Accelerate Global Energy Interconnection
Jointly Open up a New Chapter of China-Africa Energy and Power Cooperation

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Distinguished leaders and guests, welcome to the 2019 Global Energy Interconnection & China-Africa Energy and Power Conference
Grave global challenges, such as resource depletion, environmental pollution, climate change, poverty and health issues are threatening the very survival and development of mankind. The root cause is over reliance on and huge consumption of fossil fuels.
On September 26, 2015, Chinese President Xi Jinping proposed discussions on establishing Global Energy Interconnection (GEI), to facilitate efforts to meet global power demand with clean and green alternatives at UN Sustainable Development Summit, suggesting China's solution to promote global energy transition and sustainable development.
Global Energy Interconnection Initiative

- GEI is an important platform for large-scale development, transmission and utilization of clean energy around the globe, which can be defined as "Smart Grid + UHV Grid + Clean Energy".

**Foundation**
- Smart Grid

**Key**
- Ultra High Voltage (UHV) Grid

**Priority**
- Clean Energy
Global Energy Interconnection Initiative

- China has been putting a lot of efforts in developing UHV technology, and built the world's largest UHV AC and DC hybrid power grid.

- Chinese UHV technology was successfully applied in Brazil.

10 UHV AC projects and 14 UHV DC projects have been put into operation.

4 UHV AC projects and 4 UHV DC projects are under construction.

Phase I: put into operation in late 2017

Phase II: put into operation in October 2019

The UHV grid in China
Building GEI will help deliver on the 2°C and even the 1.5°C target of Paris Agreement with low cost, few investment and optimal mitigation pathways.

Offering a package of systematic solutions that is technologically feasible, economically competitive, viable, scalable and quantifiable to accomplish the UN 2030 Agenda.
Achievements in GEI Development

- Reach broad consensus
  - We held over 500 international meetings, the GEI initiative in a large scale.
  - GEI has been incorporated into the frameworks of promoting the BRI, the UN 2030 Agenda, *Paris Agreement*, global environmental protection, and addressing power access, poverty and health issues.
Achievements in GEI Development

Specify the development paths

• Propose theories such as "Two Replacements" and "Integration of Energy, Information and Transportation “.

- **Clean Replacement**
  In the energy production side, replace fossil fuels with clean energy such as hydropower, solar and wind

- **Electricity Replacement**
  In the energy consumption side, replace coal, oil, gas and firewood with electricity generated from clean energy

The integrated development of energy, information, transportation networks
Achievements in GEI Development

**Specify the development paths**

- Dozens of reports have been released globally, and the GEI top-level design has been completed generally.

### Achievements in GEI

<table>
<thead>
<tr>
<th>Action Plan</th>
<th>Strategy Research</th>
<th>Planning Research</th>
<th>Technology and Equipment</th>
</tr>
</thead>
</table>
| • Global Energy Interconnection Action Plan to Promote the UN’s 2030 Agenda for Sustainable Development  
• GEI Action Plan for Promoting the Implementation of the *Paris Agreement*  
• GEI Action Plan for Promoting Global Environmental Protection  
• Global Energy Interconnection Action Plan for Addressing Electricity Access, Poverty and Health Issues | • GEI Development Report on Implementing the Belt and Road Initiative  
• Global Energy Interconnection Development Index  
• Global Energy Interconnection Development and Outlook  
• Global Energy Analysis and Outlook | • Global Energy Interconnection Backbone Grids  
• African Energy Interconnection  
• Asia Energy Interconnection  
• Europe Energy Interconnection  
• North America Energy Interconnection  
• Research on Hydropower Development and Transmission in the Congo River Basin  
• BRI Countries Energy Interconnection | • GEI Technology and Equipment Innovation Outline 2018-2025  
• GEI Standard System Research 2018  
• Transnational and Intercontinental Grid Interconnection Technology and Outlook |
Achievements in GEI Development

- **Take Active Actions**
  - Propose the co-development model of Electricity, Mining, Metallurgy, Manufacturing and Trade, and prepare the establishment of African Energy Interconnection and Sustainable Development Alliance (AEISDA).
  - Huge improvements made in several interconnection projects such as China-ROK, China-Myanmar-Bangladesh, as well as Ethiopia and Gulf States.
Achievements in GEI Development

- **Pool Global Strength**
  - Members of GEIDCO have reached 756, covering 106 countries.
  - GEIDCO signed 42 cooperation agreements with the United Nations, national governments, enterprises and institutions.

