



Global Environmental Policy

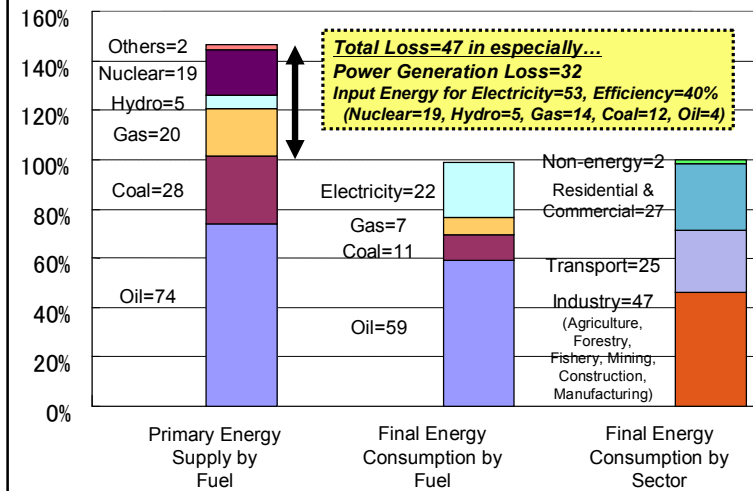
<http://sunshine.naoe.t.u-tokyo.ac.jp/jun/kougi/gep/gep.html>

11, April, 2006
Jun TAKAHASHI

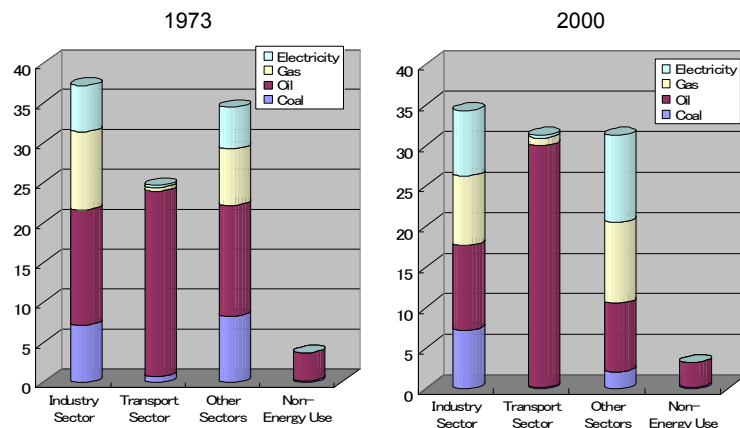
- ✓ Outline of this lecture series.
- ✓ How to read statistics data ?
 - ✓ Long-term viewpoint
 - ✓ Suspect an interpretation and the data itself !
- ✓ How to make a policy ?
- ✓ Quiz



Japanese Energy Balance on 2001 (Source EDMC2003)



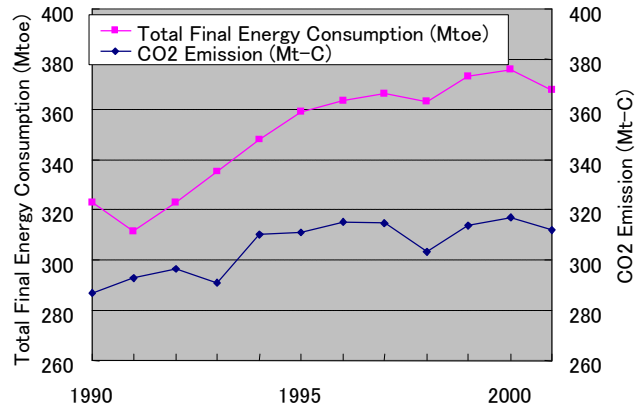
Sectoral shears of the world total final energy consumption (Unit: %)



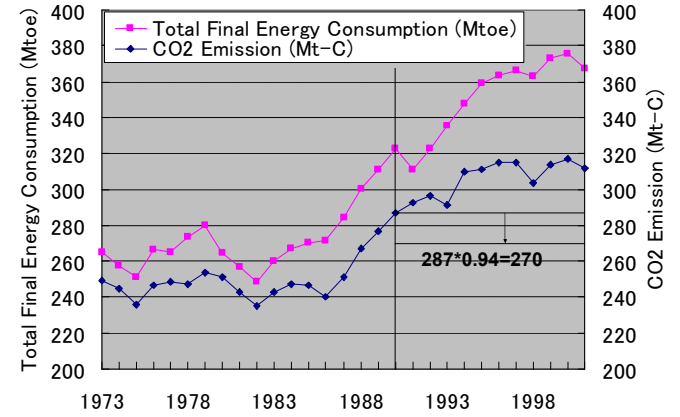
- Homework Subject
 - Write some graphs by using [the given data](#). And, propose the quantitative policy of fossil fuel saving by using those graphs.
- Submit this homework
 - **by Power Point File**
 - by e-mail to jun@sunshine.naoe.t.u-tokyo.ac.jp
 - by April 17th
- If you want to submit this as one of the final reports, submit a complete version **by July 25th again.**



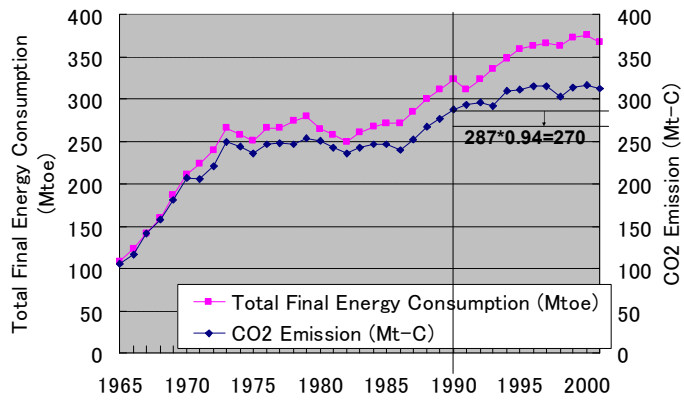
Japanese TFC and CO2 Emission (1990-2001)



Japanese TFC and CO2 Emission (1973-2001)

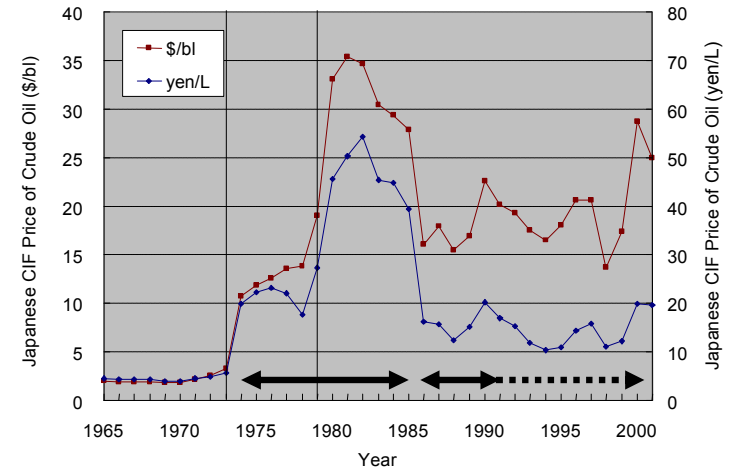


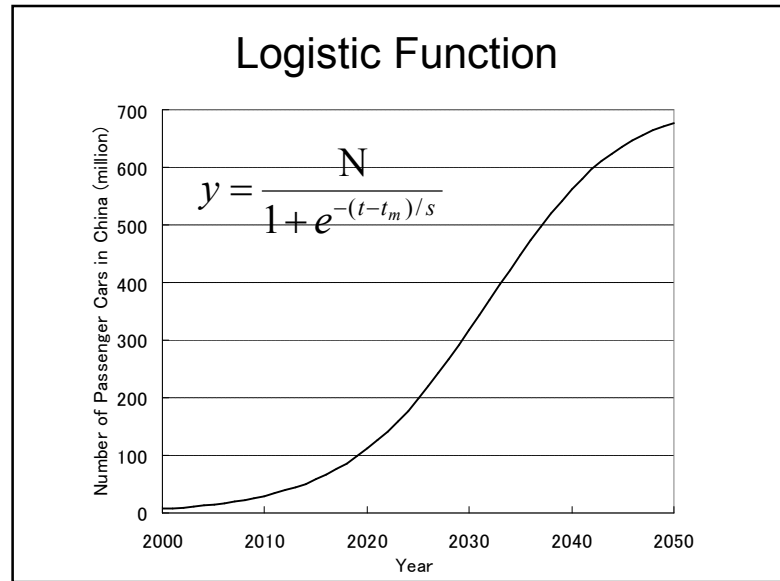
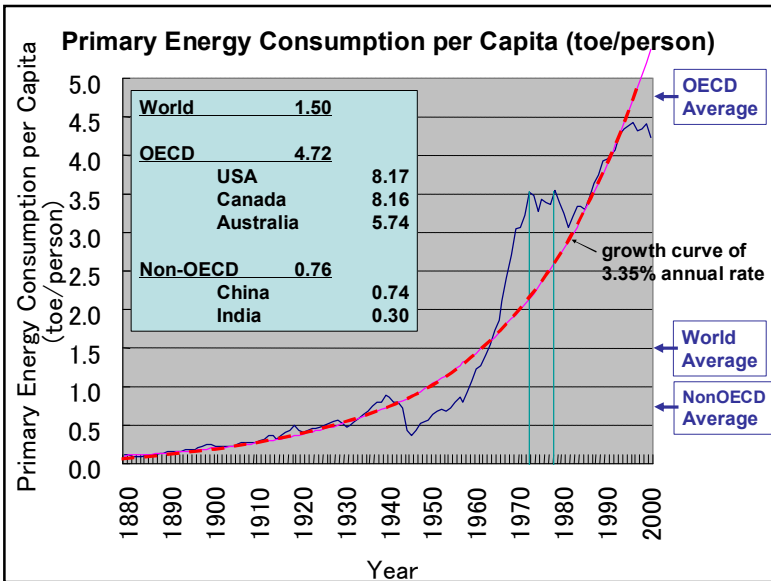
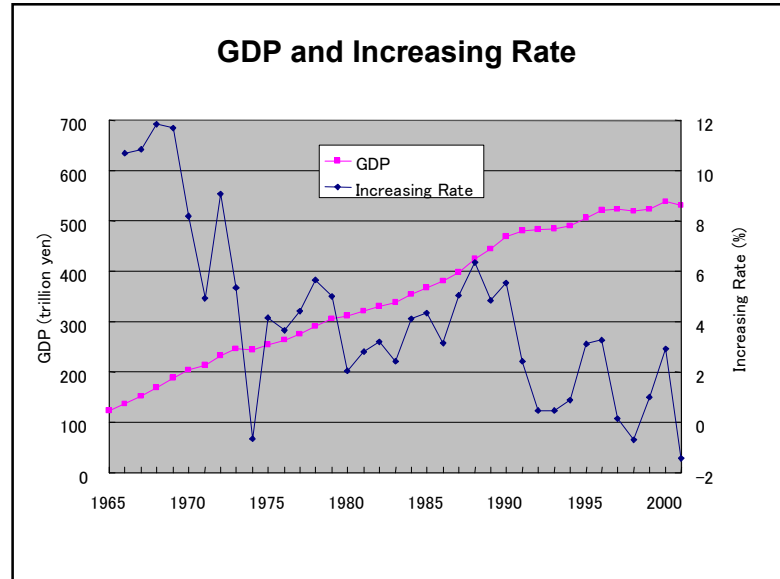
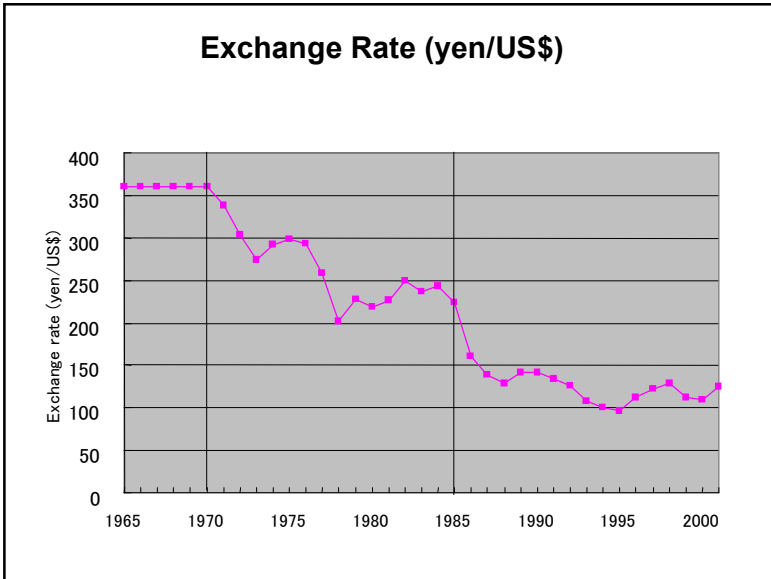
Japanese TFC and CO2 Emission (1965-2001)



