Global Environmental Policy

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

20, April, 2004
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- ✓ **Statistical information and interpretation for the decision making**

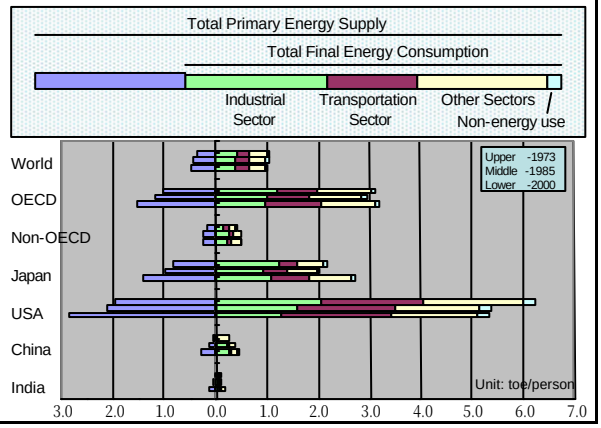
Total Primary Energy Supply and Final Energy Consumption

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

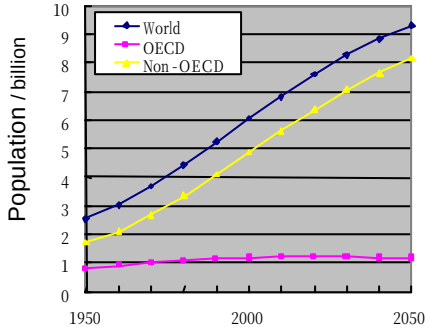
2000's world statistics rearranged by per population
Source: EDMC2003

		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

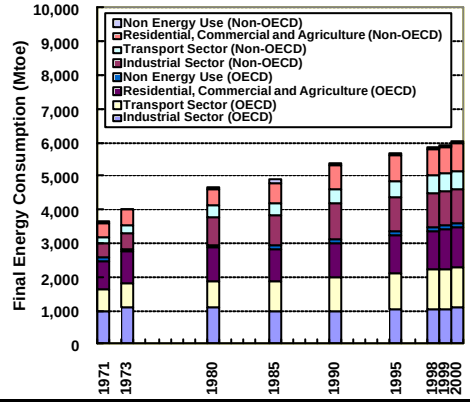
Total final energy consumption per capita (toe/person)



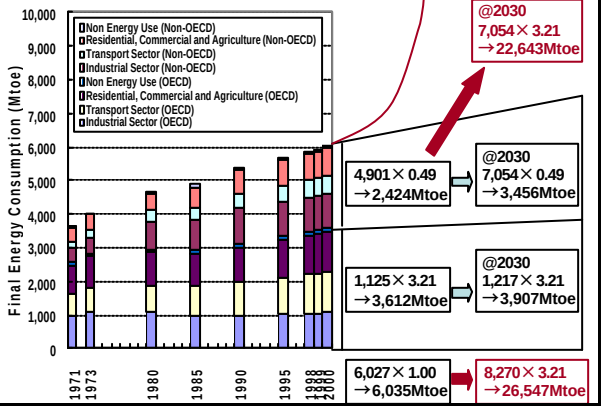
Transition of the population in the world
Source: UN



