

The Role of Nuclear Power for a Sustainable Development in China

Prof. Zeng Wenxing

China Guangdong Nuclear Power Corporation Ltd.

Introduction

Entering into the new century, China, as a largest developing country, is facing tremendous pressure from population, resources and environment aspects in her development in future. Energy is closely linked with these three elements. If no sustainable energy development there would not be sustainable economic development in China.

China and other Asian countries view the nuclear power as a necessary option for sustainable energy development, in spite of the decline of nuclear power in the United States and Some European countries. This strategic consideration is based on the specific conditions in our country.

Challenges Facing China

Low energy consumption per capita

The primary energy consumption per capita in 1997 is around 1 ton coal equivalent, only one tenth of that for the United States, one fifth of Japan or South Korea

Fast Economic Growth

For reaching the target of modernization, China's GDP per capita is projected to increase from current 1000 USD (1997 Dollars) to 4200 USD in 2020 and more than 10000 USD in 2050, with a rate of 6.9%, highest growth rate in the Developing Asia.

Energy Demands Forecast

Annual primary energy demand expected to increase to 2694 Mtce in 2020 and 3440 Mtce in 2050 (2.2 ton per capita). This projection is based on assumption that energy intensity could be dramatically reduced to nearly 20 % of present level, otherwise much more energy is required.

High Energy Intensity

Dramatic reduction of energy intensity was achieved in the past 20 years owing to reform in industries and the intensive efforts in energy efficiency improvement. Still, it is very high compared with those in the developed countries, due to the industrialization.

Limited Primary Energy Resources per Capita

The annual supply capability of primary energy in 2050 hopefully could reach 3300 Mtce, 2.2 tons per capita, including:

- 1700 Mtce coal at the limits of coal mine capability;
- 260 GW Hydro is fully explored, generating electricity equivalent to 240 Mtce primary energy;
- 120 GW nuclear in operation, generating electricity equivalent to 220 Mtce primary energy,
- Oil & Gas also at the limits of domestic supply.

Environmental Issues

Due to dominant coal use, environment problem has always been major concern in China.

SO₂ Emissions 23.7 million tons in 1997, resulting in acid rain over 30 % of nation's territory. It will exceed 39 million tons in 2020 and 43 million tons in 2050 respectively, if no control measures are taken. The emission could be reduced significantly by using combined Clean Coal Technologies as indicated in the Fig.

GHG Emission

Carbon dioxide emission in China is expected to grow from 686 Mtce (Million Metric Tons Carbon Equivalent) in 2000 to 1115 Mtce in 2020, accounting for nearly 50% of that in the Developing Asia.

Strategies to Overcome the Challenges

Due to the industrialization process is going on , the energy intensity in China is comparatively high. There is a big room for improvement. In the past two decades, tremendous efforts have been made in industry restructuring and energy saving and energy

intensity has significantly reduced (see figure). In the coming decades more efforts should be made in order to reduce the energy intensity to 20% of current level.

Electrification: the Bridge to Sustainable Future

- Electrification-necessity of a modern society;
- Energy intensity was found decreasing with increase of electricity share in energy end use;

Hazardous emission could be reduced if coal is converted to electricity as much as possible;

Current Status of China Power Industry

- Generating capacity of 310 GW, ranking second in the world;
- 6 regional power networks with capacity of 30 GW -40 GW;
- Bulk power transmission by 500 kV AC and HVDC;
- 5 level dispatching centers

Future Development of Electric Power Industry

- Fast growth of electricity is projected
- Program of „West-East Power Transmission“ is launched ;
- Deregulated power market will be introduced ;
- Nuclear power is expected to grow in the coastal areas.

Exploring Hydropower in West China

- As a clean energy, hydropower is exploring in West China as first priority.
- In Southern China, 10000 MW power is scheduled to be sent from West China to Guangdong in the next 10 years;
- HVAC and HVDC transmission projects are under construction

The Indispensable Role of Nuclear Power

The conclusions could be drawn from the forecast of domestic supply capability in the year of 2050

- All the domestic energy resources will come to their limits of supply, except nuclear;
- If China intent to avoid dramatically increase of oil and natural gas imports, there is only one possible practical solution for sustainable development: to enhance the contribution of nuclear power .

- Nuclear Power is also a unique option of large-scale power generation without GHG emission.

Nuclear Power - Indispensable supplement to the primary energy resources for power generation.

What Restricts the Development of Nuclear Power in China

1. Massive investment is needed to establish nuclear power industry in economic scale;
2. Competitiveness of nuclear power over coal-fire power.

That is why today nuclear power could be developed only in the coastal area of China.

Performance of Daya Bay Nuclear Power Station

- It has supplied more than 81 TWh electricity
- to the grid since its commercial operation in 1994;
- Significantly improved performance has been achieved in nuclear safety and availability;
- It has already repaid 3.92 Billion US dollar, accounting for 72 % of its liability.

Strategy for Promoting Nuclear Power Development in China

- Nuclear power could be made competitive with coal-fired power in the coastal area of China, if nuclear safety and high availability can be achieved by consistent innovation and modern management.
- Two step-approaches could be considered for future development:
- Strategy for Promoting Nuclear Power Development in China
 - Step one:
 - To ensure nuclear safety and high availability based on existing mature technology;
 - Make nuclear power cost effective through self-reliance and localization;
 - Strategy for Promoting Nuclear Power Development in China
 - To set up national nuclear power industry through the construction of a series of standardized of 8 to 10 units;
 - Step two:
 - To switch to new generation of reactors when technology is commercially available;

Promote Nuclear Power Development for Our Sustainable Future