Source: EDMC, Energy & Economic Statistics 2011

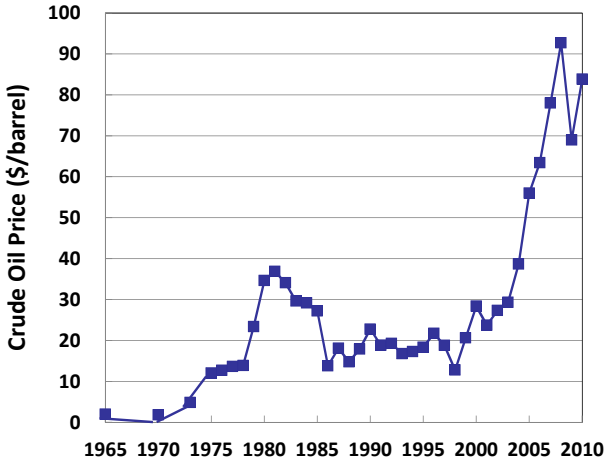
The world population and car ownership



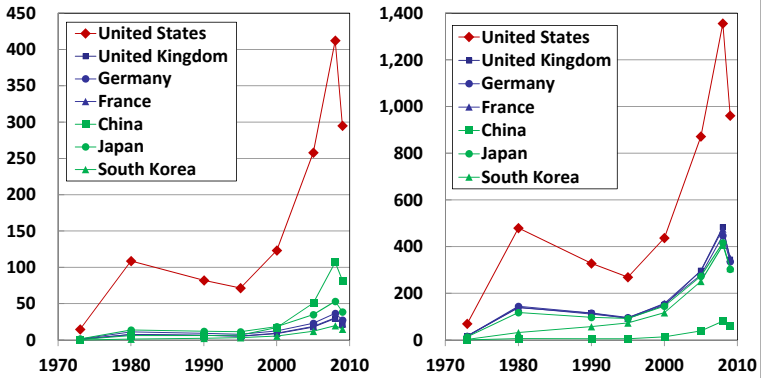
- Number of automobile in OECD countries are about an half of the population, and it will not increase.
- Number of world automobile will increase due to the moralization of non-OECD countries.



Long Term Trend in Crude Oil Price



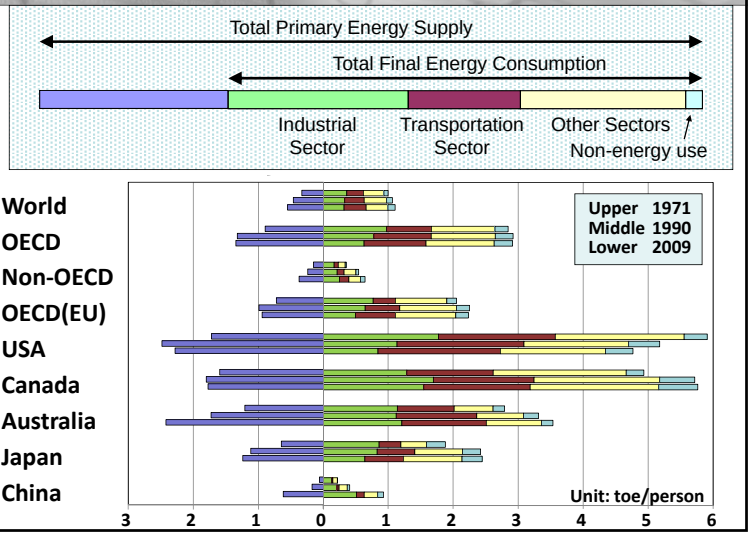
National Energy Cost of the Transport Sector



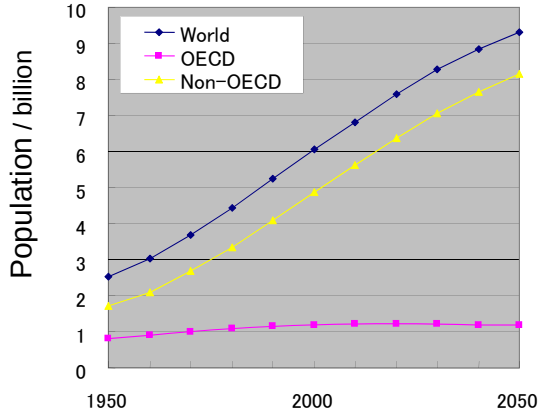
Annual Energy cost in Transport Sector (billion $)

