



To : The Foreign Affairs Department, the State Electricity Regulatory Commission,  
SERC, People's Republic of China  
From : Joint US China Co-operation on Clean Energy (JUCCCE)  
Date: December 18<sup>th</sup>, 2007

Dear respectable foreign affairs department officials,

#### Basic Information Report on Smart Grid

In mid of November, Mr. Steve Papermaster, Co-chairman of US President's Council of Advisors on Science and Technology (PCAST) had a chance to meet up with the senior leaders with SERC and communicated use of clean energy in the power industry and the concept of smart grid. Several days later, JUCCCE China Chairperson Ms Peggy Liu and Beijing Chief Representative Ms Holly Cheng revisited SERC and discussed the way forward concerning smart grid with the Foreign Affairs Department.

The result of the discussion was that SERC requested JUCCCE to first provide a more detailed background report on smart grid. SERC shall then be responsible to co-ordinate with the related departments and players in China to eventually form a sino-foreign communication workshop on smart grid in Beijing. Nowadays smart grid is a new topic in China although some of the related concepts may have been touched upon. There has not been systematic study on whether China should choose to start with smart grid. JUCCCE, at the invitation of the government authority, has provided the attached report. The purpose of the report is to provide some basic concepts on smart grid which can be used as basic information to involve sino foreign experts in discussion on the need of smart grid in China. And more importantly we hope this would lead to discussions and definitions on the key decisions which the government bodies need to make in order not to preclude the option of smart grid and not to miss the best planning period for smart grid.

Today we are very pleased to provide you with our report. We are willing to hear any comments you may have.

Holly Cheng  
Beijing Chief Representative  
JUCCCE

\*ENGLISH VERSION

Confidential Ref: 20071220sg/djh



# Smart Grid – Future Grid?

## - A Basic Information Report On Smart Grid

December, 2007

*\*this is a courtesy translation into English. Original report is in Chinese version*

## Executive Summary

In mid of November, Mr. Steve Papermaster, Co-chairman of US President's Council of Advisors on Science and Technology (PCAST) had a chance to meet up with the senior leaders with SERC and communicated use of clean energy in the power industry and the concept of smart grid. During the same period, several discussions on the same subject were also conducted between JUCCCE and other governmental bodies and different players. The result of these discussions confirmed the common understanding on the need of energy saving in the power sector as well as the need for energy demand/consumption management. There have been strong interests on smart grid concepts given its anticipated benefits in energy demand management. Our revisit to SERC confirmed their invitation on us to provide, on top of Mr. Papermaster's face-to-face introduction, a more detailed background information report on smart grid in order for the work to proceed. This report was compiled under that background.

The information report consists the following headline contents:

- ◆ What is Smart Grid
- ◆ Application of the Smart Grid
- ◆ Smart Grid Milestones in USA – Road towards a State Policy
- ◆ Smart Grid Players
- ◆ Business Opportunities with Smart Grid
- ◆ Road towards Smart Grid – When to Plan – Now or Future

Basic conclusions of these information:

- ◆ US and other western countries, taking advantages of their technical advantages, have started its journey towards smart grid. In US, smart grid has gain strong political attention and it has been raised to the level of being part of the 21<sup>st</sup> State strategy for the federal government
- ◆ Smart grid can potentially bring large amount of new business opportunities;
- ◆ Seize the opportunity and plan now

Nowadays smart grid is a new topic in China although some of the related concepts may have been touched upon. There has not been systematic study on whether China should be engaged with smart grid or not. JUCCCE, at the invitation of the government authority, has therefore provided the attached report. The purpose of the report is to provide some basic concepts on smart grid which can be used as basic information to involve sino-foreign experts to be engaged in discussion on the need of smart grid in China. And more importantly we hope this would lead to discussions and definitions on the key decisions which the government bodies have to make in order not to preclude the option of smart grid and not to miss the best timing for planning the smart grid.

In compiling the report, JUCCCE have gained support from the following organizations: USPCAST, McKinsey&Company, Foundation Capital as well as BSGalliance. We would like to acknowledge that and express our sincere gratitude.

