

Korea's Smart Grid Policy Initiatives

2010 KSP with the Kingdom of Saudi Arabia

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1. Korea and Power Industries : An Overview

South Korea Overview



- Area: 99,720km² (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



(National Dimension) Climate Change and Energy Solution

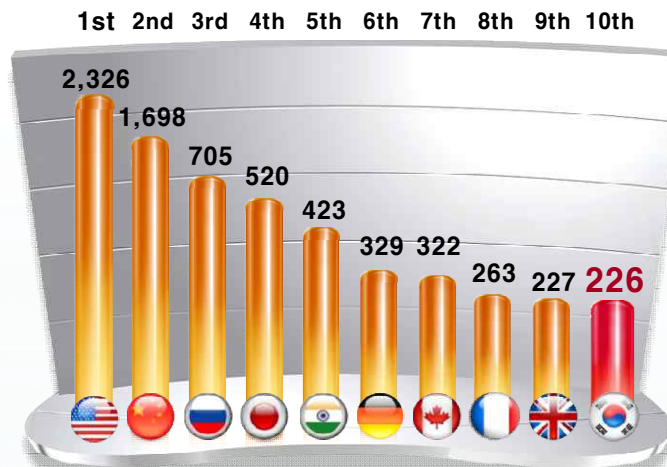
As-Is

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

Objectives

- 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

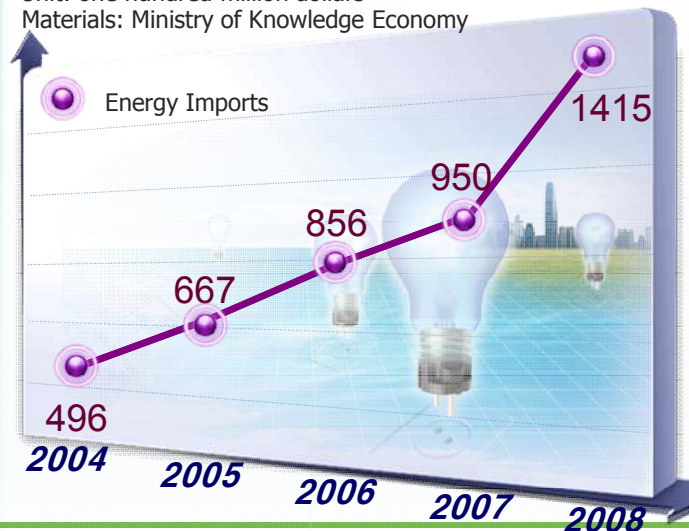
Global Energy Usage



Source . Consumption of Energy and Oil 2006:
BP Statistical Review of Energy(BP,'07.6)

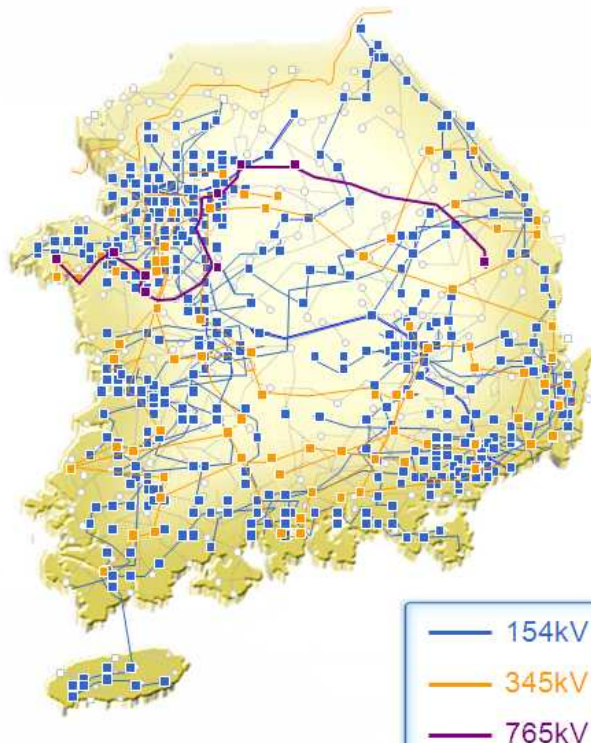
Energy Imports

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



Korea Electricity Industry

Power System in 2008



Installed Capacity 72,491MW (12th in the world)

