Perspectives on Power Grid Interconnection in Northeast Asia

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Outline

- Benefits of interconnection
- Power systems in Northeast Asia
- Proposals for NEA interconnections
- Issues for NEA interconnections
Driving Forces for Interconnection

- Economical
  - Utilization of most favorable energy resources
  - Use of larger and more economical power plants
  - Flexibility of building new power plants at favorable locations
  - Sharing generation to take advantage of non-coincident load demand
  - Cost reduction through joint economic dispatch.
  - Sharing spinning reserve
Driving Forces for Interconnection

- Environmental
  » Coordinated use of environmentally friendly resources
  » Replacing resources with adverse environmental effect.
  » Generating electricity away from population.
- Reliability
  » Providing emergency support.
  » Strengthening network connection
- Others
  » Stimulating economic cooperation and growth.
  » Technology transfer
Power Systems in Northeast Asia

- China
- Russia
- Japan
- South Korea
- North Korea
- Mongolia
Power Systems in China

- Sustained annual growth 8-12% in the last decade.
- Significant foreign investment.
- Load centers are away from resources.
- Growing interconnection.
Installed Capacity (MW)
Demand Growth

- 1990: 100
- 2000: 200
- 2010: 800
- 2020: 1000
- 2050: 1600

The graph shows the projected demand growth from 1990 to 2050, with a significant increase by 2050 compared to 1990.
Regional Demands
Sources of Generation

- Thermal: 82%
- Hydro: 17%
- Nuclear: 1%
Resources and Loads

82% of coal in North and Southwest
70% of consumption in Central and Coastal areas
67% of hydro in Southwest
National Interconnected Power Network
Russia

- Negative load growth
- Abundance in resources
  - 38% world gas reserve
  - 13% world oil reserve
  - 12% world coal reserve
- Interconnected networks
Electricity Production in CIS

The chart shows the electricity production in CIS from 1991 to 1997. The production levels are shown in units, with the years listed on the x-axis and the production levels on the y-axis.
Energy Sources

- Thermal: 68%
- Hydro: 21%
- Nuclear: 11%
- Gas: 56%
- Coal: 29%
- Oil: 15%
East Siberia

- **Surplus capacity in electricity**
  - Installed capacity 33GW
  - Planned to supply Urals and European part of Russia, but unused.

- **Natural resources**
  - Hydro
Japan

- Heavy electric consumption
- Stable economy
- Poor in fuel resources
  » Imports oil and gas
- High price of electricity
  » 19c/kwh
South Korea

- Considerable growth
  - High growth in recent years
  - Moderate growth in the future

- Poor in fuel resources
  - Importer of oil and gas
North Korea

- Slow load growth
- Some natural resources
- 50% thermal 50% hydro
Mongolia

- Electric system covers only central and part of western areas
- Low level of consumption and low growth.
- Thermal plants
Northeast Asia Countries

- **Difference in stages of economic developments**
  - Electricity consumption varies and growth varies too
  - Maturity in power system developments is different, hence difference in operation and control requirements

- **Difference in natural resources**
  - Sources of electric generation varies

- **Long distance interconnection is required.**
  - Several thousand kilometers
Northeast Asia Interconnection
Russia-Japan

- Siberia-Sakhalin-Hokkaido-Honshu
- Ushurk hydro (Komsomolsk on Amur)
- 10GW
- ± 650kV HVDC
- Utilizing non-coincidental peak
  » Supply Japan’s summer peak
Russia-China-Korea

- Primorsk-Shenyang-Seoul
- 1800km
- +500kV HVDC, 3GW
- Utilizing non-coincident peak
  » Supply South Korea summer peak
Russia-Mongolia-China

- Bratsk HPP-Irkustsk-Ulan Bator-Tangshan
- $+600kV$ HVDC, 2500km, 3GW
- Utilizing hydro to supply growing demand in North China
Issues in NEA Interconnection

- Economical dimension
  » Resources
- Institutional dimension
  » Effect of power market
- Environmental dimension
  » Sustainable development
- Technical dimension
  » Technical feasibility
- Political dimension
  » International cooperation
  » Energy security
- Financial dimension
  » Investment