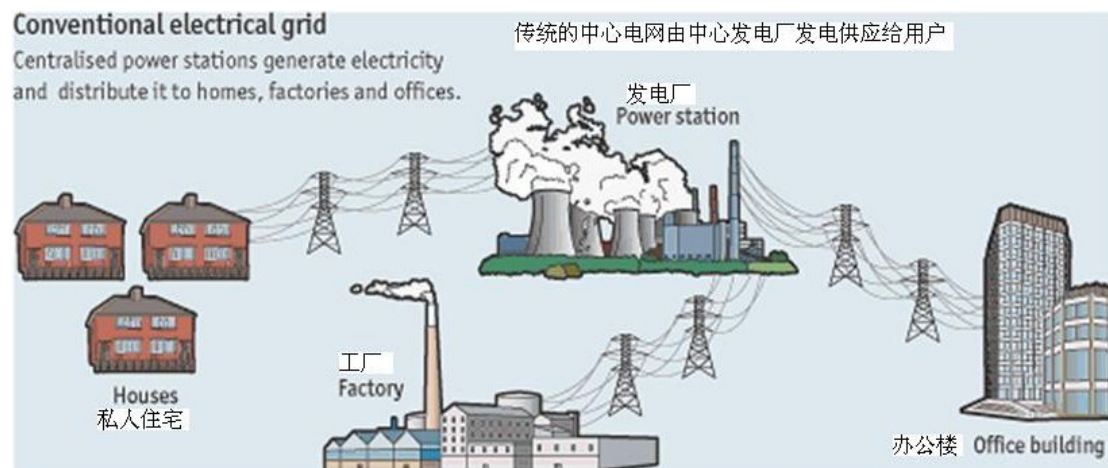
Any comments and suggestions on this report please forward to JUCCCE directly.

# Smart Grid, Future Grid?

## What is Smart Grid

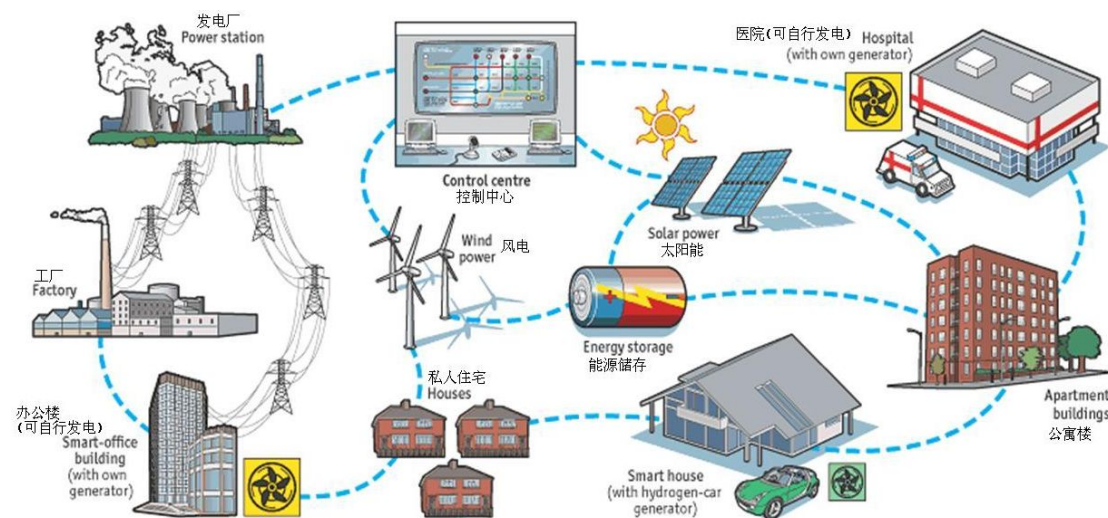
In simple terms, smart grid is a new type of grid which combines information technology with electricity infrastructure. It can also be called “energy internet”. It is the combination of devices, network and software which are designed to improve energy efficiency, reduce environmental impact, improve reliability and visibility and reduce electricity theft.

The conventional electrical grid is composed of the centralized power stations which generate electricity and distribute it to homes, factories and offices, as shown in figure 1 below.



(Figure 1: Source: US PCAST)

“Energy internet” has many small generating facilities, including those based on alternative energy sources such as wind and solar power, and they are orchestrated using real time monitoring and control system (Shown as in figure II). Offices or hospitals generate their own power and sell the excess back to the grid. Hydrogen powered cars can act as generators when not in use. Energy-storage technologies smooth out fluctuations in supply from wind and solar power. Distributing power generation in this way reduces transmission losses, operating costs and the environmental impact.



