Smart Grid Initiative of Korea
Korea’s Smart Grid Overview
1-1. Overview of South Korea (1/2)

- Area: 99,720 km² (115th in the world)
- Population: 48 million (26th in the world)
- GDP: US$929.1 billion (14th in the world [2007])
- Trade: US$950 billion (10th in the world)

Key Industries and Global Ranking:
- Semiconductor 1st
- Petrochemical 5th
- Automobile 5th
- Steel 5th
- Shipbuilding 1st
1-2. Overview of South Korea (2/2)

As-Is

- One of 10 largest energy consumption countries
- Foreign Energy Dependency (97%), (2008: US$141.5 billion)

Objective

- Secure energy security and improve trade balance through reducing dependency on fossil fuel
- Implement measures on UNFCCC (UN Framework Convention on Climate Change) through increasing the efficiency in using electric energy

Global Energy Usage

1st 2nd 3rd 4th 5th 6th 7th 8th 9th 10th

2,326 1,698 705 520 423 329 322 263 227 226


Energy Imports

Unit: one hundred million dollars
Materials: Ministry of Knowledge Economy

2004 2005 2006 2007 2008

496 667 856 950 1415

<5-27>
1-3. Korea Electricity Industry

**Power System in 2008**

- **Installed Capacity**: 72,491 MW (12th in the world)
  - Output: 422,355 MWh
  - Peak Demand: 62,794 MW (2008)
  - Trading Volume: 24.3 billion dollars
- **Transmission lines**: 29,929 c-km

**Industry structure**

- Generation market share: KEPCO affiliates (88%), IPPs (12%)
- T&D, Retail Owner: KEPCO
- ISO/RTO: Korea Power Exchange

Values for T&D Loss:
- US: 6.8%, JP: 5.0%, KR: 4.0%

Values for Load Factor:
- US: 59.3%, JP: 62.9%, KR: 76.6%
1-4. Smart Grid Concept and Scope (1/2)

- Consumer oriented two way system
- Opened platform
- Dynamic service
- Supplier oriented one way System
- Closed platform
- Standard service
- Real time rate information exchange
What is smart grid?

- Next generation network that integrates IT into existing power grid to optimize energy efficiency through two-way exchange of electricity information between suppliers and consumers in real time
- **Components**: Advanced Smart Meter, EV charging infra, distributed energy resource, real time pricing, self automated recovery system, integration/ sales of renewable etc.

**Definition**

- EV/Battery – EV charger/electric discharge system
- Green energy (renewable) – Green energy microgrid
- Optimize nation’s grid security – Flexible AC Transmission System
- North-South /East-West connection – High voltage direct current transmission system
- Provide wide range of consumer choices – electricity distribution of various quality
- New Growth Engine – AMI installation
- Green IT, LED, smart appliances – DC (Direct Current) Power supply
- Optimize use of energy efficiency – Advanced Smart Meter

<8-27>
1-5. Need for Smart Grid

 Establishment of **Smart Grid platform** for low carbon green growth vision

**Innovative Technologies for Year 2030**

**Address climate change**
- 2008: 2.4%
- 2030: 11%
- Wind, solar power development
- Grid-connected technology

**Increase energy efficiency**
- (2006 standard): 46.7%

**Implement electric transportation**
- 2009: 0
- 2020: 1.0 million
- Electric vehicle charging station
- Fuel battery, DC distribution
1-6. Progress Overview

August 2008
- Proclaimed Low Carbon Green Growth Vision
  - 60th anniversary of the founding of the Republic of Korea on August 15, 2008 -

December 2009
- Selected consortia and signed a contract of agreement for Jeju smart grid demonstration project

January 2010
- Released the National Smart Grid Roadmap

October 2010
- Submitted a Legislation to the National Assembly
  - Smart Grid Stimulus Law
**1-7. National Smart Grid Roadmap**

**Chronology**
- Mar. 2009, Inaugurated National Smart Grid Roadmap Administrative Committee
- June~ Dec. 2009 Created provisional draft of the roadmap through experts’ participation and public hearings
- Jan. 2010 Announced National Smart Grid Roadmap

**Vision**
- Establish smart grid platform for low carbon green growth vision

**Goals by Phase**
- Smart pilot City
  - Phase 1 (~2012)
- Widespread Smart grid
  - Phase 2 (~2020)
- Nationwide smart grid
  - Phase 3 (~2030)

