

South Korea

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smart grid revolution

South Korea: Smart Grid Revolution.

Employing smart grids would help the country (South Korea) use more renewable energy sources and cut overall energy consumption. A smart grid, which helps cut energy consumption and accommodate more wind and solar power, is essential for reducing harmful gases as the power sector is the biggest emitter in every country.¹

- Hong Sung-eui
(Technology Official at KEPCO)

When a growing nation with growing energy needs such as South Korea proclaims it's going to smarten up its electric grid, technology companies across the globe — not surprisingly — take note. South Korea has a rich and determined plan for a completely integrated smart grid by 2030. The major Asian economic region has finally realized its industry advantages in the smart grid sphere and developed a comprehensive road map to leverage these assets toward a nationwide smart grid. Kim Seung Woo, an analyst at Samsung Securities, told Bloomberg, "The upgraded power grid will help the nation, which buys all its energy needs from overseas, reduce import of coal, gas and oil."² Currently, the government has utilized its resources and that of the state-run transmission operator, KEPCO, to implement one of the world's largest and ambitious smart grid test projects on Jeju Island. Jae-Seob Kim, CEO of Korea Smart Grid Institute (KSIG) explained to Zpryme, "on Aug 2008 during the occasion of the 60th Anniversary of the Republic of Korea, President Lee Myung-bak announced Low Carbon Green Growth as the new national vision for the next 50 years. Since then Korea has

¹ Bloomberg News, March 2011

² Ibid.

been bracing on low carbon "green" technologies such as smart grid. Recognizing smart grid as the key solution to achieve Low Carbon Green Growth vision, in 2009, Korea announced its National Smart Grid Roadmap and came up with a proactive and ambitious plan to build a smart grid test-bed on Jeju Island. The Jeju smart grid demonstration project has 168 Korean and foreign companies participating and is the largest scale of smart grid test-bed carried out in Korea. Korea plans to develop new business models through the test-bed and hope to contribute to global GHG reduction goals." Faster than industry experts expected, South Korea has joined the ranks of smart grid and clean tech deployment global leaders such as the U.S. and China.

Projected South Korea Smart Grid Equipment & Technology Market

2010 - 2015 | in U.S. millions

Compound Annual Growth Rate = 12.3%

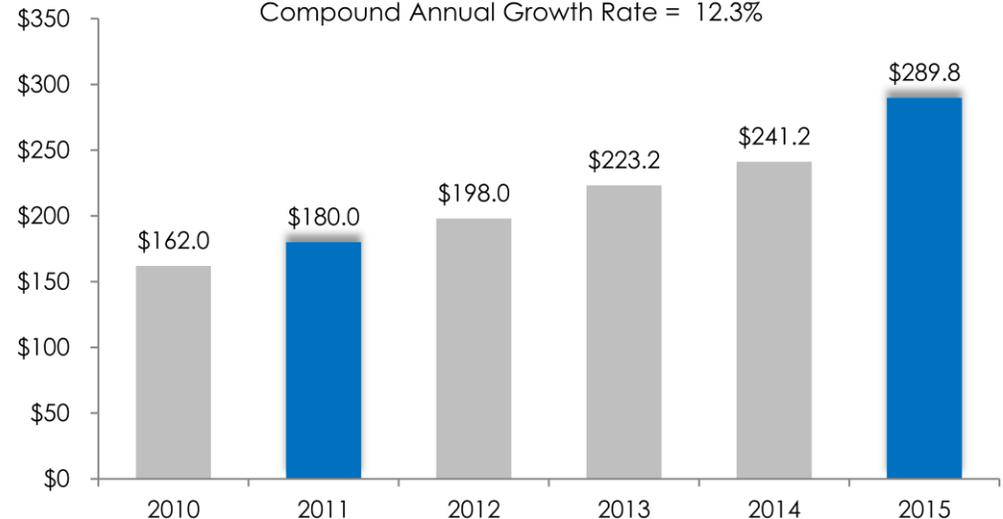


Figure 1 - Source: Zpryme

South Korea has a US\$162 million smart grid equipment and technology market, projected to grow over the next five years at a compound annual rate of 12.3 percent. By 2015, the total will be nearly US\$290 million, a sizable opportunity for firms interested in breaking into the market.

