Smart Cities

South Korea: Jeju Island Smart Grid Test-Bed

Developing Next Generation Utility Networks

Executive Summary

A major challenge faced by cities around the world is how to pursue development and growth, while curbing climate change. Many national and municipal governments have set ambitious goals to reduce CO2 emissions over the next two decades, paving the way for a more sustainable future. To help achieve these goals, utility companies are building smart grids to support the distribution of energy generated from widely-dispersed renewable sources, while enabling more efficient transmission, storage and the consumption of energy.

Smart grid test-beds are now being set up around the world, most recently by the Smart Energy Collective in the Netherlands. Their aim is to test the advanced technologies required to support new elements of the power grid, such as electric vehicle charging infrastructure, wind and solar power and automation of transmission and distribution networks. These test-beds also research new market and business models. Just as importantly, the test-beds are exploring ways to change end-user energy consumption habits, which will be fundamental to achieving major reductions in CO2 emissions.

In South Korea, the government has set ambitious goals to reduce CO2 emissions by 30% from the anticipated "business as usual" levels in 2020. To test and evaluate Korea's future green-growth infrastructure and services, the government has teamed up with private companies to set up the national smart grid project on Jeju Island. Approximately 240 billion won (USD 208 million) is set to be invested in the project, of which 64 billion won (USD 56 million) is committed by the government and the rest by private companies, on the basis of plans to transpose the resulting innovation to a wider commercial base, and internationally. As one of the first smart grid test-beds globally, the Jeju Island programme will help Korean companies achieve a leading position in the early commercialisation of smart grid technology.

Some of the key features of the Jeju test-bed project include:

- A close public–private collaboration that involves significant investment commitments on both sides;
- The test system aims to demonstrate the management of next generation utility networks and how they can be supported by modern IT platforms and communications networks;
- The test-bed will be a launch pad for wider country deployment and to open up export markets;
- The project is supported by Korea's three major telecommunications service providers KT, SKT and LG Telecom. Telcos are testing a variety of smart grid services and solutions for smart places (homes and buildings) and smart transportation.
- If the government's plans come to fruition, by 2030, South Korea will generate 11% of all energy from renewables from 2.1% in 2012[1], eliminate approximately 230 million tonnes of greenhouse gas emissions, create 50,000 jobs annually, and generate 74 trillion won (USD 64 billion) worth of domestic demand for new technologies.

1 http://www.smartgrid.or.kr/10eng4-1.php

Introduction

Located on the southernmost tip of the Korean Peninsula, Jeju is the largest island in South Korea.

The island is a popular tourist destination, and the location of the World Heritage Site Jeju Volcanic Island and Lava Tubes. The sunny and windy climate makes the island an ideal location to test the concept of distributed energy generation and micro-grids. By 2030, the island plans to become carbon-neutral and fully-sustainable through the use of renewable energy.

The Jeju Test-Bed is being overseen by the Korean Ministry of Knowledge Economy, is set to run between May 2009 and May 2013. A total of 168 companies are participating in the project, which covers approximately 6,000 homes. The aim is to optimise energy usage by utilizing new and renewable energy sources and energy storage facilities. The smart grid - an intelligent power transmission and distribution system - will collect real-time data on energy usage and demand. That data can be used to limit the unnecessary use of electricity and increase the efficiency of energy consumption.

The project is being financed by both the national government and private companies. A total investment of 240 billion won (US$208 million) is committed to the construction of test-bed facilities, projects and services, of which $56 million comes from public funds and the rest from private investment.

The first phase of the project, concluded in May 2011, involved the construction of smart grid facilities and infrastructure. The second phase, lasting from summer 2011 until May 2013, is testing and demonstrating the infrastructure and services, and preparing the technology for expansion and export to mainland Korea and overseas.

"KT, a leading mobile operator in smart grid, aims to achieve the green growth driven by Korean government. KT consortium is developing low-carbon, energy efficient smart grid technologies in the Smart Place sector and creating a new value."