Japanese CIF Price of Crude Oil

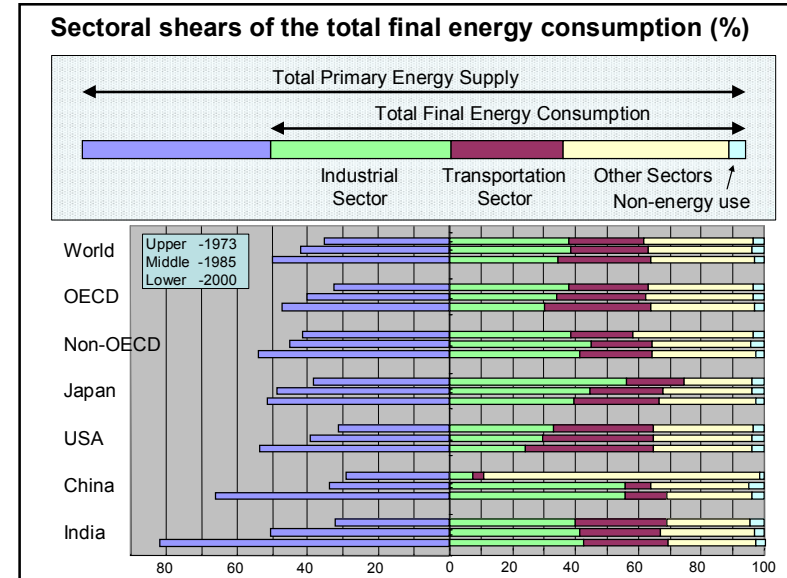
CIF: Cost + Insurance + Freight





Total Primary Energy Supply and Final Energy Consumption

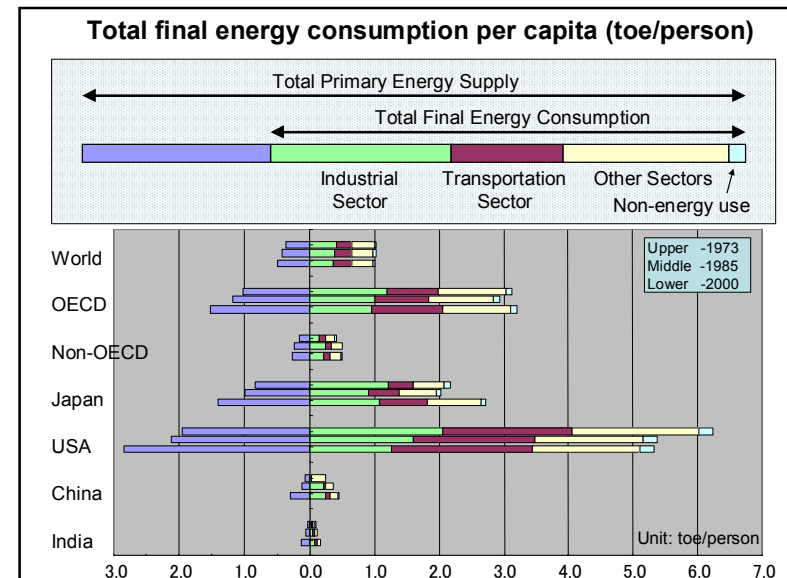
Statistics of 2000 by EDMC2003		World	OECD	Non-OECD	Japan	USA	China	India
Population	Million	6,027	1,125	4,901	127	282	1,262	1,016
GDP	1995 USG\$	34,199	27,675	6,525	5,688	9,009	1,040	482
CO2 Emission	Mt-C	6,422	3,470	2,952	328	1,580	881	266
Total Primary Energy Supply	Mtoe	9,043	5,317	3,726	525	2,300	928	300
	%	149.8	147.2	153.7	151.3	153.4	166.0	181.8
Total Final Energy Consumption	Mtoe	6,035	3,612	2,424	347	1,499	559	165
	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Industrial Sector	Mtoe	2,088	1,087	1,004	137	360	311	70
	%	34.6	30.1	41.4	39.6	24.0	55.6	42.6
Transportation Sector	Mtoe	1,780	1,221	560	94	610	74	44
	%	29.5	33.8	23.1	27.1	40.7	13.3	26.8
Other (Residential, Commercial, Agriculture, etc.) Sectors	Mtoe	1,986	1,188	795	106	474	153	46
	%	32.9	32.9	32.8	30.5	31.6	27.4	27.7
Non-energy use	Mtoe	184	117	67	10	56	22	5
	%	3.0	3.2	2.8	2.8	3.7	3.9	3.1

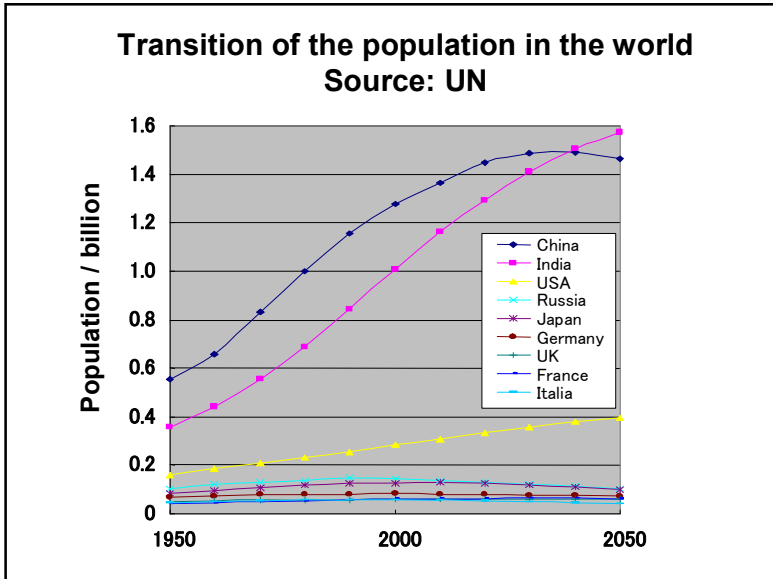
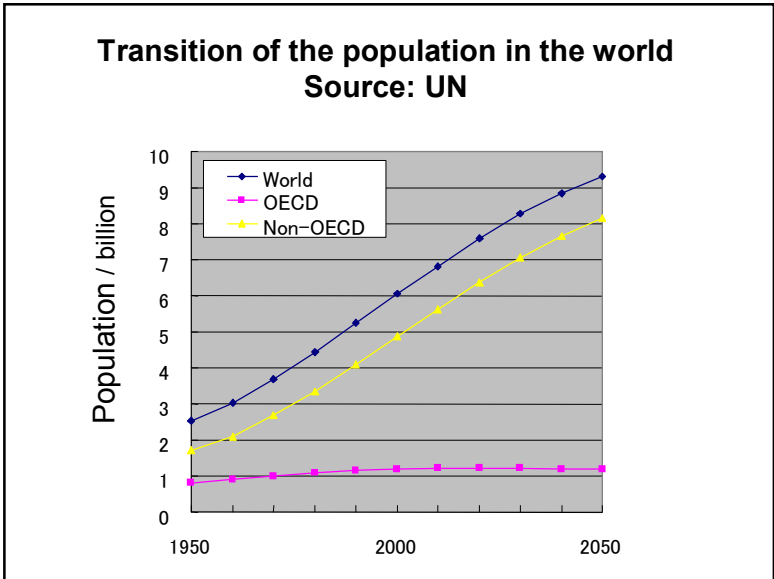


