



From Microgrids to Global Interconnection: The Electricity System of the Future

State Grid Corporation of China
Global Energy Interconnection Development and Cooperation Organization
North America Representative Office

Mengrong CHENG

Sept. 11th 2018



Overview

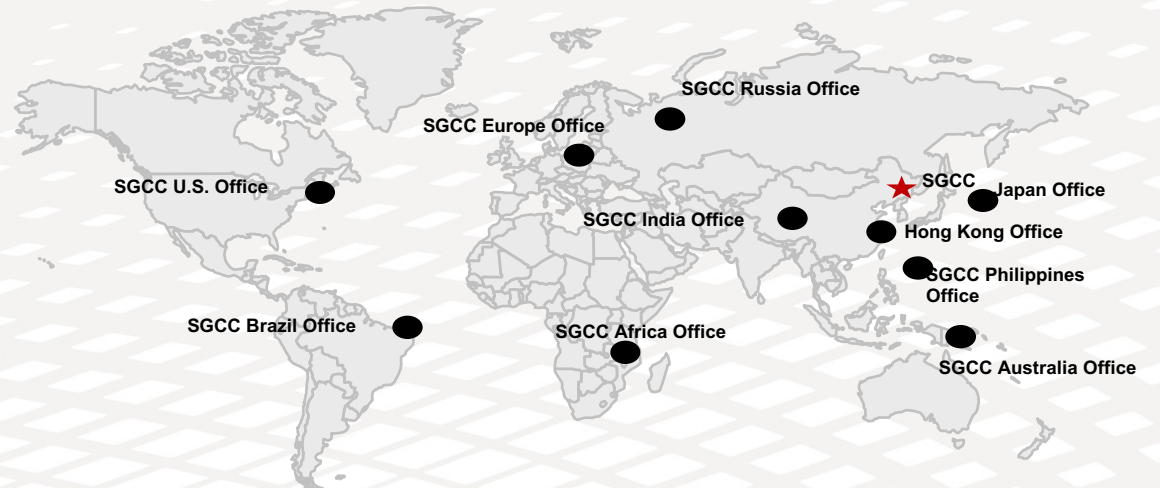
- Established in 2002 to develop and operate power networks, transmitting, distributing and supplying electricity to over 1.1 billion people in China
- SGCC is the largest utility in the world
 - Asset base over \$590 billion as of 2017
 - Revenue over \$350 billion in 2017, ranking 2nd on 2017 Fortune Global 500
- SGCC now has a global presence with 10 offshore offices, operating \$65 billion overseas asset in 7 countries with local partners
- SGCC has world-leading technological capabilities and extensive management experience in different regions
- It operates and manages the world's first, largest and most technologically extensive ultra-high voltage AC/DC hybrid power grid