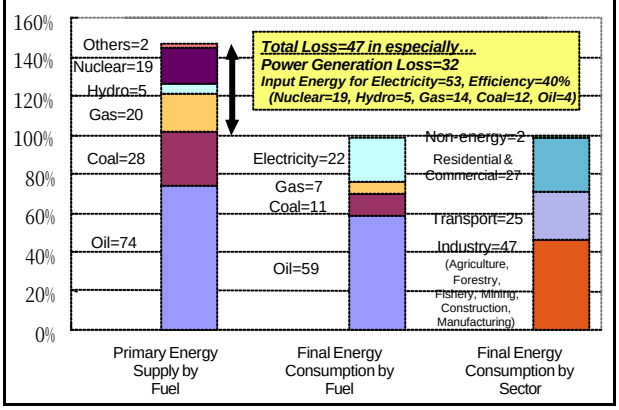
World Final Energy Consumption



World Final Energy Consumption

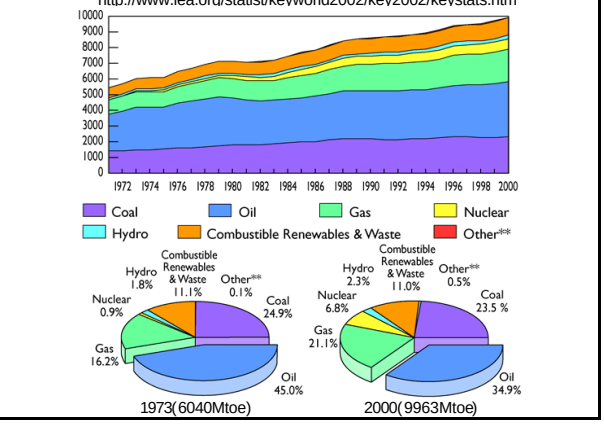


Japanese Energy Balance on 2001 (Source EDMC2003)



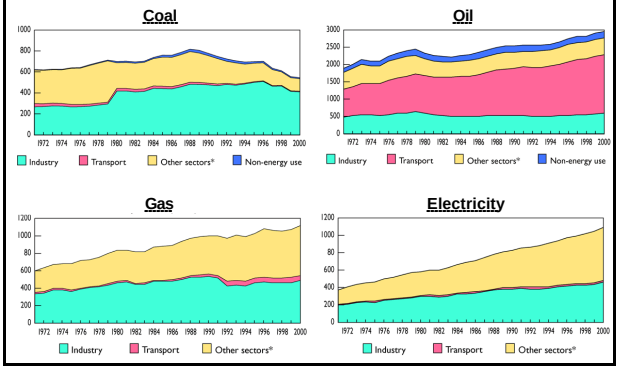
Evolution from 1971 to 2000 of World Total Primary Energy Supply* by Fuel (Mtoe)

http://www.iea.org/statist/keyworld2002/key2002/keystats.htm

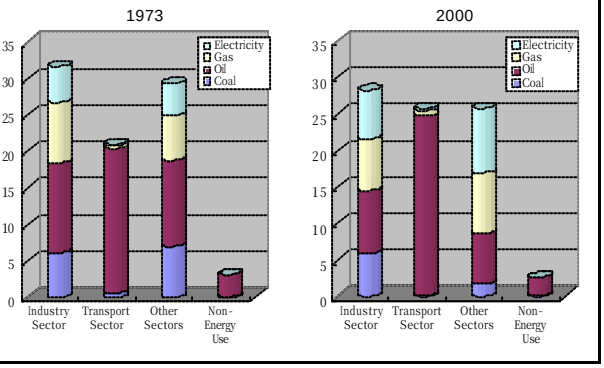


Evolution from 1971 to 2000 of Total Final Consumption by Sector (Mtoe)

http://www.iea.org/statist/keyworld2002/key2002/keystats.htm



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



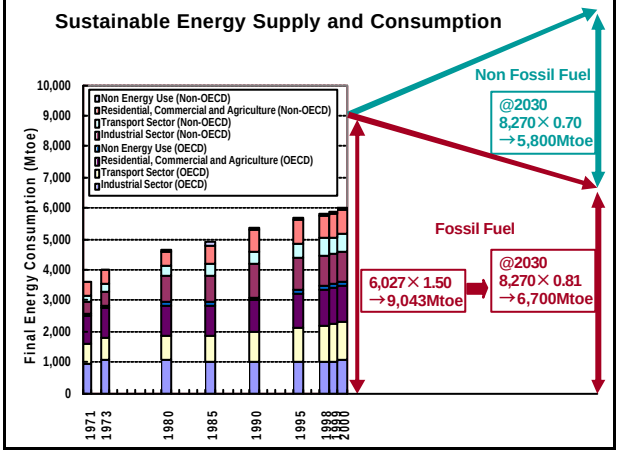
Target to Sustainable Society (Energy Supply)

- **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**

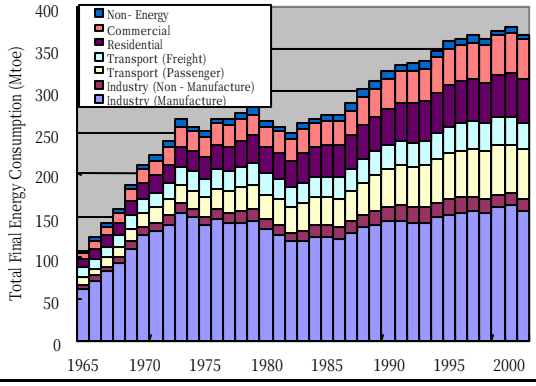
Target to Sustainable Society (Energy Supply)

- 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?