Annual Energy cost in Transport Sector ($ par capita)

Total final energy consumption per capita (toe/person)



Transition of the population in the world
Source: UN



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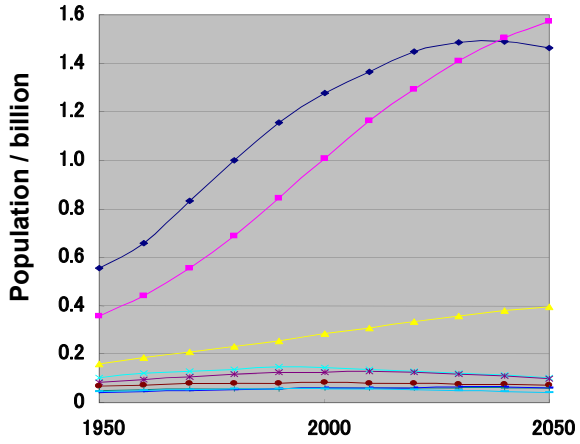
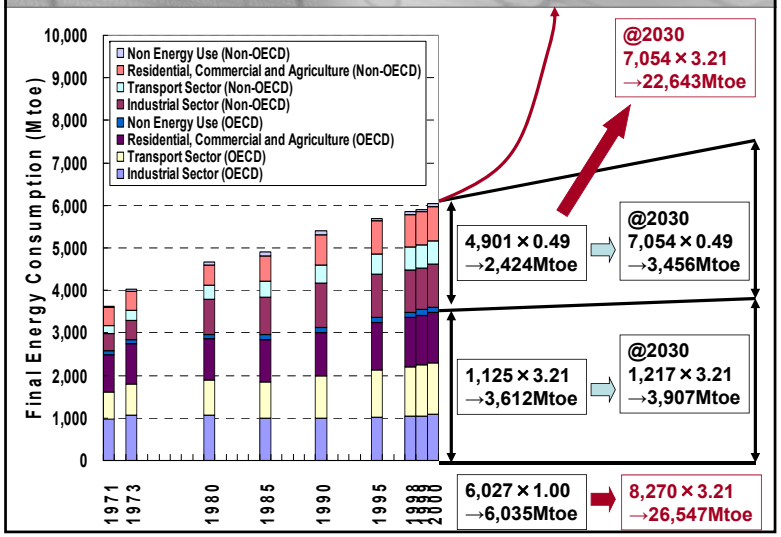


World Final Energy Consumption



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

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

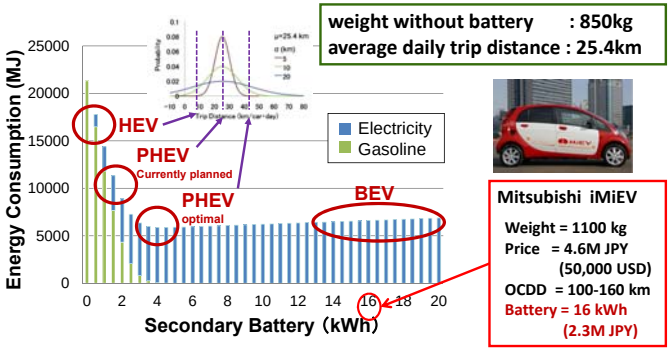
$= 0.7 \times 1.286 \times 10^{14} [m^2] \times 1367\ [J/m^2 s]$

