Perspectives on Power Grid Interconnection in Northeast Asia

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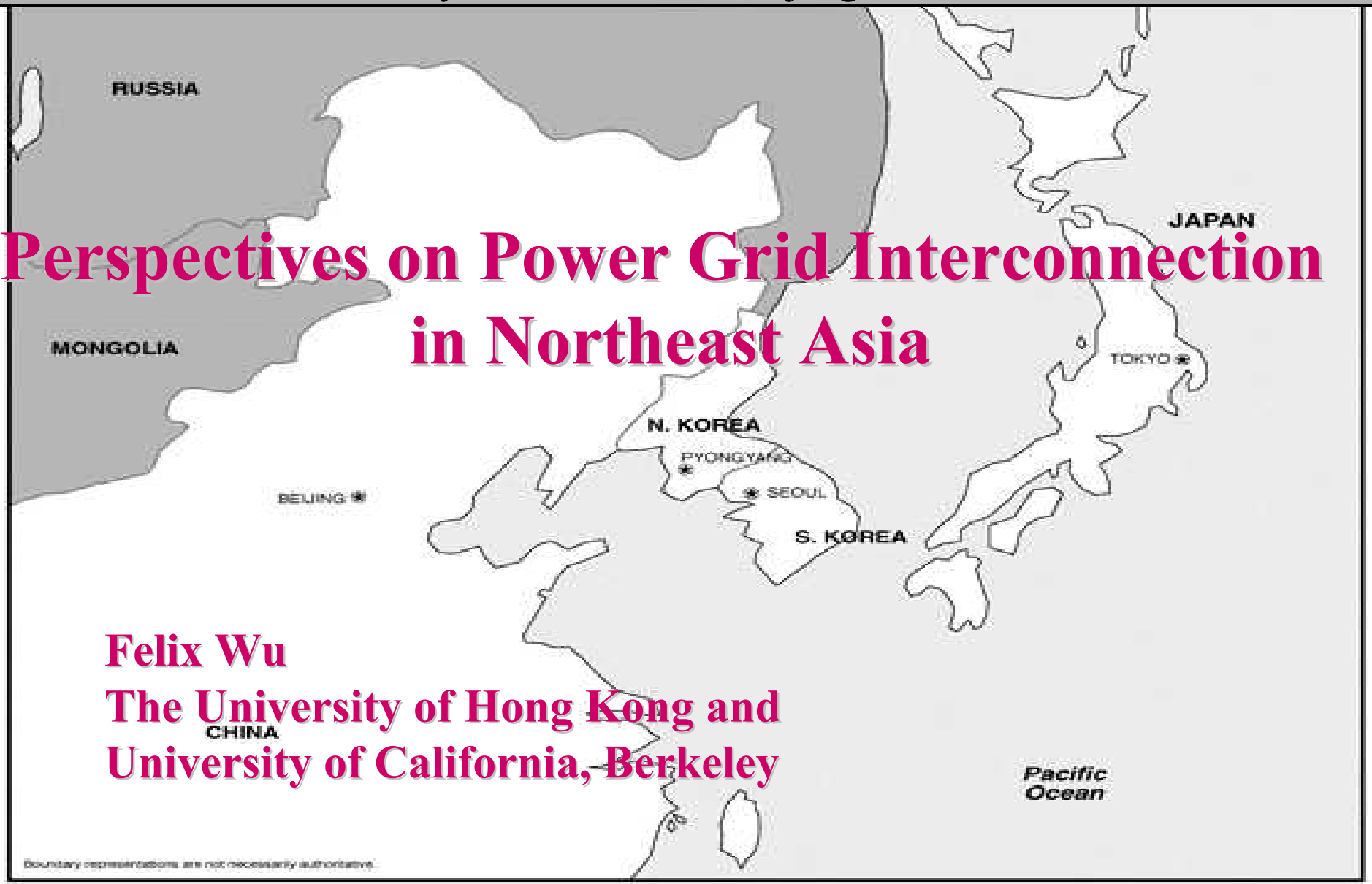


Nations of Northeast Asia

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-coincidental 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