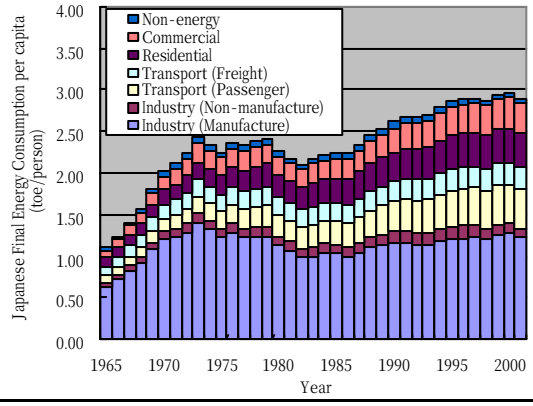
Sustainable Energy Supply and Consumption



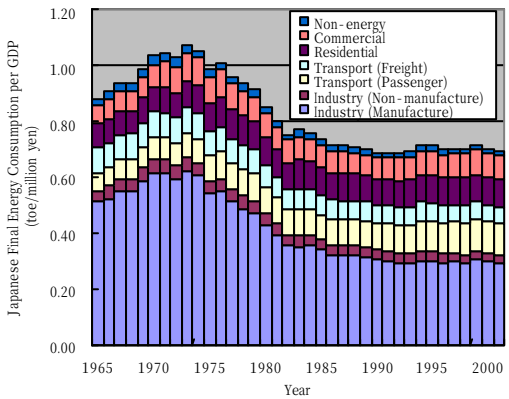
Japanese TFC by Sector (Mtoe)



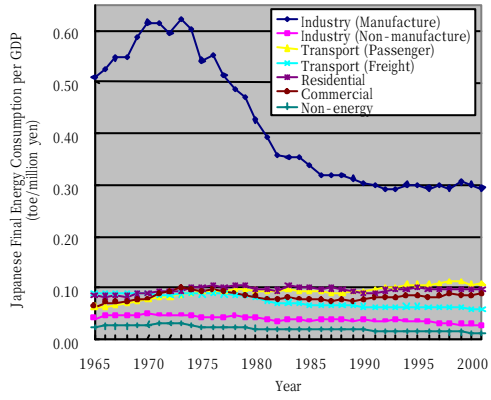
Japanese Final Energy Consumption per capita (1)