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

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

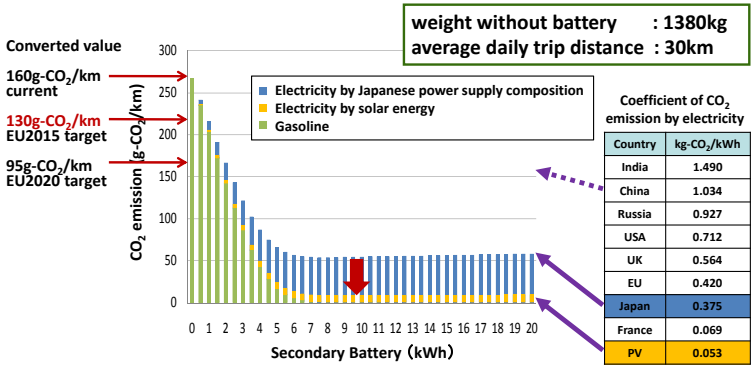
$= 2.94$ [Mtoe/s] （$= 1.5 \times 10^4$ [toe/year par capita]）

Energy Consumption Structure of mini-PHEV



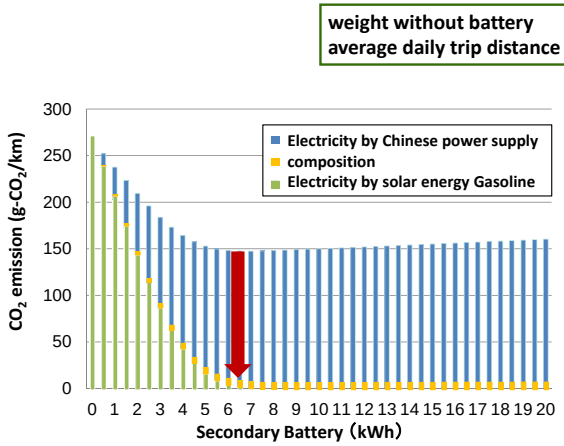
- There is an optimal amount of secondary battery depends on the weight of vehicle and average daily trip distance.
- Hence, the spread of such an optimal PHEV must be difficult in case of heavier cars and countryside.

CO_2 Emission Structure of Japanese PHEV

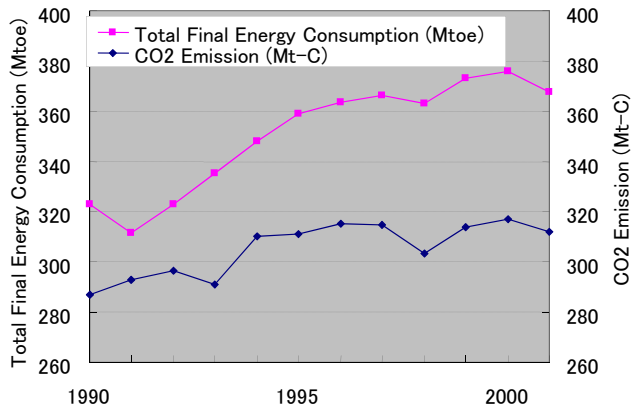


- Combination of solar and PHEV shows a significant effect !!!
  - $3m^2$ of PV generates 2kWh daily, hence PV-PHEV is possible.
  - The amount of secondary battery is more important from a viewpoint of CO_2 emission.

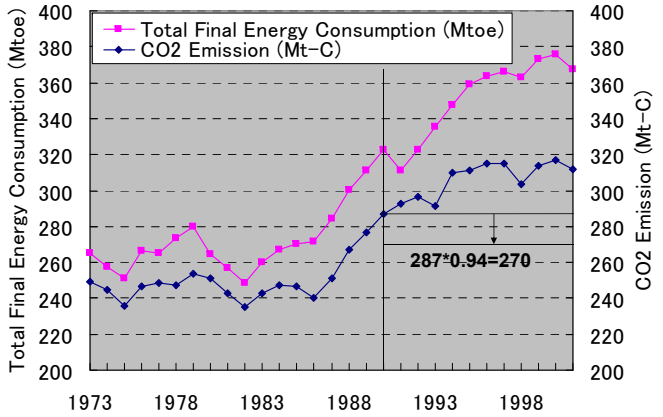
CO_2 Emission Structure of PHEV in China