Extensive coverage in China



- Over 1.1 billion people
- Cover 26 provinces
- 88% of the national territory

Worldwide presence

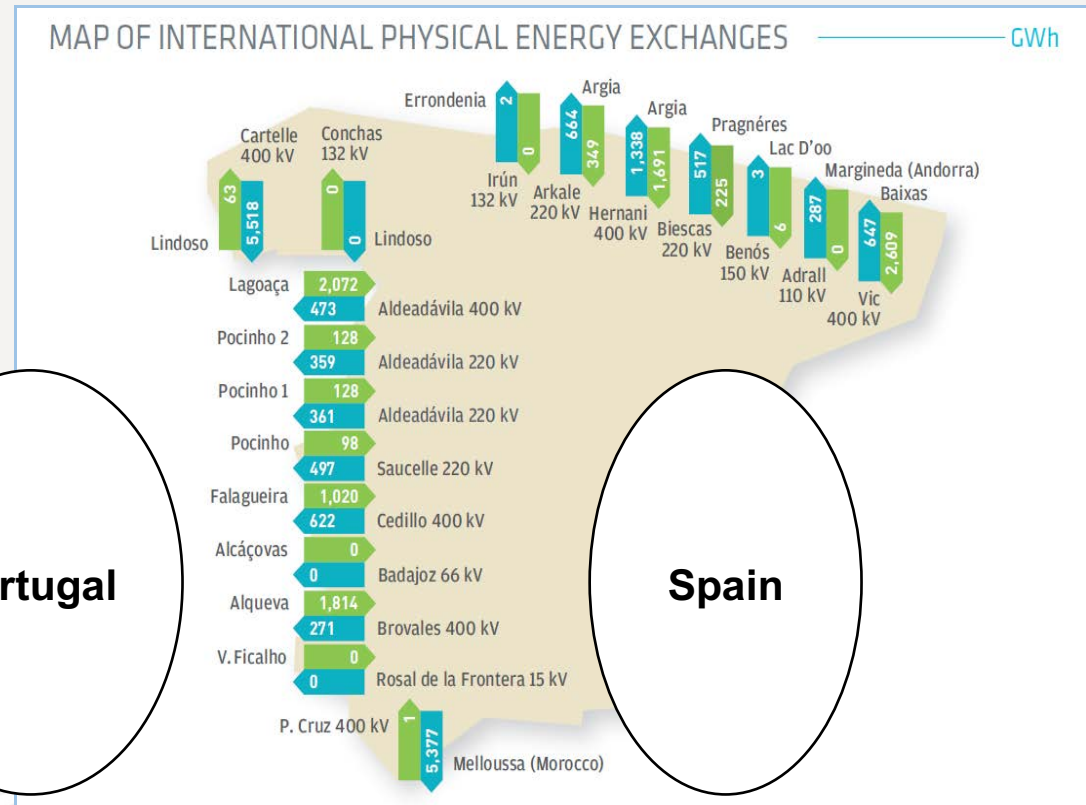


Case 1 : High penetration of RE in Portugal



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

Portugal ran on solar, wind and hydropower energy for 107-hours straight from 6:45 a.m. May 7 to 5:45 p.m. May 11, 2016



Solar: 577 MW

Wind: 5049 MW

Hydro: 6.17GW

Peak load: 8.62 GW

Case 2: Qinghai Province, CHINA



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

During the 9 days from June 20th to 28th, 2018, power demand of the whole Qinghai Province was totally covered by clean energy including hydro, solar and wind.

- ❑ Total Generation: 2.1 TWh
- ❑ Maximum Load: 8.54GW
- ❑ Average Load: 8.15GW
- ❑ New energy capacity: 10.7GW



Case 3: Jiangsu Province, CHINA



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

A new record high peak load of Jiangsu Province was 102.26GW, on August 8th, 2018.

20% of the peak load was satisfied by 4 UHVAC and DC transmission projects, which are delivering bulk power from North and West China all the way down to Jiangsu Province.

Without cross-provincial and regional grid interconnections, there would have been severe shortage of power supply in Jiangsu Province.



