Connotation of Global Energy Interconnection and Asian Grid Interconnection

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Global Energy Interconnection Development and Cooperation Organization
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全球能源互联网发展合作组织
Global Energy Interconnection
Development and Cooperation Organization

- **Date of foundation**: March 2016
- **Mission**: Building global energy interconnection to meet global power demand with clean and green alternatives
- **Current members**: 80 members, 14 counties, 5 continents
- **17 international council member (corporate/ Individual)**
1 Challenges to World Energy Development
2 Global Energy Interconnection
3 Asian Grid Interconnection
4 Asia-Europe-Africa Grid Interconnection
5 Outlook of Global Energy Interconnection
Challenges to world energy development

Three challenges to the world energy development

Resource Constraints

- The global proved reserve for coal, oil and natural gas can only sustain for 100, 53 and 54 years respectively if the current level of exploration remains the same.

- Remaining proved recoverable reserves of global fossil energy:
  - Coal: 52% (891.5 billion ton for 110 years)
  - Oil: 28% (239.8 billion ton for 53 years)
  - Natural gas: 20% (187 trillion m$^3$ for 54 years)
Environment Pollution

• Large scale production, transportation, storage and use of fossil fuels have caused serious pollutions to air, water and soil, and posed great threat to human health.

• In many regions, the damages are beyond the capacity of the environment, depriving the self-recovering ability of nature.

The oil spill in the Gulf of Mexico

Serious smog in Beijing

Sink-Holes in Inner Mongolia

Air Pollution in Tokyo
Climate Change

- The carbon emission from fossil fuel is the major cause for global warming. Global temperature has risen by an average of 1℃ since industrial revolution.
- If no actions were taken, global temperature rise would exceed 4℃ by the end of this century, severely threatening human existence.
- COP21 reached the agreement of holding the increase in the global average temperature to well below 2℃ and pursuing efforts to hold the temperature increase to 1.5℃ by the end of this century.

Atmospheric carbon dioxide concentration and surface average temperature rise

Melting of glaciers in the Arctic
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Main countermeasures – two replacements

Clean Replacement
Clean replacement on the generation side, replacing fossil energy with clean energy such as solar, wind and hydro energy.

Electricity Replacement
Electricity replacement on the energy consumption side, replacing coal, oil and gas by electricity, drastically reducing the direct combustion of fossil fuels.
Global Energy Interconnection (GEI) is a globally interconnected strong and smart electric grid, which applies ultra-high voltage technologies to transmit and allocate green and low-carbon energies globally.
Definition of GEI

GEI = Smart Grid + Ultra High Voltage electric grid + Clean Energy

Quoted from *Global Energy Interconnection*, Mr. Liu Zhenya

**UHV Grid is the key**
- 1000kV and over AC Transmission
- ±800kV and over DC transmission

**Smart Grid is the foundation**
- Advanced transmission, intelligent control, renewable energy integration, new types of energy storage
- Remarkable flexibility and adaptability
- Integration of clean energy and distributed generation, plug-and-play of smart devices as well as smart interaction services

**Clean energy is the core**
- Centralized and decentralised generation by clean energy
- Wind energy in the Arctic
- Solar energy in the Equatorial region
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The theoretical reserves of hydropower, wind power and solar power in Asia are 18 trillion, 500 trillion and 37,500 trillion kWh/year respectively. **Large hydropower bases** are located in southwest China, Russian Far East, Siberia, Southeast Asia and the Mekong region, **Wind power bases** in China "Three North" region, Russian Far East, central and western Kazakhstan, southeastern Mongolia and **Solar power bases** in Qinghai-Tibet Plateau, southern Xinjiang, southern Kazakhstan, central and southern Mongolia, as well as Saudi Arabia and Yemen.
Asia Grid Interconnection Planning

- Asia power grid is proposed composing of six grids, i.e. Northeast Asia Grid, Central Asia Grid, South Asia Grid, Southeast Asia Grid, West Asia Grid, and China Grid.
- Clean, secure, efficient and modern Asia power grid:
  - covering major large-scale clean energy bases and load centers.
  - serving as a platform of optimizing the allocation of clean energy resources.
  - bringing about complementation between wind, solar, and hydro power.
- UHV/EHV technologies will be used to built robust synchronous grids in each region.
- UHV AC or DC technologies will be used in trans-regional connectivity projects.