Jinsoo Sohn, Head of Smart Grid & Energy Business Unit, KT

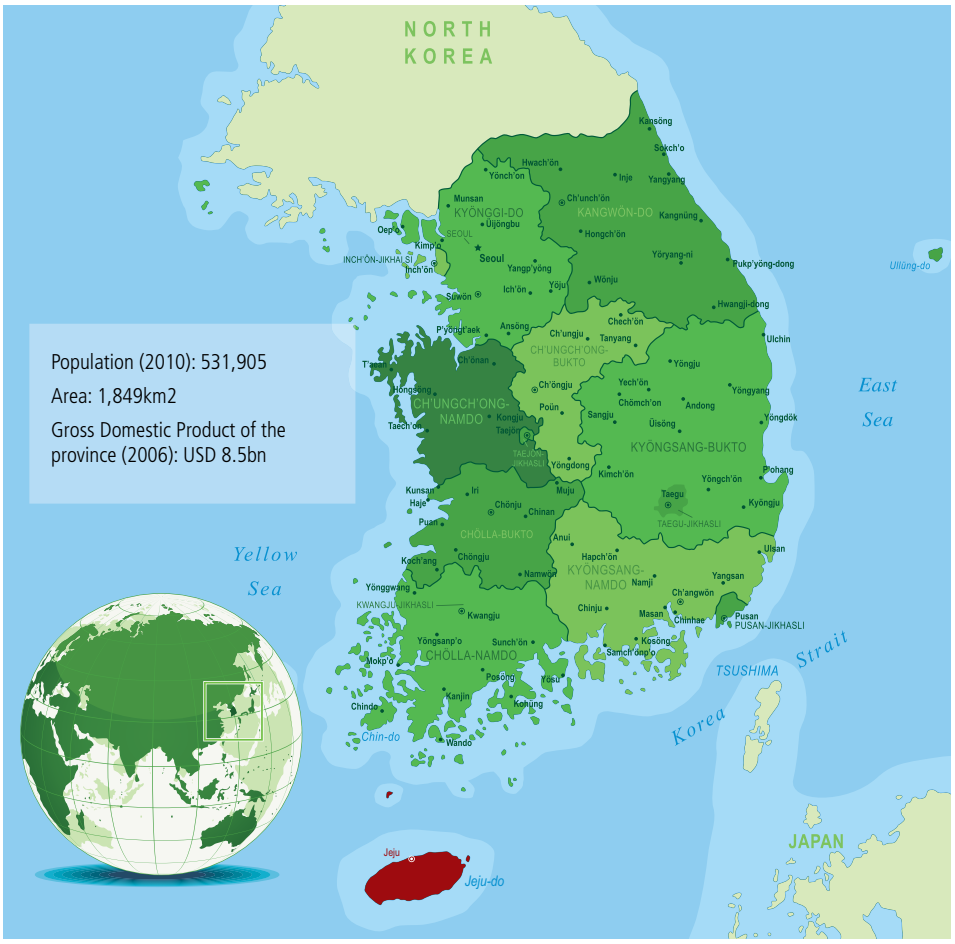
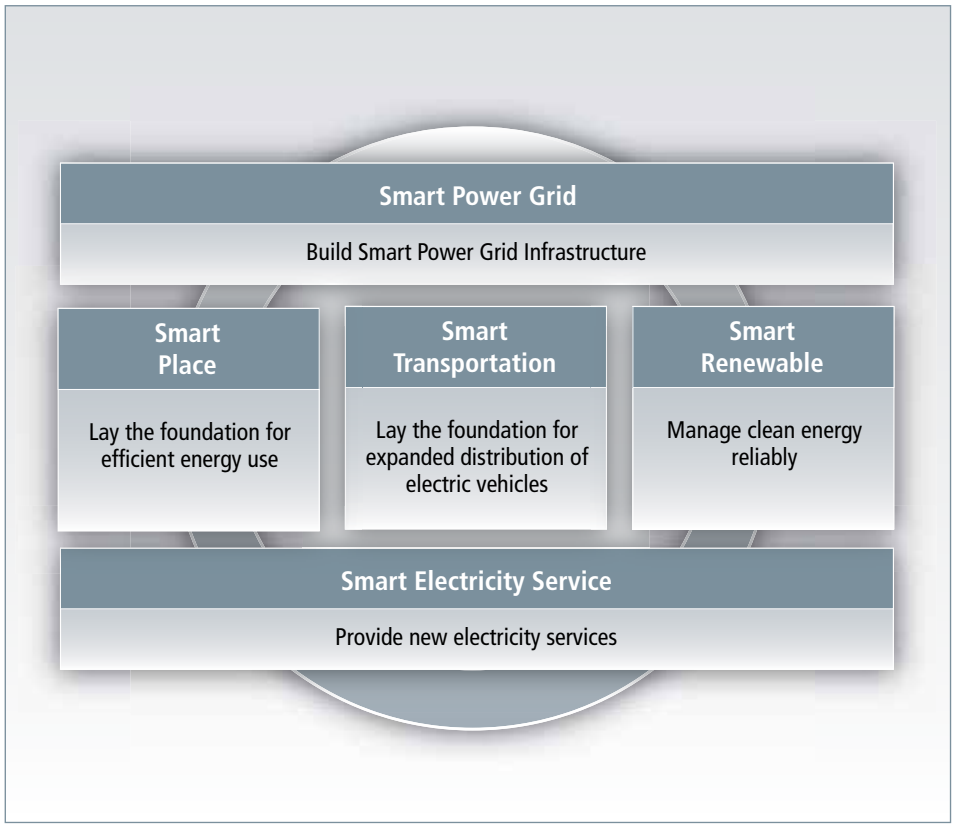