- Output : 422,355MWh
- Peak Demand : 62,794MW (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

Power Quality

- Black-out Hours : 17 minutes/home/year
- T&D Loss : 4%

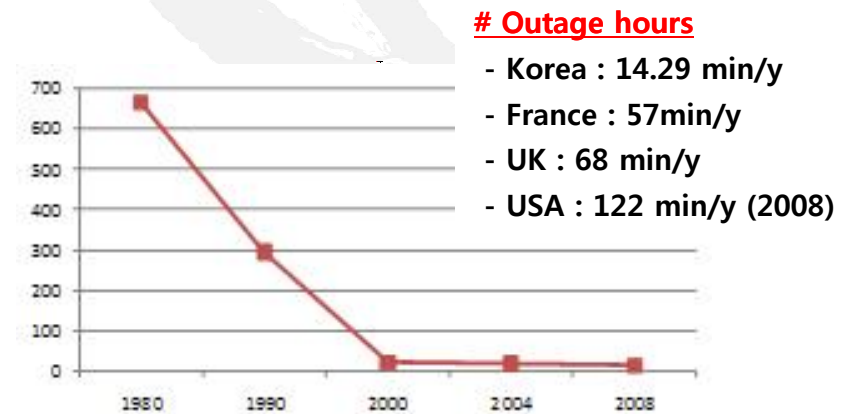
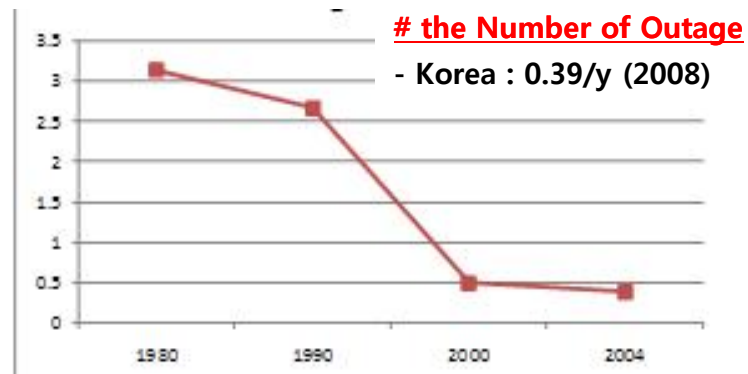
Comparison of Power INFRA

Korea Power IT Infra : Young and already SMART

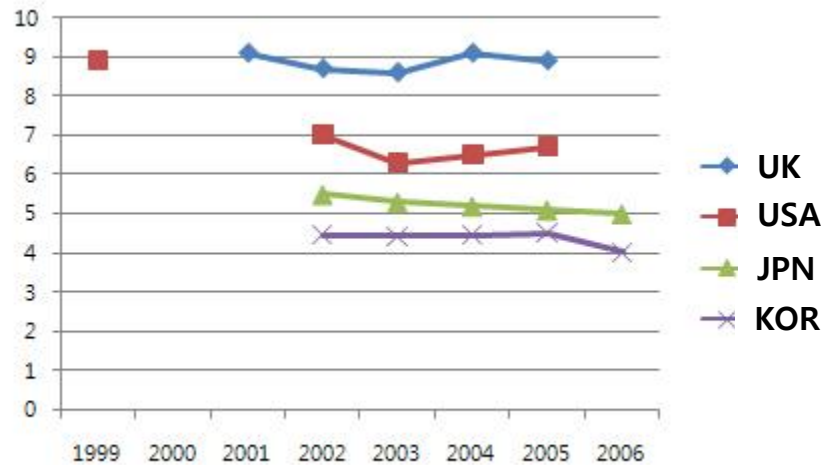
Advanced Country : Superannuated Power INFRA → Required Investment