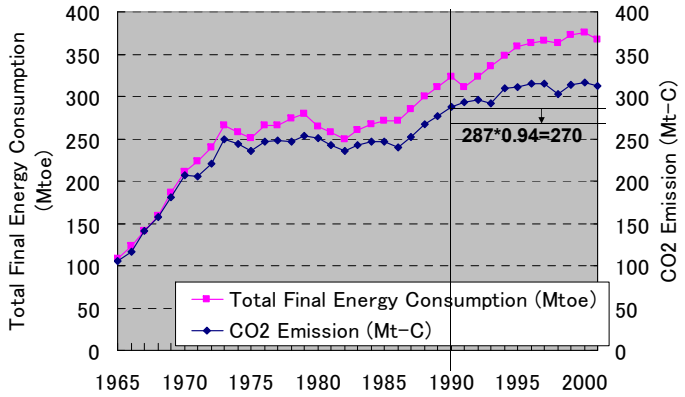
Japanese TFC and CO2 Emission (1990-2001)



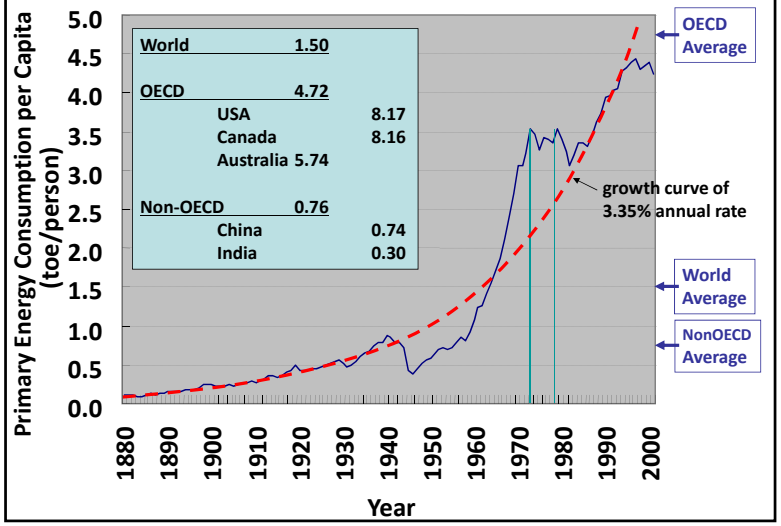
Japanese TFC and CO2 Emission (1973-2001)



Japanese TFC and CO2 Emission (1965-2001)



Primary Energy Consumption per Capita (toe/person)