2000's world statistics rearranged by per population

Source: EDMC2003

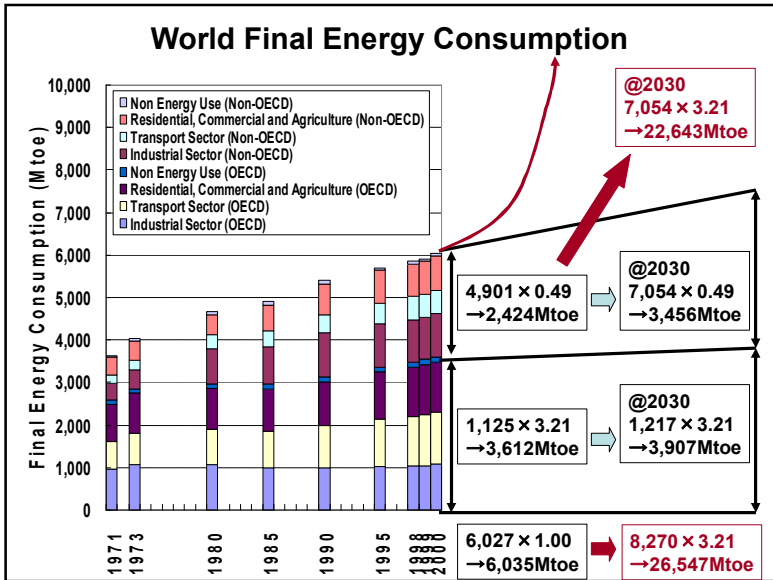
		World	OECD	Non-OECD	Japan	USA	China	India
Population	Million	6,027	1,125	4,901	127	282	1,262	1,016
GDP	1995US\$ /person	5,674	24,600	1,331	44,787	31,947	824	474
CO2 Emission	t-C /person	1.07	3.08	0.60	2.58	5.60	0.70	0.26
Total Primary Energy Supply	toe /parson	1.50	4.73	0.76	4.13	8.16	0.74	0.30
Total Final Energy Consumption	toe /parson	1.00	3.21	0.49	2.73	5.32	0.44	0.16
Industrial Sector	toe /parson	0.35	0.97	0.20	1.08	1.28	0.25	0.07
Transportation Sector	toe /parson	0.30	1.09	0.11	0.74	2.16	0.06	0.04
Other (Residential, Commercial, Agriculture, etc.) Sectors	toe /parson	0.33	1.06	0.16	0.83	1.68	0.12	0.04

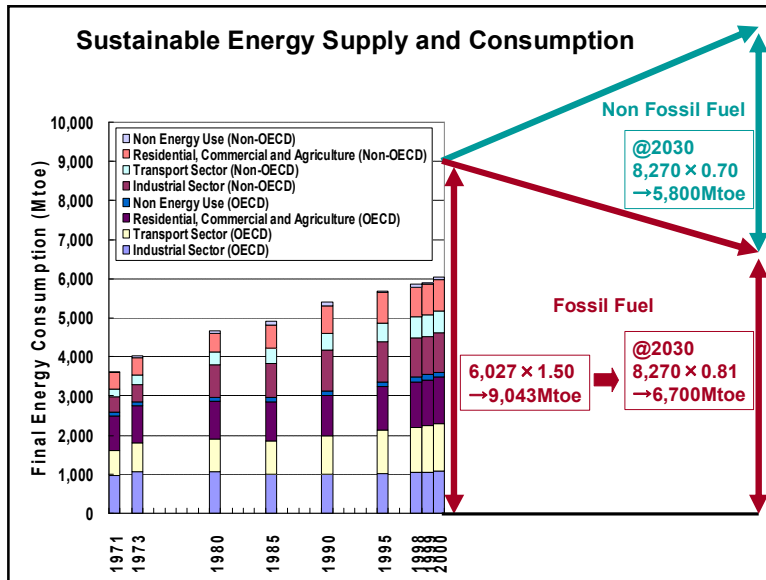




“In terms of the CO₂ issue... we will not do anything that harms our economy. Because, first things first, are the people who live in America.”

“If I had my way, I'd have [tax cuts] in place tomorrow, so that people would have money in their pockets to deal with high energy prices.”

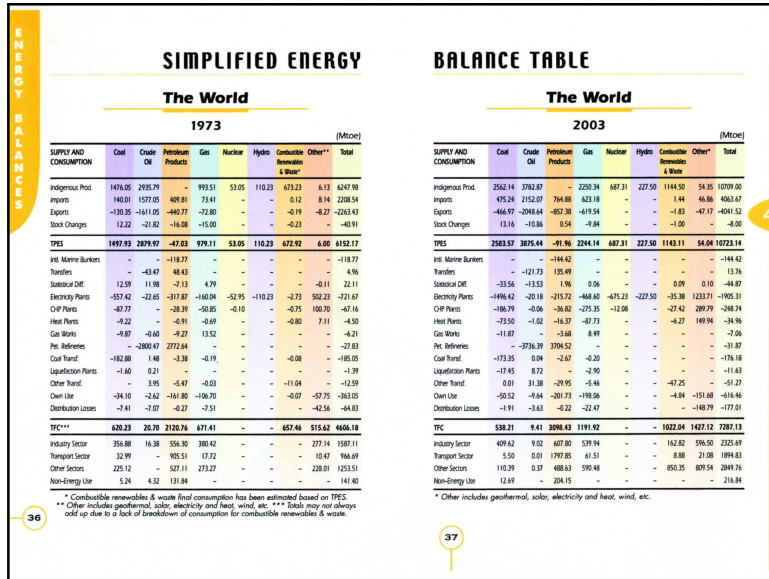




- ### Target to Sustainable Society (Energy Supply)
- Residential, Commercial and Agriculture : **1.06 toe/person@OECD2000**
 - Save 50% (0.53 toe/person) by co-generation etc.
 - Supply **0.53 toe/person** by renewable energy
 - Transport Sector : **1.08 toe/person@OECD2000**
 - Save 65% (0.70 toe/person) by fuel efficient technology etc.
 - Supply **0.38 toe/person** by fossil fuel
 - Industrial Sector : **0.97 toe/person@OECD2000**
 - Save 0.17 toe/person (50% of processing) by co-generation
 - Save 0.33 toe/person (50% of material production) by recycle and renewable materials
 - Supply **0.17 toe/person** by renewable energy
 - Supply **0.33 toe/person** by fossil fuel as raw material
 - Non Energy Use (0.10 toe/person@OECD2000) is assumed to be kept.
 - Supply **0.10 toe/person** by fossil fuel as raw material
 - As a result, final energy consumption per capita will be 1.51
 - This is less than half of 3.21 toe/person@OECD2000
 - However, **0.70 toe/person** will be supplied by renewable energy
 - Then, consumption of fossil fuel will be 0.81 toe/person
 - This is only 17% of primary fossil fuel consumption @OECD2000

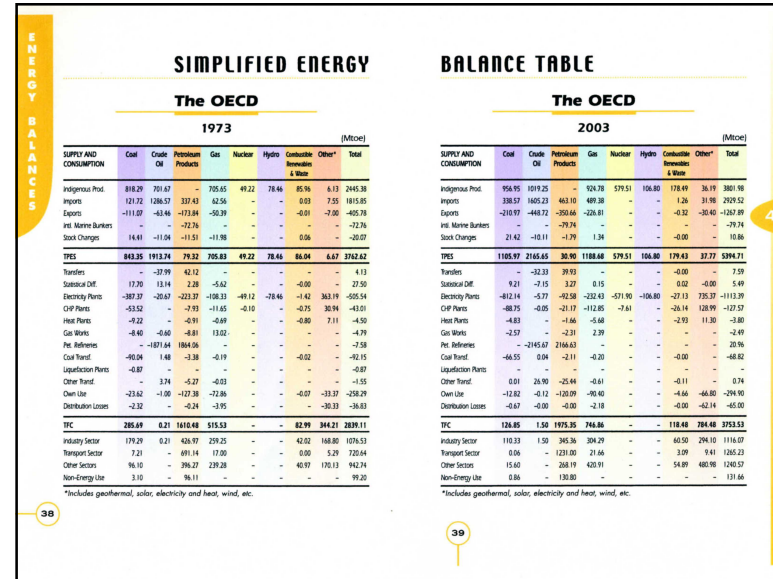
- ### Target to Sustainable Society (Energy Supply)
- At 2000, **1.50 toe/person of fossil fuel** is supplied for 6,027 million people.
 - Then, **9,043 Mtoe of fossil fuel** is consumed annually.
 - In the sustainable society,
 - Final energy consumption is **1.51 toe/person**
 - 0.81 toe/person** is supplied by fossil fuel
 - 0.70 toe/person** is supplied by renewable energy
 - Then, at 2030, when the world population is 8,270 million,
 - About **6,700 Mtoe of fossil fuel** is consumed annually.
 - This is 74% of current fossil fuel consumption
 - About **5,800 Mtoe** is supplied by renewable energy.
 - This is more than 5 times of current electric power generation
 - THIS IS JUST A SET OF TARGETS.**
 - How to realize?
 - How is cost effectiveness?
 - In which turn should it perform?

