

New Business Opportunities in Asian Smart Grids

The development and expenditures on Smart Grid-related projects in Asia are already impressive. Nonetheless, even after massive power sector reforms, China, India and other Asian nations still face shortages in electric power. According to the US Energy Information Administration, the world's electricity generation is projected to increase by 77 percent from 2006 to 2030. But the Asian countries will increase generation by 200% over that period. So the need for grid improvements is increasing.

China has embarked on a 10-year project to build a "Smart Grid" that will catapult its power transmission into the digital age, securing electricity supplies and boosting energy conservation. The Government of India has devised a scheme which is called the Restructured Accelerated Power Development and Reforms Programme to address the strengthening & upgrading of the Indian transmission and distribution network. The program calls for an investment of US \$ 10 billion over a five year span. The Japanese trade ministry has estimated the shift to renewable power will require a grid upgrade at a cost of between US\$ 51 Billion and US\$74 Billion by 2030. Korea aims to create a nationwide Smart Grid by 2030 for an electricity market worth US\$ 60 Billion.

Within Asia, the demand for Smart Grid capability is quite diverse in nature ranging from reflecting the sophisticated nature of electricity demand in developed nations such as Japan and South Korea, to the need for first deployment of grids and massive grid upgrades in the developing economies of India and China. Yet, there is also general consensus that existing electricity grids in Asia are not sufficient in terms of capacity, efficiency, reliability, security, and environmental impact to supply the electrical power needs of modern societies.

Further, because of growing environmental concerns, Asian grids needs to become far more flexible than they are today, accommodating distributed power generation from renewable sources and use several energy-efficiency techniques.

With all this in mind, NanoMarkets/Smart Grid Analysis believes that Asia, offers huge potential for suppliers of Smart Grids technology, systems and software. As a result, we are publishing this report which identifies and quantifies the business opportunities that are appearing as a result of the deployment of Smart Grids in Japan, Korea, India, Taiwan, China, Malaysia, the Philippines, Singapore, Thailand and Vietnam.

For all of the countries covered, this report (1) analyzes the key drivers for Smart Grids such as environmental concerns, enhanced grid reliability and security, need to integrate renewable energy, need to upgrade existing facilities to meet demographic changes, etc. and (2) discusses the likely timetable for Smart Grid deployment. It also talks about major projects and trials in each Asian nation. On the supply side, the products and strategies of leading transmission and distribution, metering, storage, communications and software firms in Asian Smart Grid markets are discussed and analyzed.

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Chapter One: Introduction

1.1 Background to This Report

Electric grids in Asia as elsewhere are required to connect billions of devices and still operate reliably. There is a general consensus that the current grids are not sufficient in terms of efficiency, reliability, security, and environmental impact to supply the electrical power needs of modern societies. Further, because of growing environmental concerns, grids need to become far more flexible than it is today, accommodating distributed power generation from renewable sources and use several energy-efficiency techniques.

NanoMarkets/Smart Grid Analysis believes that Asia offers huge potential for Smart Grids. According to the US Energy Information Administration, the world electricity generation is projected to increase by 77 percent from 2006 to 2030. But the Asian countries will increase generation by 200% over that period. Within Asia, the demand for Smart Grid capability is quite diverse in nature ranging from reflecting the sophisticated nature of electricity demand in developed nations such as Japan and South Korea, to the need for first deployment of grids and massive grid upgrades in the developing economies of India and China.

1.1.1 Opportunities in Smart Grids Market

Overall, in Asia as in other countries, there are trends towards energy efficiency and increased use of renewable energy sources. While blanket energy efficiency is important, countries would greatly benefit from intelligent energy efficiency in the form of demand response and grid responsive appliances. Renewable energy sources, when integrated into the grids, will help consumers determine operating costs, improve energy efficiency and prevent depletion of existing fossil fuel resources.

China and India are likely to continue their growth in both economic and population terms and together account for 33 percent of the entire Asian economy. This is the case even though, per capita power consumption is very low. The rapid growth rates have meant that the demand for electricity in Asia is on the rise and transmission and distribution capacity developments need to keep pace. However, even after massive power sector reforms, China and India still face shortages in electric power.