South KOREA : Newer Equipments, Ability of Operation, High Efficiency
* World Best of Korea IT INFRA → IT KOREA

Outage Hours of Korea(2008)



Comparison of Power INFRA(Cont')



(Source : KEPCO)

- Loss Rate of US
 - 1970 : ~ 5 %
 - 2001 : 9.5%
- Loss Rate of Korea
 - 1960 : ~ 28.4%
 - 2001 : 5 %

 **In Korea, it is more important to keep the efficiency in future environment than improvement of it.**

 **Smart Grid Oriented KOREA :**
Fusion & Cooperation among the different industry sectors

Strengths of Korea Electricity



Korea Electricity Industry

- One of the biggest energy-consuming countries in the World
- Relatively new power infrastructure & Superior ability of operation
- "World Best" power qualities
 - Outage hour in Korea : Just 14.29min/year**
(France : 57min/year, UK : 68min/year, USA 122min/year)
 - Loss rate of transmission/distribution in Korea : about 4%**
(UK : 9%, USA: 7%, JAPAN : 5%)
- Power IT Infra : Young and already SMART

Korea was selected as a leader in Smart Grid technology at 2009 G8 Summit!

Related IT Convergence Industry

- "World Best" of Korea IT infra → "IT KOREA"
 - Broadband internet deployment ratio : World's #1(95.9%, OECD 2009)
- Builds the world's first nationwide Smart Grid system currently
 - Jeju Smart Grid Test-bed : World's largest Smart Grid community
- "World Best" smart home appliance, automobile, EV, construction, and shipbuilding

Prospects for Power Generation & Power Facilities Deployment in Korea



Major Issue : Reducing Fossil Energy Use / Increasing Renewable Energy Use

- Reduce the ratio of power generation using fossil fuel gradually**
 - Fossil fuel generation: **65.4%(2010) → 38.5%(2024)**
- Search for the various substitute energy sources such as nuclear and renewable energy**
 - Substitute energy generation : **32.7%(2010) → 56.5%(2024)**
- Enhance Power Grid including EV & self-healing, distributed generation**