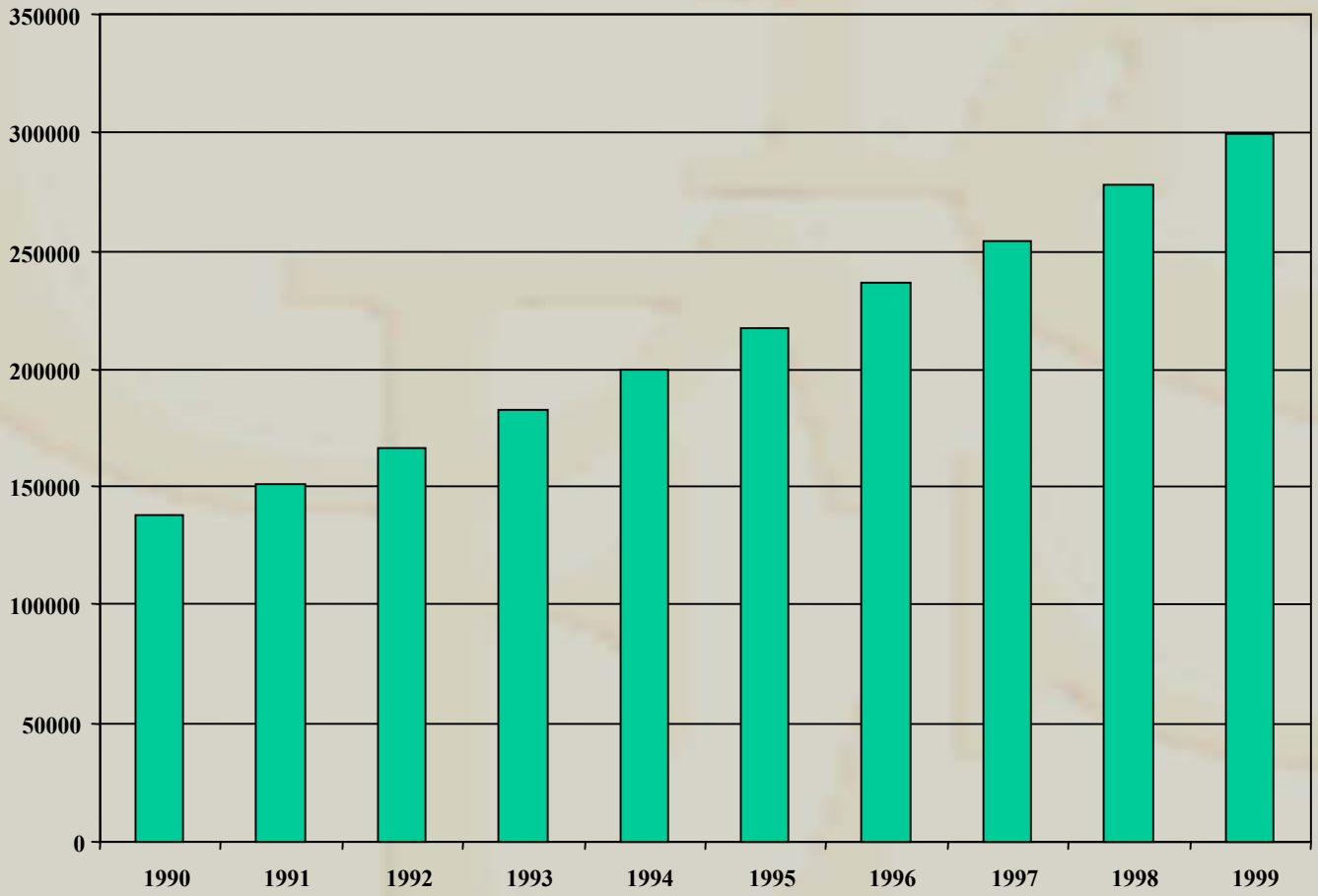
Power Systems in Northeast Asia

- China
- Russia
- Japan
- South Korea
- North Korea
- Mongolia

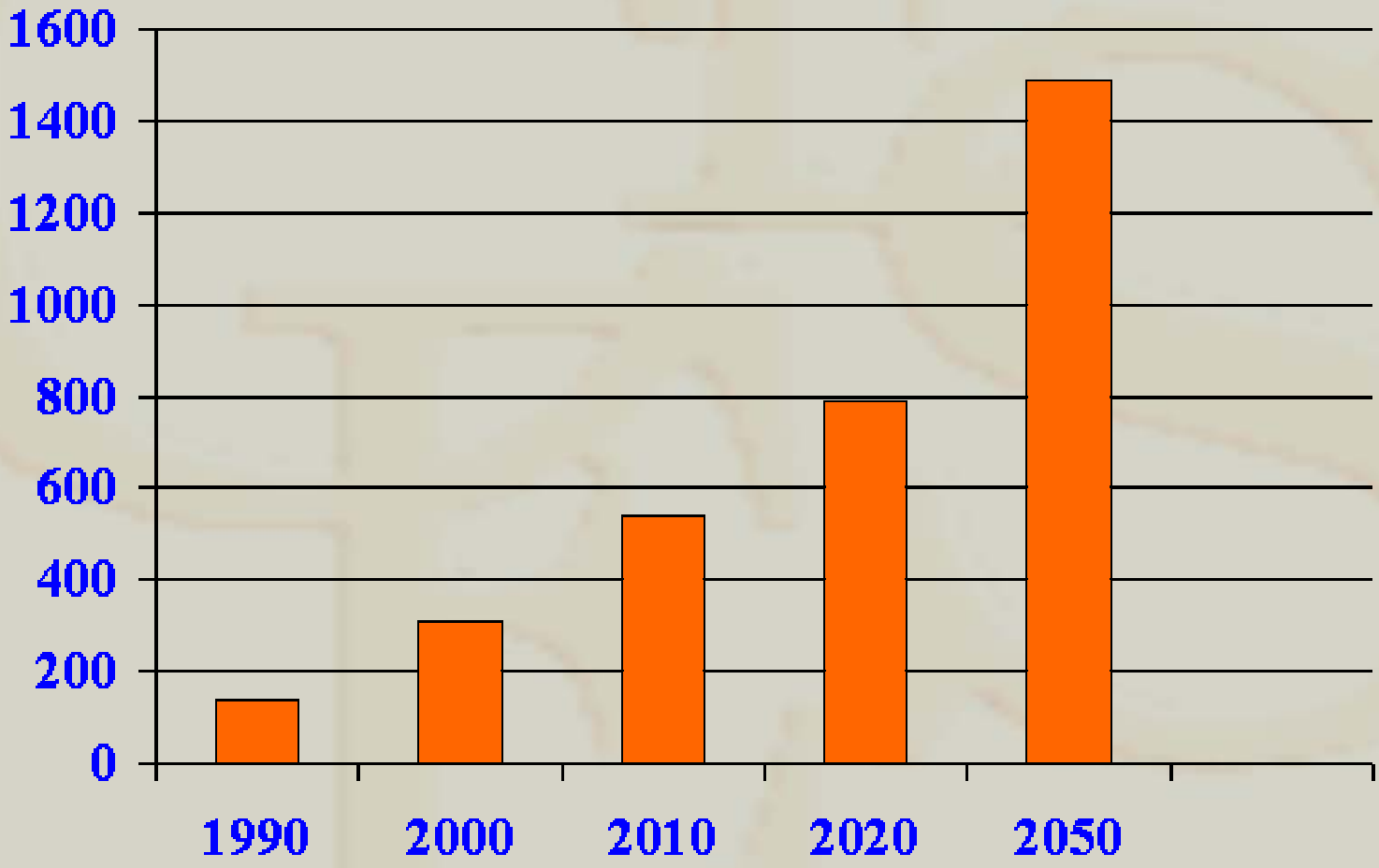
Power Systems in China