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

Transport Sector

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

Non Energy Use

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

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

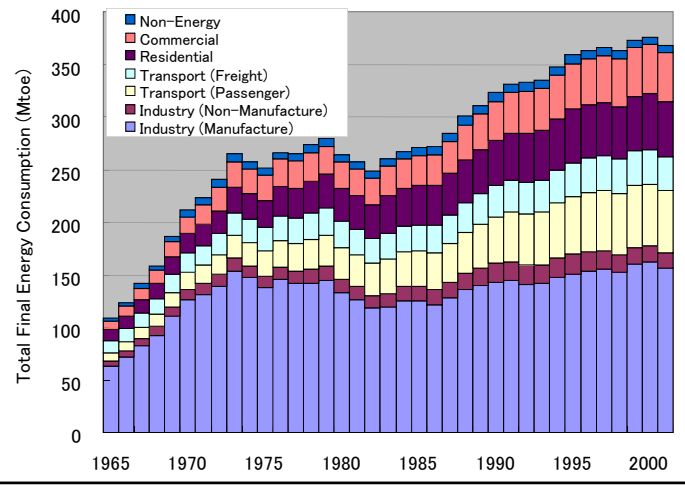
運輸部門

- 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

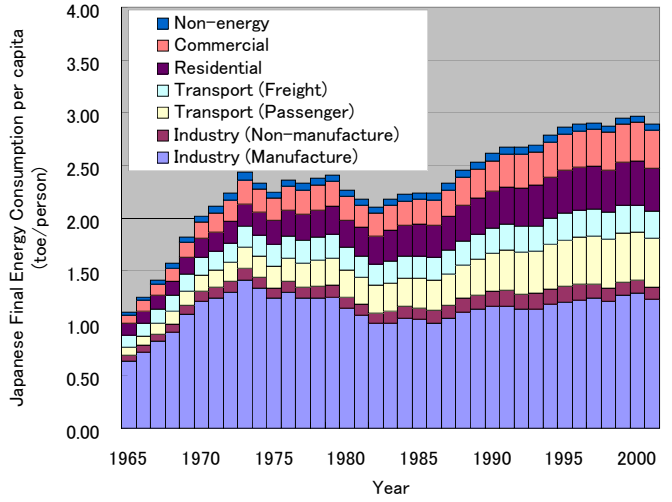
非エネルギー

アスファルト、グリース、パラフィン、潤滑油等

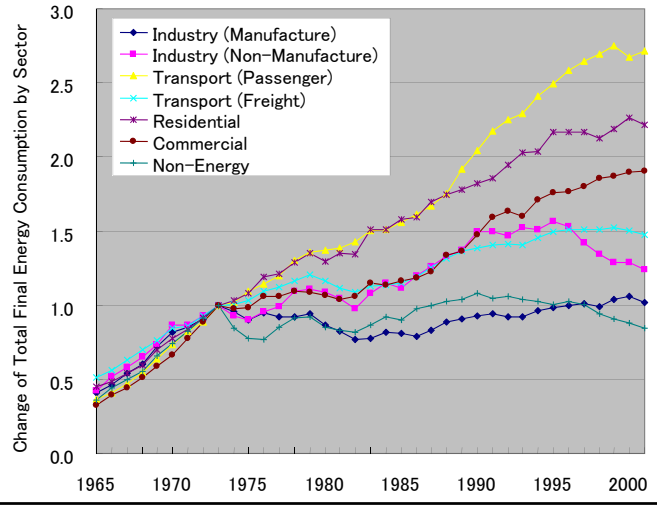
Japanese TFC by Sector (Mtoe)



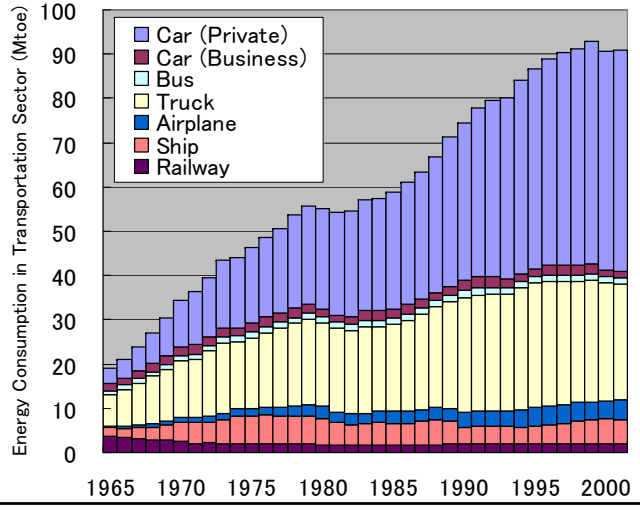
Japanese Final Energy Consumption per capita



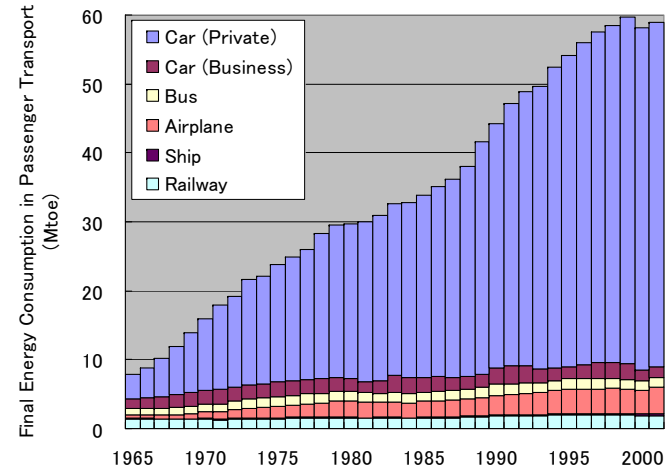
Change of TFC by Sector (in comparison with 1973)