Evident by the nation's metro areas gradually becoming festooned with solar panels, broadband technology, and all-things-new-tech and billions in clean tech investment; look for South Korea to not only gel seamlessly with the smart grid revolution, but also lead it.

South Korea: What's the Government's Role?

Seizing upon the country's past success with consumer electronics, broadband internet and mobile communications South Korea is taking bold steps toward global leadership in smart grid development. With the stated goal of creating a national smart grid, the Korean government has partnered with industry, international groups and foreign countries to set out a 20-year agenda intended to reduce the country's carbon footprint and develop a new economic engine to stimulate exports. A 2008 "green-growth" national plan resulted in a subsequent committee that developed the country's comprehensive smart grid roadmap in 2009. Korea plans to spend US\$15.8 billion of government and private money on the smart grid between 2009 and 2016 – and between US\$24 and US\$30 billion by.³ The amount spent just on smart grid technology includes US\$1.93 billion from the government and US\$4.23 billion from industry.⁴ Another US\$18.05 billion will be spent on smart grid infrastructure build-out, with US\$440 million of that coming from the government.⁵ Domestically speaking, South Korea has enough electric generation and transmission capacity to meet its needs and already provides a relatively high level of power quality to industry and citizens. Because of this, the government needed to establish policies that would incentivize private

development of smart grid infrastructure and technology. The starting point of these efforts is a binding commitment to reduce the country's carbon output in 2020 by 30 percent from the Business As Usual projections. Other targets aim to add value to energy efficiency by reducing usage by 10 percent, lowering the average annual blackout minutes per household from 15 minutes to nine and trimming transmission line loss to 3 percent. Perhaps most significantly, the government aims to capture 30 percent of the global smart grid market.⁶ The lofty economic goals include a projected 50,000 annual jobs created, US\$43 billion in avoided energy imports and \$3 billion in avoided power generation costs. Through the Ministry of Economic Knowledge the government has taken the lead in building coalitions, defining the smart grid, establishing benchmarks and has already begun implementing a roadmap (see page 3) that will guide the country from pilot projects through development and commercialization of smart grid technology and ultimately to a national smart grid.

South Korea: Defining the Smart Grid.

The government defines the smart grid as the convergence of electrical transmission and information technology in five spheres: smart places, smart renewables, smart electricity services, smart transportation and smart power grid. The first of these is intended to enable enhanced consumer choice, integrating smart appliances with homes and buildings. This portion of the project includes a goal of 100 percent diffusion of AMI and achieving the aforementioned efficiency targets by 2030. Smart transportation entails Vehicle to Grid systems, nearly 2.5 million electric vehicles

³ KEPCO Smart Grid Announcement and Korea Smart Grid Institute (2010)

⁴ Ibid.

⁵ Korea Smart Grid Institute, 2010

⁶ Fehrenbacher, Katie, Get Ready for the South Korean Smart Grid Firms

used in country and 27,140 charging stations all by 2030. Smart renewables refers to targets utilizing microgrids in conjunction with wind and solar energy generation to increase that portion of Korea's energy generation to 11 percent of load. In addition, this sphere targets 30 percent of households to be energy self-sufficient (Katherine and Michael 2010).⁷

The smart power grid is intended to lay the groundwork for these developments by enhancing and enabling a wider range of interconnections between generation and load, thus allowing implementation of new energy business models. Specifically, this will result in the smart electricity services portion of the smart grid. Intended to take advantage of energy production and information and communication technology (ICT), these new services would rely upon real-time electricity trading and markets. The goal for this portion of the smart grid is to have 30 percent of consumers participating in such services by 2030. The national roadmap breaks these long-term goals into three phases backed by significant government investment in the smart grid sector. Phase One is the initial construction of a smart grid test-bed on Jeju Island, and is scheduled to run from 2009 through 2012. It will include work on the Smart Power Grid, Smart Places and Smart Transportation, linking grid networks to consumers and EVs.

