



STATE GRID
GEIRI NORTH AMERICA
全球能源互联网美国研究院

Smart Grid and Synchrophasor Applications in China

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Smart Grid Workshop
Texas A&M University
April 18, 2017

Key Facts of SGCC

- Ranked 2nd in Fortune Global 500 (2016).
- Largest utility in the world.



• Service Territory

- 26 out of 32 provinces in China
- 88% of China's territory

• Customer

- Serving over 1.1 billion population
- 83% of China's population

• Employee

- 1.72 million

• Core Business

- T&D development and operation
- Electricity sales and energy services
- R&D in power sector

• Oversea Business

- Overseas business in the Philippines, Portugal, Brazil, Australia, Italy, etc.

GEIRI North America is an overseas R&D subsidiary and collaboration platform of SGCC.

Website: www.geirina.net.

West to East Power Transmission



Resource

- 76% of coal in North and Northwest
- 80% of hydropower in Southwest, mainly in upper stream of Yangtze River
- All inland wind in Northwest
- Solar resources mainly in Northwest

Load

- 70%+ of load in Central and Eastern parts

Transmission

- Distances between resource and load center reaches up to 2000+km
- UHVDC and UHVAC are good option to transfer huge amount of power over long distance

Challenges

- Hybrid operation of AC and DC systems
- System stability, security, and reliability

SGCC Vision: Strong and Smart Grid

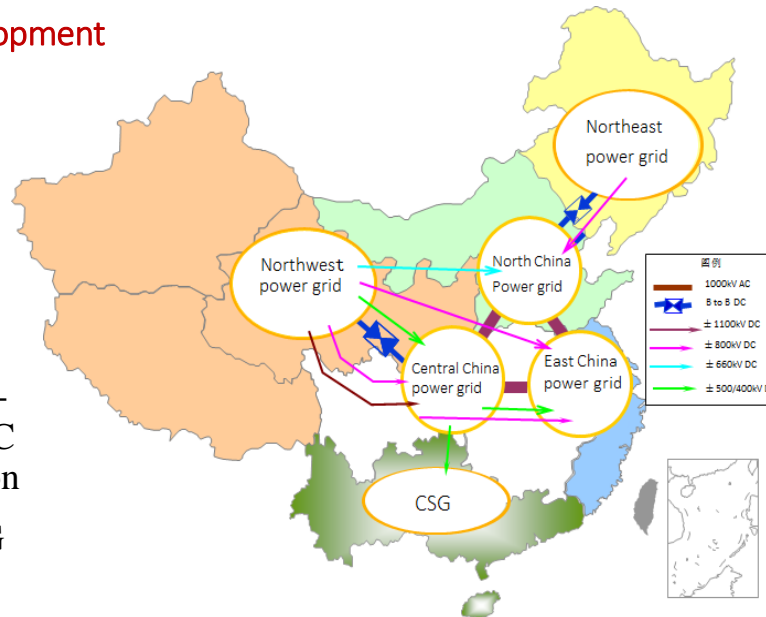
Overall Goal: Reliable and Reasonably priced electricity; High energy efficiency; Low emission

Accelerate clean energy development

- By year 2016,
- 149 GW wind power
- 77 GW solar power

Enhance Interconnections

- North China-Central China-East China with 1000kV AC synchronous interconnection
- West China-Northeast-CSG with DC asynchronous networking



China Power Transmission Framework

Upgrade power system to “1U4L”

Promote the development of

- UHV grid
- Large thermal
- Large hydro
- Large nuclear
- Large renewable energy bases

“Two Replacements”

Electricity Replacement strategy

- Renewable generation replace fossils generation
- Electricity replaces fossil fuel for end-user

Power grid planning in 2020

- 30 UHV lines
- Inter-regional power transmission: 450GW
- UHV power transmission: 330GW
- Wind power access to grid: 200GW
- Optimize power distribution.