- ### HOW TO MAKE A POLICY ?
- Plan → Do → Check → Action → Plan → Do → Check → Action → Improvement →
 - Step1: Information gathering ← Council, etc.
 - Global and individual problem
 - Related statistics
 - Step2: Policy decision ← Government
 - Vision (ideal target) decision
 - Examination of the realization method
 - Bottom-up approach; Industry respect type
 - Top-down approach; Target achievement by innovation or integration
 - How to execute and what cost effectiveness is expected?
 - Law creation, administrative guidance, etc.
 - Budget application (Control by the subsidy and the taxation system)
 - Reconsideration of a realizable vision



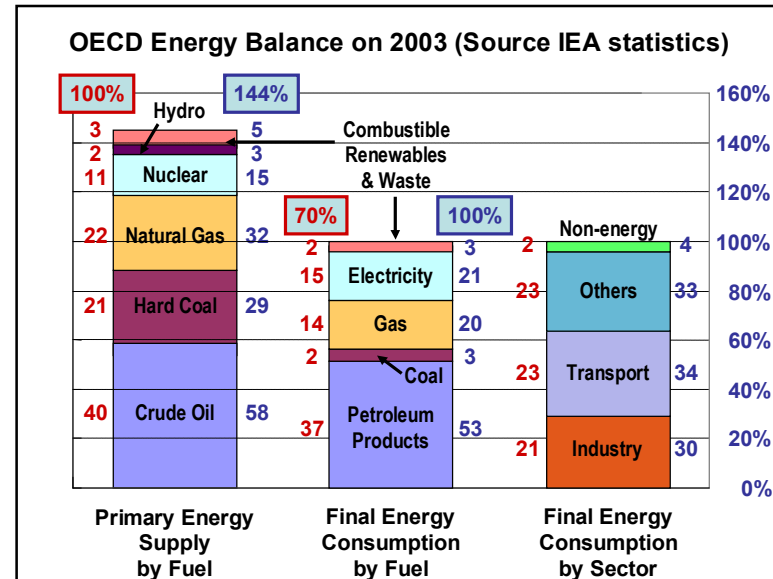
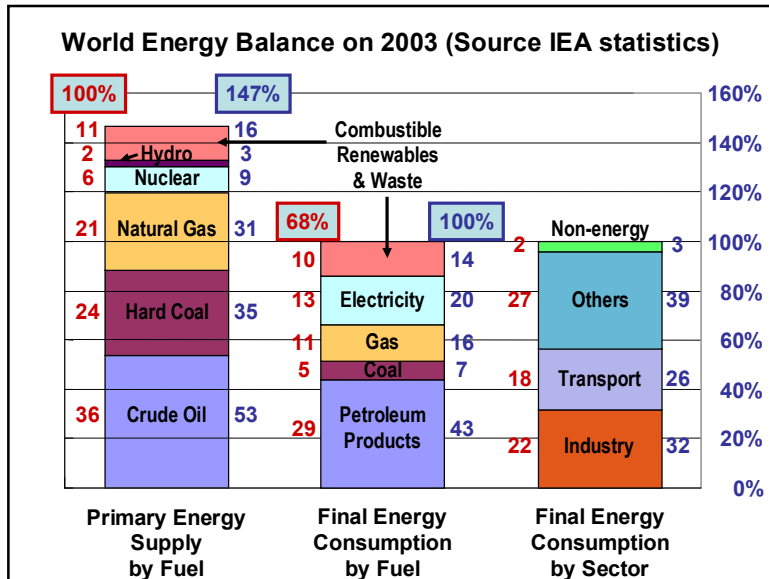
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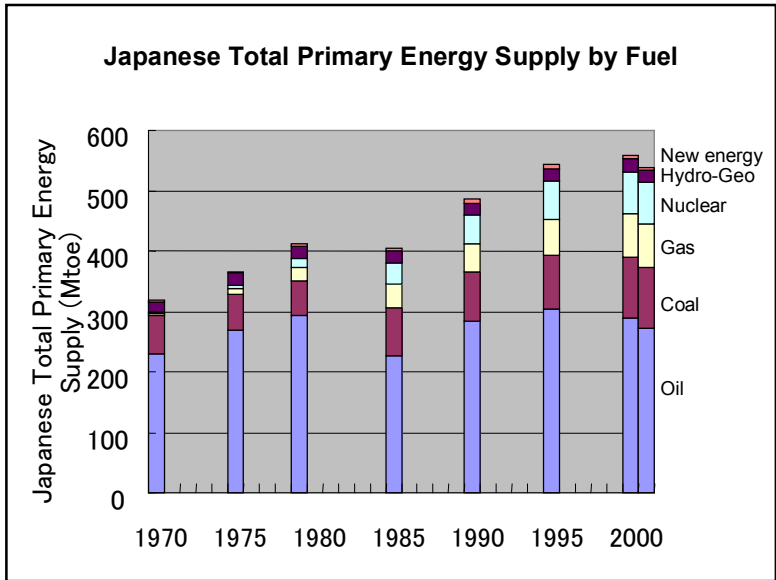
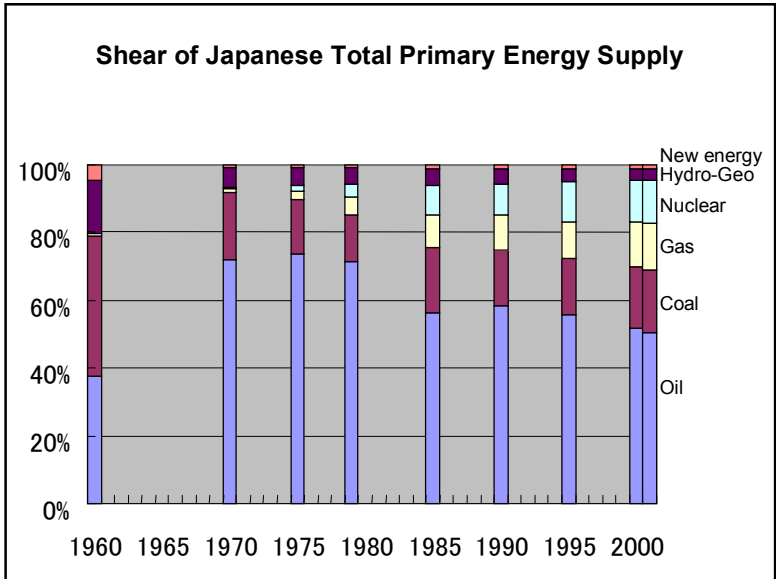
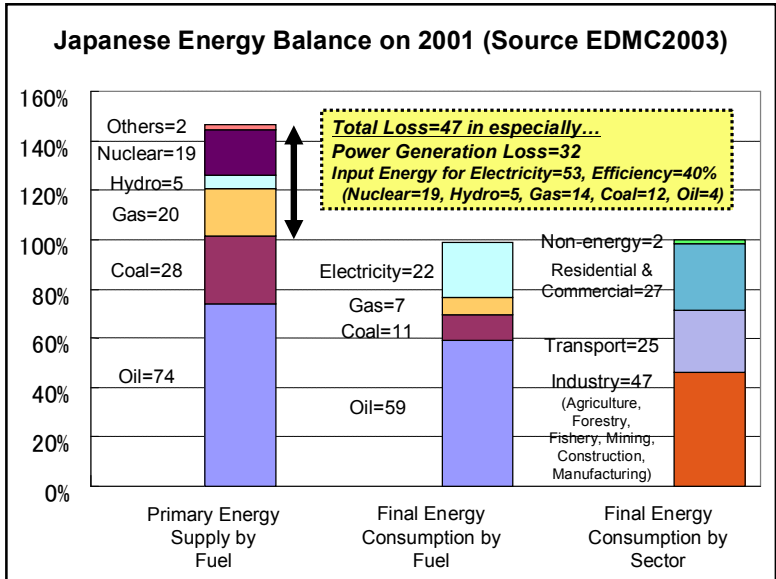
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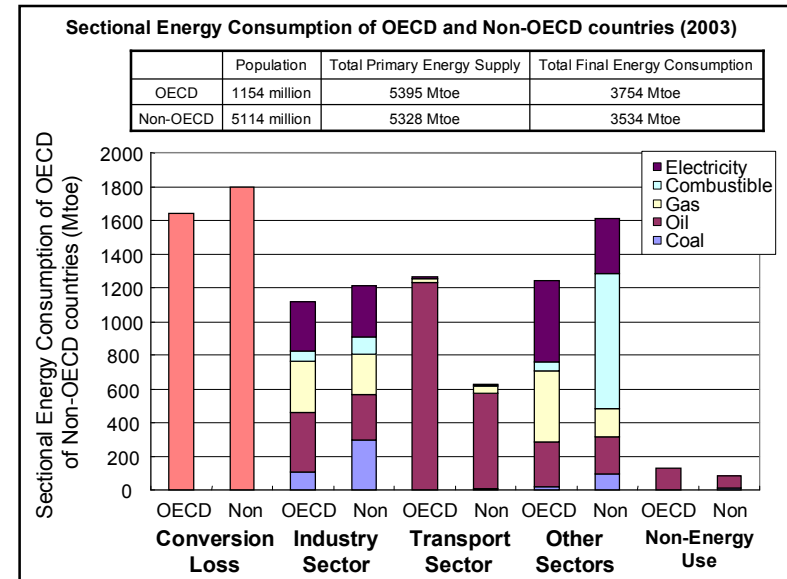
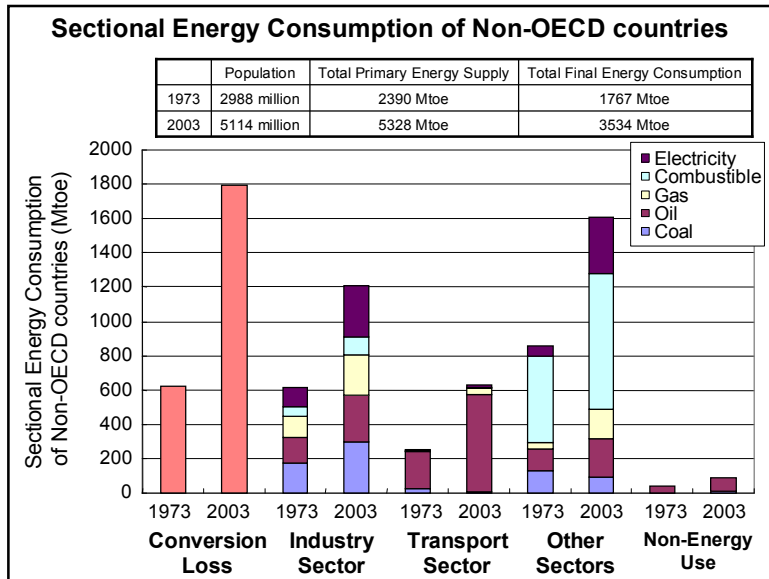
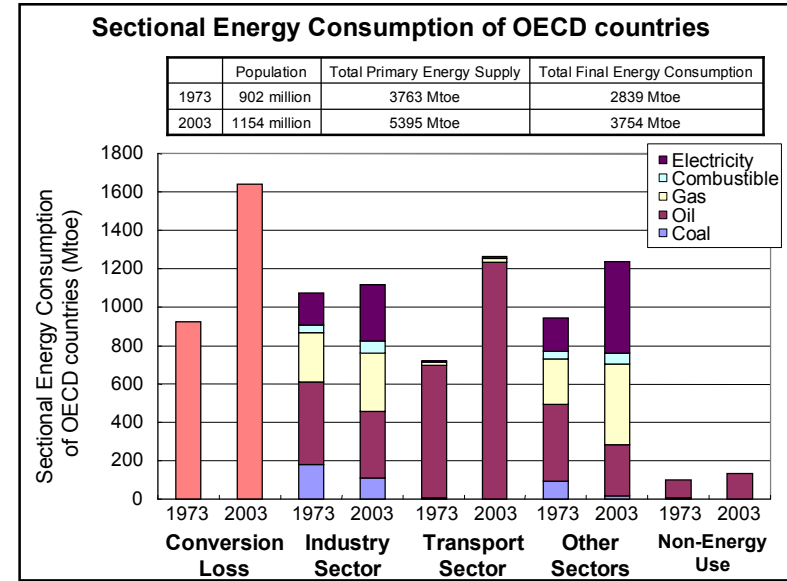
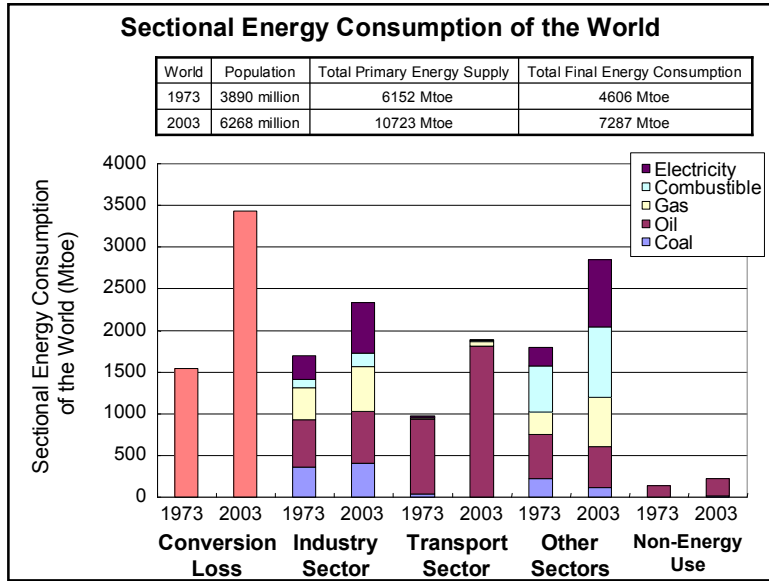