China: In China, regional power shortages occur frequently when generation drops in one province and the lack of long-distance power transmission capacity means that power cannot be routed in from other regions where there is surplus capacity. China's Northern areas experience energy shortages in winter due to increased heating demand and problems with

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coal deliveries. Eastern and southern areas are prone to shortages in late spring/early summer as temperatures and air-conditioning demand rise, while reservoir levels and hydro output fall until the arrival of the summer rains in July and August. China's power shortage reached 40 million kilowatts at the beginning of 2008 after the country was hit by the worst snowstorm in 50 years.

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China has embarked on a 10-year project to build a "Smart Grid" that will catapult power transmission into the digital age, securing electricity supplies and boosting energy conservation. The proposed Smart Grid will be capable of handling alternative energy sources, such as wind and solar power, more effectively. The total investment in the Chinese Smart Grids is estimated to be \$586 billion over the period 2011-2020. Today, most of the China's electricity is produced by coal-fired stations. In 2007, China had a total installed electricity generating capacity of 624 Giga Watts (GW), and could have added another 80 GW of new installed capacity in 2009.

With regard to power grid infrastructure, China's State Council has identified 10 areas for increased investments. Improvement of the rural power grid was specifically mentioned as a priority, while the upgrading of the urban power grid was highlighted in the list of significant infrastructure projects. In the new investment plan for 2009-2012 announced by the State Grid Corporation of China (SGCC) US\$43 billion is allocated to grids within urban areas US\$37 billion to rural grids. In addition to the power capacity addition and development of grid infrastructure, China wants to clean up the air by boosting the portion of energy that comes from renewable sources to 15 percent by 2020. But at present, power companies have shied away from new energy sources because they are intermittent and require elaborate backup energy pools. The motivation for deploying Smart Grids in China is therefore both to increase capacity and to shift the focus away from coal generation.

India: Due to shortage of electricity, power cuts are common throughout India. India has a 12% shortage in power during the peak hours between 5pm and 11pm. The western region is the worst affected in the country with around 19% power shortage.

With a peak shortage of 16,000 MW, it is estimated that India needs to add nearly 80,000 MW of generation capacity by year 2012, to the existing 140GW in 2007-08. This is estimated to entail investments to the tune of US\$ 258 billion in the power sector. To support this investment India needs to build a modern intelligent grid to maintain an aggressive growth path for energy generation sources. In India's power systems, aggregate Technical and Commercial (AT&C) losses are estimated to be 35% (2005-06), which is financially non-viable in its current state. The Government of India has devised a scheme which is called

Restructured Accelerated Power Development and Reforms Programme (R-APDRP) to address AT&C losses through strengthening & up-gradation of Sub-Transmission and Distribution network and adoption of Information Technology. The program calls for an investment of US \$ 10 billion over a five year span. Specific references to Smart Grid include projects for establishment of baseline data and IT applications for energy accounting, auditing & consumer services.

Japan: Japan accounts for the most electricity consumption in OECD Asia, but it has the lowest demand growth rate in the region. Of the country's total electric power generation, roughly 60 percent comes from conventional thermal sources, 29 percent from nuclear sources, 9 percent from hydroelectric sources, and 2 percent from other renewables.

Being a country with very few energy resources, Japan is putting its best efforts to increase the use of renewable energy sources in the future. To achieve this goal, the Japanese government has plans to produce 28M k W energy using solar panels by 2020. Further, the country is committed to 50% reduction in Greenhouse gases by 2050 in the G8 Tokyo summit agreement. Therefore, Japan's Smart Grid initiatives primarily address the efficient use of renewable energy so that it reduces country's dependence on fossil fuels and also cuts down Greenhouse gas emissions. The Japanese trade ministry has estimated the shift to renewable power will require a grid upgrade at a cost of between US\$ 51 Billion and US\$74 Billion by 2030.

South Korea: South Korea is OECD's fastest-growing "carbon polluter" and the world's fifth-largest oil importer. The country is betting on Smart Grids to manage electricity use more efficiently. It aims to create a nationwide Smart Grid by 2030 for an electricity market worth US\$ 60 Billion. The project is seen enabling the country to cut greenhouse gas emissions by 150 million tonnes by 2030 and to reduce oil imports by 344 million barrels.