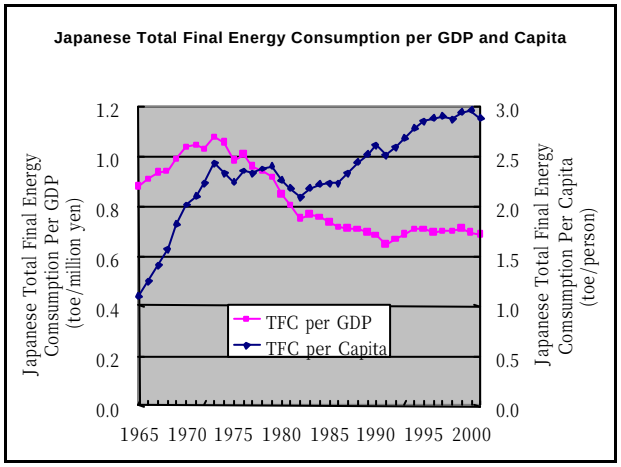


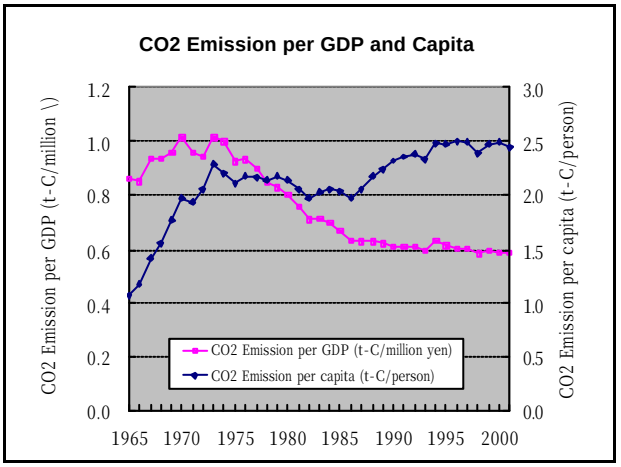
Japanese Final Energy Consumption per GDP (1)

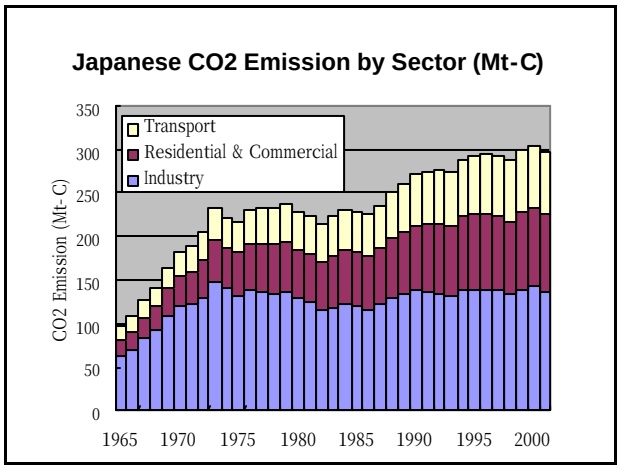


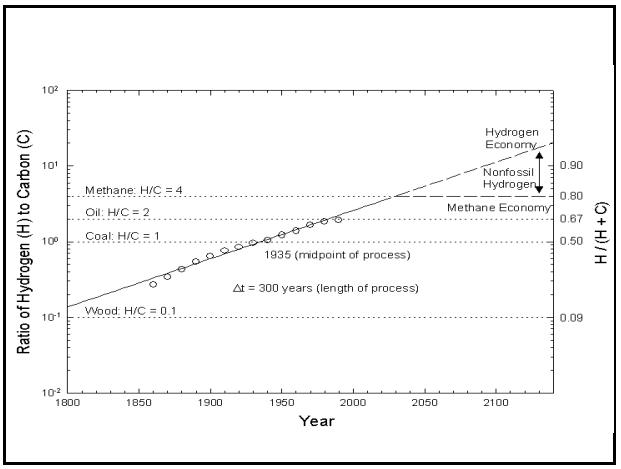
Japanese Final Energy Consumption per GDP (2)