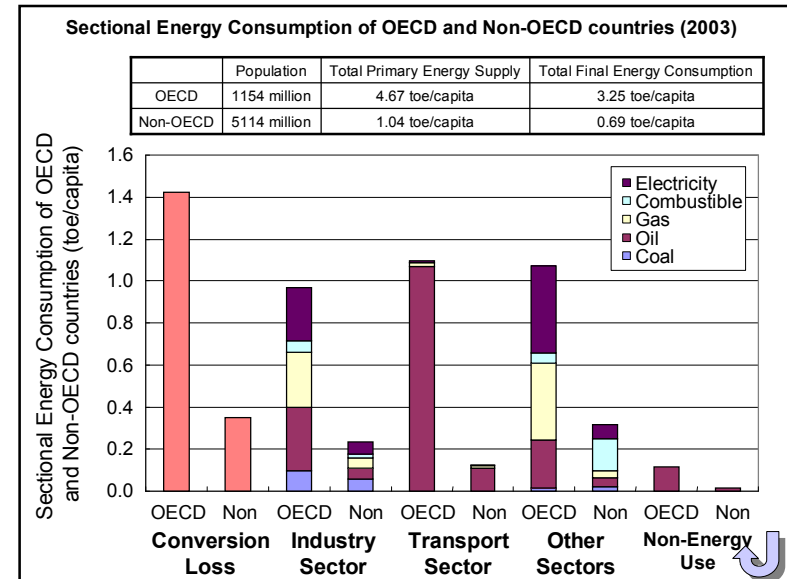
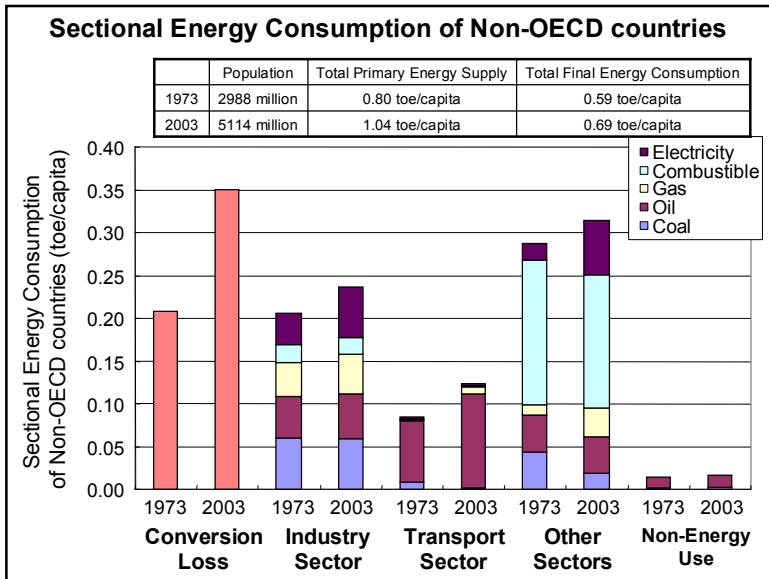
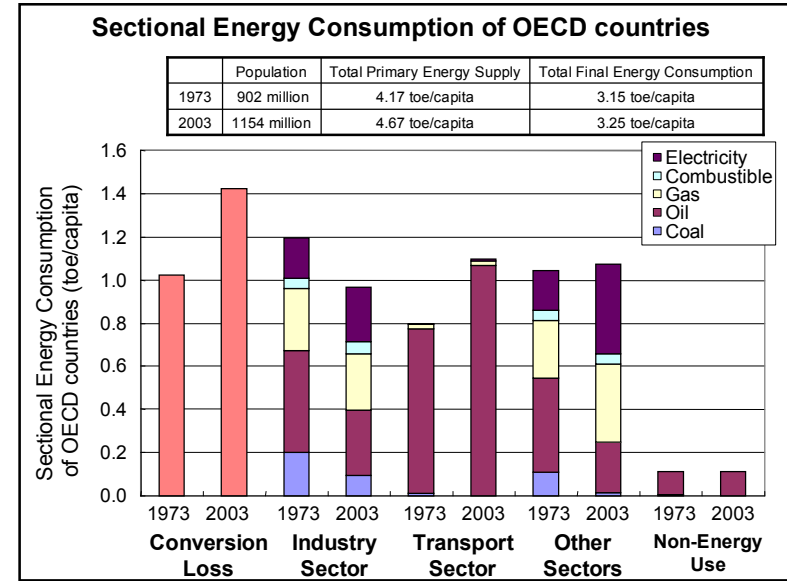
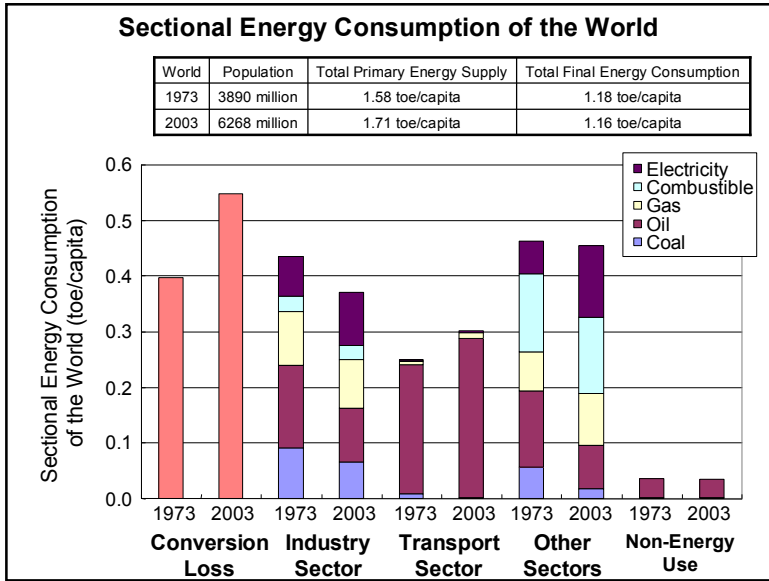
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地球の温度の計算（その1：単純計算）

- ① 温度Tの物体（地球）から放射される単位面積・単位時間あたりのエネルギーは σT^4 [J/m²s]（ σ は物理定数： 5.67×10^{-8} [J/m²sK⁴]）
- ② よって、地球（半径R）の表面から放射される単位時間あたりのエネルギーは $4\pi R^2 \times \sigma T^4$ [J/s]
- ③ 同様に、太陽から放射されるエネルギーが計算できるので、そのうちの地球に当たる部分も計算でき、これを単位面積・単位時間あたりS [J/m²s]とすると、地球表面に入射する太陽からのエネルギーは $\pi R^2 \times S$ [J/s]（S=1367 [J/m²s] → 単位面積あたり1367ワット！）
- ④ 入射エネルギーと放射エネルギーがつりあって、地球は現在の温度になっているのだから、現在の地球の温度をTとすると
 $\pi R^2 \times S = 4\pi R^2 \times \sigma T^4$
→ $T^4 = S / 4\sigma = 1367 / (4 \times 5.67 \times 10^{-8}) = 60 \times 10^8$
→ $T = 279$ [K] = 6 [°C]
- ⑤ 実際の地球の平均気温（約15°C）との食い違いの原因は？