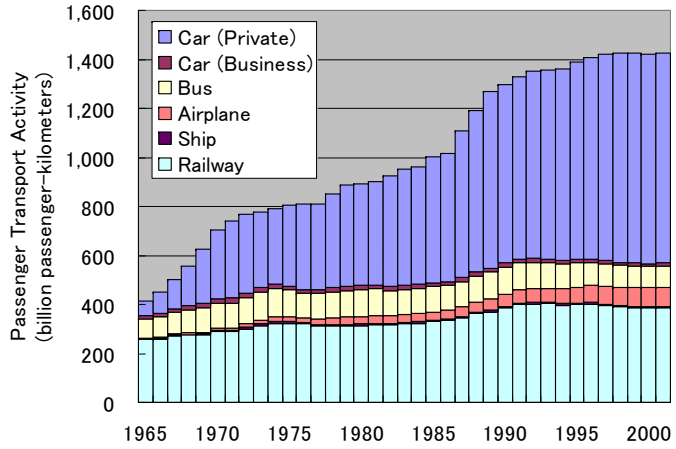
Energy Consumption in Transportation Sector (Mtoe)



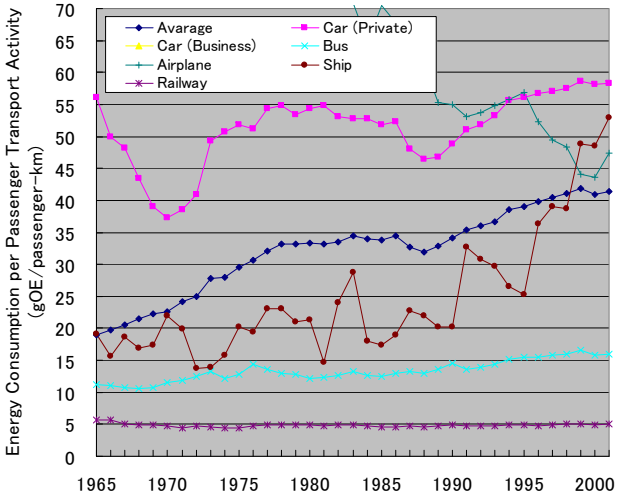
Energy Consumption in Passenger Transport (Mtoe)



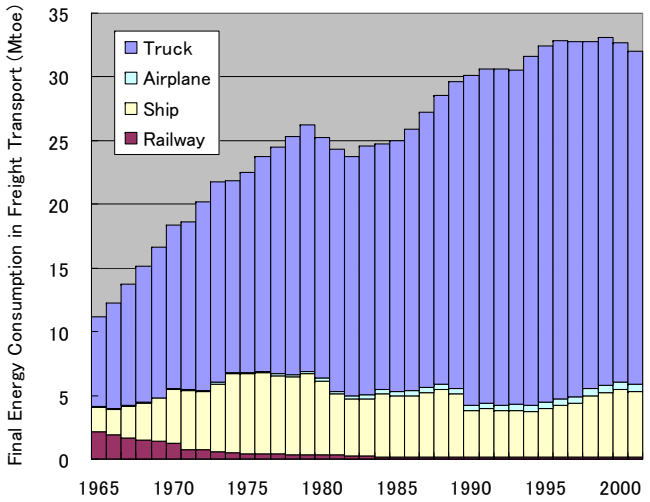
Passenger Transport Activity (passenger-kilometers)



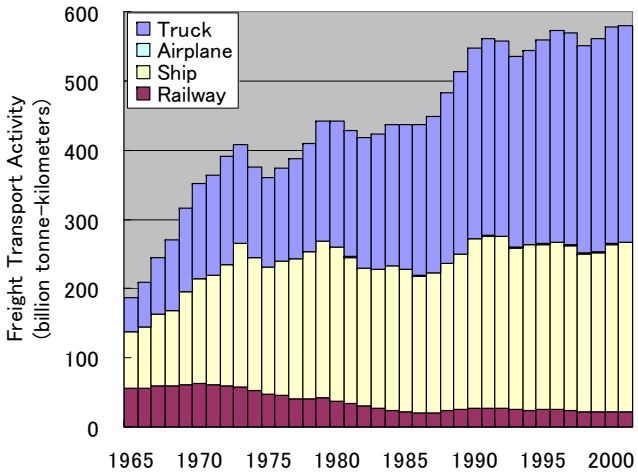
Energy Consumption per Passenger Transport Activity