- Sustained annual growth
  8-12% in the last decade.
- Significant foreign investment.
- Load centers are away from resources.
- Growing interconnection.

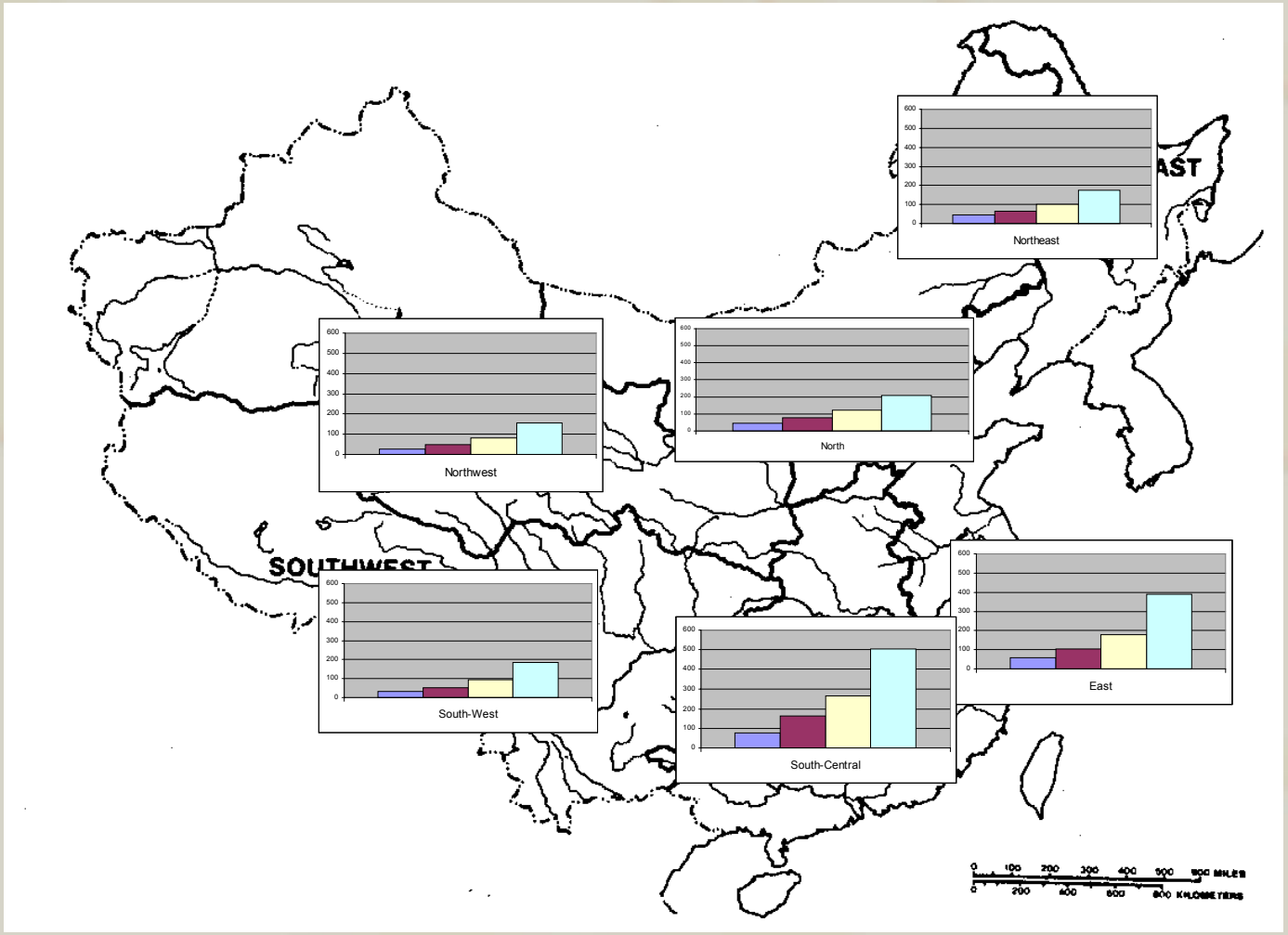
Installed Capacity (MW)