**5 Domains**
- **Smart Power grid**
  - Create flexible power grid
  - Implement self-automated recovery system
- **Smart Place**
  - Install AMI
  - Create energy management system
- **Smart Transportation**
  - Establish Nationwide EV Charging infra
  - Provide V2G and ICT service system
- **Smart Renewable**
  - Construct large Scale renewable Power plant
  - Implement energy Independent buildings
- **Smart Electricity Service**
  - Provide Dynamic pricing rates
  - Create power Exchange system
Smart Grid Demonstration Overview
2-1. Smart Grid Demonstration Progress Timeline

- 2013 May: Final completion of the project
- '11.6.1: Plan for 2nd Phase
- '10.5.31: Completed the project for its 1st year
- '09.12.16: Selected participating consortia and signed contract for the Demonstration Project
- '09.4: Initiated restructuring and expanding smart grid demonstration project
- '08.12: Established test-bed for Power IT
2-2. Why Jeju?

- Abundant supply of Renewable
  - Independent Power Grid
- Island with World Natural Heritages

Incubator for Smart Grid Technologies
2-3. Objectives for Jeju Smart Grid Demonstration

Create business models, and allow immediate commercialization

**Strategies**

- **Assess Business Models**
  - Assess smart grid technologies and verify effectiveness of smart grid related services for consumers

- **Select from open–bid**
  - Allow companies to openly bid for different areas of demonstration project to create innovative BIZ models

- **Induce Competition**
  - Induce competition amongst participating consortia in different domains to make effective assessment
2-4. Features of Jeju Demonstration Project

Enterprise Competitiveness
- Deduce globally competitive business industries
- Tele-communication, electricity, transportation, smart appliances etc, total of 168 companies participating

Jeju Bigbang
- Convergence of businesses
- Create innovated BIZ models using state of the art technology

Big Investment
- Companies are making greater investments for the demonstration project
- 3X increase in private investment (57.5 million $ → 173 million $)
  ※ 2 of the consortia are participating using own budget
2-5. Project Domains Per Consortia

- Smart Place
- Smart Transport
- Smart Renewable

Diagram showing various domains such as Smart Power Grid, Smart Green Homes, Smart Power Market, Smart Renewables, and Smart Transport.
## 2-6. Consortia for Jeju Smart Grid Demonstration

<table>
<thead>
<tr>
<th>Leads</th>
<th>Participating</th>
<th>Investment (Dollar)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Smart Place</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SK telecom</td>
<td>Samsung electronics, Korea Cable TV, Jeju broadcast etc (29 companies)</td>
<td>Govt: 5 million Private: 25 million</td>
</tr>
<tr>
<td>SK telecom</td>
<td>Samsung SDS, Samsung Trade, Rootech etc (14 companies)</td>
<td>Govt: 4.7 million Private: 30 million</td>
</tr>
<tr>
<td>LG Electronics</td>
<td>LG U+, GS pure cell, GS construction etc (15 companies)</td>
<td>Govt: 4.7 million Private: 17.5 million</td>
</tr>
<tr>
<td>OCEPCO</td>
<td>Samsung electronics, Taihan Electric, Nuri Telecom etc (38 companies)</td>
<td>Govt: - Private: 10 million</td>
</tr>
<tr>
<td><strong>Smart Transport</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KEPCO</td>
<td>Samsung SDI, Lotte data communication, P&amp;E Solution etc (22 companies)</td>
<td>Govt: 4.5 million Private: 14 million</td>
</tr>
<tr>
<td>SK energy</td>
<td>SK Network, Iljin Electrics, Ientech etc (13 companies)</td>
<td>Govt: 4.5 million Private: 13 million</td>
</tr>
<tr>
<td>GS Caltex</td>
<td>LG CNS, ABB Korea, NexCon Take etc (7 companies)</td>
<td>Govt: 4 million Private: 8 million</td>
</tr>
<tr>
<td><strong>Smart Renewable</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KEPCO</td>
<td>KOSPO, Hyosung, LSIS etc (16 companies)</td>
<td>Govt: 4.7 million Private: 15.3 million</td>
</tr>
<tr>
<td>HYUNDAI</td>
<td>Maxcom, Icellkorea etc (6 companies)</td>
<td>Govt: 4.7 million Private: 7 million</td>
</tr>
<tr>
<td>POSCO ICT</td>
<td>LG Chem, Woojin Industrial System, Daekyung Engineering etc (6 companies)</td>
<td>Govt: - Private: 9 million</td>
</tr>
</tbody>
</table>
2-7. Smart Power Grid

