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

Mahmoud Bakr, Jordi Cravioto, Toshihiro Shibata, Ken-Ichi Amano, Varman Mahendar, Park Seung-Won, Li Fang Jiao, Saizo Aoyagi, Katsuhiro Matsumoto, and N. Agya Utama

Graduate School of Energy Science, *Graduate School of Engineering, Kyoto University.

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.

Japanese CO₂ emissions outlook

In the years 1990 – 2007
- Global rank: 5th
- Per capita Global rank: 23rd
- Percent Global Total: 5.09%
- 148.1 T/person (cumulative)
- Kyoto Target:-6% of 1990
- Emission change 1990-2007: +8.2%
- Targets by 2020: -25% Of 1990
- Targets by 2050: ~80% of 1990

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 linear expansion to GDP PPP (as from 1990 to 2007).

2- CO₂ emission from electricity & heat output
- Assumptions:
  1. Total emissions aimed to be reduced according to governmental targets by 2020, -25% & by 2050, -80% compared to 1990.
  2. Emissions by Industry, Transport and Other Sectors will be reduced according to the projections by Energy Revolutions.

Discuss
- 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.

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.