Phase Two consists of taking the ideas and technologies from the test-bed and beginning a commercialization process that will expand the smart grid into selected urban areas. This phase is expected to run through 2020. Also referred to as the "Expansion stage" it will build off of integrated operation from 2012-13 and focus on smart renewables and electricity service. The goals are to provide new power services and accommodate

renewable energy into the power grid. The final phase of the plan is construction of the national smart grid, a project targeted to finish in 2030.

South Korea: International Smart Grid Role.

As one of Korea's primary goals for its smart grid development is a significant economic boost from exporting technology, it should be no surprise that the government has made a concentrated effort to coordinate their own smart grid efforts with the international community. In 2009, the Ministry of Knowledge Economy signed a Statement of Intent with the US Department of Energy to set a foundation of collaboration with the smart grid technologies and several other segments of the green-economy.

That same year, Korea, along with Italy, took the lead in developing a Technology Action Plan for Smart Grids for the Major Economic Forum on Energy and Climate. The plan discusses the current status of smart grid technologies, migration potential and partnerships globally. It offers up a set of best practices, incentives and challenges. Finally, it makes recommendations for future action and specific goals and timelines. Of these, Korea is already implanting most of the recommendations it has for developed countries. Primarily, these include setting specific, measurable goals and a national roadmap to achieve them. Additionally, it encourages countries to value energy efficiency and to develop policies such as real time pricing that maximizes smart grid benefits.⁸

In 2010, Korea signed an historic partnership with the US State of Illinois to collaborate on smart grid

⁷ Katherine, Tweed; Michael, Kanellos, South Korea Guns for Smart Grid Finish Line

⁸ Korea Smart Grid Institute, 2010

technology. The Korea Electrotechnology Research Institute and other related centers work with Illinois' Argonne National Laboratory and the University of Chicago to test and develop technologies. The Illinois Department of Commerce is also included in the pilot program to create smart grid technology at a facility on Jeju Island. Any commercialization resulting from this pilot will be rolled out in both countries and promising urban business models based in the smart grid will test in Chicago and Seoul.

South Korea: Future Smart Grid Policies.

In order to fulfill the promise of a national smart grid at a quality high enough to export around the world, the Korean government must continue to institute policies that will streamline its adoption. Primarily, the national government must promote R&D, especially in energy storage, core ICT technology and infrastructure, and reliable security for digital networks. Continuing the current policies and achieving stated efficiency and carbon reduction targets should stimulate domestic demand for a growing smart grid industry, while adopting trade policies favorable to these technologies will enhance global demand for Korean goods in the sector.

Observing and evaluating successful models developed in pilot programs is critical to step-wise implementation of legal and regulatory frameworks needed to advance the smart grid across the country over the coming decades. Korea has already begun to turn its attention to these issues with a proposed Special Act on the Establishment and Support for Smart Power Grid

South Korea & KEPCO: What's at Stake?

In a country of 48 million people the state-owned Korean Electric Power Corporation (KEPCO) is the only power transmission line and distribution company. However, its government ties have not hampered its international success. The company is a growing force in international energy industries, particularly in the field of nuclear power. Like the government of Korea, KEPCO has lofty ambitions for its near-future, and aims to become one of the globe's top five energy companies. KEPCO's anticipated success hinges on its adaptation to a low-carbon global economy with smart grid efforts complimenting its nuclear generation and renewables portfolio. Because of KEPCO's singular significance to the national electric grid, it is working with virtually every company in the country involved with the smart grid and is involved with all five of the roadmap sectors. Specifically, they have leveraged partnerships with Hyundai Motors to develop charging infrastructure standardization and have developed two different EV charging station prototypes. It is also developing Electricity Management Systems to optimize energy use, building renewable generation around the world, and is designated to lead the national smart grid rollout. The national utility has implemented a self-healing system that complements diagnostic devices which have enabled the company to minimize blackout times and set them up to lead such advances on the smart grid front. The company estimates that renewable energy generation and the smart grid are going to account for US\$26 billion of their US\$84.5 billion in total revenues by 2030.⁹ Backing this up will be major investments in the smart grid—the equivalent of \$7.18 billion by 2030.¹⁰ Of the total investment, \$370 million per

⁹ KEPCO Annual Report, 2010

¹⁰ KEPCO Smart Grid Announcement, 2010

year will be spent in the next five years, \$2.1 billion through 2020 and the remainder invested through 2030.¹¹

South Korea: Smart Grid Pilots & Industry Players.