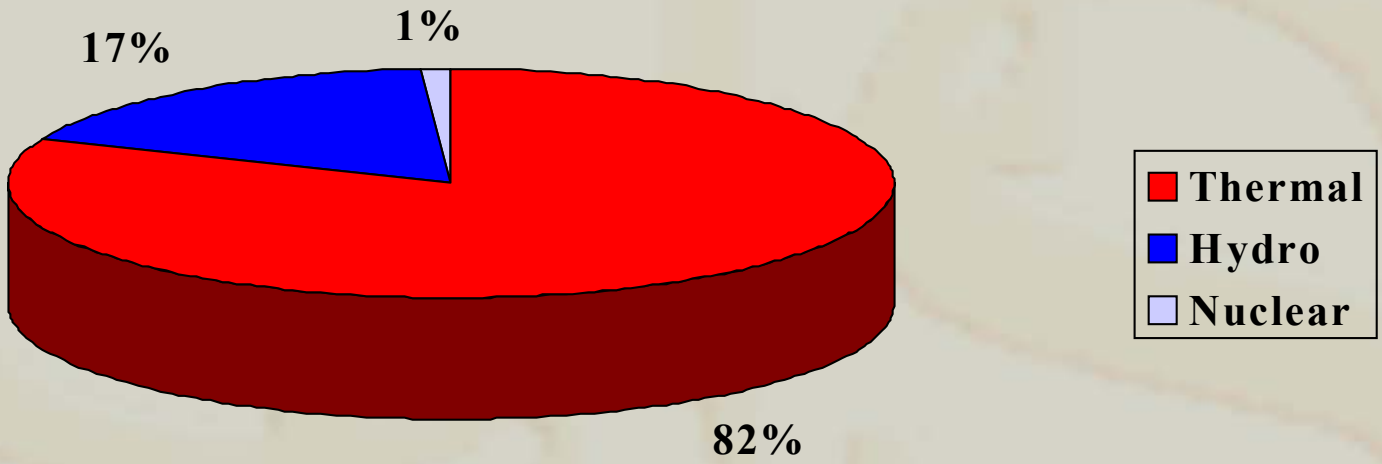
Demand Growth



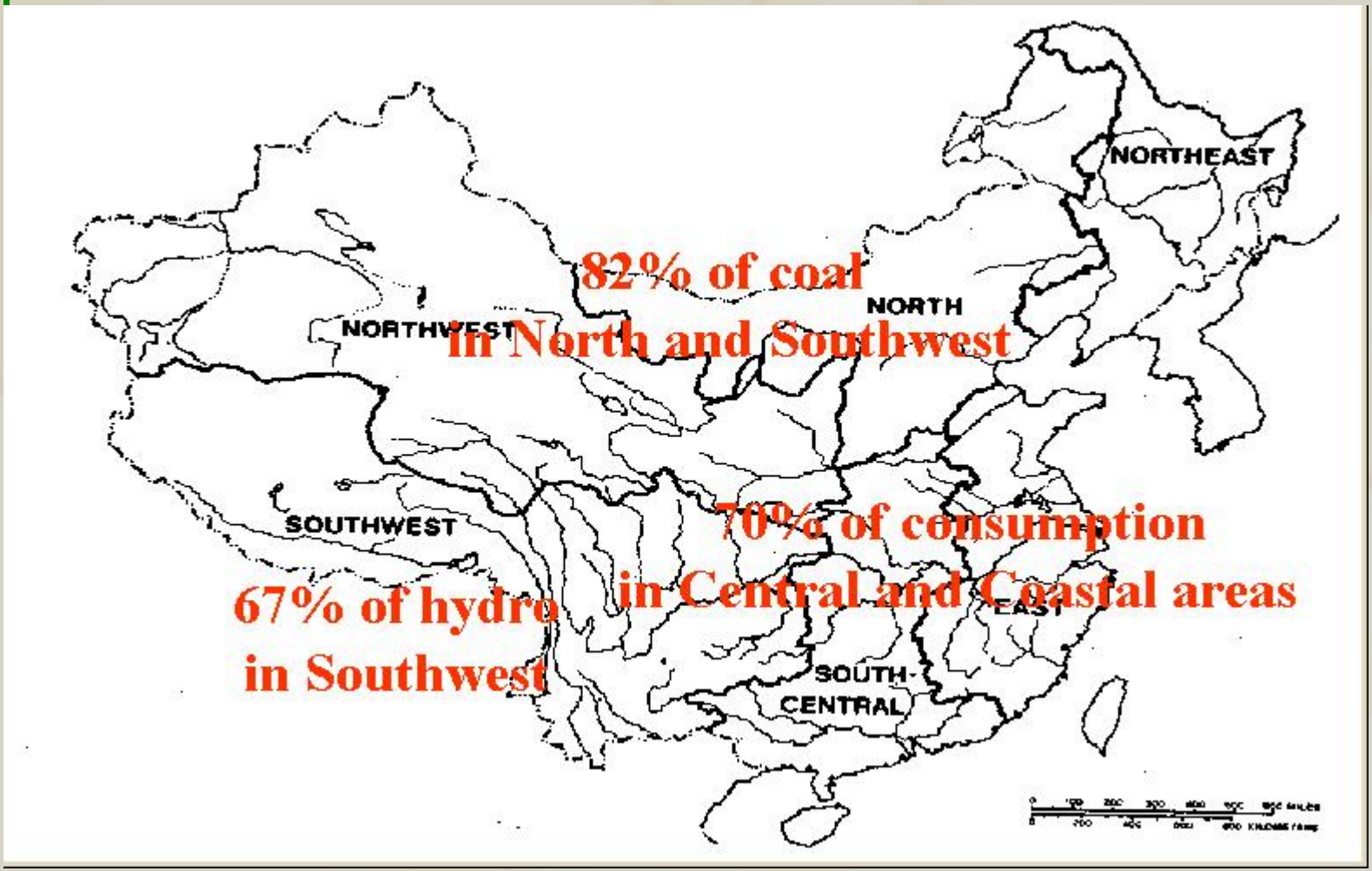
Regional Demands



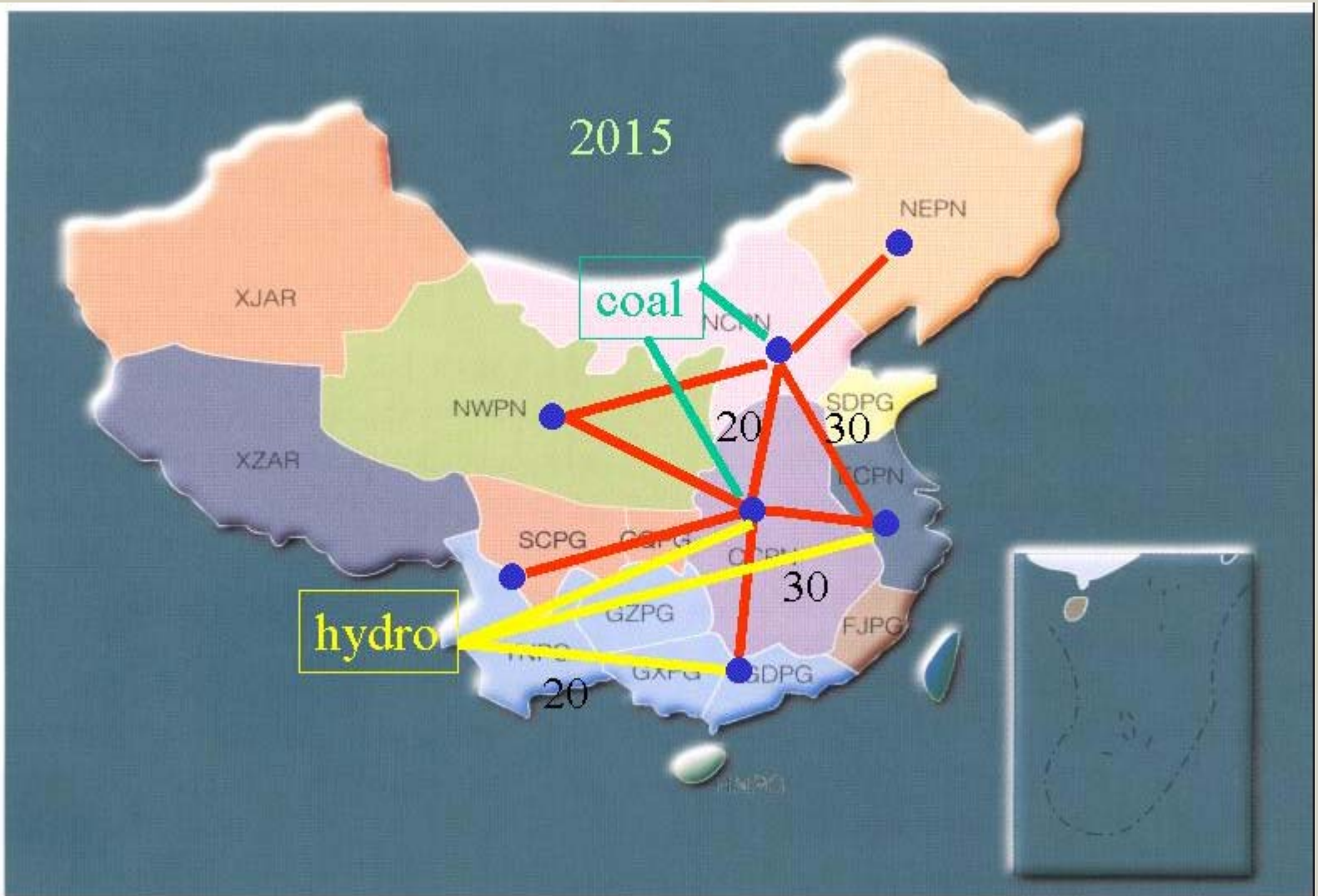
Sources of Generation