**Objective**

- To establish flexible power grid that allows new integrated/complex businesses
- To increase energy efficiency and quality through self-automated recovery system

**Key Technology Developments**

- Pilot smart grid technology: distribution/transmission (’12)
- Create self-automated recovery system for broad area

**Business Model**

- Testing/certifying system of smart power grid technology
- Exporting key smart power grid

**Goals by Critical Index**

<table>
<thead>
<tr>
<th>Transmission/Distribution Loss (%)</th>
<th>Power failure (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9 2012</td>
<td>15 2012</td>
</tr>
<tr>
<td>3.5 2020</td>
<td>12 2020</td>
</tr>
<tr>
<td>3.0 2030</td>
<td>9 2030</td>
</tr>
</tbody>
</table>
2-8. Smart Place

**Objective**
- To increase energy efficiency and reduce energy use via AMI installation
- To adjust energy use via two-way communication energy management System

**Key Technology Developments**
- Develop (AMI) and set standard (2012)
- Develop system to connect DR with the grid (2020)

**Business Model**
- Emergence of smart appliances and energy management service providers
- Emergence of prosumers (sell and consume)

**Goals by Critical Index**

<table>
<thead>
<tr>
<th>Energy save(%)</th>
<th>Smart meter installation(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstration</td>
<td>'12 '20 '30</td>
</tr>
<tr>
<td></td>
<td>5 10 100</td>
</tr>
<tr>
<td></td>
<td>5.6 100</td>
</tr>
</tbody>
</table>

[Image of a network diagram with buildings and energy sources connected]
2-9. Smart Transportation

Objective
- To establish nationwide charging infrastructure
- To allow consumers to charge during low-demand/low-rate hours and re-sell during peak hours

Key Technology Development
- Develop EV parts and materials (2012)
- Develop Vehicle to Grid system and ICT service (2020)

Business model
- Emergence of EV/battery rental service
- Emergence of EV operating management service business

Goals by Critical Index

<table>
<thead>
<tr>
<th>EV Distribution (1,000 units)</th>
<th>EV Charging infra (unit:unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>'14</td>
</tr>
<tr>
<td>------</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
</tr>
</tbody>
</table>
**Objective**

- To create large-scale renewable generation power plants
- To build green homes and buildings that are energy independent using renewable

**Key Technology Developments**

- Develop technology for stable connection of renewable generation to the grid (2012)
- Develop energy storage system for bulk renewable generation ('20)

**Business Model**

- Production and sales of renewable energy
- Exportation of energy storage system that is connected to the grid

**Goals by Critical Index**

- **Renewable Energy(%)**
  - '12: 3.1
  - '20: 6.1
  - '30: 11.0

- **Zero net energy building(%)**
  - '12: Pilot City 10
  - '20: 30
  - '30: 30
2-11. Smart Electricity Service

**Objective**
- To encourage consumer participation via dynamic pricing rates
- To promote on-line system for power exchange and derivatives

**Key Technology Developments**
- Develop real-time pricing and demand response system (2012)
- Develop on-line power exchange system (2020)

**Business Models**
- Customer based power providers
- Diverse power derivatives are expected to emerge

**Goals by Critical Index**

<table>
<thead>
<tr>
<th>Consumer choice billing</th>
<th>Consumer participation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstration</td>
<td>Nationwide</td>
</tr>
<tr>
<td>'12</td>
<td>'20</td>
</tr>
<tr>
<td>15</td>
<td>30</td>
</tr>
</tbody>
</table>
2-12. Future Test-bed Layout

- **Electricity Business**
- **Electric Grid Surveillance**
- **Micro Grid**
- **Power Operation Center**
- **Bulk generation Center**
- **Smart grid’s home buildings**
- **Electric Vehicles**
- **Self healing**

- **Demand Response**
- **Storage system**
- **Wind power generation**
- **Nuclear power Generation**
- **PV Power Generation**
- **Fuel Battery Generation**
- **NAN**
- **HAN**
- **WAN**
- **Micro Generator**
- **Smart Meter**
- **Gas/Water Meter**
- **Load Switch**
- **Home Server**
- **Smart Thermostat**
- **Energy Display**
- **Recharging station**
- **Electric Business**
- **Electric Grid Surveillance**
- **Power Operation Center**
- **Smart grid’s home buildings**
- **Electric Vehicles**
- **Self healing**
- **Bulk generation Center**