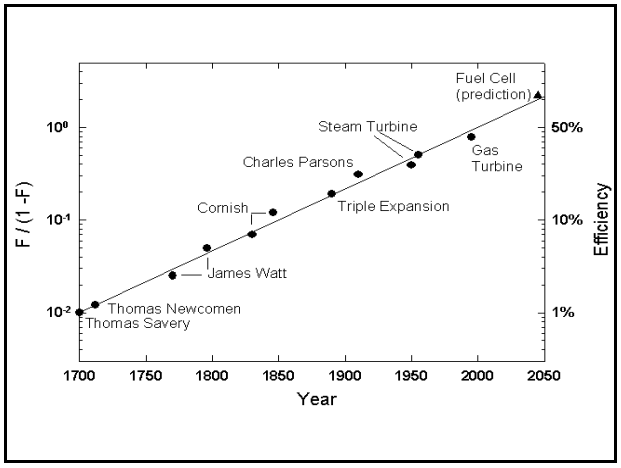


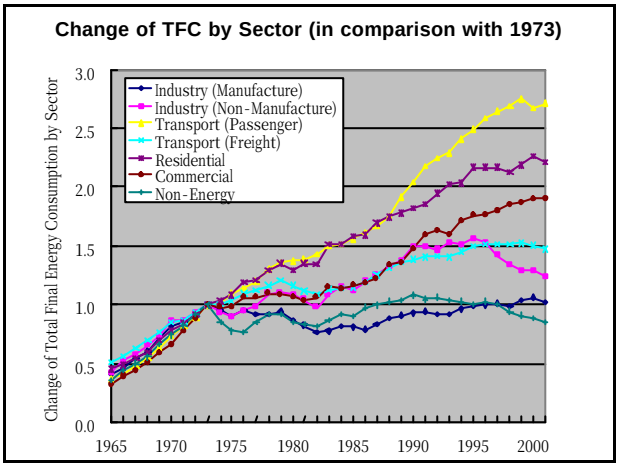

Japanese Total Final Energy Consumption per GDP and Capita
Japanese Total Final Energy Comsumption Per GDP (toe/million yen)
Japanese Total Final Energy Comsumption Per Capita (toe/person)
TFC per GDP
TFC per Capita
1.2
1.0
0.8
0.6
0.4
0.2
0.0
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1965 1970 1975 1980 1985 1990 1995 2000


CO2 Emission per GDP and Capita
CO2 Emission per GDP (t-C/million \)
CO2 Emission per capita (t-C/person)
CO2 Emission per GDP (t-C/million yen)
CO2 Emission per capita (t-C/person)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1965 1970 1975 1980 1985 1990 1995 2000


Japanese CO2 Emission by Sector (Mt-C)
CO2 Emission (Mt-C)
Transport
Residential & Commercial
Industry
350
300
250
200
150
100
50
0
1965 1970 1975 1980 1985 1990 1995 2000


Ratio of Hydrogen (H) to Carbon (C)
H / (H + C)
Year
Hydrogen Economy
Nonfossil Hydrogen
Methane Economy
Methane: H/C = 4
Oil: H/C = 2
Coal: H/C = 1
Wood: H/C = 0.1
1935 (midpoint of process)
Δt = 300 years (length of process)
0.90
0.80
0.67
0.50
0.09
1800 1850 1900 1950 2000 2050 2100


F / (1 -F)
Efficiency
Year
Fuel Cell (prediction)
Steam Turbine
Gas Turbine
Charles Parsons
Cornish
Triple Expansion
James Watt
Thomas Newcomen
Thomas Savery
50%
10%
1%
1700 1750 1800 1850 1900 1950 2000 2050


Change of TFC by Sector (in comparison with 1973)
Change of Total Final Energy Consumption by Sector
Industry (Manufacture)
Industry (Non-Manufacture)
Transport (Passenger)
Transport (Freight)
Residential
Commercial
Non-Energy
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1965 1970 1975 1980 1985 1990 1995 2000

The Items of Final Energy Consumption(368Mtoe/100%)

Industrial Sector(171/47)

- Manufacturing(156/42)
  - Material(112/30)
    - Steel(40/11)
    - Chemicals(51/14)
    - Cement(11/3)
    - Paper and Pulp(10/3)
  - Processing/assembly (44/12)
    - Foods(6/2)
    - Textile(3/1)
    - Nonferrous metals(3/1)
    - Machines(10/3)
    - Others(23/6)
- Non-manufacturing(15/4)
  - Agriculture, Forestry & Fishery
  - Mining
  - Construction

(99/27)

- Residential Sector(52/14)
  - Heating(14/4)
  - Cooling(1/0)
  - Hot Water Supply(15/4)
  - Cooking(3/1)
  - Power & etc. (19/5)
- Commercial Sector(47/13)

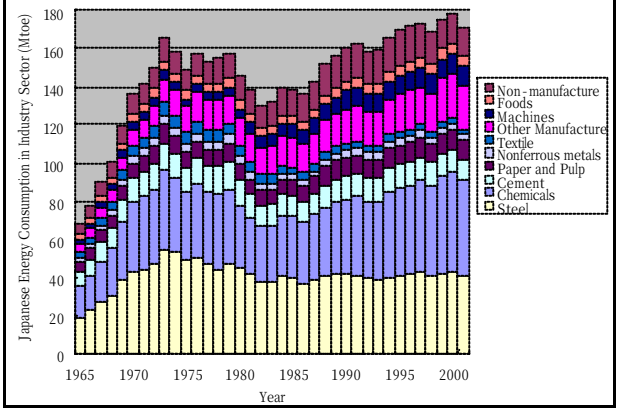
Transport Sector(91/25)