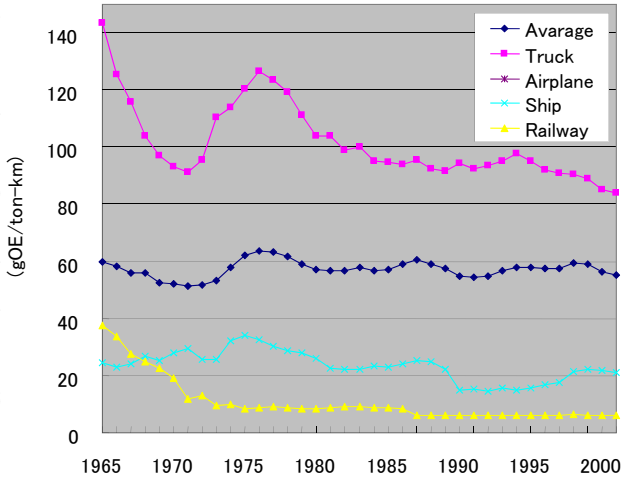
Energy Consumption in Freight Transport (Mtoe)



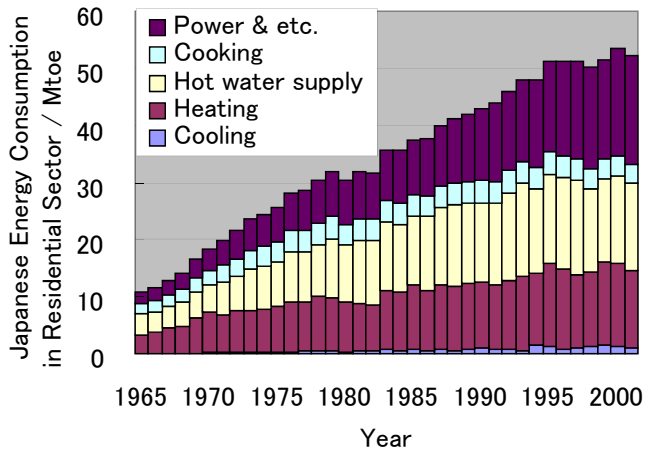
Freight Transport Activity (tones-kilometers)



Energy Consumption per Freight Transport Activity



Japanese Energy Consumption in Residential Sector



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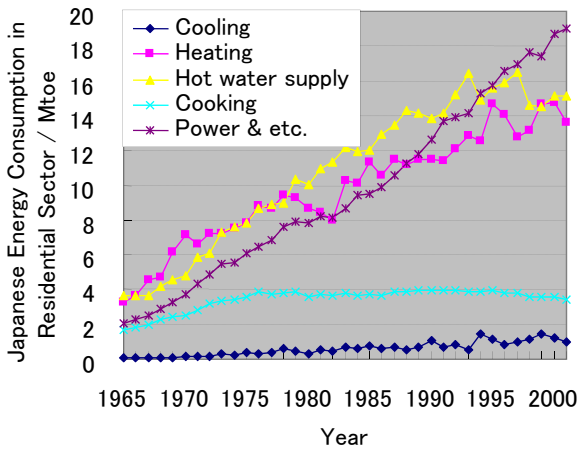