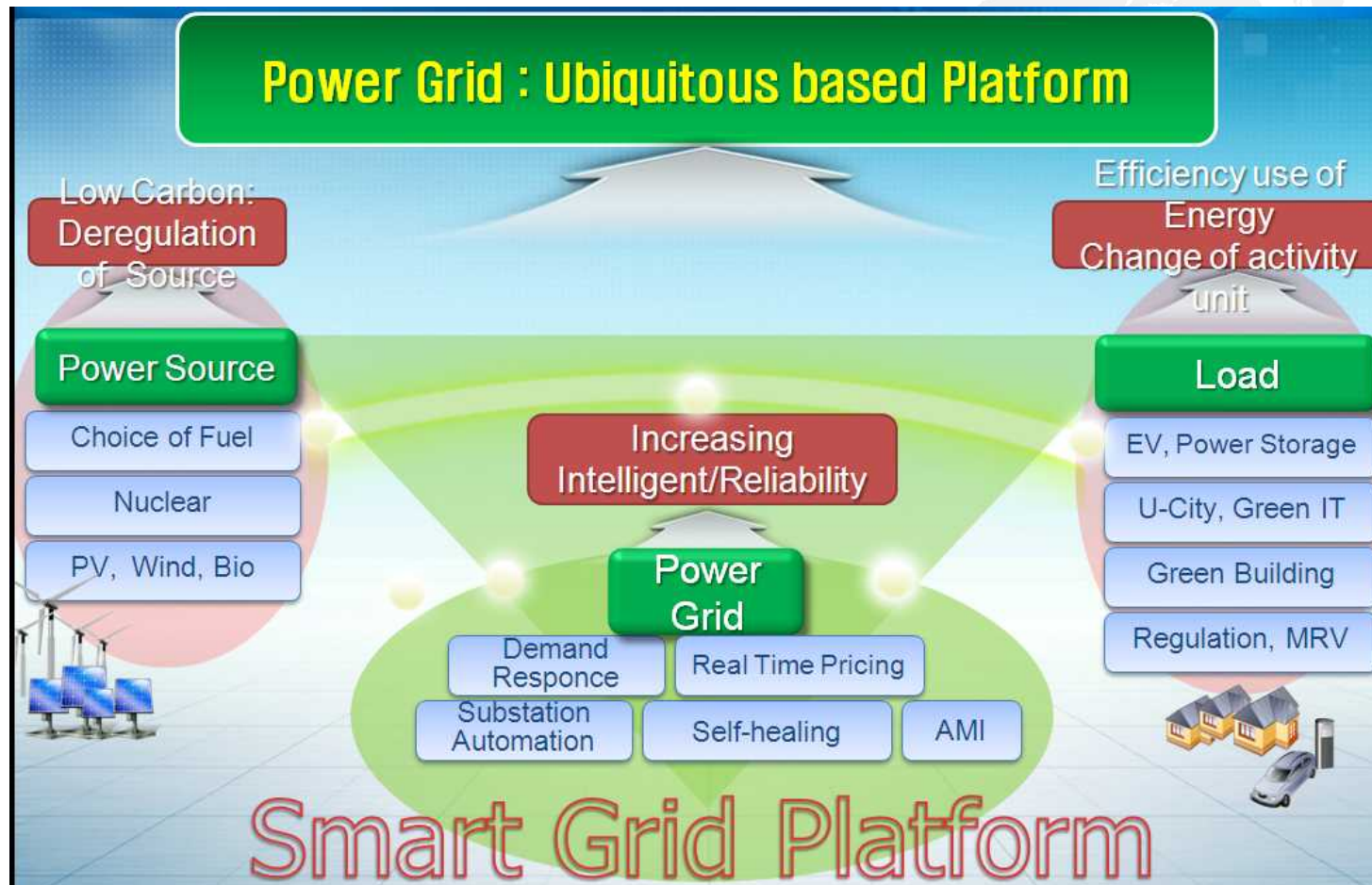
Power Generation Plan in Korea

[Unit : GWh, %]

Year	Nuclear	Coal	LNG	Oil	Pumping-Up	Renewable	Integrated	Total
2010	144,856	191,497	92,165	17,861	2,048	5,949	7,489	461,866
	31.4%	41.5%	20%	3.9%	0.4%	1.3%	1.6%	100%
2024	295,399	211,640	21,361	5,566	7,431	54,467	23,970	619,833
	47.7%	34.2%	3.4%	0.9%	1.2%	8.8%	3.9%	100%

2. Why Smart Grid?

Core Engine of Green Growth : Smart Grid Concept



Smart Grid Construction of the world



USA	- Improvement of obsolete equipment - Economic Revitalization	- Integration: Standard (R & D) and Inter -ISO, Local - Consumers Energy Savings: Distribution Company (Grant)
EU	- Practical way to forward - Focus on Carbon Reduction / Renewable - International/National/Local Level Approach	- Integration of Generation / Transmission Power according to Various Types of EU Regional Feature (PV, Wind, Gas, etc.) - Systematic Approach
Japan	- System Stabilization by Renewable - 2009, Introduced the term "Smart Grid" begins - 2010, 100 billions won pilot project started	- Enhance Energy self-sufficiency as Energy importers through Renewable
China	- Resolution of Energy Gap Between West and East - Energy of the wind turbine and high-pressure transmission at West Region	- Economic supply of Smart Grid facilities
Brazil	- Most Needs Covered by Water electric power - Renewable power generation Complement Difference between dry and Wet Season	- Approach to Complementary access systems
Indo	- The lack of absolute power - Introduction of local energy source	- Promotion to the Energy Supply in the shape of Micro Grid system
Australia	- Solar City Demonstration Project / SG expand a pilot project - Inefficient distribution system (hundreds of km)	- Expanding renewable and Efforts to expand storage device instead of Increased demand for power distribution equipment
Hong Kong	- Pollution caused by high population density	- The introduction of EV processed actively (industrial interests Low)