### United Nations Organizations
- World Meteorological Organization
- UN Sustainable Development Solutions Network
- United Nations Department of Economic and Social Affairs
- United Nations Economic and Social Commission for Asia and the Pacific
- United Nations Economic Commission for Africa
- Secretariat of the United Nations Framework Convention on Climate Change
- United Nations Human Settlements Programme

### International Organizations
- International Center for Green Technology and Investment Projects
- African Union
- League of Arab States
- Regional Energy Integration Commission
- Latin American Energy Organization
- ……

### Government Department
- The Guinean Government
- The Ministry of Water, Irrigation and Electricity of Ethiopia
- The Ministry of Electricity and Renewable Energy of Egypt
- The Ministry of Energy of Chile
- The Ministry of Mines and Energy of Brazil
- ……

### Business Institution
- Central African Power Pool
- China General Technology Group
- Association of Power Utilities of Africa
- West African Power Pool
- Eastern African Power Pool
- Korea Electric Power Corporation (KEPCO)
- Bloomberg Philanthropies
- Royal Academy of Engineering
- International Hydropower Association
- ……
Achievements in GEI Development

- Pool Global Strength

One Board and One Committee

Advisory (Consultant) Board

Technical (Academic) Committee

Two Publications

Four Alliances

University Alliance

Think Tank Alliance

Finance Alliance

Equipment Alliance
Achievements in GEI Development

GEI provides new ideas and solutions for countries seeking the sustainable development road, and sets up a broad platform for all parties to participate in international energy cooperation. GEI is playing an increasingly important role in building a community of shared future for mankind.
The United Nations Climate Action Summit has specified the goals of 45% of emission reduction by 2030 and net-zero emission by the middle of this century, which call for actions.

Building GEI is consistent with the interests of all countries, promising a bright future.

Mr. António Guterres (UN Secretary-General), Global interconnectivity allows for inclusivity for energy to reach everybody in need. GEI is in the centre of the two central concepts (sustainability and inclusivity) of our commitment to Agenda 2030.
Deepen the Understanding of the Concept of GEI

- **Clean Energy Production**
  - Let clean energy such as hydropower, wind and solar become dominant energy.
  - Restore coal, oil and gas to their basic attribute as industrial raw material.
Deepen the Understanding of the Concept of GEI

- **Wide-range energy allocation**
  - An optimal and wide-area energy allocation layout will be in place, and the differences of *global resources, time zones, seasons and electricity prices* can be coordinated, so that clean energy will be developed in a most efficient manner.

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Solar power generation

Hydropower

Distributed electricity sources

"Energy storage across time and space" of extensively interconnected power grid

UHV Grid

Smart Grid

Wind Power

Nuclear Power

Micro-grids

The randomness and fluctuation of new energy power generation

Supply-demand imbalance
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Deepen the Understanding of the Concept of GEI

Electricity-centered energy consumption

Promote the extensive consumption of electricity in industrial, commercial, transport and residential sectors

Raise electrification rates across the society

Meet the demand of mankind by using electrofuels and raw materials
Advance innovations in key aspects

**Strategic Planning**

- Develop innovations in concept, models and planning principles of energy development, encourage various countries to improve their energy and power development plans.