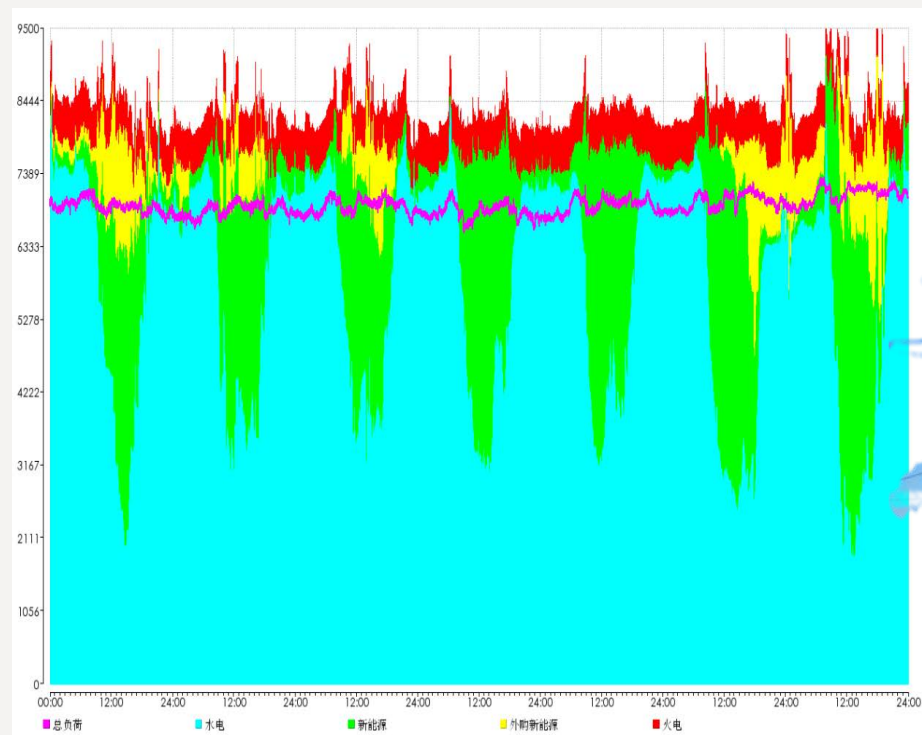
Main Takeaways from these 3 cases



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



Clean energy is trending



High penetration of clean
energy is feasible

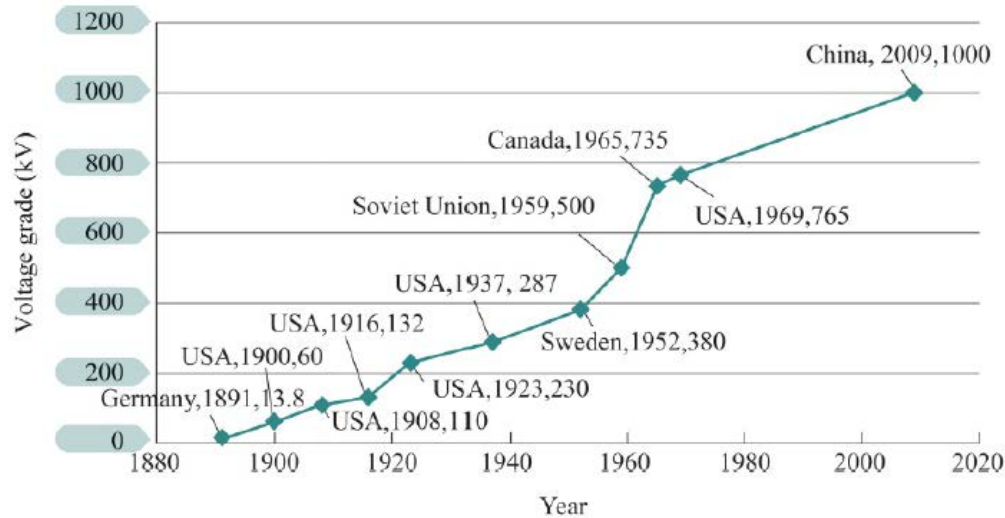


Grid interconnectivity is of great importance
to accelerate deployment of clean energies

Breakthrough of UHV technology in China



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



Ultra-high voltage:

> 1000kV AC; $\geq \pm 800$ kV DC

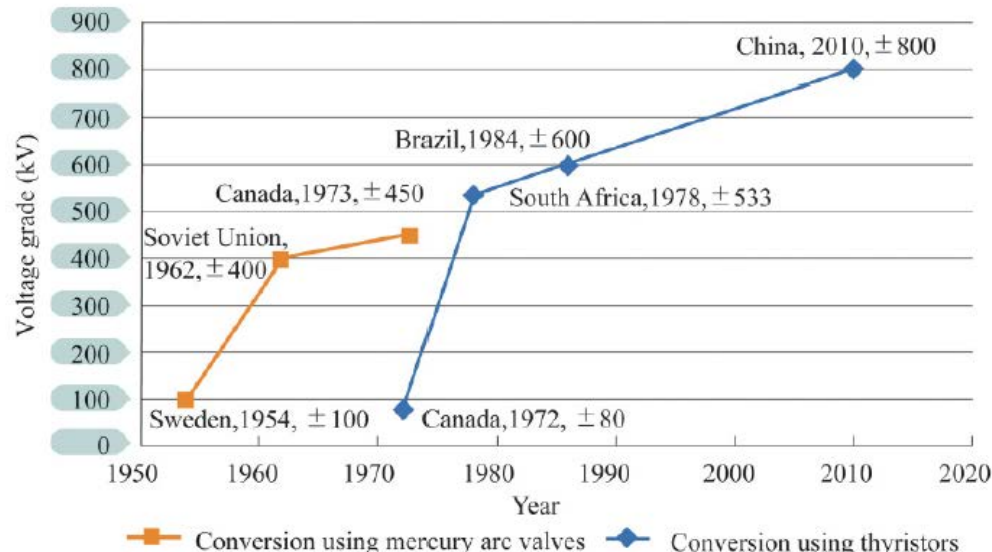
■ 1000kV AC

- ✓ Transmission capacity: 5GW
- ✓ Transmission length: 1000-2000km

■ ± 800 kV DC

- ✓ Transmission capacity: 10GW
- ✓ Transmission length: 2000-3000km

State Grid Corporation of China has made major breakthroughs in UHV AC and DC technologies since 2004.