Background of Korea Smart Grid Necessity



✓ Expectation of continuous increase for power demand

- Continuous increase of new demand (Quality of life)
- Demand transfer from primary energy to secondary energy (Price distortion)

✓ Deteriorating conditions to build power transmission facilities

- Severe constraints of constructing power line tower (NIMBY : Not in my back yard)
- An operation unavailable situation occurs cause of problems to build power transmission facilities after constructing power generation equipments Ex): Shingori - Bukgyeongnam 765kv construction delay

✓ Expectation of tighter regulation for CO2 → Positive response of customers

- visualization of allocation between parts due to management by objective(MBO), Emission Trading(ET)
- Early distribution as a result of renewable energy RPS introduction
- Vitalization of DR : Expand BEMS/HEMS/FEMS and Smart Appliances is expected

✓ Increased desire for cooperation b/w power & other industries:

Companies related to Communications, Constructions and Power

- Demand increase for green (energy and CO2)

➡ ***Bidirectional, smart and distributed power system is needed***

The basic direction of Korea Smart Grid Promotion



✓ The problem of the complexity will be solved by Distribution Management System : Automation and Intelligent Acceleration

- Intelligent integration of the local unit of SG operation (D-EMS)
- Stable for the next generation power distribution system, distribution system operations
- Effectively integration information and communication system

✓ S/W technical ability should be Strengthen : compared to H/W

- The operating system needed form intelligent algorithms and applications

✓ It is suggested a roadmap for the power grid intelligence : legally binding

- Through Smart Grid Promotion Act, promoting a stable operation

✓ New growth Engine : Creating collaboration structure between industries

- Social infrastructure (electricity/communications/water supply and drainage) and service (education/public safety/health, etc.) of the integrated pursuit
- Smart Grid oriented implementation of the U-City (electric power companies/telecommunications companies/construction companies collaboration promotion)
- Primary response of the electric power industry needs
: Exclusively as social infrastructure needs of national readership

3. Korea Smart Grid Demonstration Overview

Korea's Smart Grid Progress Overview



● Launched Power IT Project (2005)

- Enhanced power infrastructure and created additional services
- Technology-Driven Policy

Bench marked
U.S.'s intelligent grid model

● Power IT as New Growth Engine (2008)

- Attempt to shift focus on export-oriented integrated model

Energy technology
development(2007)

● Adapt Smart Grid program (2009)

- Base business models on converged businesses
- Business model driven Policy

Influenced by U.S.'s Smart Grid
policy (2008)

The Presidential Committee on
Green Growth established to lead
Korea into green development

● Korea designated as Smart Grid leading country at Major Economies Forum (2009)

- Induced to propose Global Model
- Introduced open grid structure

● Initiated Jeju Smart Grid demo. Project & launched Total Operation Center(2010)

- 168 companies and 12 consortia participating, Creating new BIZ models

Smart Grid Demonstration Progress Timeline



Completion of Jeju Smart Grid Test-bed

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
an agreement for Demonstration Project**