Exhibit 1: Five Areas of the Jeju Test-Bed



Source: Korea Smart Grid Institute

Testing the use of IT Platforms to Manage Next Generation Energy Networks

Moving from closed utility systems to open service platforms

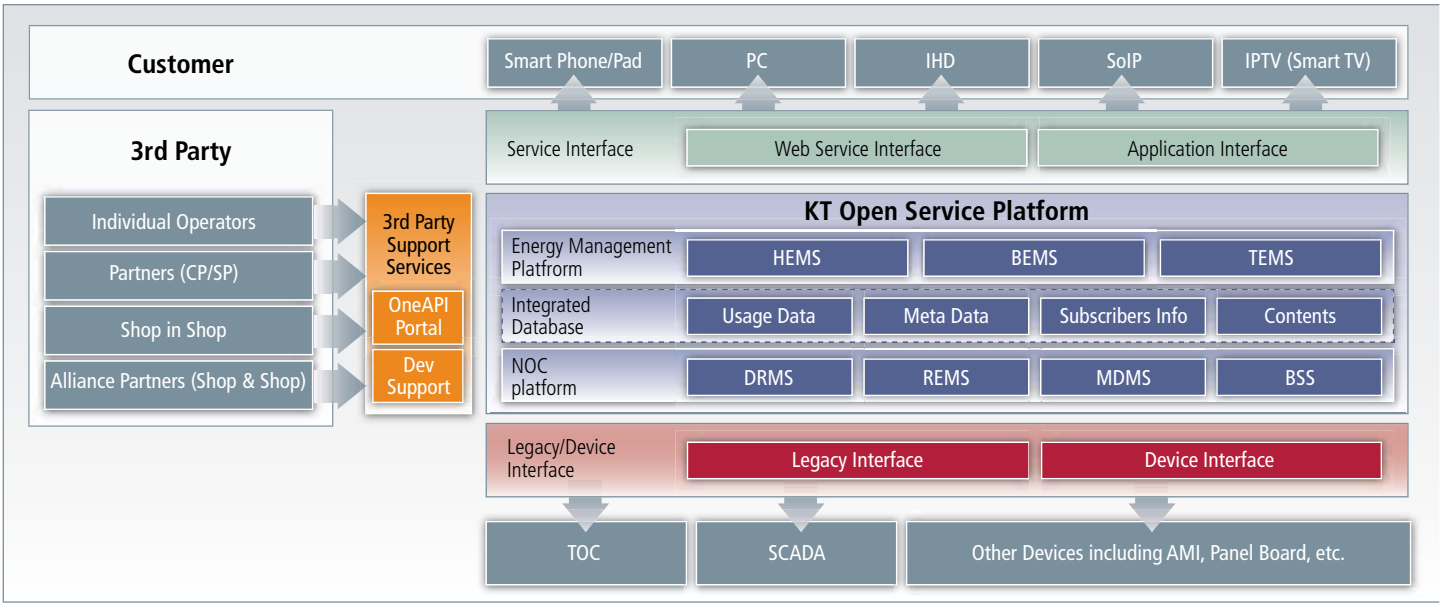
Successful operation of the smart grid will require secure and interoperable ICT infrastructure and platforms to support new services, such as demand response (DR), building energy management and power retail. Demand response will enable utilities companies to curtail the consumption of energy by home and business users during times of peak demand, by controlling the use of electricity and appliances at customer premises and rewarding them through price discounts and other incentives. Building energy management services will provide real-time energy monitoring and control tools to end-users themselves. Lastly, power retail will give consumers choice of electricity rates, allow them to sell renewable energy back to the grid, and implement a real-time pricing system nationwide.