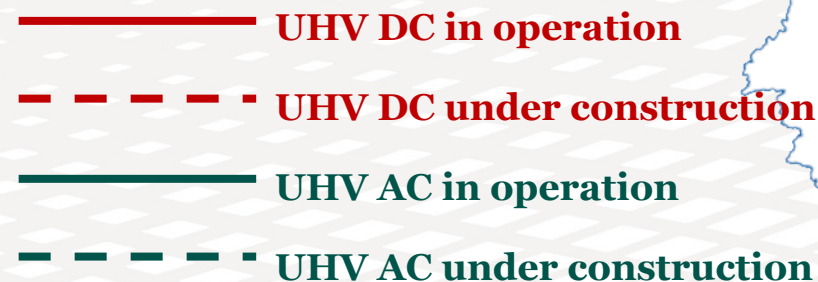
Breakthrough of UHV technology in China



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

UHV grids are becoming energy highways through which electricity is transmitted from China's West to East and from North to South

- **21** projects of 8 AC and 13 DC UHV grids have been completed
- **4** projects of 3 AC and 1 DC UHV grids are under construction
- **37,000** km in operation and under construction
- **370** GVA (GW) transforming (converting) capacity
- **150** GW trans-regional transmission capacity





- Cooperation with Brazilian partners on UHV grid

Belo Monte $\pm 800\text{kV}$ UHV DC Outgoing Transmission Project in Brazil



Project phase I :
2084 km,
put into operation
at the end of 2017

Project Phase II :
2518 km,
planed to be put into
operation in 2019



Climate Change

Global Consensus

UN: To limit the temperature rise within 2°C to avoid catastrophic impacts on Humankind.



Low Carbon Development

Greenhouse Gas Reduction

The key is to transform the energy system from fossil-based to clean energy based in the following decades.



Two Replacements

Energy Revolution

Clean Replacement-
more clean energy

Electricity Replacement-
more green electricity



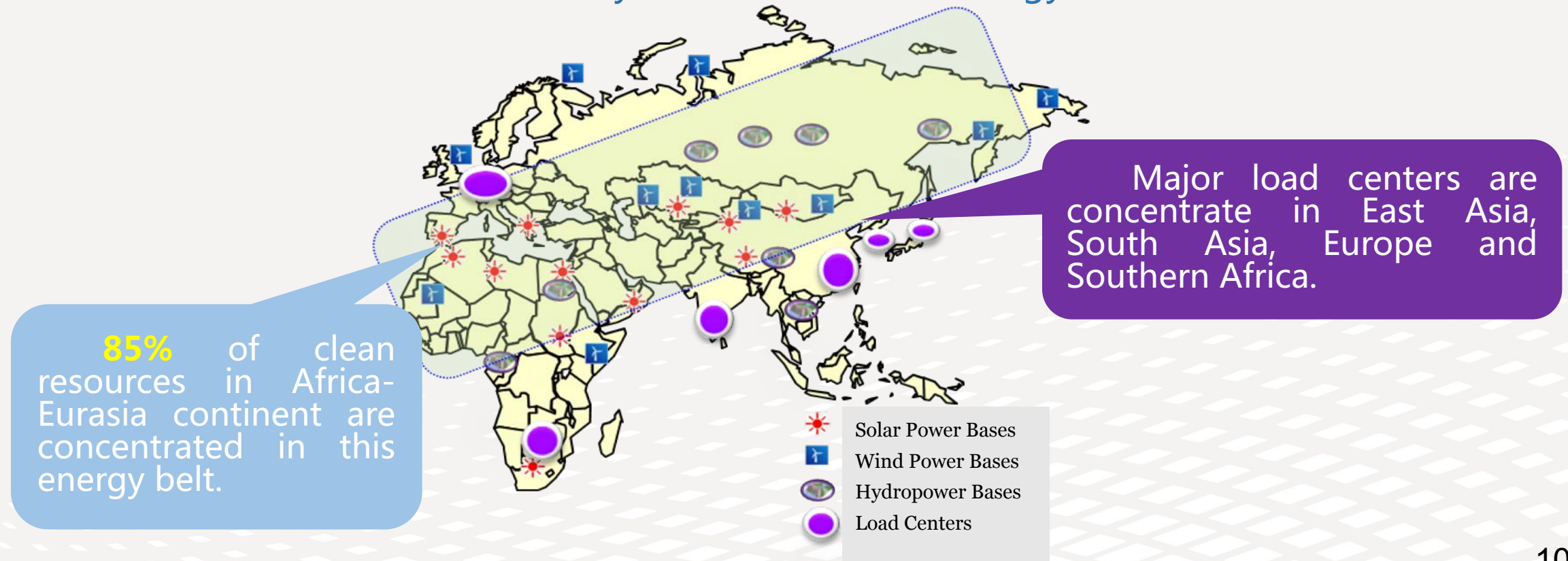
Why to build GEI?