Jeju Island, is Korea's smart grid shining star, designated as the national test-bed for the five smart grid spheres identified by the government's roadmap. The island is a "special autonomous province" less than 200 km south of mainland Korea and connected with a 300 MWHVDC line. Jeju Island will potentially see US\$200 million invested in the smart grid between 2009 and 2013.¹² The project has recently completed construction of the Total Operation Center which will serve as a hub for the various projects at work on island. The test bed includes work on in-home displays, appliances, smart meters, renewables and EVs. It will include a PR center and four exhibition halls. One aim is to draw conferences and provide in depth demonstrations to outside businesses, governments and universities in order to highlight the project. Currently, the \$65 million pilot program on Jeju has a fully integrated Smart Grid System for 6,000 households; wind farms and four distribution lines.

South Korea: Industry at a Glance.

While the Korean national government, KEPCO, the Korea Smart Grid Institute (KGSi), Jeju Special Autonomous Province and Korea Smart Grid Association are the key players in the Jeju Island pilot project, the totality of the initiative involves a number of Korea's global corporations and over 160 companies. These companies and organizations, along with academic

¹¹ Ibid.

¹² Kim, Jinho; Hong-II, Park, A National Vision, IEEE Power & Energy Magazine (jan-feb 2011)

and government institutions will test technologies and business models to ultimately roll out in selected cities on mainland Korea. Participants in the Smart Places include SK Telecom, KT, LG and 101 other companies investing US\$80 million.¹³ The Smart Transportation sphere involves SK Energy, GS Caltex and 39 others totaling US\$40 million. Companies participating with the Smart Renewables portion of the pilot include Hyundai, Posco and 37 others with total investment of US\$35 million. The Korean Power Exchange (KPX) and six other companies are putting US\$15 million toward smart electricity service and the Smart Power segment will include 21 other companies putting US\$30 million toward automated protection and recovery as well as smart transmitters. KEPCO, as stated is involved with each of these spheres of the pilot program.

South Korea's Net Electricity Generation, 2000 - 2015
in billion kilowatt-hours

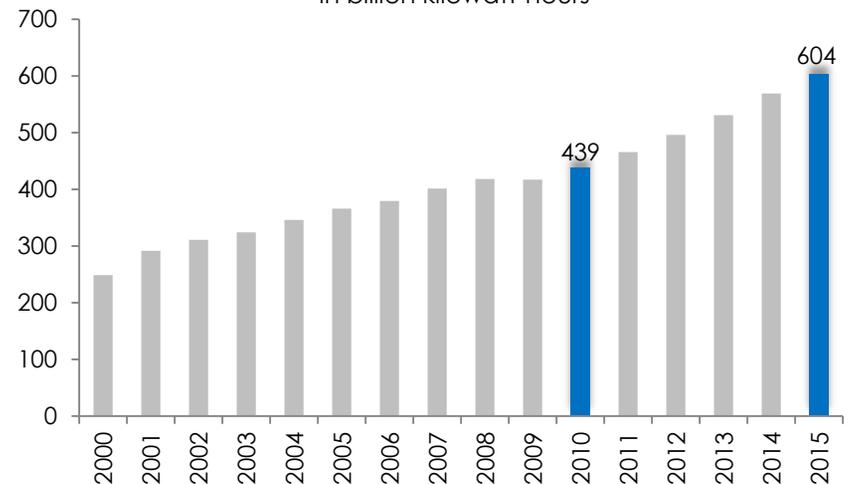


Figure 2 - Source: U.S. EIA & Zpryme (2010 - 2015 projection)

IBM, KEPCO and the IEC have recently teamed up to develop a set of communications standards to be utilized in practice at the Jeju Island Total Operations Center. The

¹³ Ibid.