- In the East: connected with the North American Grid via Bering Strait
- In the South: receive equatorial solar energy in Oceania
- In the West: interconnect with the European Grid via Central Asia and receive equatorial solar energy in North Africa.
The figure shows the diagram of interconnection and coverage area. The transmission method and voltage level should be studied further.
In the Global Energy Interconnection conference in 2016, SGCC has signed the Memorandum of Understanding of joint promotion of an interconnection electric power grid spanning northeast Asia with Korea Electric Power Company, Softbank and Russia Electric Company and achieved a consensus of cooperation.
Mongolia - China - South Korea - Japan interconnection project

Adopting UHV/EHV DC Technology to formulate the project which will transmit the renewable energy from Mongolia to the load center of Northeast Asia. The sending terminal is located in Mongolia and receiving terminals are located in China, South Korea and Japan.
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The trend of transcontinental power flow pattern among Asia, Europe and Africa in 2030 will be as:
Asia-Europe-Africa interconnection is characterized by four latitudinal and three longitudinal interconnections

- Between Asia and Europe: two latitudinal channels
- Between Asia and Africa: two latitudinal channels
- Between Europe and Africa: three longitudinal channels
Projects under Study

A. Turkey-Iran DC back-to-back project:
   - 1.2 GW converter station in Turkey
   - Two 400kV AC lines to Iran

B. Israel-Cyprus-Greece interconnection project:
   - ±400kV submarine cable
   - 1520km
   - 2GW

C. Tunisia-Italy ±400kv DC project:
   - 1250km
   - 2GW

D. Portugal-Morocco networking project:
   - 220km
   - 1GW
Existing grids Interconnection

<table>
<thead>
<tr>
<th>Region</th>
<th>Area (10,000km²)</th>
<th>Installed Capacity (GW)</th>
<th>GDP (USD Trillion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern North America Synchronous Power Grid</td>
<td>520</td>
<td>760</td>
<td>11.7</td>
</tr>
<tr>
<td>European Continent Synchronous Power Grid</td>
<td>350</td>
<td>700</td>
<td>13.3</td>
</tr>
<tr>
<td>Russia-the Baltic Sea Interconnected Power Grid</td>
<td>2300</td>
<td>200</td>
<td>3</td>
</tr>
<tr>
<td>&quot;North China-East China-Central China&quot; Power Grid</td>
<td>268</td>
<td>670</td>
<td>7.7</td>
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</table>
Transcontinental backbone network

GEI is a feasible solution.

Global Energy Interconnection

Global Transport Network (Airlines)

Global Telecommunication Network
### Roadmap of the development of GEI

#### Three phases to develop GEI:

<table>
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<tr>
<th>Now</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
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**Phase I: Intracontinental interconnection**
- Promote formation of a consensus before 2020
- Develop, deliver and consume clean energy via intracontinentally interconnected grids
- Fast development of transnationally interconnected grids.

**Phase II: Transcontinental interconnection**
- Large-scale development of wind energy bases in the Arctic region, solar energy bases in the equatorial region and other key clean energy bases worldwide
- Economic benefits from sharing energy resources across continents become more prominent. A globally interconnected network begins to take shape

**Phase III: Global interconnection**
- Full development of solar, wind and other clean energy bases
- Clean energy takes the lion’s share of power generation by replacing fossil fuel fired generation
- Sharp decline in the development, delivery and consumption of fossil energies
## Way forward

### Extending the coverage of research

The establishment of GEI involves not only technical issues, but politics, economy, environment, investment and other areas as well.

<table>
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<tr>
<th>Energy policy</th>
<th>Different countries have different energy policies. The development of GEI needs research and coordination of policies of different countries.</th>
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<tr>
<td>Business model</td>
<td>An open, interactive, sharing and win-win business model is needed, such as the apportionment of cost of transnational and transcontinental power grid projects and income sharing mechanism, electric power price, tax, settlement and other market operation mechanisms.</td>
</tr>
<tr>
<td>Geopolitics</td>
<td>Changes in the world energy pattern will have a significant effect on the geopolitics. A new geo-political pattern characterized by cooperation and win-win should be established.</td>
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<td>Climate change</td>
<td>The trend of climate change should be continuously tracked and researched, different countries should work together and provide support to cope with climate change. Obviously, the development of GEI is a way forward.</td>
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Promotion of innovation

• The development of GEI relies on technical breakthroughs. R&D on power supply, power grid, energy storage, information communication etc. should be greatly enhanced.

• Applications of ultra-high voltage technologies, intelligent control, clean energy generation, energy storage and other advanced technologies should be speeded up.

• Cloud computing, big data, Internet of Things, mobile internet and other technologies should be used in the power industry more widely.

• The construction of smart grids should be continued and demonstration projects on transnational and transcontinental interconnection should be started in due course.
Acceleration of clean energy development

- The construction of clean energy bases should be accelerated.
- GEI makes it possible to transmit clean energy from remote areas and hence more clean energy will be consumed.
Thank you!