Traditional, closed single-utility ICT systems aren't capable of delivering the required range of technological and operational capabilities. The new smart grid will involve multiple companies and require real-time monitoring and management of millions of widely distributed managed objects and devices, including meters, feeder automation devices, and distributed generation assets. Smart grid market participants will need to apply sophisticated analytical tools to deal with large amounts of data in real-time, and be able to bill and invoice customers for large volumes of transactions.

ICT infrastructure for smart grid will be digital, capable of two-way low-latency communication, and designed to be highly reliable, even self-healing. For telco network providers involved in smart grids projects, the main challenge is therefore to optimise and monitor the communication network performance, and to deal with exploding amounts of data, while ensuring that ICT infrastructure does not compromise stability and security of the grid. However, their role in supporting a smart grid will go further than networks and infrastructure.

At Jeju Island, KT, for example, is testing a range of solutions for smart home and building energy management, as well as electric vehicle mobility solutions through the KT Consortium, which consists of 14 corporations, such as Samsung, Hyosung, Omni system, ABB, and four research institutes for advanced technologies, such as Korea Institute of Energy Research and Korea Electronics Technology Institute. At the heart of KT's operations is a smart grid NOC (network operating centre), built on its Open Service Platform. The platform inter-works with a variety of connected devices and the legacy grid network, and provides third party support services through an open API portal (see Exhibit 2).

Exhibit 2 KT Open Service Platform to support smart grid services



Source: KT Smart Grid Brochure

Mobile technology is being used on Jeju Island to support the delivery of a wide range of smart grid solutions. In addition to connectivity for smart devices, mobile infrastructure is used for various support services, such as billing, authentication and security.

Creating a new customer experience

The Jeju Island project is also testing new market and business models by involving the entire ecosystem of utilities, ICT companies and public administration companies. Korea's three major telecommunications service providers KT, SKT and LG Telecom are testing a variety of smart grid services and solutions for smart places (homes and buildings) and smart transportation. The telcos are also piloting end-user services and tools, including web-based cloud platforms for energy management.

Smart grids will only realise their full potential if households and businesses change from passive consumers of electricity to well-informed and proactive users of energy management systems. On Jeju Island, such a change is being enabled by the introduction of new connected devices at customer premises, real-time analysis of consumption data, and a major effort to teach smart grid customers how to use the new systems.

At the Jeju test-bed, the KT consortium is testing a wide range of connected devices, sensors and web-based cloud services to analyse and present energy consumption data. These include:

- Connected home devices include smart meters, smart tags (smart switches which monitor the power usage of each electrical device) and smart boxes (gateways connected to a wide area network (WAN) via WCDMA, WiBRO or FTTH and used to control all household appliances). In combination with temperature and humidity sensors, these devices are used for real–time monitoring and control of energy consumption. The data is transmitted to KT's network operating centre over a wide area network.
- Energy consumption info portal: Householders can view their energy consumption data on four different screens, such as in-home displays, TVs, tablet PCs, smartphones. Moreover, every household can compare its usage with comparable houses and neighbours.

By 2030, the South Korean government plans to engage 30% of all citizens in a real-time power trading market, giving them choice of electricity rates and allowing them to sell renewable energy back to the grid. To achieve this, the participating consortiums will need to invest in a significant amount of research into end-user energy consumption habits and education of household users about the benefits and use of new smart grid services. On Jeju Island, the Smart Grid Information Centre (SGIC) has been educating householders through meetings, presentations, conferences and forums. Even so, progress has been slow in some areas, where large proportions of the population are elderly. According to the 2010 Jeju Statistical Yearbook, for example, 44 per cent of the Gujwa-eup test area's 3,282 residents were over the age of 65[2], and most would struggle to understand what to do with new smart meters and information home displays

Such educational programmes will need to be replicated when smart grid services are transposed to a wider commercial base, both in Korea and abroad.