地球の温度の計算（その2：補正された計算）

- ⑤ 実際の地球の平均気温（約15°C）との食い違いの原因は？
(1) 大気による入射エネルギー（ $\pi R^2 \times S$ ）の反射
(2) 大気による放射エネルギー（ $4\pi R^2 \times \sigma T^4$ ）の放射
（正確には赤外光の吸収と再放射）→ **温室効果**
- ⑥ 上記（1）については、地球の場合の反射率は30%だから、計算し直すと
 $0.7 \times \pi R^2 \times S = 4\pi R^2 \times \sigma T^4$
→ $T^4 = 0.7S / 4\sigma = 0.7 \times 1367 / (4 \times 5.67 \times 10^{-8}) = 42 \times 10^8$
→ $T = 255$ [K] = -18 [°C]
- ⑦ 地球の実際の平均温度である15°Cとの差、33°Cが上記（2）の温室効果によるモノである。
- ⑧ 入射を遮るガスが増加すれば地球は冷え、温室効果ガスが増加すれば地球は温暖化する。

Calculation of the amount of solar energy

Solar energy flowing into the earth

$$\begin{aligned} & 0.7 \times \pi R^2 \text{ [m}^2\text{]} \times 1367 \text{ [J/m}^2\text{s]} \\ &= 0.7 \times 1.286 \times 10^{14} \text{ [m}^2\text{]} \times 1367 \text{ [J/m}^2\text{s]} \\ &= 1.23 \times 10^{17} \text{ [J/s]} \text{ (} 6 \times 10^9 \text{人で割ると、} 2 \times 10^7 \text{ [J/人s])} \\ &= 2.94 \times 10^{13} \text{ [kcal/s]} \text{ (//、} 5000 \text{ [kcal/人s]} = 4000 \times 10^5 \text{ [kcal/人日])} \\ &= 2.94 \text{ [Mtoe/s]} \text{ (//、} 500 \text{ [goe/人s]} = 15000 \text{ [toe/人年])} \end{aligned}$$

参考

- 食事により摂取されるエネルギーは約2000kcal/人日で、これは石油1kgから得られるエネルギーの約5分の1。
- 世界の一次エネルギー供給量は約90億toe/年（世界平均で約1.5toe/人年=約4koe/人日）で、食事として必要なエネルギーの約20倍。
 - 非OECD平均は約2koe/人日
 - OECD平均は約13koe/人日（日本は約11koe/人日、米国は22kg/人日）



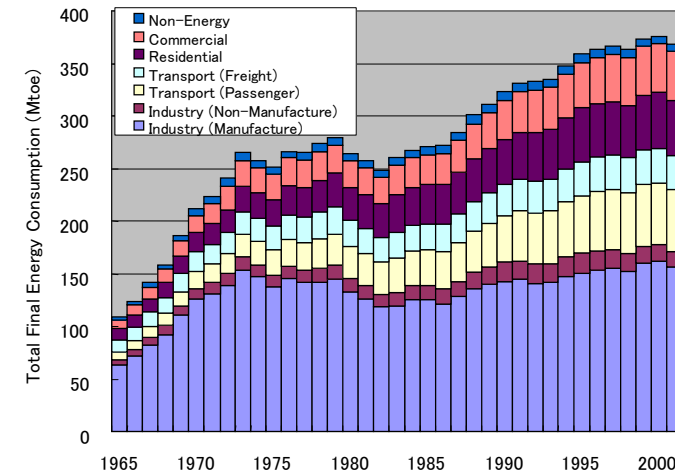
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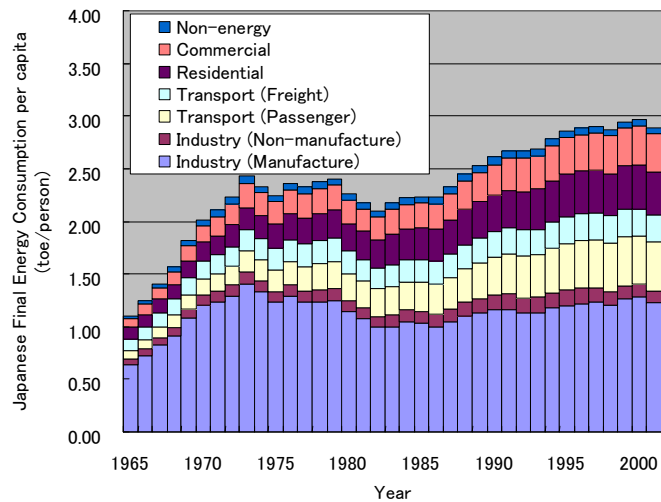
18, April, 2006
Jun TAKAHASHI

- ✓ Energy saving and policy making
 - Industrial sector
 - Residential and Commercial sector
 - Transport sector

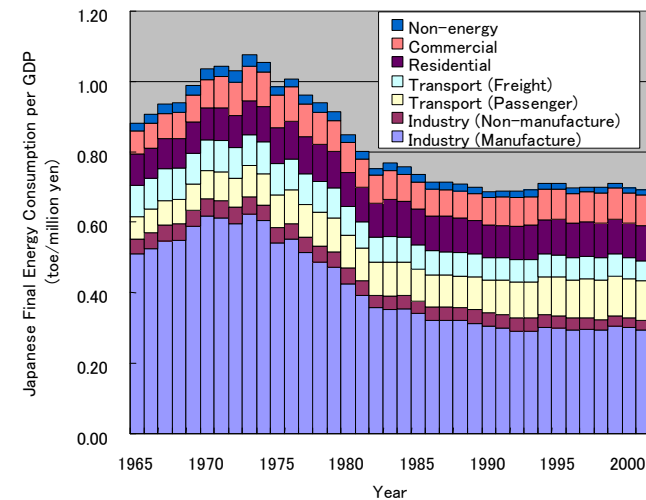
Japanese TFC by Sector (Mtoe)

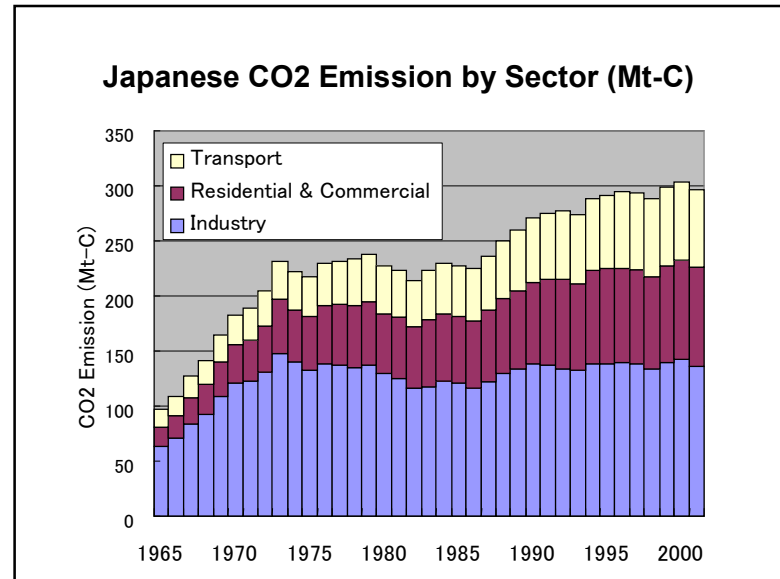
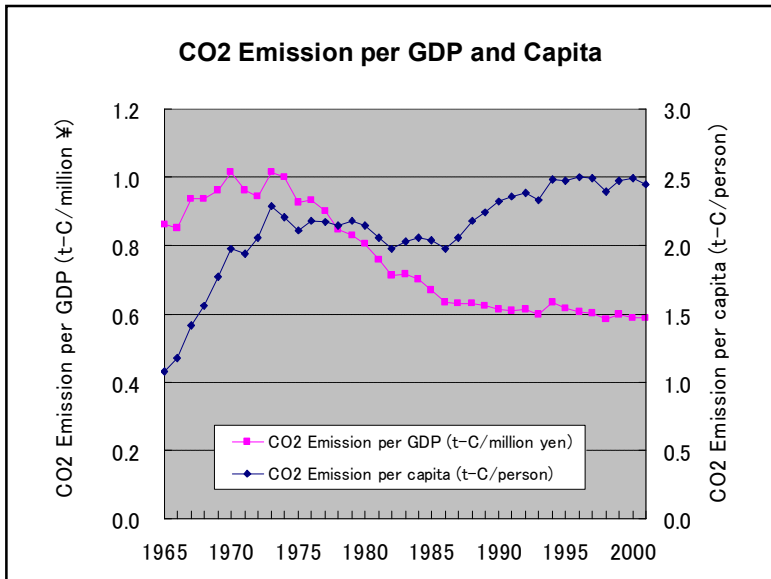
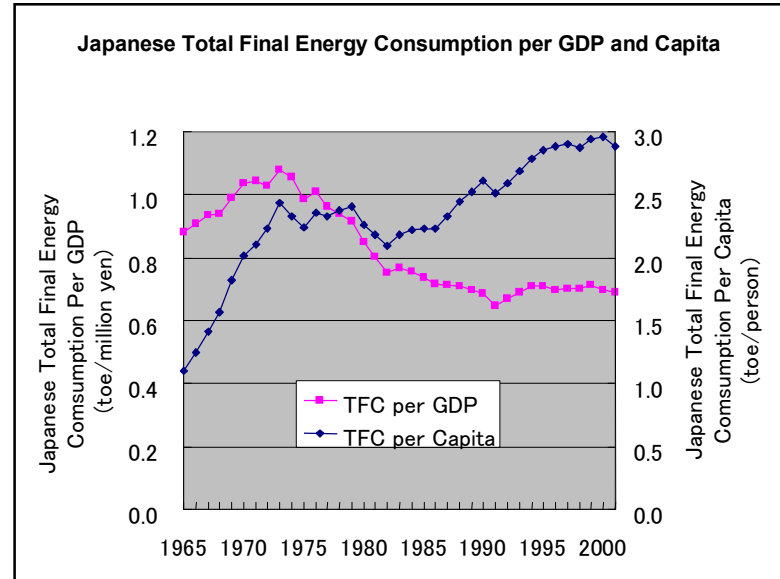
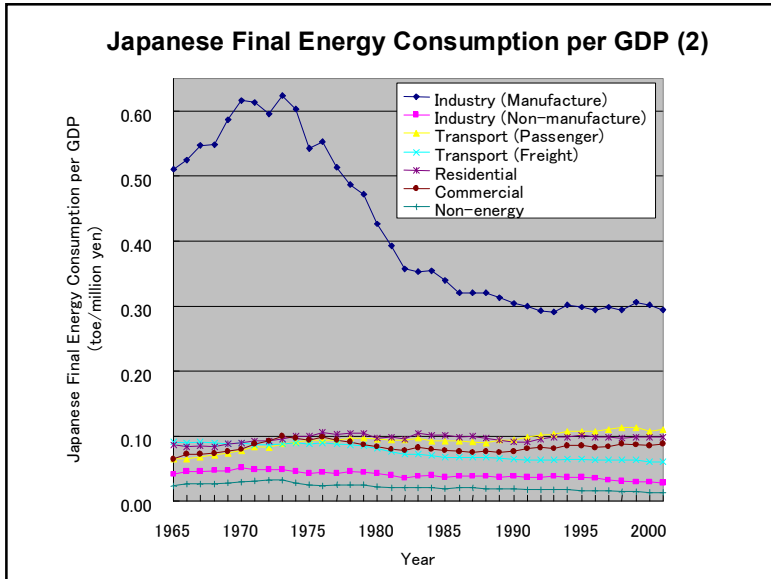