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

The key of implementing two replacements is to massively develop and utilize clean energy.

- **Power Generation:** Intermittent and volatile wind and PV power can enjoy better development by being integrated into a large power grid.
- **Resource Distribution:** unevenly distributed clean energy resources.



What is GEI?



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

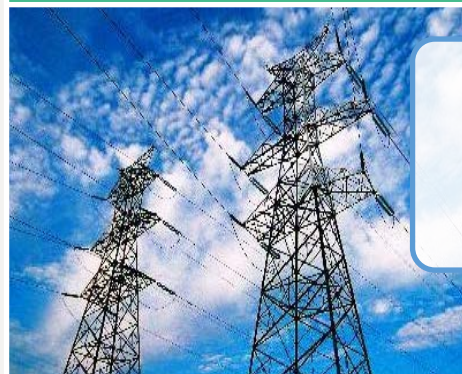
GEI is a clean energy-dominant, electric-centric modern energy system that is globally interconnected, jointly constructed and mutually beneficial to all.

foundation



Smart
grid

key



UHV
grid

priority







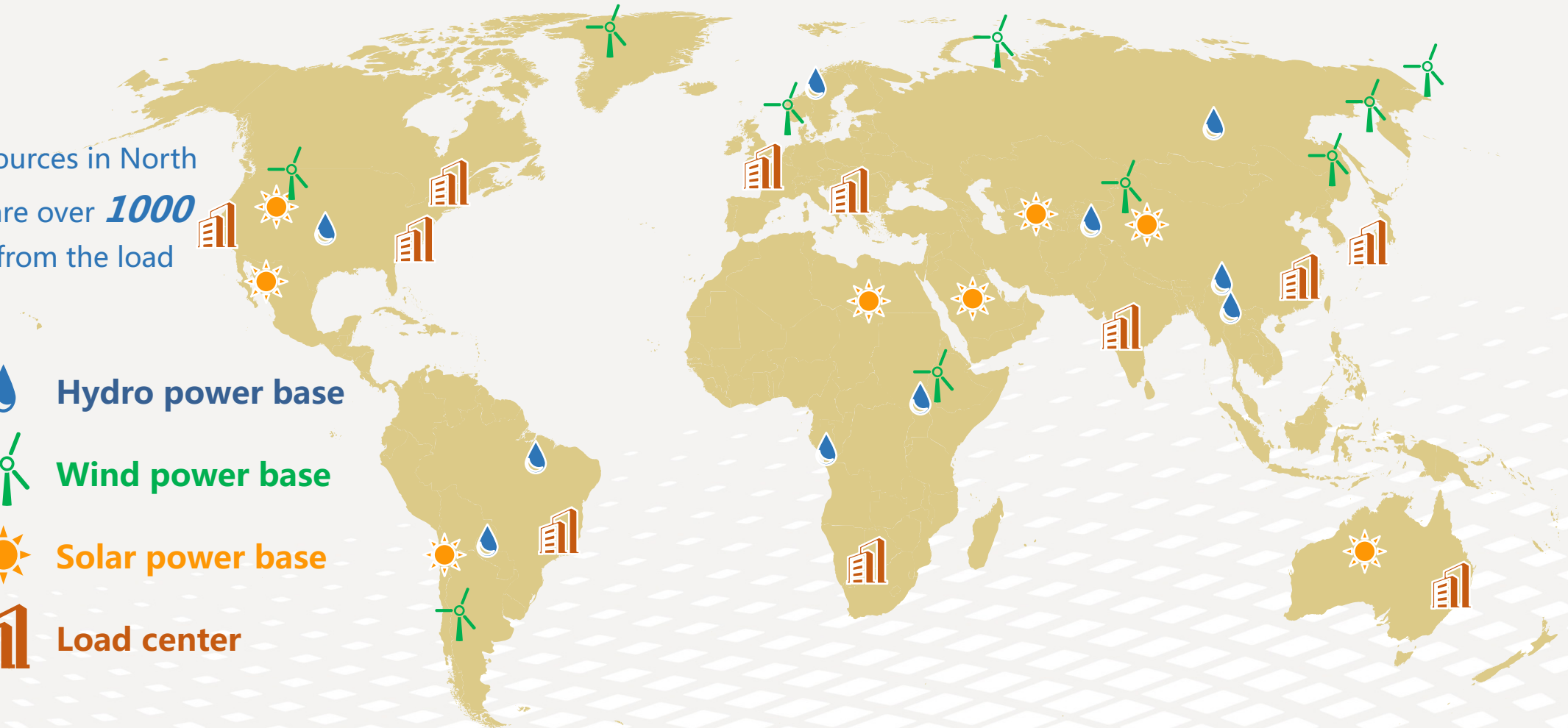
Clean
energy



GEI to Realize Large-scale Transmission of **Concentrated Clean Resources**

Clean resources in North America are over **1000** km away from the load centers

-  **Hydro power base**
-  **Wind power base**
-  **Solar power base**
-  **Load center**