**Key Elements**
- **Smart Meter**
- **Smart Thermostat**
- **Load Switch**
- **Home Server**
- **Smart Appliances**
- **Energy Display**
- **Micro Generator**
- **Gas/Water Meter**
- **Recharging station**
- **Demand Response**
- **Storage system**
- **Wind power generation**
- **Nuclear power Generation**
- **PV Power Generation**
- **Fuel Battery Generation**
Demonstration Progress Report and Next Steps
3-1. Phase 1 Progress Report (1/3)

Construction plans

<table>
<thead>
<tr>
<th>Phase</th>
<th>Areas</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>PowerGrid • Place • Transportation</td>
<td>Grid, consumers, Vehicle to Grid connection</td>
</tr>
<tr>
<td>(Infrastructure)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase 2</td>
<td>Renewable • Electricity Service</td>
<td>New electricity service, Renewable to grid connection</td>
</tr>
<tr>
<td>(Operation)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Accomplishments

<table>
<thead>
<tr>
<th>Smart Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructed operation centers for each consortia</td>
</tr>
<tr>
<td>Installed 550 residential AMIs / 100 PVs</td>
</tr>
<tr>
<td>Installed energy monitoring device</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Smart Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activated EV charging infrastructure &amp; Deployed EVs</td>
</tr>
<tr>
<td>Constructed infra operating system, Designed security system</td>
</tr>
<tr>
<td>Developed paying method</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Smart Renewable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructed renewable generation plant</td>
</tr>
<tr>
<td>Designed systems to stabilize intermittency</td>
</tr>
<tr>
<td>Developed data center model coordinated with total operation center</td>
</tr>
</tbody>
</table>
3-2. Phase 1 Progress Report (2/3)

**Goal Oriented**
- Exceeded in number of technology developments and smart grid services (EMS, security etc)
- Focused on establishing standards to ensure compatibility between AMI and other smart grid key technologies
- Successful completion of making of smart grid key equipments (high-speed charger, BESS, power converter)

**Promotion Oriented**
- Acceleration of smart grid deployment and promotion through KSGW (G20)
- Major promotion of Jeju smart grid demonstration to imbed the theme of Green Growth
- Obtain global consensus and support for creating smart grid business models via Total Operation Center (93% complete)

**Future Needs**
- Need to expand into building in commercial and industrial regions
  - Need for a designated building for a large-scale building specifically designed for smart grid project within Koo Jwa Eup (Jeju)
  - Need a building that encompasses all smart grid technologies to be act as a model building for smart grid demonstration
  - Need a site to provide certifying, evaluating service for smart grid technologies

※ C&I : Commercial & Industry
Public consensus is necessary to implement nationwide smart grid

Companies can present and introduce smartgrid prototypes and educate the public

The exhibition will be sustained during and after the demonstration project

“Experience” the State of the Art Technologies and Viable BIZ models

- Main Exhibition center, “Comprehending” Korea’s Smart Grid Concepts and Jeju Test Bed
- 4 Smart Grid Themed exhibitions, “Experiencing” Smart and Eco-Friendly Daily Life

SKT : Smart Convergence

KT : Smart Mobile Energy

POSCO : Smart Renewables

LG : Smart Appliances
3-4. Next Steps

**System operation and verification**
- Deduce best practices by testing business models under the 5 domains of demonstration project
- Create platform for energy management; and test demand response solution
- Provide smart metering service, construct facilities for the operation of micro grid

**Induce Competition**
- Each consortium will perform in a competitive environment, and the government will provide persistent support to allow creation of new business models
- Business outcomes will be incorporated with national standard and deployment of smart grid

**Smart Grid Stimulus Law**
- Enact a law to promote smart grid and to help facilitate the execution of the national smart grid roadmap
International Cooperation
4-1. International Cooperation (1/2)

Support for ISGAN Activities

- **Government Support**
  - ISGAN Participant, Executive Committee
  - Co-lead Case Studies project, participate in (3) other ISGAN projects

- **KSGI Support**
  - Operating an interim secretariat to coordinate communication & project activities