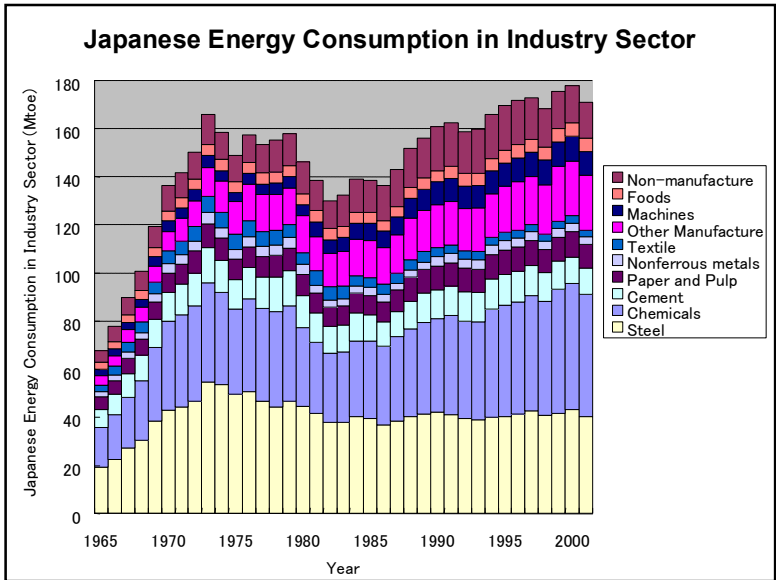
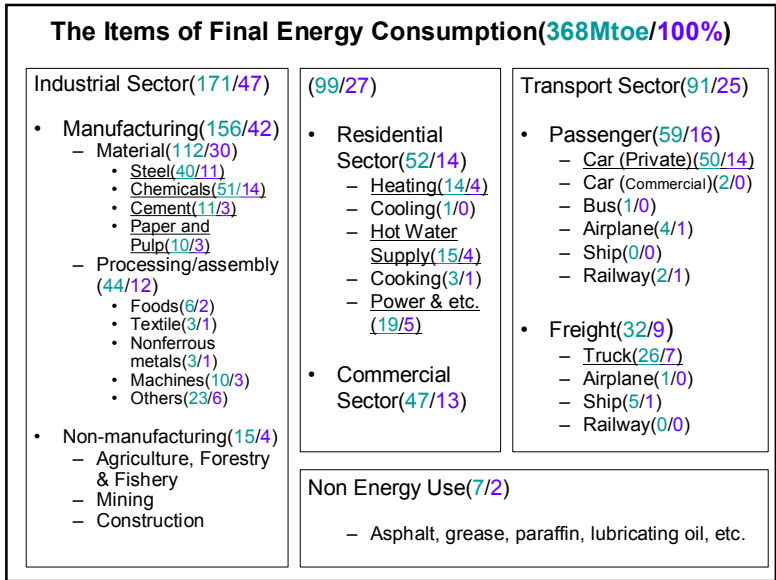
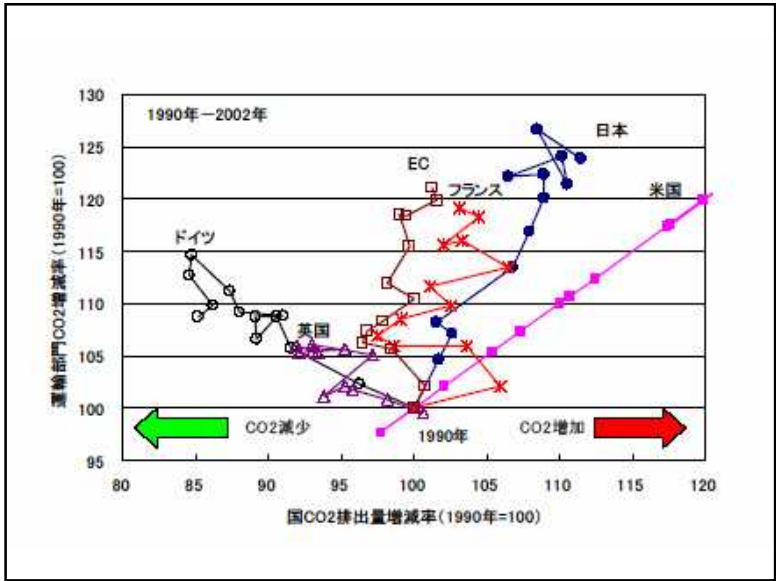
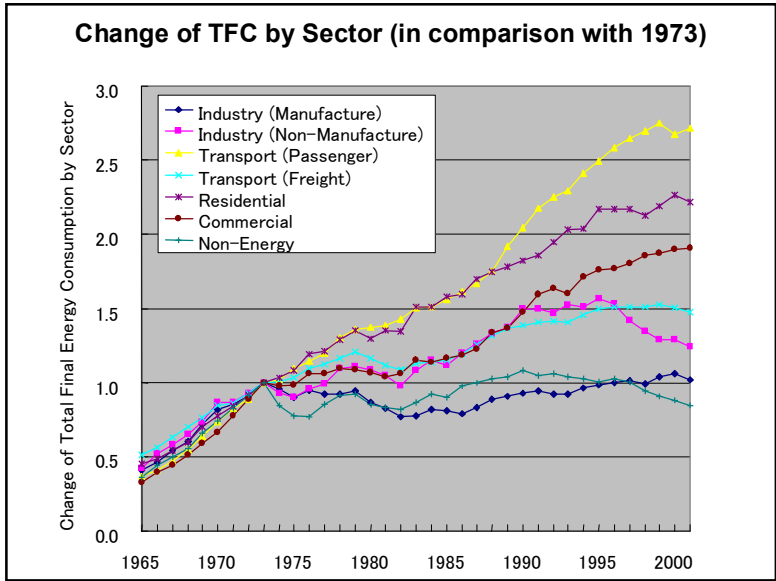
Japanese Final Energy Consumption per capita (1)



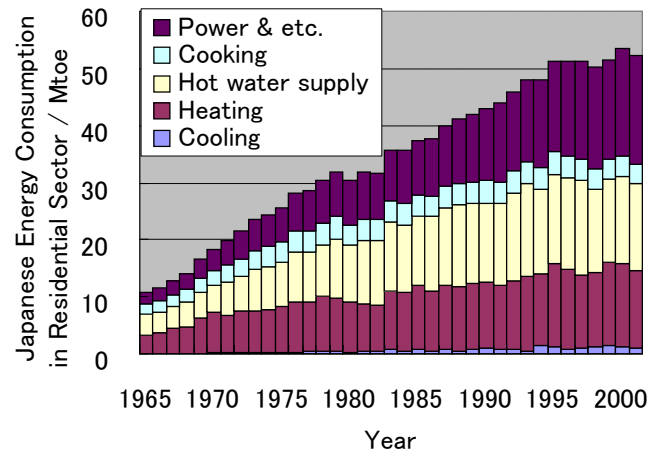
Japanese Final Energy Consumption per GDP (1)



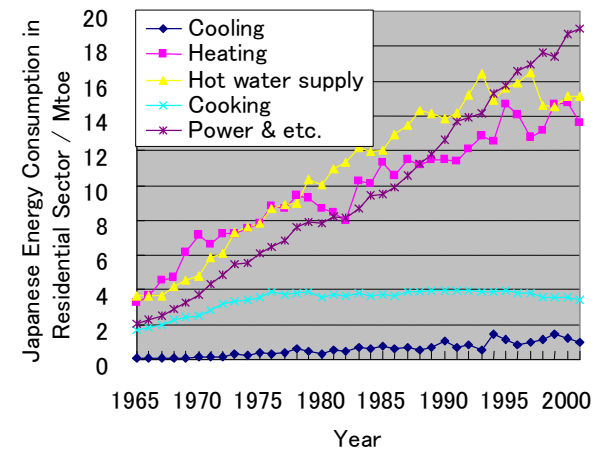




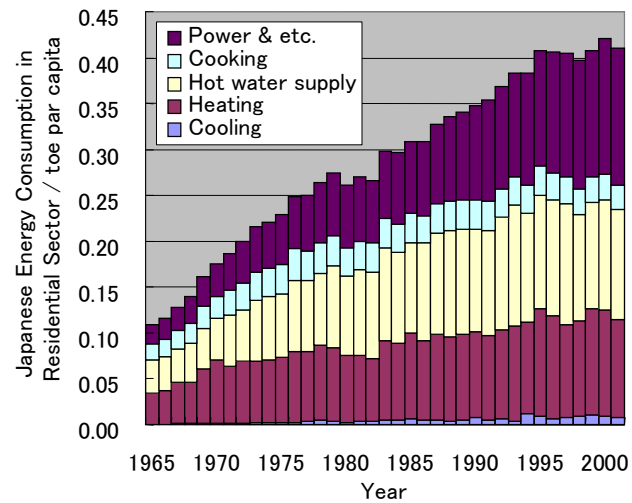
Japanese Energy Consumption in Residential Sector