GEI to Improve the Efficiency and Reliability of **Distributed Clean Resources**



Integrated to smart grids,
to solve the problems of distributed power sources



Volatility



Intermittency



**Temporary
Power Shortage**

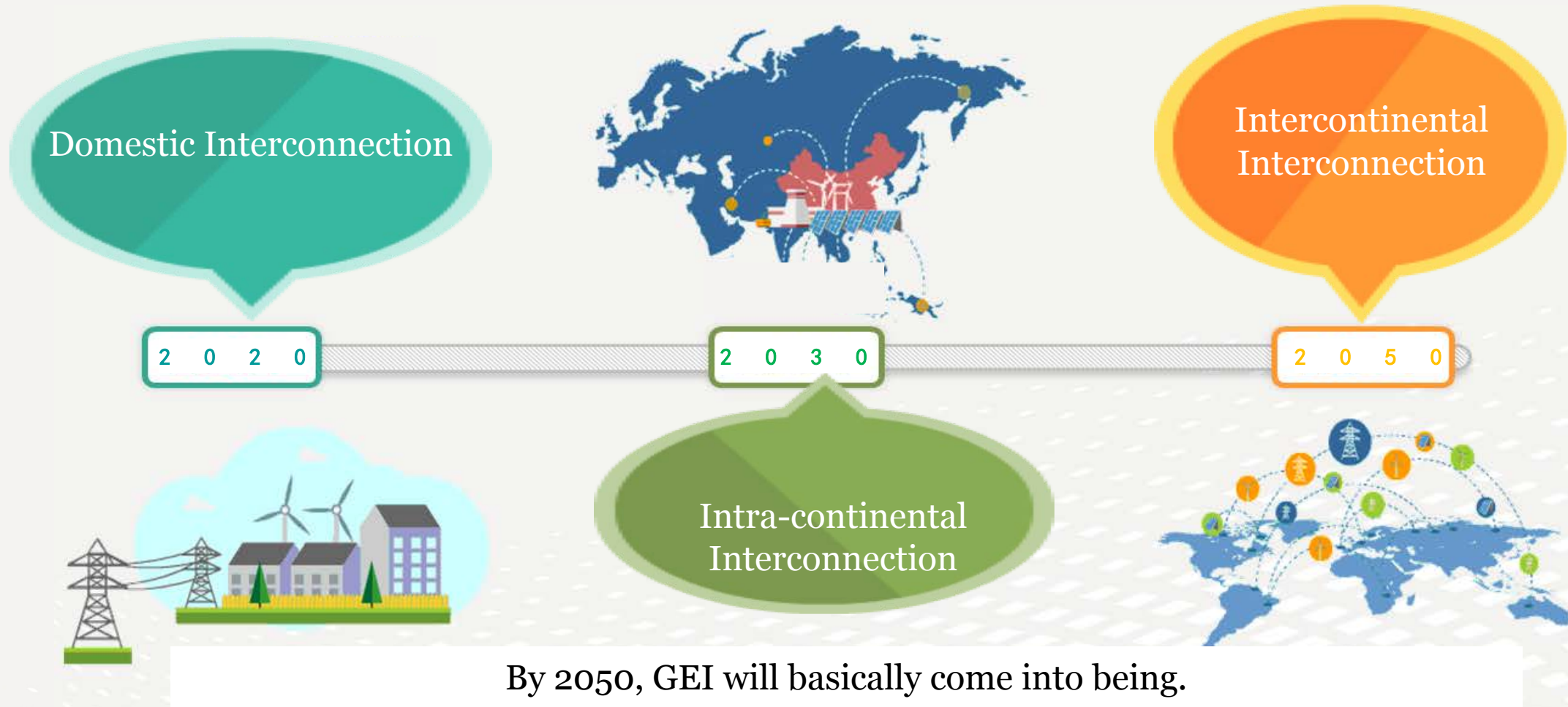


**Surplus Power
Offering**

Phased development of GEI



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



Introduction of GEIDCO



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



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

- **Established:** March 29th, 2016
- **Mission:** promote GEI to meet the global power demand with clean and green alternatives.
- **Chairman:** LIU Zhenya, former Chairman of SGCC
- **Vice Chairmen:** Steve Chu, former U.S. Secretary of Energy and Nobel Prize winner in physics; Shu Yinbiao, Chairman of SGCC; Masayoshi Son, Chairman & CEO of SoftBank Group Corp; Oleg Budargin, Former Director General of PJSC Rosseti