Resources and Loads



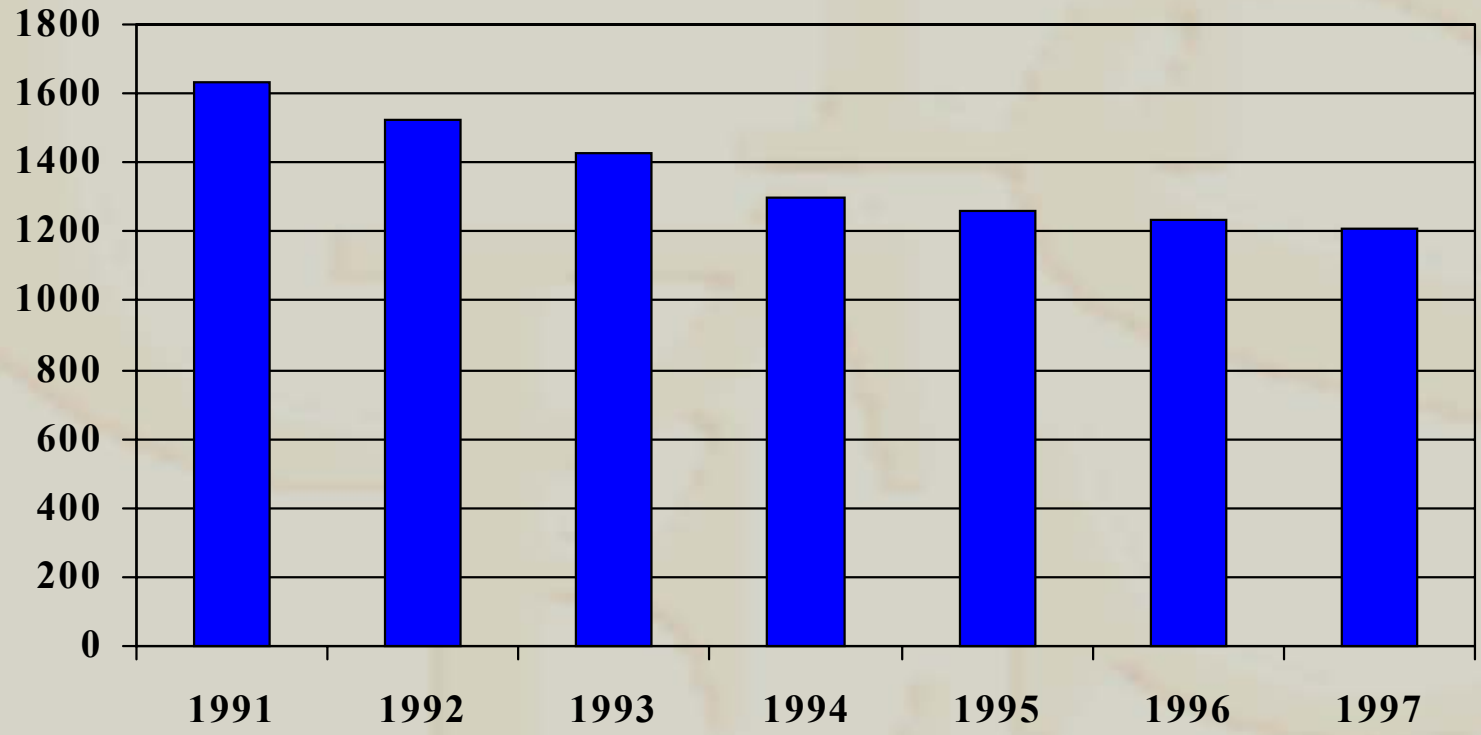
National Interconnected Power Network



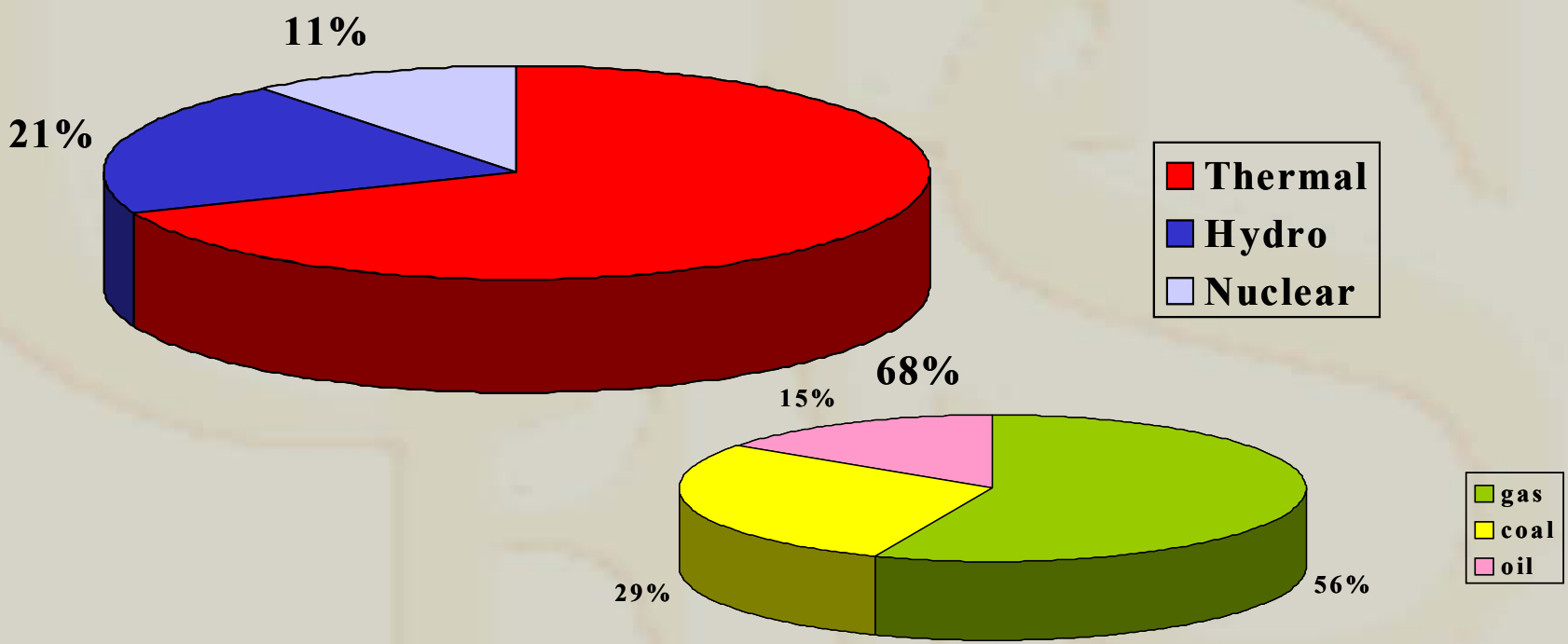
Russia

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