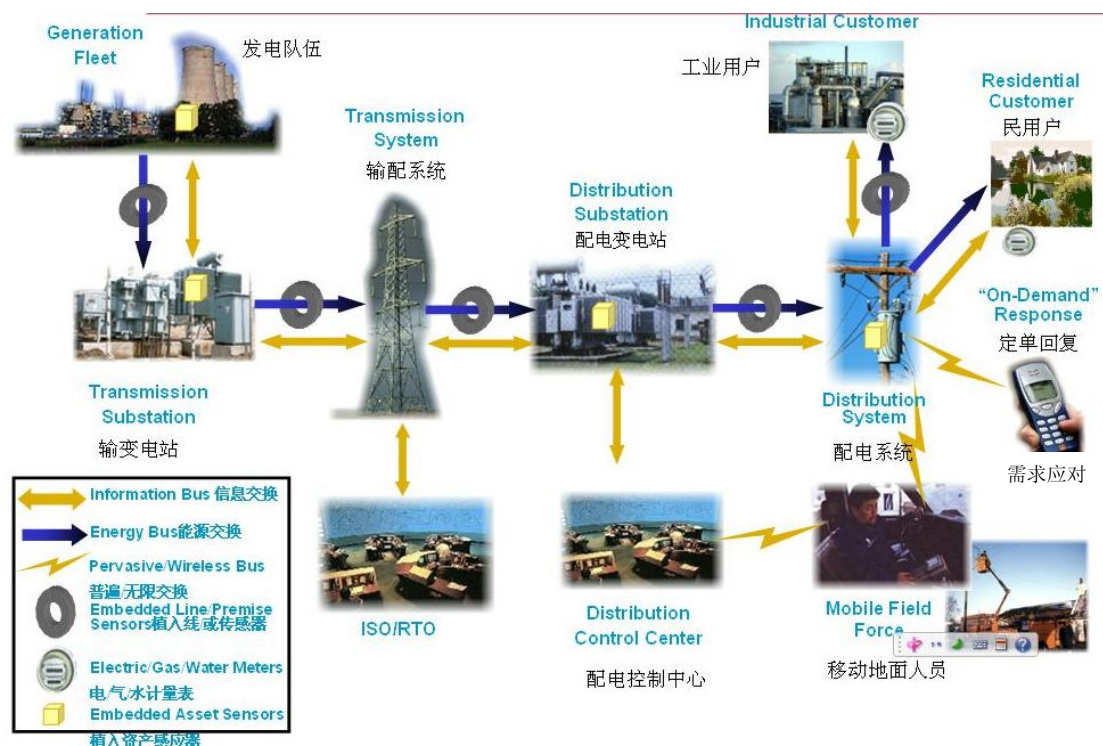
(Figure 2 Source: US PCAST)

So far, we can not say there is an aligned definition of smart grid which is used worldwide. The term “smart Grid” refers to an electricity transmission and distribution system that incorporates elements of traditional and cutting-edge power engineering, sophisticated sensing and monitoring technology, information technology and communications to provide better grid performance and to support a wide range of additional services to consumers. A smart grid is not defined by what technologies it incorporates, but rather by what it can do. The US has defined the key attributes of the 21<sup>st</sup> century grid as the followings:

- ◆ The grid will be “self-healing.” Sophisticated grid monitors and controls will anticipate and instantly respond to system problems in order to avoid or mitigate power outages and power quality problems;
- ◆ The grid will be more secure from physical and cyber threats. Deployment of new technology will allow better identification and response to manmade or natural disruptions;
- ◆ The grid will support widespread use of distributed generation. Standardized power and communication interfaces will allow customers to interconnect fuel cell renewable generation, and other distributed generation on a simple “plug and play” basis.
- ◆ The grid will enable consumers to better control the appliances and equipment in their houses and businesses. The grid will interconnect with energy management systems in smart buildings to enable customers to manage their energy use and reduce their energy costs.
- ◆ The grid will achieve greater throughput, thus lowering power costs. Grid upgrades that increase the throughput of the transmission grid and optimize power flows will reduce waste and maximize use of the lowest-cost generation resources. Better harmonization of the distribution and local load servicing functions with interregional energy flows and transmission traffic will also improve utilization of the existing system assets.

## Application of Smart Grid

Based on the characteristics of the smart grid, here are the applications:



(Figure 3: Source: US PCAST)

- ◆ Advanced Metering – wireless automated meter reading;
- ◆ Demand Response – shed non-critical loads during peak demand periods;
- ◆ Distribution Automation – monitor and control distribution equipment;
- ◆ Distributed Generation Management – integration of wind and solar resources;
- ◆ Theft Detection – increase visibility and reduce theft;
- ◆ Outage Management – efficiently identify and resolve outages;

## Smart Grid Milestones in US -- Road towards a State Policy

Based on the information we have, smart grid has gone through some major policy events in the US. From California black-outs during 1999/2001 to December 2007 when US President signed on the Energy Independence and Security Act, smart grid has become a State Policy in the US.