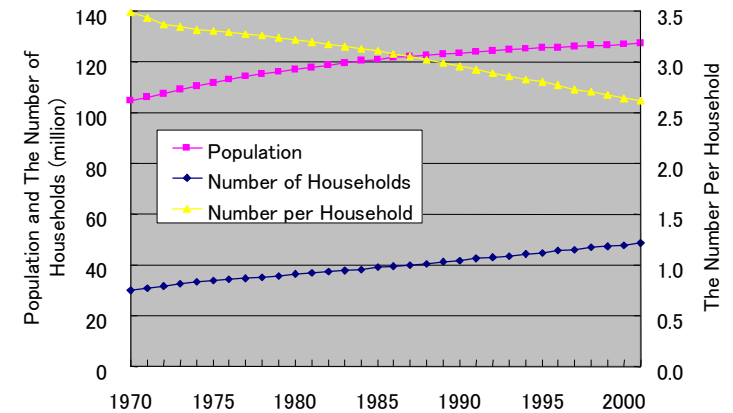
Japanese Energy Consumption in Residential Sector

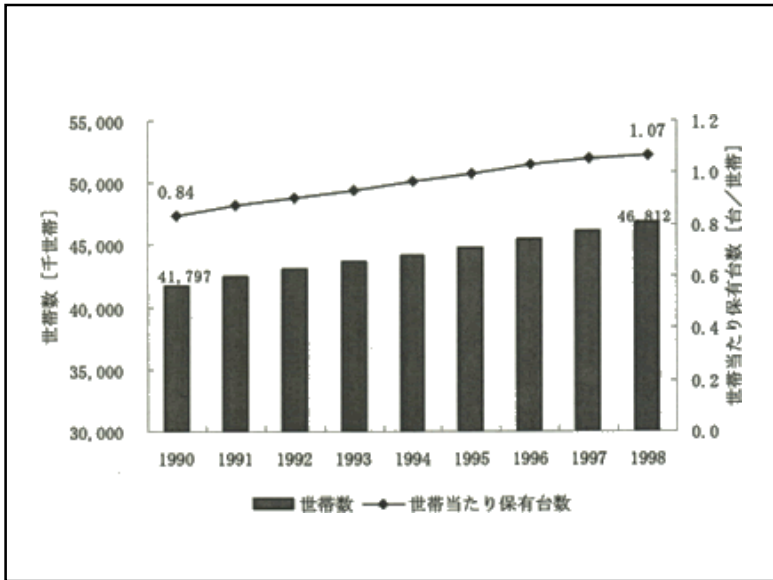
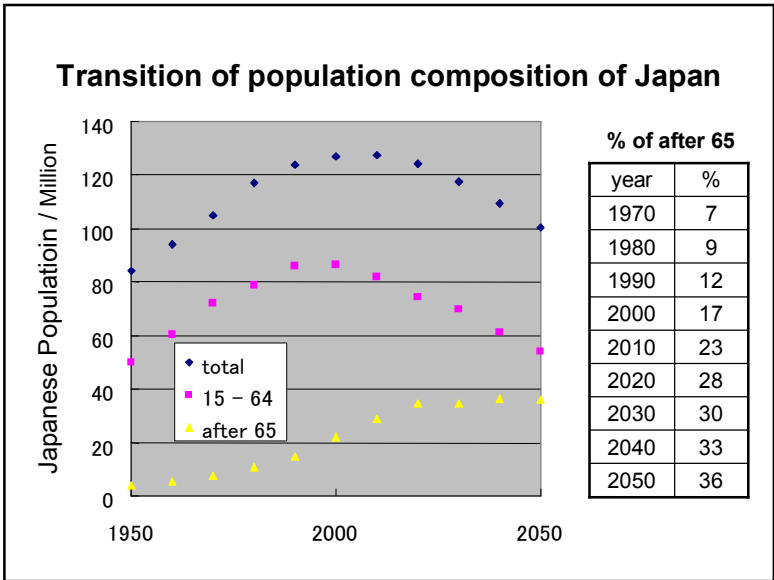
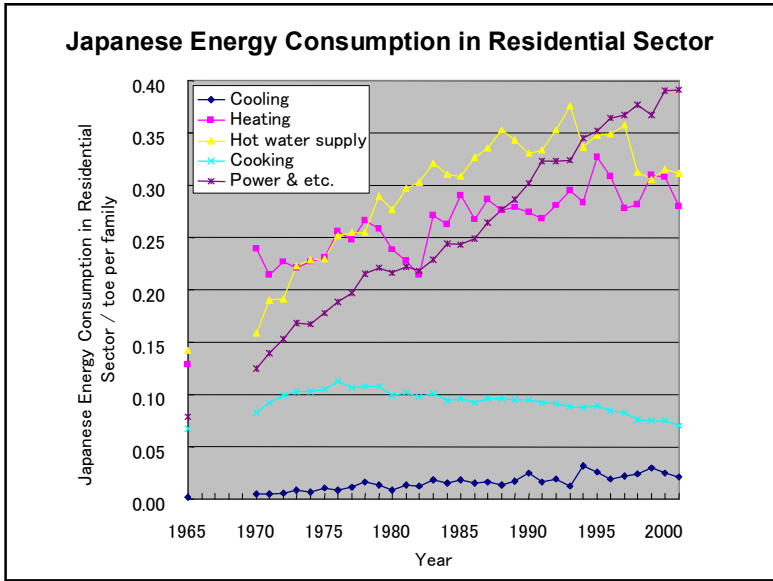
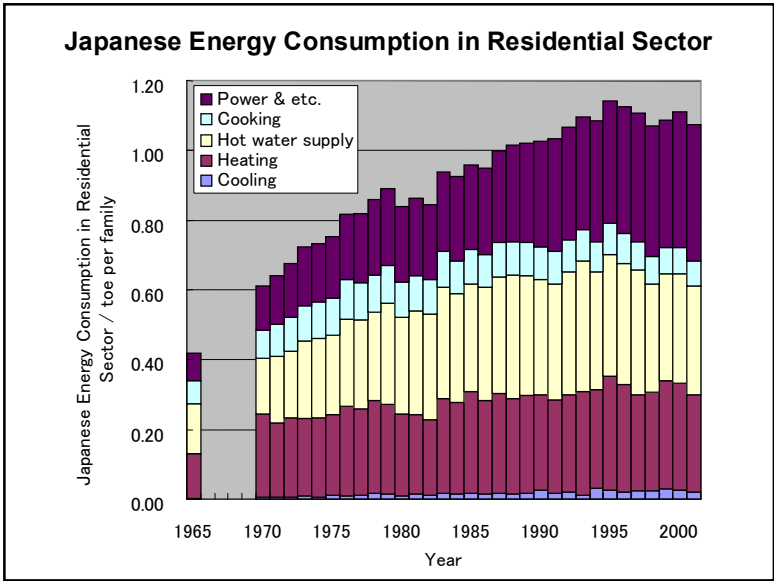


Japanese Energy Consumption in Residential Sector

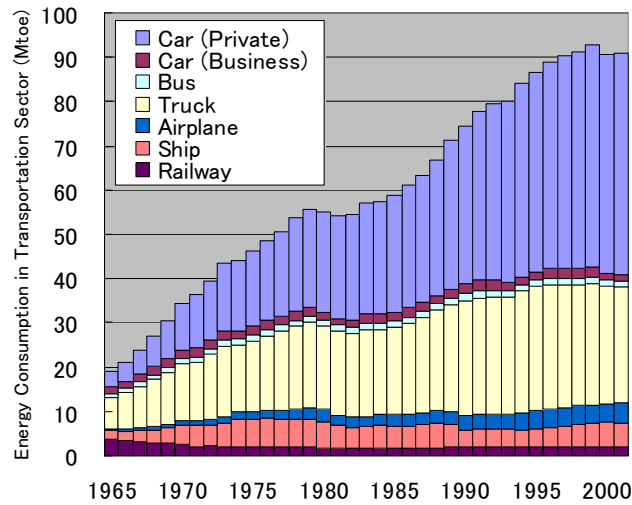


Japanese Population and The Number of Households

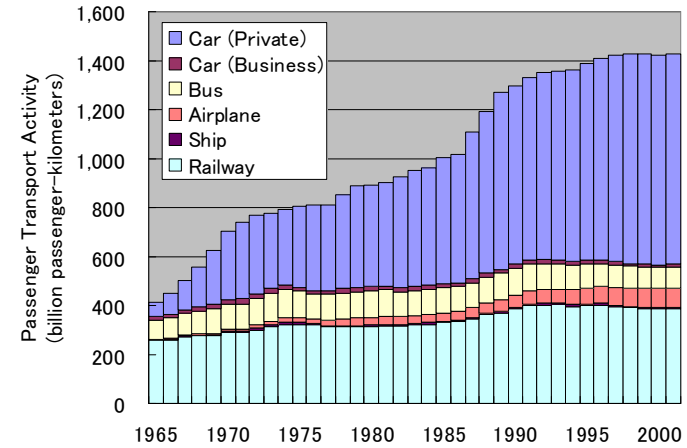




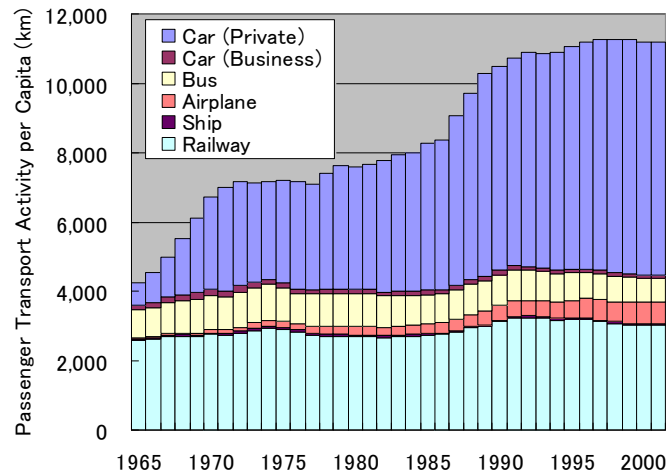
Energy Consumption in Transportation Sector (Mtoe)



Passenger Transport Activity (billion passenger-kilometers)



Passenger Transport Activity per Capita (km)



Energy Consumption in Passenger Transport (Mtoe)