Electricity Production in CIS



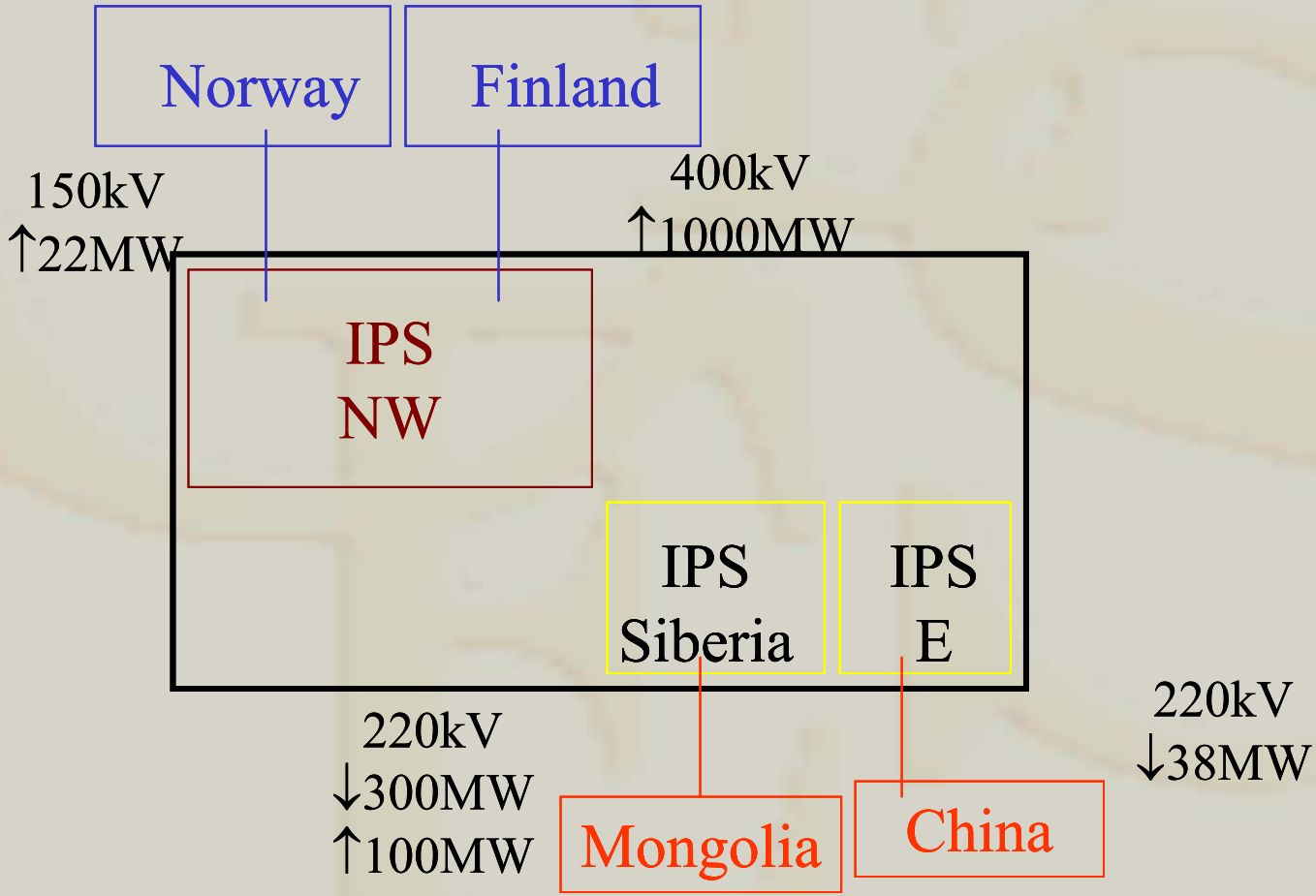
Energy Sources



East Siberia

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