Liu Zhenya



Steven
Chu



Shu
Yinbiao



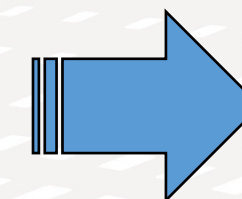
Masayoshi
Son



Oleg
Budargin



March 2016
(80)



August 2018
(445)

Members of GEIDCO

Introduction of GEIDCO



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



Four major research findings released on the 2018 GEI Conference

International Recognition of GEI



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



Northeast Asian Interconnection



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



东北亚电力联网合作备忘录签字仪式

Signing Ceremony of Memorandum of Understanding of Joint Promotion of
An Interconnected Electric Power Grid Spanning Northeast Asia



合作谅解备忘录签署仪式 협력 양해각서 체결식

2017. 12. 13 北京





■ China- Myanmar-Bangladesh interconnection

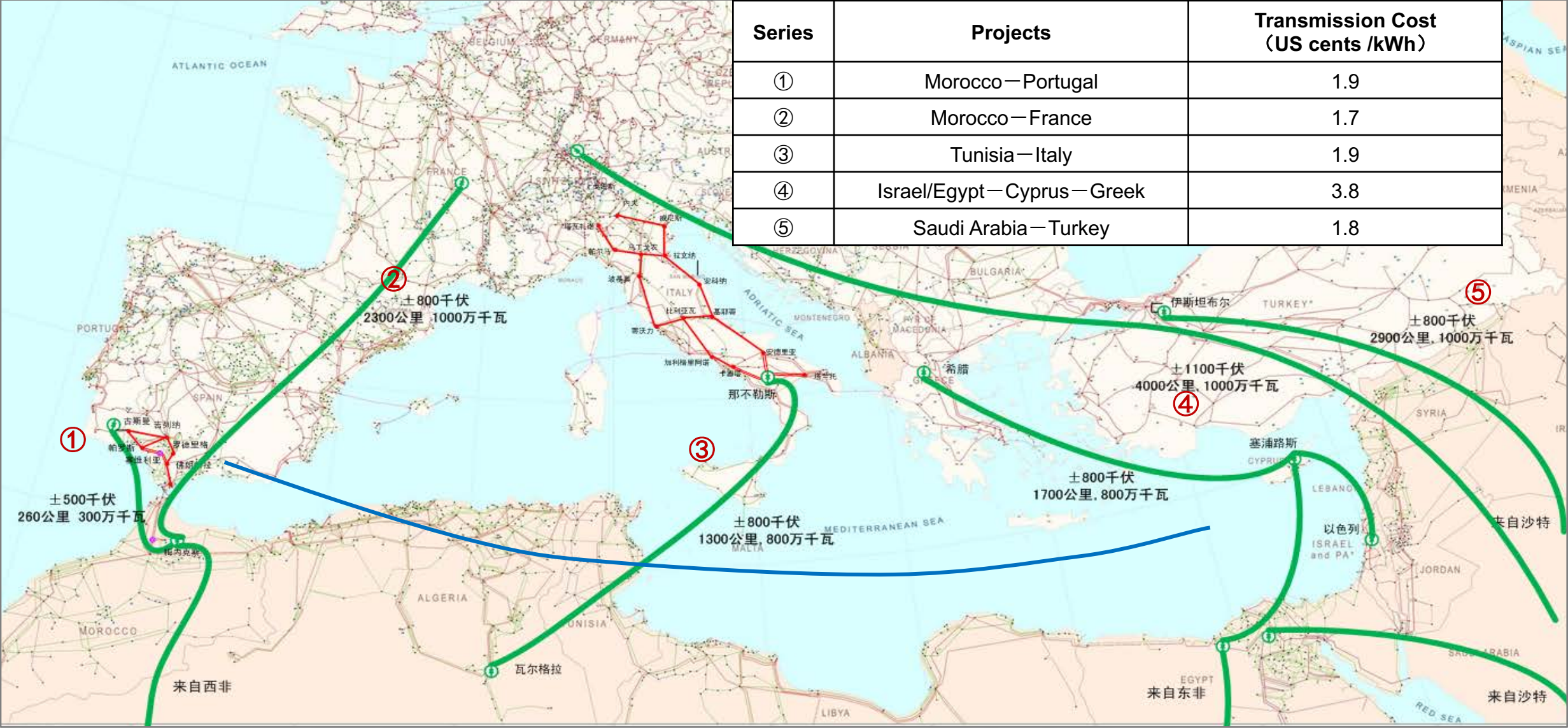
Types	Parameters
Capacity	Total:4 GW Myanmar: 1 GW Bangladesh: 3 GW
Technology	Three-ends DC Yunnan(sending end): regular DC Myanmar and Bangladesh(receiving end) : VSC-DC
Voltage level	$\pm 660\text{kV}$
Transmission Length	1200 kilometers