1.1.2 Near-Term Applications of Smart Grids: Current Projects

Japan, South Korea and China are investing about \$9 billion in 2009 in infrastructure and information technology to make electricity networks more efficient. China is pursuing Smart Grid more aggressively than any other country in the world right now. Japan and South Korea, which are a step ahead of China in the building of intelligent power distribution networks, are also ramping up Smart Grid investment. Both are ear-marking spending of more than \$800 million in 2009.

China: In the Smart Grid front, China currently focuses more on the transmission side than the distribution side. A unified national power grid network project called the "West-East

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Electricity Transfer Project,” is underway in the country. The project includes construction of three major west-east transmission corridors, each of which will have a transmission capacity of 20 GW by 2020. The Chinese government hopes that these power grids will balance the power generation and utilization disparities among different regions. Smart meter upgrade and transition to a national Smart Grid system are included as key components in China’s stimulus package announced in November 2008. According to official sources, Chinese utility companies may require approximately 300 million standard meters – both commercial and residential – during the country’s transition to a national Smart Grid system. As of 2008, only about 1 percent of China’s utility meters are automated. This indicates the sheer size of the Smart Grid market in the country.

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Japan: Japan with its reliable grid system, is focusing on distribution side rather than transmission. The government will launch a five-year trial project with total spending of US\$ 1.1 Billion to prove the efficiency of “Smart Grid” systems linking power suppliers with households using energy-saving technologies. The project will begin in four major areas—Yokohama in Kanagawa Prefecture, Kitakyushu in Fukuoka Prefecture, Toyota in Aichi Prefecture and the Keihanna area covering Kyoto, Osaka and Nara, the Ministry of Economy. The Yokohama city government plans to equip 4,000 homes with “smart meters” to automatically adjust the amount of electricity supplied to each home, while monitoring how electricity is being consumed in the entire community participating in the trial.

South Korea: The South Korean government plans to establish a nationwide Smart Grid by 2030, the first country in the world to do so. There are three stages in this plan proposed by the government. The first stage is a technical validation stage lasting two years (2010-2012), followed by second stage (2012-2020), which involves expansion of Smart Grid to metropolitan areas. The final stage (2021-2030) includes the completion of intelligent power grid. The road map for implementation of this project is given below:

- **Smart Power Grid:** Open power grids will be built to allow various kinds of interconnections between consumption and supply sources. The roll-out of such networks will pave the way for new business models, and the building of a power grid malfunction and automatic recovery system that will ensure a reliable and high quality power supply.
- **Smart Consumer:** It aims to encourage consumers to save energy by using real-time information and producing smart home appliances that operate in response to electric utility rates.
- **Smart Transportation:** It aims to build a nationwide charging infrastructure that will allow electric vehicles to be charged anywhere. It also establishes a V2G (Vehicle to

Grid) system where the batteries of electric vehicles are charged during off-peak times while the resale of surplus electricity takes place during peak times.

- **Smart Renewable:** It aims to build a smart renewable energy power generation complex across the nation by rolling out microgrids. This will ultimately lead to the emergence of houses, buildings, and villages which can achieve energy self-sufficiency through the deployment of small-scale renewable energy generation units in every end-user premise.
- **Smart Electricity Service:** With the launch of a variety of energy-saving electricity rate plans, this service aims to improve consumers' right-to-choose by satisfying their different needs. In addition, it wants to deliver a wide array of added electricity services through the marriage of electricity and Information and Communication Technology or ICT, and to put in place real-time electricity trading system for the transactions of electricity and derivatives.

India: The focus of India's Smart Grid initiative is directed towards the distribution side. The Indian Government's R-APDRP scheme's aim is to restore commercial viability of the distribution sector by putting in place mechanisms that lead to a substantial reduction in aggregate technical and commercial (AT&C) losses. This involves following steps:

- Consumer Indexing, Asset Mapping
- GIS Mapping of the entire distribution network
- Automatic Meter Reading (AMR) on DT & Feeders
- Automatic Data Logging for all Distribution Transformers and Feeders
- SCADA system in big towns / cities
- Feeder Segregation/ Ring Fencing
- IT applications for addressing consumer grievances, integrated meter reading, billing & collection
- Energy accounting & auditing and MIS
- Establishment of the Base Line data System