- Passenger(59/16)
  - Car (Private)(50/14)
  - Car (Commercial)(2/0)
  - Bus(1/0)
  - Airplane(4/1)
  - Ship(0/0)
  - Railway(2/1)
- Freight(32/9)
  - Truck(26/7)
  - Airplane(1/0)
  - Ship(5/1)
  - Railway(0/0)

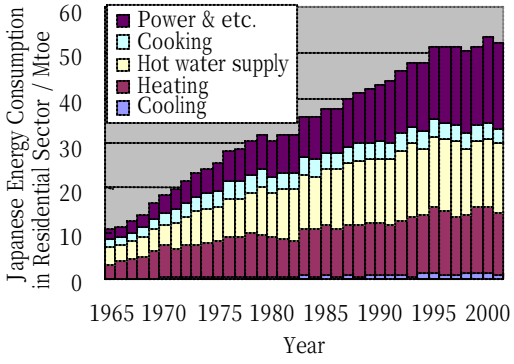
Non Energy Use(7/2)

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

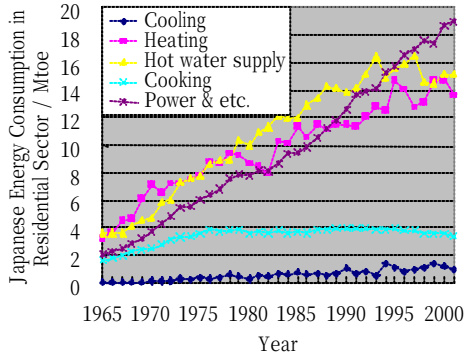
Japanese Energy Consumption in Industry Sector



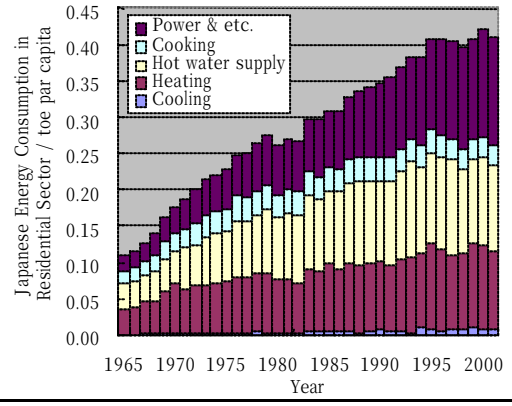
Japanese Energy Consumption in Residential Sector



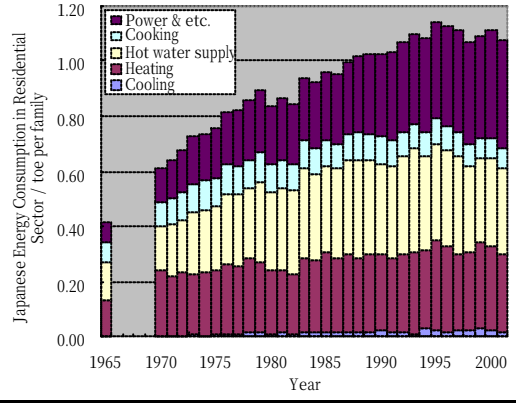
Japanese Energy Consumption in Residential Sector



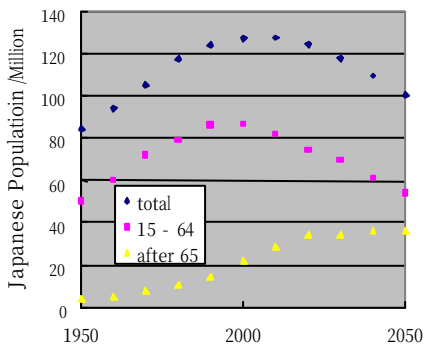
Japanese Energy Consumption in Residential Sector



Japanese Energy Consumption in Residential Sector



Transition of population composition of Japan



Japanese Population and The Number of Households