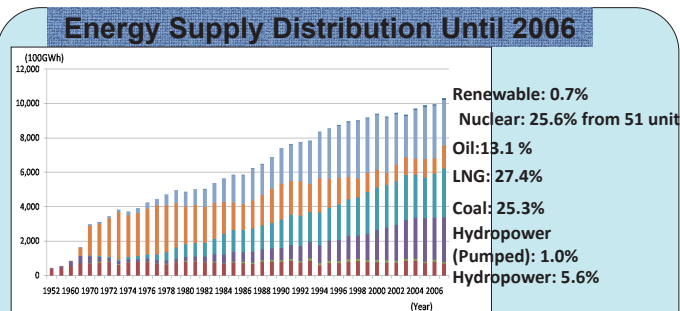


Japanese prospective nuclear power generation expansion by 2050 and its public acceptance under known renewable and fossil fuel use constraints

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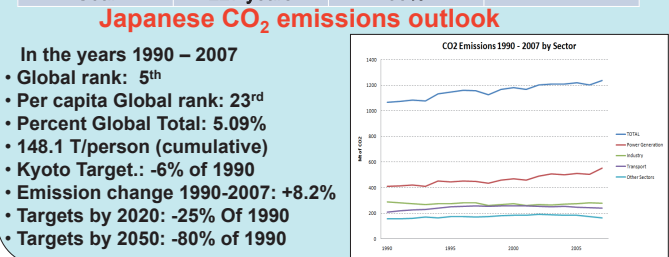
Introduction: The present international situation involving energy and global environment problems has dramatically changed.

- Resources-poor Japan is required to develop a long-term energy strategy well-organized in regard to energy supply and demand, energy security and global warming reduction commitments.
- Due to the energy demand increase in the world and the limitations of fossil fuels in terms of GHG emissions, clean power generation like NPP and renewable energies will take great importance to mitigate the shortening of the energy supply side.
- A promising future in view of the increasing worldwide acknowledgment of the Nuclear Power as a bulk-environmentally friendly energy source is envisaged; nevertheless the widespread concerns about nuclear safety means the uppermost challenge to the nuclear designers to achieve massive public acceptance of NPP.



Limitation of the Fossil Fuel Energy

	Depletion	Imported rates	Drawback
Oil	40 years	99%	Emit CO ₂
Gas	64 years	96.4%	
Coal	227 years	99%	



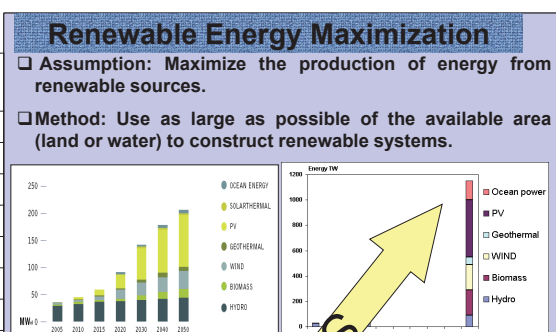
Research purpose

- estimate the projection of Japan's energy demand/supply and energy-related CO₂ emission up to 2050.
- Estimate the minimum nuclear power expansion needed in Japan by 2050.

Estimation Method: Nuclear power expansion by 2050 is calculated assuming an achievement on the governmental goals of a prospective 80% reduction of CO₂ emission from all end-use sectors, and a maximum expansion of renewable energy sources subjected to land constraints.

Surface area by use

	x1000 km ²	%	% may used
Buildings	18.5	4.9	3
Farmland	47.8	12.6	7
Forests	251	66.4	40
Water	13.4	3.5	1
Roads	13.2	3.5	1
Others	34.0	9	3
Total	377.5	100	55



Discussion

- The energy difference between the supply side and the Demand side will mitigate by using NPP, with small percentage from fossil fuel.
- 960, 500 TW may be generated by using NPP by 2020, 2050 respectively.

Estimation of the energy demand and corresponding CO₂ emission by 2020 & 2050

1- Electricity and heat output expansion

Assumption: Projections based on Total Energy Consumption limit expansion to GDP PPP (as from 1990 to 2007).

	1990	1992	1995	1997	2000	2002	2005	2007
TOTAL Electricity and Heat Output (TWh)	837.87	873.29	964.80	1009.63	1055.15	1055.00	1095.64	1130.45
Electricity Output (TWh)	835.51	870.22	960.24	1004.31	1048.64	1048.37	1088.42	1123.49
Heat Output (TWh)	2.36	3.07	4.56	5.32	6.51	6.63	7.22	6.96
GDP PPP (billion 2000 US dollars)	2867.16	2992.03	3091.83	3226.62	3246.29	3260.8	3463.36	3620.16
Population (millions)	123.48	124.43	125.47	126.06	126.84	127.45	127.77	127.76

2- CO₂ emission from electricity & heat output

Assumptions:

- Total emissions aimed to be reduced according to governmental targets by 2020, -25% & by 2050, -80% compared to 1990.
- Emissions by Industry, Transport and Other Sectors will be reduced according to the projections by Energy Revolutions.

	1990	1992	1995	1997	2000	2002	2005	2007
Electricity and Heat Output	409.02	421.89	444.72	447.80	467.60	489.02	512.15	553.86
Industry	288.83	274.50	276.51	282.55	273.23	266.91	273.80	279.99
Transport	209.66	225.17	249.20	256.56	256.57	254.16	247.75	239.38
Other Sectors	157.84	161.13	175.82	170.28	184.01	192.65	184.05	163.11
Total	1065.34	1082.70	1146.25	1157.18	1161.40	1202.75	1217.76	1236.34

3- Share of electricity and heat output from fossil fuels

Assumption: From results from 1 & 2 With Emission factor for total fossil fuels use in Electricity and Heat production (g CO₂ per kWh) will remain the same as in 2007

	1990	1995	2000	2005	2007
CO ₂ per kWh (g CO ₂ per kWh)	434.50	410.99	400.72	429.70	450.40
Total E&H Output (TWh)	837.87	964.80	1055.15	1095.64	1130.45
Fossil Fuels (TWh)	511.10	530.64	580.33	668.34	734.79
Renewables (TWh)	61.33	53.06	58.03	53.47	58.78
Nuclear (TWh)	16.56	18.04	19.73	16.57	15.28

Energy Security
 Public Acceptance
 Economic Efficiency

Obstacles against constructing new power plants

- Safety Proctors: safety against the environmental, human and technical mistakes (earthquakes, man mistakes, facility failure).
- The raw materials which are used in the NPP (Uranium or plutonium).
- Place and safety of low and high level radioactive spent fuel disposing (900-1,000 t Uranium per year).
- Public Acceptance: Public attitude toward promotion of nuclear power generation or public perception of the necessity of NPP from both build new NPP and waste the spent fuel.
- Economical cost of the NPP construction.

Conclusion & Future work

- Proposal to estimate the minimum nuclear power expansion needed in Japan by 2050 has been prepared.
- The proposal depends on:
 - Estimate the energy demand and supply by 2050.
 - Enlarge the usage of renewable energy to mitigate the fossil fuel depletion.
- More calculations & considerations are required to solve the obstacles.
- Survey will be conducted to check the NPP public acceptance.