Africa-Europe Interconnection



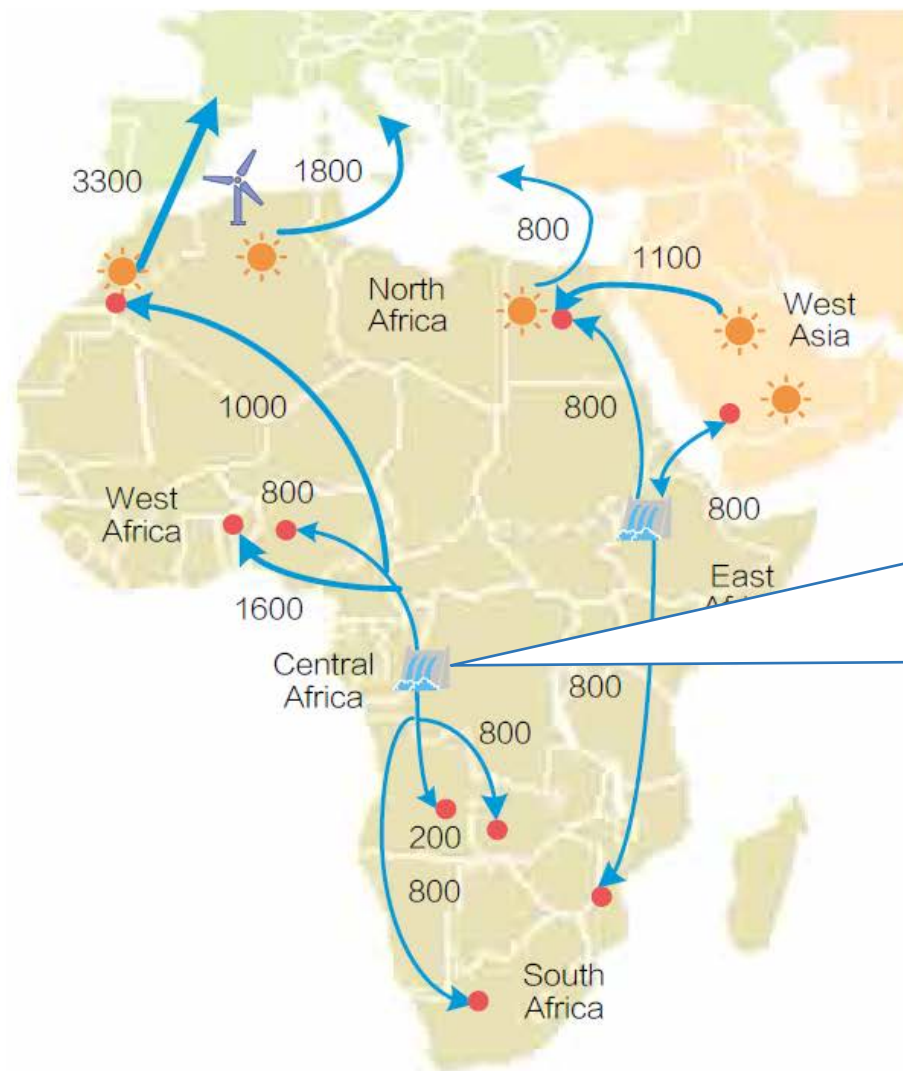
Global Energy Interconnection
Development and Cooperation Organization
全球能源互联网发展合作组织



Grand Inga Hydropower



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



Grand Inga hydropower project are being planned to provide a total installed capacity of over 40GW.

Hydropower generated from Grand Inga could not only satisfy local power demand, but also be supplied to Northern and Southern Africa through UHVDC lines.

Figure 2.20 Africa Power Flow Map in 2050 (10 MW)



Thank you !



国家电网公司
STATE GRID
CORPORATION OF CHINA

<http://www.sgcc.com.cn/>



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

<http://www.geidco.org/>