- ◆ 2000-2003: Rolling blackouts and power shortages raise awareness of grid infrastructure issues
- ◆ 2003: EPRI publishes Electricity Sector Framework for the Future, outlining what is now known as the Smart Grid
- ◆ 2003-2004: California conducts field studies and working groups to define requirements for Smart Metering / Grid
- ◆ 2004: Gridwise Alliance formed to promote adoption of Smart Grid
- ◆ 2004: Gridwise Architecture Council formed for standards in the Smart Grid
- ◆ 2005: US Energy Policy Act requires all State and Federal jurisdictions to evaluate Demand Response and Smart Metering
- ◆ 2005: OpenAMI formed as industry task force for standards development
- ◆ 2006-2007: State Utility Commission studies overwhelmingly validate the value of Smart Metering and Demand Response, begin to address concerns of Network Reliability
- ◆ 2007: California, Texas and Many other US States, along with many European Countries, Canada and Australia begin mandates of Advanced Metering / Smart Grid Deployments
- ◆ 2007 US Congress passed the Energy Independence and Security Bill Act, broadly mandating Smart Grid as 'the policy of the United States'

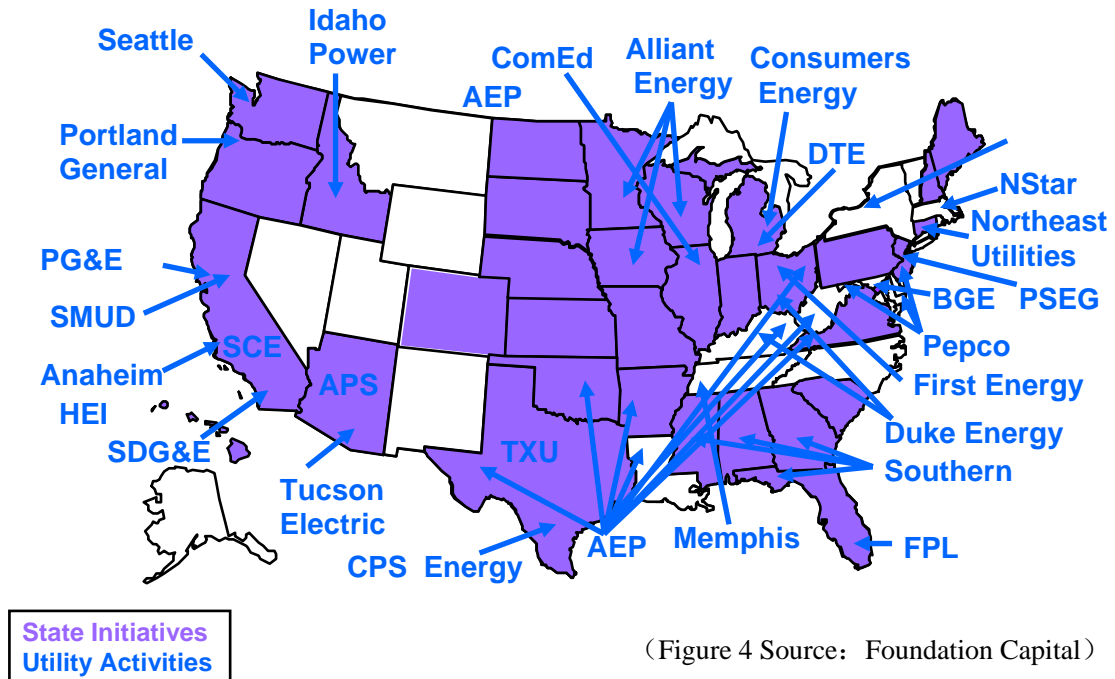
The US may be the first country who raised the clear smart grid concept; it may also be the first country which had mandated smart grid as their state policy. The Energy Independence and Security Act mandated by US Congress in December 2007 has numerous provisions. Some major ones are:

- ◆ Clear, broad definition of Smart Grid
- ◆ Funding for initial deployments and testing
- ◆ Subsidies for deployments
- ◆ National evaluation of deployments within 18 months
- ◆ Federal organization / oversight of standards implementation
- ◆ Metering, Demand Response, Distributed Generation and Storage and more

In the Appendix A (conducted by the US Smart Grid Working Group) of Challenge and Opportunity: Charting A New Energy Future, the Working Group gives the following description in supporting adoption and promotion of smart grid: the US economy has moved into the digital age, electricity's role as an enabler of economic productivity has become even more important.

The transmission and distribution network forms the critical link. The electricity grid has not kept pace with the growing demand for high-quality, high-value services to end-users. The potential benefits of an enhanced power delivery system are enormous, including better ability to manage energy use and energy costs, and better support for use of distributed generation. A scenario prepared by the Electric Power Research Institute (EPRI) suggests that transformation of the power grid over the next 20 years could result in substantial increases in productivity and GDP growth, reduced carbon emission, and increased national security.