**Development Concept**

Vigorously promote the construction of GEI

**Development Model**

Promote the new development model characterized by clean energy sharing and cooperation

**Planning Ideas**

Promote the UHV "heart to heart" large-capacity long-distance direct transmission

**Win-win Cooperation**

Promote the partnership featuring extensive consultation, joint contribution and shared benefits
Advance innovations in key aspects

- Project Implementation
  - Create new business models innovatively, set up a global financing platform with multiple players and channels, and speed up the implementation of projects.
Advance innovations in key aspects

- Market Operation
  - Improve cross-border power trade mechanisms, develop a flexible and efficient global electricity-carbon market, which can realize collaborative governance between climate and energy.
Advance innovations in key aspects

- **Technology and Equipment**

  - **Efficient and Clean Power Generation**
  - **±800kV Submarine Cables**
  - **±800kV VSC-HVDC Transmission**
  - **Large Capacity Power Storage**
  - **Large Power Grid Interconnection**
  - **Electric Vehicles**
The construction of GEI can be divided generally into three phases:

- **Phase One (2025):** domestic interconnection
- **Phase Two (2035):** intra-continent Interconnection
- **Phase Three (2050):** Global Energy Interconnection
Further Advance GEI Development

- With the progress and widespread application of key technologies like UHV, smart grids and clean energy, we are set to embrace significant breakthroughs in GEI.
Long-standing friendship between China and African Countries

- President Xi emphasized that China will always be a nice friend, collaborative partner and close brother to Africa. In China-Africa cooperation, both sides should leverage their respective advantages to achieve win-win cooperation.

- African Energy Interconnection, an important part of GEI, offers an essential solution to Africa's sustainable energy development, and will open up great opportunities for both Africa and China.
Accelerate the development of African Energy Interconnection

- **Huge energy development potential**
  - The per capita annual power consumption is **18%** of the global average, with average electricity price of **14 USD cents/kWh** and nearly half of the population living without electricity access.
  - African’s fossil energy has proven reserves of only **3.4%** of the world’s total, while the total technically exploitable capacity of hydropower, solar and wind are 734 trillion kWh/year, accounting for **39%** of the world’s total.

The distribution of clean energy in Africa
So Africa needs follow the road to clean development, and the core is to build the African Energy Interconnection, the main idea of which is to accelerate clean energy development in Africa, intensify power grid construction in all countries and trans-national, trans-continental interconnection, finally building an "electric highway" reaching every corner of Africa.
Congo River hydropower plays a leading role

- **Hydropower resources of the Congo river**
  - The Congo River has a theoretical hydropower reserve of about **2500 TWh/year**, and the installed capacity and annual generation capacity of the part from Kinshasa to Estuary are **110 GW** and **700 TWh**.

  ![Distribution Map of Hydropower Reserves in the Congo River](image)

<table>
<thead>
<tr>
<th></th>
<th>Installed Capacity (0.1TW)</th>
<th>Annual Generating Capacity (0.1TWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>From Kinshasa to Estuary</td>
<td>1.1</td>
<td>7000</td>
</tr>
<tr>
<td>Three Gorges</td>
<td>0.22</td>
<td>1000</td>
</tr>
</tbody>
</table>
About Congo River hydropower

### Development and Outbound Delivery Plan

Parameters of cascade hydropower stations in the lower reaches of the Congo River (represented by the water level of 175m in Grand Inga Dam)

<table>
<thead>
<tr>
<th>Project</th>
<th>Unit</th>
<th>Cascade 1</th>
<th>Cascade 2</th>
<th>Cascade 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development Methods</td>
<td>-</td>
<td>Pioka</td>
<td>Inga</td>
<td>Matadi</td>
<td>-</td>
</tr>
<tr>
<td>Regulating Performance</td>
<td>-</td>
<td>Dam</td>
<td>Hybrid</td>
<td>Dam</td>
<td>-</td>
</tr>
<tr>
<td>Installed Capacity</td>
<td>10 MW</td>
<td>3500</td>
<td>6000</td>
<td>1500</td>
<td>11000</td>
</tr>
<tr>
<td>Number of Utilization Hours</td>
<td>Hour</td>
<td>6320</td>
<td>6200</td>
<td>6110</td>
<td>6230</td>
</tr>
</tbody>
</table>

General Layout of Grand Inga Dam  
Preliminary 3D Rendering of Pioka Hydropower  
Preliminary 3D Rendering of Matadi Hydropower
About Congo River hydropower

Development and Outbound Delivery Plan

- While meeting the power demands in the local region, the hydropower can be delivered to Western Africa, Northern Africa, Eastern Africa, and Southern Africa via 11-circuit UHVDC channel, with total transmission capacity about 80 GW and annual transmission amount 500 TWh.