Monitoring & Control Infrastructure

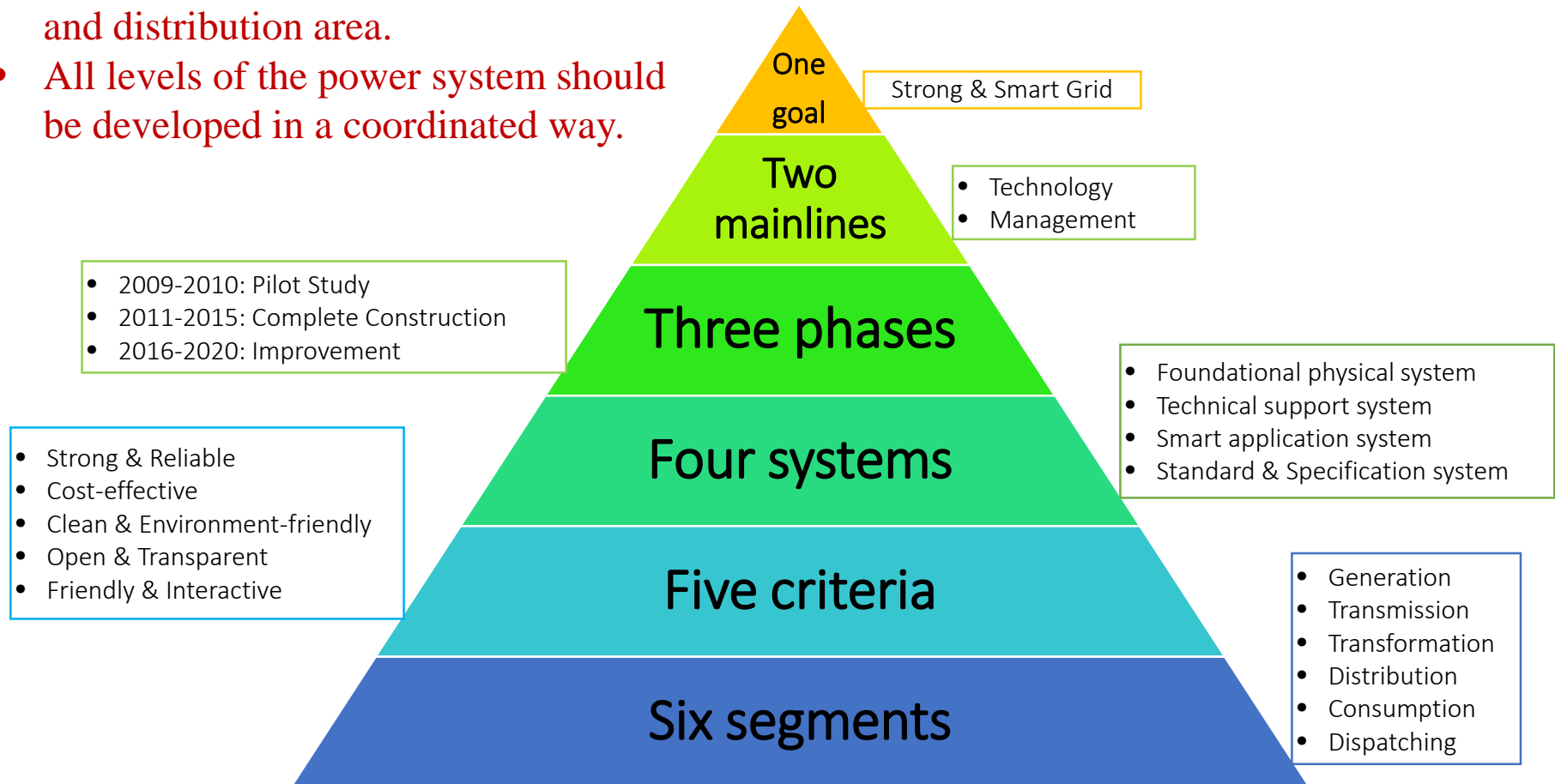
- EMS: D5000 fully deployed
- Promote PMU/WAMS applications
- Advanced Metering infrastructure
- DAS deployed for major areas in major cities
- 100% optical fiber for 110kV and above substations

Distribution Outlook as of 2016

- DAS with DER integration
- DSM, DR programs, Microgrid
- Smart building, house, community
- 460 million smart meters deployed
- 1140 EV charging station and 153,000 charging poles

2009 SGCC Strong and Smart Grid Pyramid

- Strong and Smart Grid focuses on the entire power system rather than DER and distribution area.
- All levels of the power system should be developed in a coordinated way.



PMU Application

1. Parameter identification/model validation/data calibration
2. Dynamic operation monitoring
3. Low frequency oscillation (LFO) monitoring
4. Forced oscillation source location
5. Grid disturbance identification
6. Event-driven case management
7. Performance monitoring of primary frequency regulation
8. Natural frequency characteristic parameter identification
9. Performance monitoring of generator excitation
10. Performance evaluation of wind power
11. Improved state estimation
12. Sub-synchronous oscillation monitoring

Summary

1. PMU/WAMS has provided useful applications to support the strong and smart grid.
2. As more HVDC/UHVDC lines, large wind farm and PV generations are put into operation in China, power system is being challenged with increasing power electronic devices and emerging issues, PMU/WAMS can be an effective tool.
3. Improving reliability and quality of PMU data is fundamental.
4. Push PMU Applications from mission-supportive to mission-critical.



Thank you!