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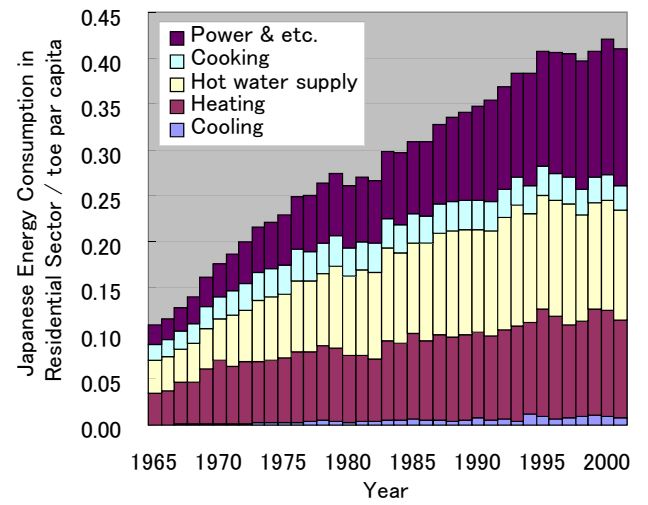
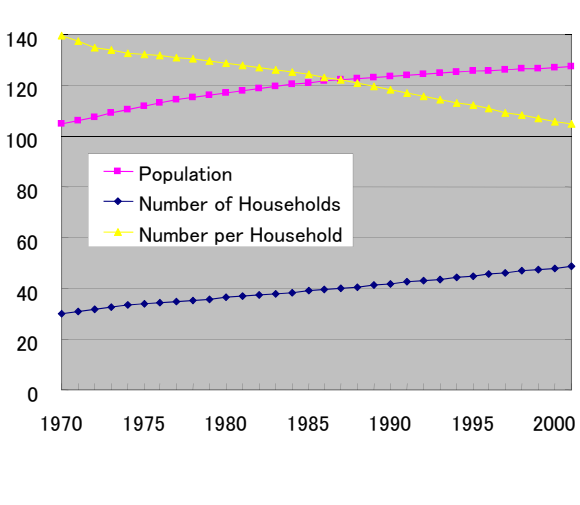


Japanese Population and The Number of Households



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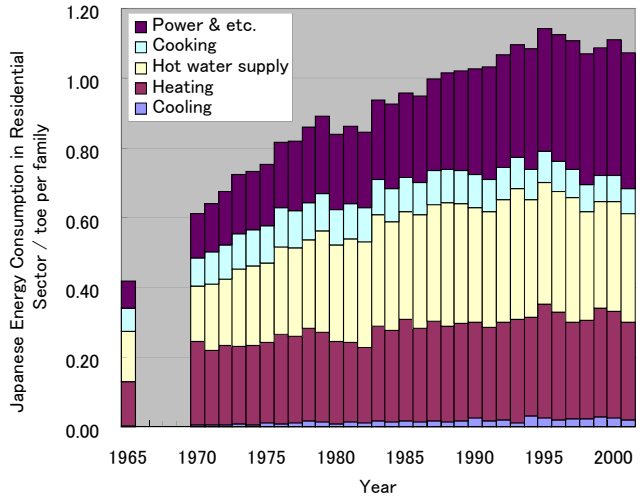

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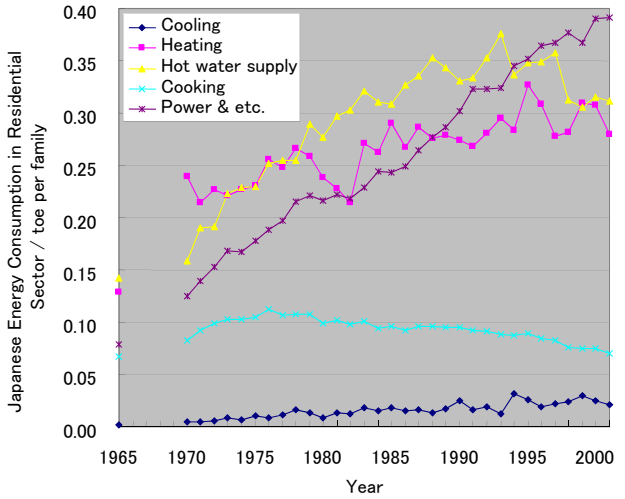
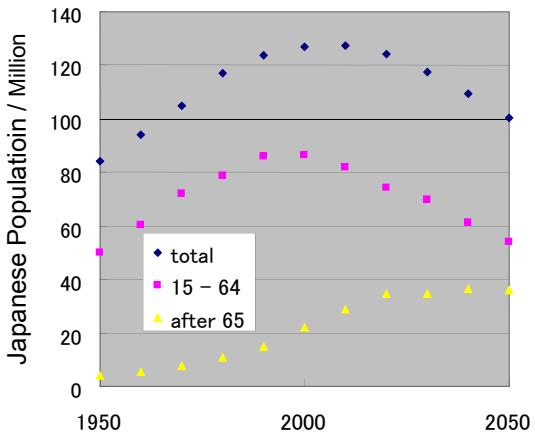


Transition of population composition of Japan



% of after 65

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

Student's Presentation at 21st 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 21st 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 21st 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 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 21st October.