1.1.3 Future Advantages of Smart Grids

While countries like China and India are currently upgrading distribution and transmission grids with communications and controls, Japan and Korea are focused on smart meters and home energy network. In the future, distribution grids will need a whole host of new technologies to manage the increased share of renewable energy, demand response-enabled homes, and future plug-in hybrid and electric vehicles that will soon place unprecedented new pressures on utilities. The future of Asian Smart Grid programs are discussed below:

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China: China will focus on cities, for the launch of distribution Smart Grid implementation. Key areas include distribution automation, GIS (Geographic Information System), power quality monitoring and control, large scale storage and electric vehicle connection facilities. Other applications include, home-based charging stations for plug-in hybrid electric vehicles. Hybrid vehicles will enable the wide adoption of electric cars, which can greatly reduce China's dependence on oil while significantly reducing carbon emissions.

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Japan: Japan's long term plan is to completely shift from fossil fuels to renewable energy for power generation. Renewable energy, which originates from a natural cycle, will replace fossil fuels. The resulting grid would be "Nature Grid", which makes the best use of local renewable energy with a view to maximizing total efficiency. Nature Grid" will be composed of both community and national grids. Where community grid will ensure consumption of all energy produced in the community area, national grid will be connected to the community grid in order to satisfy base load consumption. Exemplary Components would include, an active demand response system to better adjust to fluctuations in energy supply and batteries of electric cars and at home for energy storage / backup. All the focus areas are summarized below:

- Autonomous control of solar power generation and heat pump loads according to the load of the grid
- Control of electric flow in distribution network
- Collaborative control of storage batteries and power plants according to fluctuating solar power generation
- Moving toward all-electric house to leverage heat storage by heat pump, power storage by plug in electric vehicle (PEV's), etc.

South Korea: A nationwide Smart Grid is planned by the South Korean government by 2030. Some of the future advantages of South Korea's Smart Grids are in the segments such as electricity consumers, transportation, renewable energy and electricity services. In the consumer sector, future applications include smart power management of buildings/factories and encouraging consumers' power production. Expanding electric vehicle charging services throughout the nation is part of transportation applications. In renewable energy sector, the applications include optimal operation of power systems with micro grids and expanding application of power storage devices. Finally, smart electricity services would involve promoting transactions of electrical power derivatives and implementing real time pricing system nationwide.

1.2 Objectives and Scope of this Report

The objective of this report is to identify and quantify the business opportunities which are appearing as a result of the deployment of Smart Grids in Asia. The report focuses primarily on market opportunities and it includes an analysis of the complete value chain and a discussion of where the key opportunities are for equipment, software and electric utility firms. It discusses the details of Asian Smart Grid deployment plans; their requirements for equipment, software and services; and the requirements for suppliers to meet the needs of Asian Smart Grid markets.

The report focuses on the Smart Grid markets and projects in Japan, China, India and Korea. For each of the countries covered, the report analyzes the key drivers for Smart Grids such as environmental concerns, enhanced grid reliability and security, need to integrate renewable energy, need to upgrade existing facilities to meet demographic changes, etc. The report discusses the likely timetable for Smart Grid deployment. It also talks about major projects and trials in each Asian nation. And, on the supply side, the products and strategies of leading transmission and distribution, metering, storage, communications and software firms with regard to Smart Grids are discussed and analyzed.

Eight-year forecast of market size and growth is done for various segments within the Smart Grids markets. These segments include transmission and distribution equipments, energy storage systems, communications equipments, metering and customer premises equipments. The forecast is done for each of the countries.

1.3 Methodology of this Report

The primary source for the opinions and conclusions in this report is extensive interviews with various industry and academic sources carried out by NanoMarkets. Secondary research for this report was taken from information available on the World Wide Web, commercial and government databases, trade press articles, technical literature, information learned at technical conferences and trade shows, SEC filings and other corporate literature. The forecasting approach taken in this report is explained in more detail in Chapter Four.

1.4 Plan of this Report

Chapter Two of this report examines both the major driving factors as well as those slowing down Smart Grid deployment. Chapter Three provides information on the current and near-term future Smart Grid projects and market activity in Asia. Finally in chapter Four, market forecasts broken out by country, type of technology and types of products are discussed.