International Interconnection



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

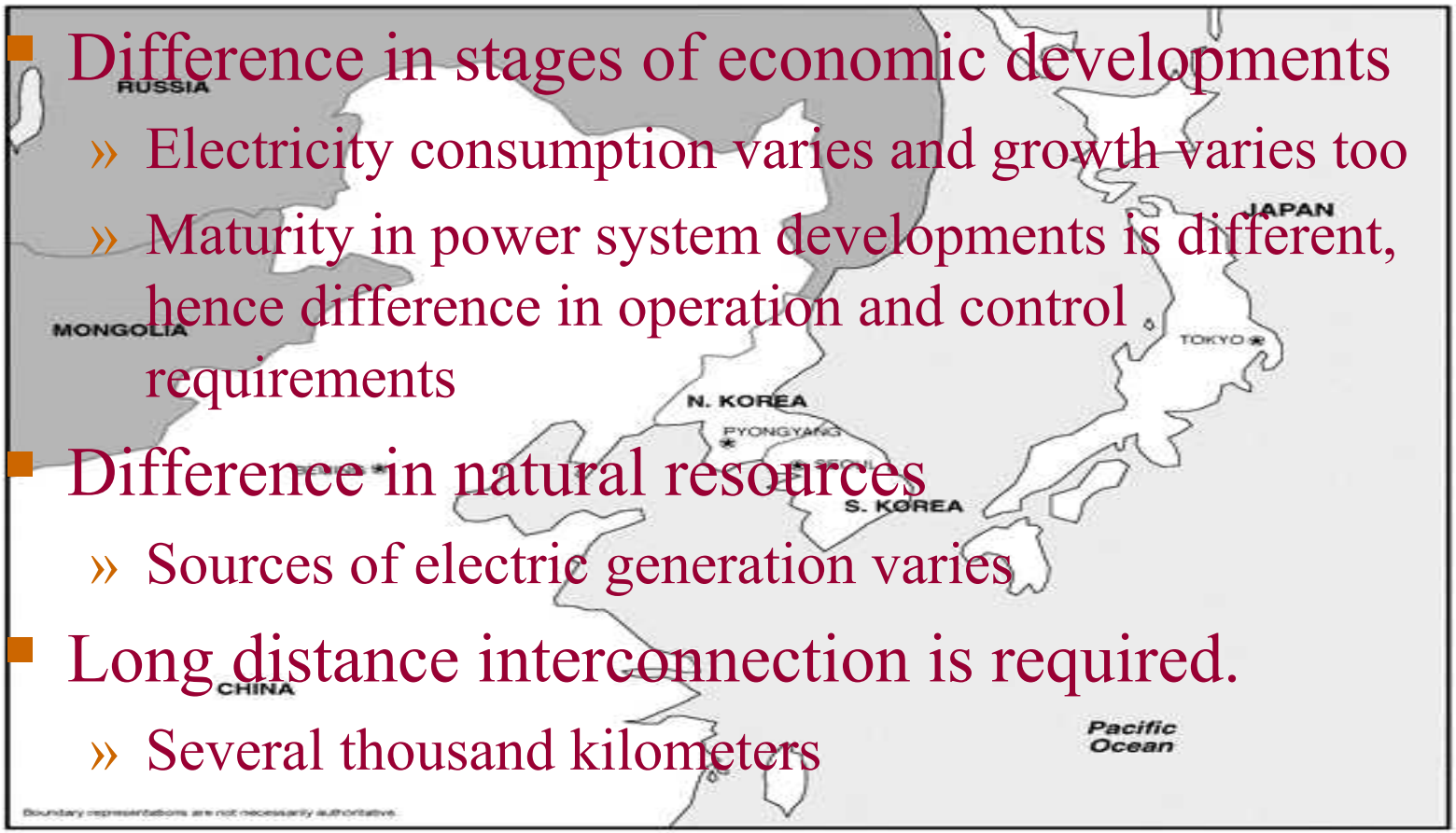
- Slow load growth
- Some natural resources
- 50% thermal 50% hydro