TOC will utilize communications protocols to collect and manage information across different smart grid systems mad by more than 100 participating companies. "Operating the smart grid involves implementing a flexible management strategy that takes into consideration the various application standards, development speeds and requirements of that particular region," said Park Jong-man, Deputy General Manager at the integrated control center of KEPCO's Jeju Demonstration Complex. "This collaboration with IBM allows KEPCO to create a model based on international standards, such as CIM that can be used to infuse intelligence into any smart grid infrastructure." "This collaboration with KEPCO will not only improve operational efficiencies at the complex but will also help drive the development of international standard technologies in the Korean smart grid market – allowing domestic businesses to operate and compete at an international level," said Guido Bartels, General Manager, Energy and Utilities industry at IBM and Chairman, Global Smart Grid Federation. "IBM's continued work with KEPCO demonstrates a host of new opportunities and initiatives that will provide a new level of insight for organizations around the world." The IBM system will enable Korean companies to further enhance their global aspirations by giving the Jeju project a foundation in international standards (IBM 2011).

South Korea: Smart Grid Technology Market Size.¹⁴

South Korea has a US\$162 million smart grid equipment and technology market, projected to grow over the next five years at a compound annual rate of 12.3 percent. By 2015, the total will be

¹⁴ Zpryme's smart grid technology forecast for South Korea does not account for government or KEPCO investments in electricity infrastructure investments or transmission and distribution upgrades.

nearly US\$290 million, a sizable opportunity for firms interested in breaking into the market.

Projected South Korea Smart Grid Market by Technology
2010 and 2015 | in U.S. millions

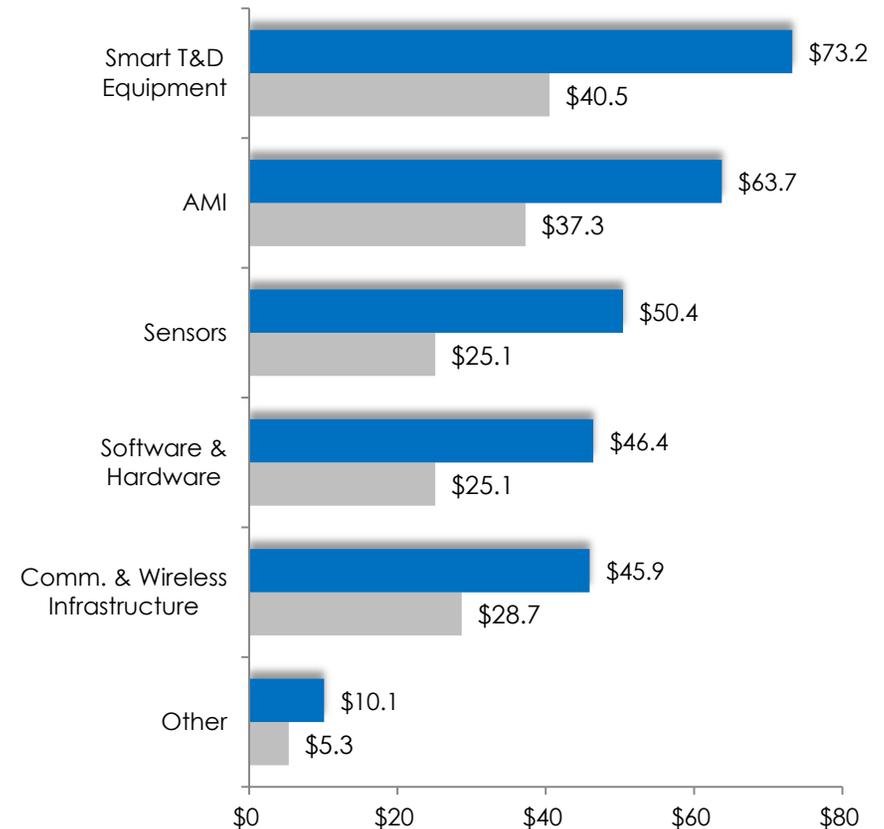


Figure 3 - Source: Zpryme

Zpryme examined six different sectors of the smart grid industry in Korea; software and hardware, sensors, communications and wireless infrastructure, smart T&D equipment, AMI and "other". Given Korea's roadmap and targets, the breakdown of some smart grid market segments is not surprising.