At present smart grid initiatives have been spread at different levels across the US. The following map (figure 4) demonstrates the spread of the activities, with blocks representing state initiatives and arrows representing utility activities.



## Players in Smart Grid

Based on the characteristics of the smart grid, companies in different industries have been engaged in smart grid activities. The leading vendors are:

### A. Meters/Devices



### B. Networking



### C. Software



#### D. Systems/Support



Large US and international organizations are driving development of smart grid business transformation:



## Potential New Business Opportunities

The Smart Grid can bring in fundamental transformation of electricity infrastructure. These changes can support dramatic new flexibility and benefits, just as the highway system has transformed US transportation patterns and the internet and mobile phones have transformed communications and business practices of the world. There are potentially major business opportunities:

- ◆ Smart metering, devices
- ◆ Power Communication business
- ◆ Computer Networking, software, system support
- ◆ End-use energy management
- ◆ Standardization
- ◆ Research and Development in related fields
- ◆ Related industries: PHEV, power storages etc.

## Road towards Smart Grid – When to Plan? – Now or Future?

The work around smart grid has been kicked off in the US. In Australia we have seen the publication of a report in July 2007. It is entitled “2007 Australia – Smart Grid – Energy Management and Broadband Report”. The report shows that high-level overviews and strategic analysis of the telecommunication developments in electricity utilities market within Australia has been conducted to some degree of depth.

China owns the world’s largest power network. Although none of these grids is smart one and some have low automotive level, these grids are supporting the Chinese economy which grows at two digits on annual basis in more than a decade. So their contribution to the economy is very obvious. According to “2007 China Power Grid Market Analysis and Research Forecast Report”, during the 11<sup>th</sup> five year plan period (2006-2010), China will invest 850 billion RMB (about 110 billion US\$) in grid transformation. The current period during which China continues to build new power sources, renovate its existing power grids or build new ones is, in our view the best timing to plan the smart grid, because:

- ◆ China has a superb opportunity to start setting up smart grid standards and not to wait till construction of power sources and grids are finished;
- ◆ China has become one of the most important global markets in renewable energy. The renewable energy sources requires more complicated grid to achieve its good performance. And more and more diversified and distributed power generation sources also requires more complicated grid.
- ◆ Smart Grid technologies have been proven. It has the advantages in costs and scale.
- ◆ China can take part in the early research and development of some of the new cutting-edge technology by taking advantages of its cost competitiveness. With such advantages they can also develop both the Chinese and international markets.
- ◆ China can take full advantages in early participation and adoption of combining high-tech telecommunication with electricity infrastructure which will bring strong potential benefits to the country.
- ◆ Some countries such as the US have gained experience in smart grid from industry to political levels. China can learn from the experiences and lessons from the western countries so as to accelerate the pace in power industry modernization.

In order to cope with the rapid economic development, China has invested heavily in power generation supply. The government and State/regional grid companies have tried very hard in expanding different supply sources including gradually raising the proportion of renewable energy sources in power generation mix. And in the demand side, lower the power demand by providing better management at the end-user side can bring direct effect to reduce carbon emission. Based on some initial analysis done in US, smart grid has the potential to reduce power consumption by 5-10% and reduce demand during critical peak hours by 20-50%. The Chinese government has set up “hard and binding” targets on energy saving and emission reduction during the 11<sup>th</sup> Five-Year-Plan period: by 2010, per unit GDP energy consumption will be reduced by 20% and major pollutants reduced by 10%. Saving energy is the most efficient and quickest way to reduce carbon emission and smart grid can contribute directly due to the increased ability in demand side energy management.

Nowadays smart grid is still a new topic in China although some of the related concepts may have been touched upon. There has not been systematic study on whether China should be engaged with smart grid or not. JUCCE, at the invitation of the government authority, have therefore provided this report. The purpose of the report is to provide some basic concepts on smart grid which can be used as basic information to involve sino-foreign experts to be engaged in discussion on the need of smart grid in China. And more importantly we hope this would lead to discussion and definitions on the key decisions which the government bodies have to make in order not to preclude the option of smart grid and not to miss the best timing for planning the smart grid.

We believe the best opportunity is now.

Meanwhile we also understand that smart grid is a systematic concept which covers different industries such as power, telecommunication and computer etc. and would involve a lot of government bodies and industry players. Therefore the time needed to introduce the new concept of smart grid will be understandable. However we remain confident with the Chinese market and we wish that the information we have provided here today is useful to China.

JUCCCE is willing to continue promoting communication and co-operation on smart grid and other energy saving and emission reduction initiatives between US and China.