Strong Smart Grid of China

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History to Date

• Started in May 2009
• Have conducted 298 pilots covering G, T, Substations, D, consumption, system dispatch and information/communications system areas; cover all the provinces in China
• Have developed technologies in smart system dispatch, DA, and collection of customer end-use load data.
• Implementation started from top down – T to D to customers.
Demo Projects

- 7 cities In 2009 of demo projects, covering
  - Solar PV generation in parking lots
  - Microgrid energy storage system
  - Underground smart substation
  - Distribution automation
  - Smart house showroom
  - EV battery charging/swapping stations
  - Smart business office

- Another 17 demo projects in 2012 working toward Smart City, covering
  - Smart Energy to provide secure and reliable urban electric services
  - Eco-Smart to promote green cities
  - Infrastructure by building the urban ecosystem
  - Smart industry by promoted related industries
  - Public services by enriching the urban services
Technologies Covered by Demo Projects in 2012

- Resilient and robust transmission systems
- Utility-scale renewable energy transmitted over long distance
- Distributed renewable energy
- End-use energy management
- Green transportation
- Communications infrastructure
- Power FTTH
- Big data/analytics services
- Smart charging & battery swapping services
Strong Transmission Grid

- UHV transmission projects, including 1000 kV AC lines, 800 kV UHV DC projects
- Map to show the projects
- Provides backbone for delivering utility scale renewable resources from the remote west to the load centers in the east
Renewable Energy Integration

- In SGCC service area – 74 GW of wind, and 19 GW of solar PV
- Developed weather forecast and then used for short term wind and solar PV power forecasts.
- Renewable energy and storage system integration to firm up intermittency
- Graph shows results on page 12
- Involves lithium ion, vanadium redox flow, and sodium sulfur batteries
Asset Condition Monitoring

• Primarily transmission and substation asset right now
• Condition-based maintenance based on online condition data
  – Conductor temperature
  – Ice detection image
  – Contaminant
  – Vibration
  – Line droop
• Also involves robots, drones and helicopters for monitoring
Smart Substations

- 927 Smart Substations at 110 kV – 750 kV voltage levels
- Integrated monitoring systems, IEC 61850-based communications, smart HV devices, etc. to enable:
  - Digitized substation information
  - Networked communications platform
  - Standardized information sharing
  - Interactions among advanced applications
Distribution Automation

• Functions includes
  – Automated service restoration
  – Grid and end-user interaction
  – Efficient operations
  – Flexible integration of DER and energy storage
AMI Systems

• Over 200 million smart meters
• Back haul communications (fiber, GPRS/CDMA), WAN, FAN, HAN
• Functions include
  – Prepay services
  – Load measurements
  – Interval load metering
EV Charging

• Use both battery quick charge and battery

• Could quick-charge the cars or battery-swapping

• 400 EV Charging/Battery Swopping stations; 19000 EV Charging Poles across 26 provinces
Smart Dispatch Center

• Has 2027 PMUs
• WAMS with situation awareness capabilities, moving towards WAMPACS with
  – event-triggered online stability alarming,
  – Grid event-oriented network analysis
  – CIM-based integrated model management
Plan by 2015

• Smart substations penetration at 30% at > 110 kV
• Integration of 140 GW of wind and 21 GW of solar PV farms
• DMS/SCADA systems for DA functions at key cities and pilots for DER, microgrid integration
• >250 million AMI meters installed to collect customer load interval data
• Smart Dispatch Systems at centers at all provincial control centers and above
• SG-ERP fully deployed
Latest Development in Electricity Reform

• In March 2015, a new government policy on electricity reform
  – Independent Electric System Operator
  – Independent Electricity Energy Exchange Center
  – C&I customers can participate in the Energy Exchange Market; focus on DR and DER
  – Similar to the deregulated electricity market in N. America, Europe and Australia
New Operating Environment

Independent Energy Trading Center

C&I Customers

Independent System Operators
Vision by 2020

• 65% smart substation penetration
• Integrating 200 GW wind power and 50 GW solar PV
• Widely apply smart dispatching support system for transmission grid
• Moving towards grid and generation, and grid & end-use customers