- **Anticipated Effects**
  - Ensure an image of global smart grid leader, establish robust int’l collaboration
  - Establish smart grid inventory, and operate a int’l smart grid clearing house
  - Obtain int’l smart grid information from established networks

Collaborative effort for exportation

- **Korea-Illinois Smart Grid Collaboration**
  - Collaborative R&D on Distributed Energy Resource → IIT & KERI
  - Collaboration on smart grid security project → NSRI & UIUC

- **Collaboration with the UK for AMI market**
  - Effort to export smart meters to utilities in UK

- **Iran-KDN(KEPCO)**
  - Established a joint venture between Iran-Korean companies
  - Established smart grid demonstrative system
  - Modernized Iran’s electricity system via deployment of smart grid
4-2. International Cooperation (1/2)

**Role**
- Coordinate consensus from private individuals regarding smart grid and continual effort to develop smart grid standard domestically in correspondence to int’l standard

**Collaborative approach**
- Organized Korea-U.S. Smart Grid Forum between KATS (Korea) and NIST (U.S)
- Creating a collaborated network between U.S.’s ‘SGIP and Korea’s ‘SG Standard Forum under consideration
- Exchange of information and human resources between two countries
- Anticipates to hold collaborative workshops, seminars for smart grid standard

**Next Steps**
- Outreach collaboration with European countries, China, Japan and other countries in regards to int’l smart grid standard

**Korea-U.S smart grid Standard collaboration**

**Int’l Outreach**

**Government**
- Collaborated with the U.S. government for smart grid (Korea-U.S. Summit on 2009)
- ISGAN participant along with other 20 countries

**Korea Smart Grid Institute**
- Create wide networks with other int’l smart grid organizations and Embassies of other countries

**Private sector**
- Collaborating with GSGF and other smart grid related associations
5
Smart Grid Stimulus Law
4-1. Background

Provide legislative support for Smart Grid

**Current**: Smart grid R&D is much dependent on voluntary participations from companies.

**Future**: Need legislative support to sustain project and maintain companies’ participation.
- Major economies such as the United States and EU are designing to enact legislations to support R&D, standards, and smart grid deployment.
- There’s an urgent need to provide legislative support for smart grid to address climate change issues and to compete in the global green market.

Transcend current ordinance and institutional constraints

**Current**: Electricity Enterprise Act restricts convergence of businesses
- Electricity Enterprise Act: Applied to generation, transmission/distribution and electricity sales.

**Future**: Need to transcend current legislative constraints by regulating a law that advocates converged infrastructure.

Advocate convergence of businesses

- Smart grid is a key technology to help save energy, to help deploy electric vehicles and to allow integration of renewable energy.
- Formulated solid framework to facilitate enactment of smart grid regulations.
  - i.e. National Smart Grid Roadmap and Jeju smart demonstration project.
4-2. The Significance of Enacting Smart Grid Stimulus Law

Smart Grid Stimulus Law coordinates smart grid road map, demonstration and pilot city.

- Smart Grid Stimulus Law allows technological and institutional progression for smart demonstration and smart pilot city project.

- The project outcome from Jeju smart grid demonstration will help coordinate different aspects of smart grid businesses, such as smart grid deployment, R&D, workforce development, etc.

- Enactment of smart grid stimulus act will provide solid foundation for smart grid related businesses and induce greater investments.
VI. Conclusion
The initial expectation of internet was mainly on providing e-mail service but modern internet opened other business opportunities such as Internet phone, UCC, on-line markets, IPTV etc.

The government will provide support for 12 consortia participating in the Jeju smart demonstration project to induce creation of innovated business models.

Deduce smart grid deployment model for nationwide implementation.

Korea plans to share case study on Jeju smart grid demonstration with the international community. We hope to contribute reduce global GHG emission and continue our support for smart grid.
5-2. Reinforce International Collaboration

Propose continuous conference on smart grid demonstration

- Propose to continuously hold Jeju smart grid demonstration conference even after KSGW; conference will allow exchanging of global case studies for smart grid

Reinforce international collaboration through ISGAN

- Provides a framework for high-level government coordination amongst member countries to enable seamless global development and deployment of smart grid

Support participation from companies overseas

- Foreign companies participating in Jeju project include ABB Korea, Renault Samsung, GE Korea
- Plan to encourage and support participation from other foreign companies
Thank you

For more information: jerryyang@smartgrid.or.kr