South Korea Smart Grid Market by Segment

(All figures in U.S. million dollars)

Smart Grid Segment	2010	2011	2012	2013	2014	2015	CAGR (2010 - 2015)
Software & Hardware	\$25.1	\$27.4	\$30.7	\$34.5	\$37.4	\$46.4	13.1%
AMI	\$37.3	\$41.4	\$44.7	\$49.1	\$53.6	\$63.7	11.3%
Sensors	\$25.1	\$28.6	\$32.6	\$38.8	\$42.7	\$50.4	15.0%
Communications & Wireless Infrastructure	\$28.7	\$31.8	\$34.7	\$37.8	\$40.3	\$45.9	9.9%
Smart T&D Equipment	\$40.5	\$44.6	\$48.6	\$55.8	\$60.0	\$73.2	12.6%
Other	\$5.3	\$6.3	\$6.8	\$7.1	\$7.2	\$10.1	13.6%
Total Smart Grid Market Value	\$162.0	\$180.0	\$198.0	\$223.2	\$241.2	\$289.8	12.3%

Percent of Total Market	2010	2011	2012	2013	2014	2015
Software & Hardware	15.5%	15.2%	15.5%	15.5%	15.5%	16.0%
AMI	23.0%	23.0%	22.6%	22.0%	22.2%	22.0%
Sensors	15.5%	15.9%	16.5%	17.4%	17.7%	17.4%
Communications & Wireless Infrastructure	17.7%	17.7%	17.5%	16.9%	16.7%	15.8%
Smart T&D Equipment	25.0%	24.8%	24.5%	25.0%	24.9%	25.3%
Other	3.3%	3.5%	3.4%	3.2%	3.0%	3.5%
Total	100%	100%	100%	100%	100%	100%

Figure 4 - Source: Zpryme

With the goal of 100 percent penetration of AMI, that market is projected to continue to dominate the industry through 2015, making up roughly 23 percent of the total smart grid space. As well, smart T&D equipment is projected to continue to make up roughly a quarter of smart grid spending through the next five years.

Projected South Korea Smart Grid Market Segmentation by Technology, 2010

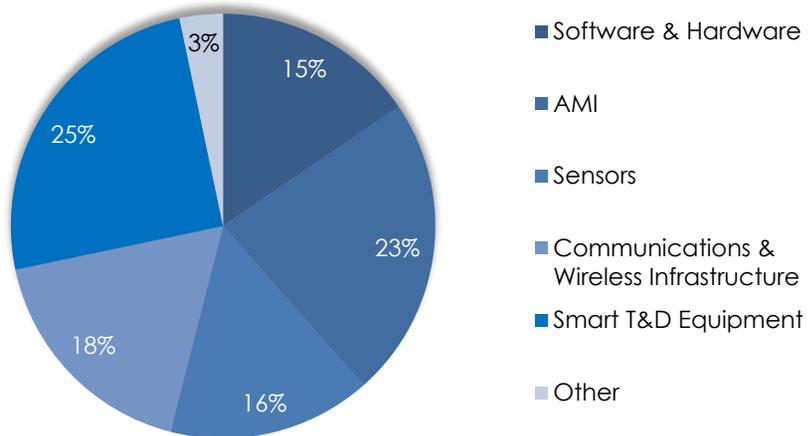


Figure 5 - Source: Zpryme

From a 2010 baseline through 2015 the only segments projected to have any substantial change in market share are communications and wireless infrastructure and sensors.

