Fuel Choice in Power Generation for a Low-Carbon Future

Mitsuho Uchida, Chukyo University

YLP Seminar on Energy & Environment

UlaanBaatar, 25 August, 2010

Requirements for a higher quality and secure electricity supply are greater than ever

- **Electricity is produced in many ways, using different fuel sources and very different ways.**
- **Fossil fuels are a commonly spread primary energy sources in the world.**
- **Their limited availability and uneven distribution brings about the security issues.**

Characteristics of Electricity

- Electricity demand is never constant.
- Demand must always be met instantaneously, as electricity cannot be stored economically in a significant amount.
- So as to meet instantaneous demand, ESI must have enough capacity.
- A very wide range of technologies is used to generate electricity economically.

Nuclear Power

- Nearly 50 years ago, the Calder Hall nuclear reactor was plugged into the national grid in UK for the first time and nuclear power was seen as the fuel of the future:clean, cheap and potentially unlimited.
- Construction of nuclear power plants in the U.S. and EU declined following the 1979 Three Mile Island accident and the 1986 disaster at Chernobyl.
- Many factors affect nuclear policy ie: high capital costs, decommissioning, public acceptance, no-CO2 emissions, oil price etc.
- Nuclear power is key of the solution to both energy security and climate change.

Hydropower

- The earliest form of electricity production in many countries.
- Nowadays, pumped storage plants are built to “store electricity in the form of water pumped to a higher level to be later released to drive turbines.
- No more big dam construction are allowed in Japan and Korea.

Renewable Energy

- Heterogeneous group of technologies –ie: wind power, solar power, small hydro-power, different forms of biomass. They have different attributes.
- Hydro and biomass plants can be “scheduled”, but solar and wind cannot be “scheduled”.
- Care must be taken by policy makers to provide transparency to customers of the subsidies used to expand renewable energy and the higher cost which can be associated with them.

Fossil Fuel Fired Plants

- Different technologies are used to burn fossil fuels(gas, coal, oil, lignite, peat) for electricity generation.
- Steam cycle
- Gas turbines (require clean gas)
- Combined cycle plants(high production efficiency)
- Cogeneration or CHP (where real heat load exists, overall energy efficiency is very high)

Role of Fossil Fuels in NEA

- In NEA, more than 80 % of primary energy is supplied by fossil fuels.
- About 70 % 0f electricity is generated from fossil fuels.
- Coal plays the main role as a fuel input in power generation.
- But natural gas is keeping the pace in JPN and KOR. China considers switching to natural gas installation?

Natural gas: quick way to cut CO2 emissions

- We will need a faster way to drastically cut CO2 emissions. One solution could be converting to natural gas in our existing thermal power generation systems.
- When generating the same amount of heat, natural gas releases only about half the CO2 discharged by burning coal.
- If a conventional coal-fired power plants were to be replaced by the latest combined-cycle power plant fueled by natural gas, CO2 emissions could be cut to less than half to generate the same amount of power.

Natural gas advantage

- Since the gas system is compact, it can be easily installed in inland areas or on factory premises, as long as a natural gas pipeline is close by.
- Another advantage is that fuel-cell cogeneration systems using natural gas to extract hydrogen can simultaneously generate both electricity and heat, which can be used to supply hot water and for building heating and air conditioning.
- If such systems are installed in commercial complexes, homes, hospitals, hotels, schools and other facilities, energy efficiency would dramatically rise while CO2 emissions would drop.

Summary

- In the long-run, ESI in NEA will be definitely basing on nuclear and coal fired plants.
- So as to overcome the severe environmental problems, further technological development is needed: clean coal gas technology, combined cycle gas turbines and CO2 capture and storage.
- Before supercritical and ultra supercritical units with extremely high generation efficiency are developed, coal and gas deposits can provide for medium- and short-term fuel supplies.