Mongolia

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

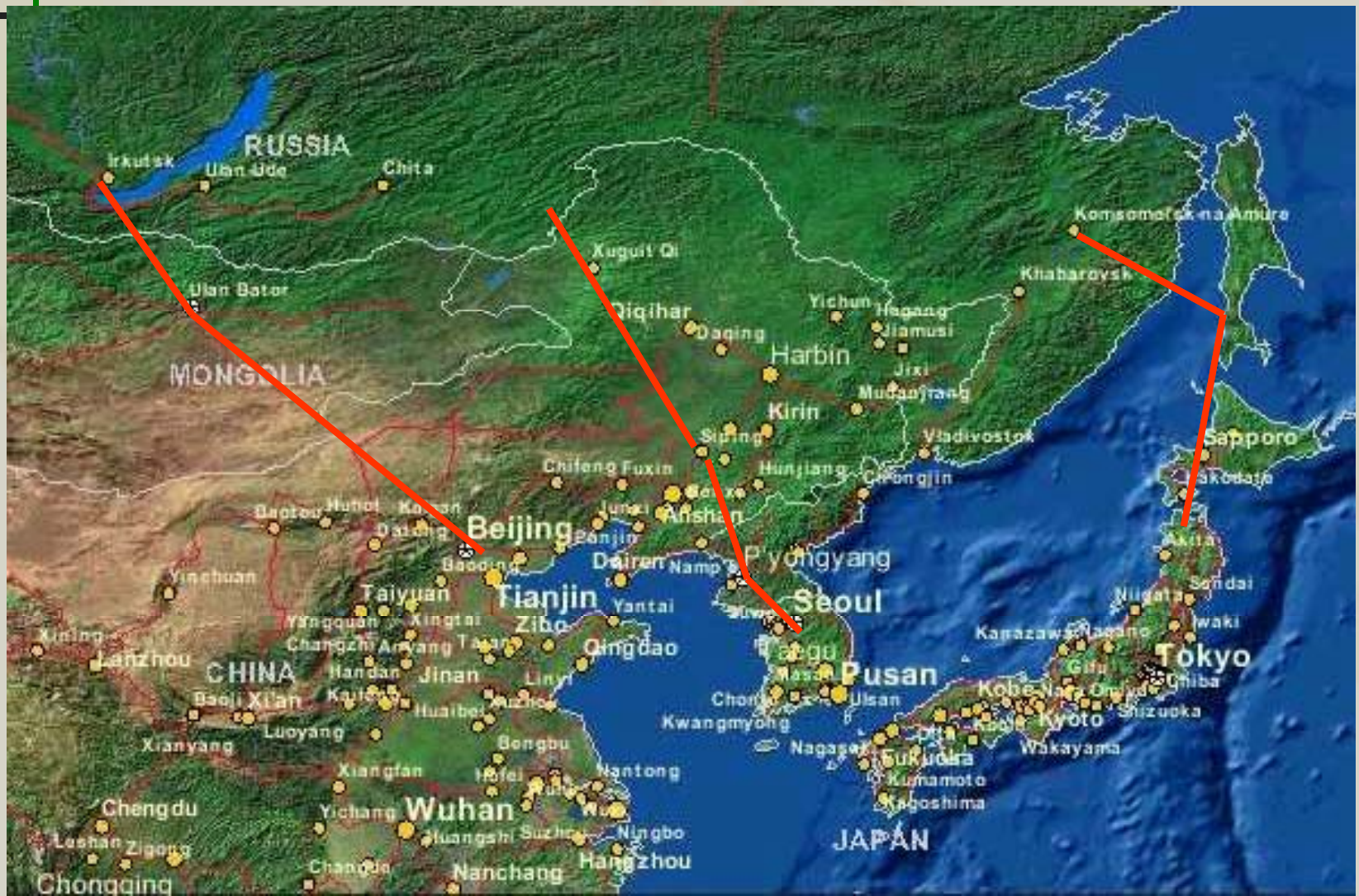
Northeast Asia Countries

- 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



Nations of Northeast Asia

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-coincidental 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