Projected South Korea Smart Grid Market Segmentation by Technology, 2015

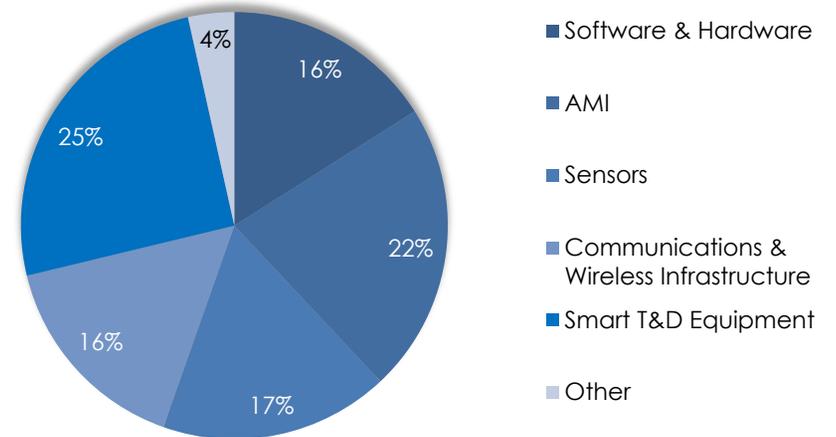


Figure 6 - Source: Zpryme

Even these two segments are only expected to deviate two percentage points off their current proportions. While electricity distribution automation and transmission upgrades present one of the largest opportunities, given KEPCO's national monopoly on T&D and the history of corporate success in Korea in the wireless and communications sector, the best areas to break into the market are likely to be in software, sensors and other information sectors.

South Korea: Entering the Smart Grid Market.

Given the stated focus of growing the Korean economy via the smart grid, the best path for foreign corporations is likely a partnership with an indigenous firm. For example, Samsung has already signed a deal with eMeter and other conglomerates such as the SK Group or LG may be ripe for similar deals (e.g. LG has

already joined the South Korean government's massive initiative for smart grid infrastructure). Another opportunity lies in developing renewable integration software and systems that enable collaboration across the utility value chain.

“South Korea’s technology prowess and remarkable progress with the Smart Grid City on Jeju Island have positioned the country as a true trailblazer in the global Smart Grid market. South Korea’s Smart Grid test bed, complete with everything from advanced metering infrastructure to electric vehicle charging stations to renewables generation, is a testament to the success of Korea’s Smart Grid Roadmap, which lays out hard deadlines and specific goals toward helping Korea build out a full national Smart Grid,” explained Gary Bloom, CEO of eMeter to Zpryme. “Successful partnerships between Korean-based companies and international organizations, such as a recent partnership between eMeter and Samsung, have further stimulated the project’s international visibility and interest from other potential global partners. South Korea now has the tremendous opportunity to become Asia’s and the rest of the world’s model for the Smart Grid.”

Recently, IBM announced its collaboration with POSCO ICT to develop South Korea's first renewable energy management system for a smart grid. Domestic players are not alone.

Some industry observers have noted that blue chips like GE, Siemens, and ABB are seeking roles in the large market and may have an advantage over Korean competition when it comes to trailblazing smart grid technologies, "particularly in system integration and monitoring", said Li of China Investment Consulting. Smart grid segments that

will thrive in South Korea as follows ((1) high to (5) less importance):

1. Smart T&D Equipment
2. AMI
3. Sensors
4. Software & Hardware
5. Communications & Wireless Infrastructure

In addition to the most favorable smart grid segments to enter above, it’s important to note:

1. The smart grid trend will be the catalyst for massive electric vehicle (EV) deployment, thus opportunities to enter EV markets such as charging infrastructure, hardware/software and next-gen automotive manufacturing will be worth the Korean pursuit. For example utilities will want to leverage their investment in smart meters and make them the nucleus for most consumption of electricity, including EVs.
2. Smart appliances for pilot smart grid initiatives will come out of Korea's backyard as LG and Samsung are actively involved in interactive, attractive, and smart consumer electronics and appliances.
3. South Korea's energy sector will benefit from the recently-implemented free trade deal with the European Union (EU) in its efforts to enhance the nation's overall competitiveness.

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