2 http://www.jejuweekly.com/news/articleView.html?idxno=1835

Jeju Island Smart Grid Test-Bed is a Launch-pad for pan-South Korean Deployments

Building a nationwide smart grid will be a lengthy process. The roadmap for South Korea's national smart grid plan cites the construction of a smart grid across metropolitan areas, together with fitting all households with smart meters, by 2020. The goal is to complete a nationwide smart grid by 2030. A significant effort will be needed to integrate new smart grid services with the existing infrastructure and services of South Korea's u-Cities, which are deploying ubiquitous connectivity and sensors to provide advanced city services. The development of the link between the two will start in May 2013.

If the government's plans come to fruition, by 2030, South Korea will generate 11% of all energy from renewables from 2.1% in 2012[3], eliminate approximately 230 million tonnes of greenhouse gas emissions, create 50,000 jobs annually, generate 74 trillion won (USD 64 billion) worth of domestic demand for new technologies, eliminate 47 trillion won (USD 40 billion) worth of energy imports, remove the need to construct 3.2 trillion won (USD 2.8 billion) worth of new power plants and generate 49 trillion won (USD 42 billion) worth of exports of technology know how.[4]

Conclusion

Achievements

South Korea was among the first countries to set up a test-bed for smart grids, preparing South Korean companies to be at the forefront of the early commercialisation of the technology. South Korean telcos will be among the main beneficiaries of this pioneering approach, as they are preparing to export their expertise and technology outside of Korea. In 2012, for example, KT started deploying its Smart Grid Network Operating Centre (NOC) technology in Finland and Uzbekistan. The operator also conducted analysis and design for four buildings in Chicago in May 2012; and it developed a pre-commercial

service for 50 homes in Bahrain in 2011. SKT, another leading Korean telco, is also planning to expand into the overseas markets for smart grids, such as the U.S. and China.

Challenges

As well as secure and interoperable technology, the success of smart grids depends on the education of consumers and businesses about the new capabilities of smart grid technologies and power market models. This can be a lengthy and resource-intensive process.

Jeju Test-Bed: Background on Participating Companies

KT

KT Corporation is a telecommunication operator in Korea providing wireless, fixed line, broadband and IP TV. It holds 86% of the national fixed-line market, 32% of the wireless market and 45% of the broadband market (19 million, 16.6 million, and 7.9 million subscribers respectively). KT proposed the U-City concept to the Korean government as a new model of city development through government-private collaboration, and applied it in the first u-City project in Dongtan in 2006. Since then, KT has been involved in 44 u-City projects in South Korea, taking part in strategic planning, design implementation or operation of u-Cities.

KT is participating in the Jeju Test-Bed project through the KT Consortium, which consists of 14 corporations, such as Samsung, Hyosung, Omni system, ABB, and four research institutes for advanced technologies, such as Korea Institute of Energy Research and Korea Electronics Technology Institute. Additional information about KT can be found at www.KT.com.

SK Telecom

SKT is a leading telecommunication operator in South Korea, providing wireless services to 26.5 million subscribers. It holds 49% of the local wireless market. On Jeju Island, SK Telecom leads a consortium of 28 companies from various industries, including Korea Cable TV and Jeju Broadcast, among others. The consortium provides facilities and devices for 1,000 households in five different areas of AMI, solar power, energy storage, smart appliances and electric vehicles. It tests various business models and smart grid services, and conducts analysis of customer needs and consumption patterns.[5]

Further Information

Korea Smart Grid Institute:
http://www.smartgrid.or.kr/10eng3-1.php

3 http://www.smartgrid.or.kr/10eng4-1.php
4 http://www.smartgrid.or.kr/Ebook/Roadmap2/Roadmap2.html
5 http://www.keei.re.kr/keei/download/seminar/101117/II101117_b03.pdf

GSMA Connected Living Programme

The GSMA's Connected Living programme is a three-year market development initiative whose mission is to help mobile operators accelerate the delivery of new connected devices and services. Our target is to assist in the creation of 700 million new mobile connections, whilst stimulating a number of service trials and launches in the Automotive, Education and Healthcare sectors. The Connected Living programme is also working with the city of Barcelona, the Mobile World Capital, to develop and showcase smart city services. Our work focuses on the adoption of mobile-based solutions and services to ensure that the cities of the future are safe and healthy places to live and work.

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Connected Living

www.gsma.com
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