Competitiveness Analysis of Electricity Price for Outbound Hydropower Delivery of the downstream Congo River

<table>
<thead>
<tr>
<th>Power Transmission Direction</th>
<th>On-grid Price</th>
<th>Price Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Africa</td>
<td>4.1~7.7</td>
<td>2~6</td>
</tr>
<tr>
<td>Southern Africa</td>
<td>4.3~5.3</td>
<td>2~5</td>
</tr>
<tr>
<td>East Africa</td>
<td>5.9~7.4</td>
<td>2~5</td>
</tr>
<tr>
<td>North Africa</td>
<td>5.4~8.0</td>
<td>2~5</td>
</tr>
</tbody>
</table>

Unit: US cent/kWh

Overall scheme for trans-regional power transmission of the downstream Congo River
Building African Energy Interconnection has promising benefits

- **Promote Clean Development**
  - By 2050, Africa will have a total installed capacity of 1.3TW, of which about 80% will be from clean energy sources.

- **Reduce Power Costs**
  - The electricity costs will be reduced by about half. The power coverage in Africa will expand to above 90%, basically allowing everyone to have access to sustainable energy.

- **Enhance Political Mutual Trust**
  - Shared clean energies, power interconnection and cross-border and inter-continental trading can be realized among countries, which will potently promote the cooperation in energy and economy and improve political mutual trust.
Accelerate Co-development of Electricity, Mining, Metallurgy, Manufacturing and Trade

- Due to limited investment and guarantee ability of many African countries, also due to the lack of market and technology, it’s difficult to raise funds for large projects.
- So abundant clean energy is lost, and mineral resources cannot be processed due to lack of electricity, which are exported as primary products.
Accelerate Co-development of Electricity, Mining, Metallurgy, Manufacturing and Trade

- Co-development model of Electricity, Mining, Metallurgy, Manufacturing and Trade

  • Integrate Africa's advantages in clean energy and mineral resources, and shape an industrial chain featuring coordinated development of electricity, mining, metallurgy, manufacturing and trade. Shape a virtuous circle of "investment-development-production-export-reinvestment".
Co-development model of Electricity, Mining, Metallurgy, Manufacturing and Trade

- African countries
- Mineral Resources
- Clean Energy
- Overall Development
- Power generation
- Power transmission
- Power utilization
- multi-party contracts
- Enterprise cluster
- Benefit sharing
- Risk sharing
- Mutual support
- Financing
- banking consortium
- consortium
- social capital

• By 2050, the total output value of smelting and processing industries such as electrolytic aluminum and steel will exceed **480 billion USD**, exports will exceed **100 billion USD**, and more than **100 million jobs** will be created.
Build a cooperation platform

- We Initiated African Energy Interconnection and Sustainable Development Alliance (AEISDA), offering a cooperation platform for governments, enterprises, financial institutions and other parties. Currently there are over 20 countries and over 80 world-renowned enterprises that have applied to join AEISDA.

- The following China-Africa Energy and Power Conferences will be held in China and Africa in turn regularly, which will promote in-depth exchange and cooperation between China and African countries.
In a word, accelerating the construction of African Energy Interconnection and implementing the co-development of “electricity, mining, metallurgy, manufacturing and trade” offer a "package" of solutions for the realization of the AU's Agenda 2063, for the construction of a new Africa that is green, prosperous, peaceful with people enjoy happiness and the building of a closer China-Africa community with a shared future.
Working Together For A Better Future