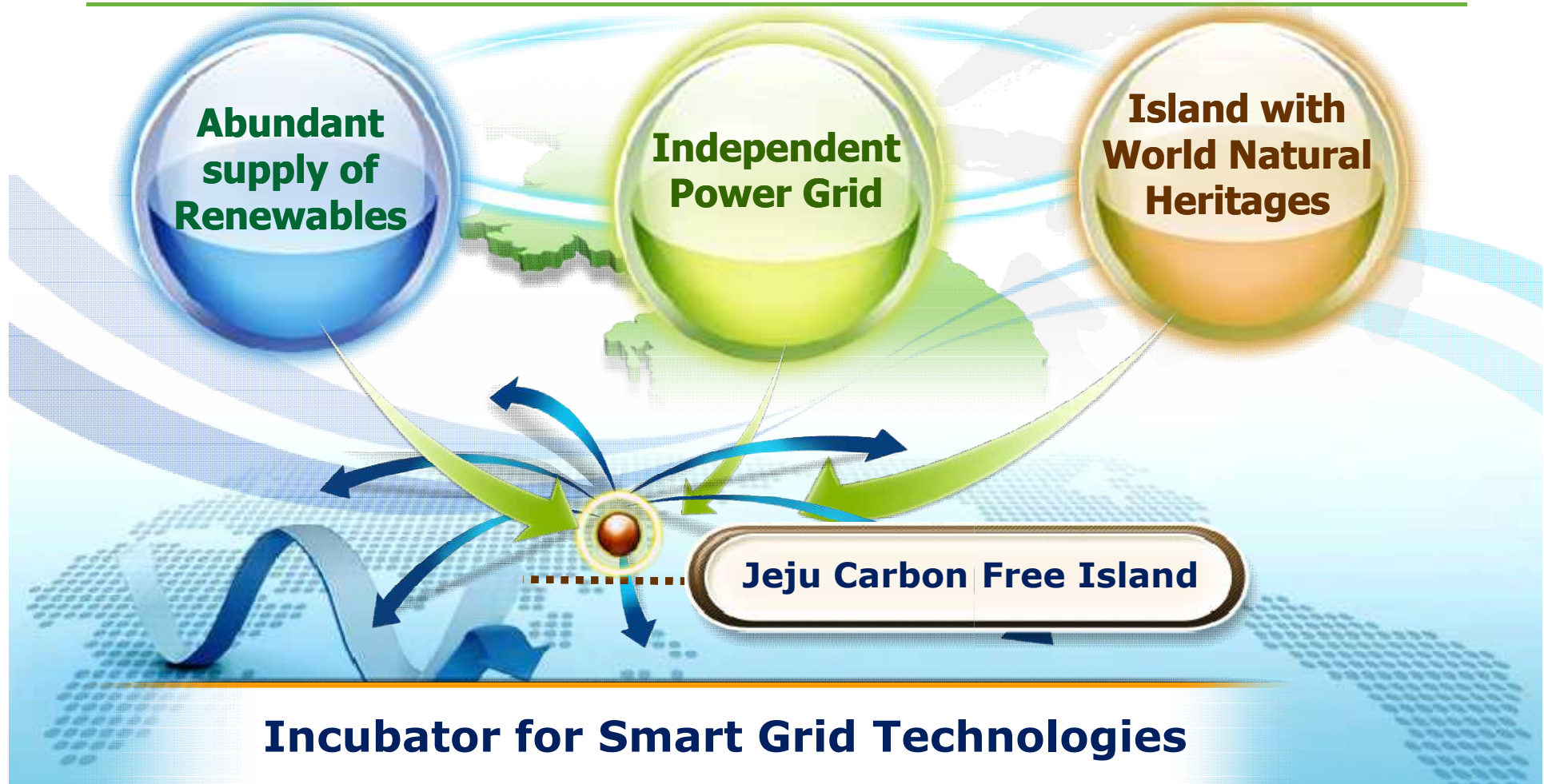
'09.4

**Initiated restructuring and
expanding of Smart Grid test-bed**

'08.12

Established test-bed for Power IT

Why Jeju?



Consortia for Jeju Smart Grid Demonstration



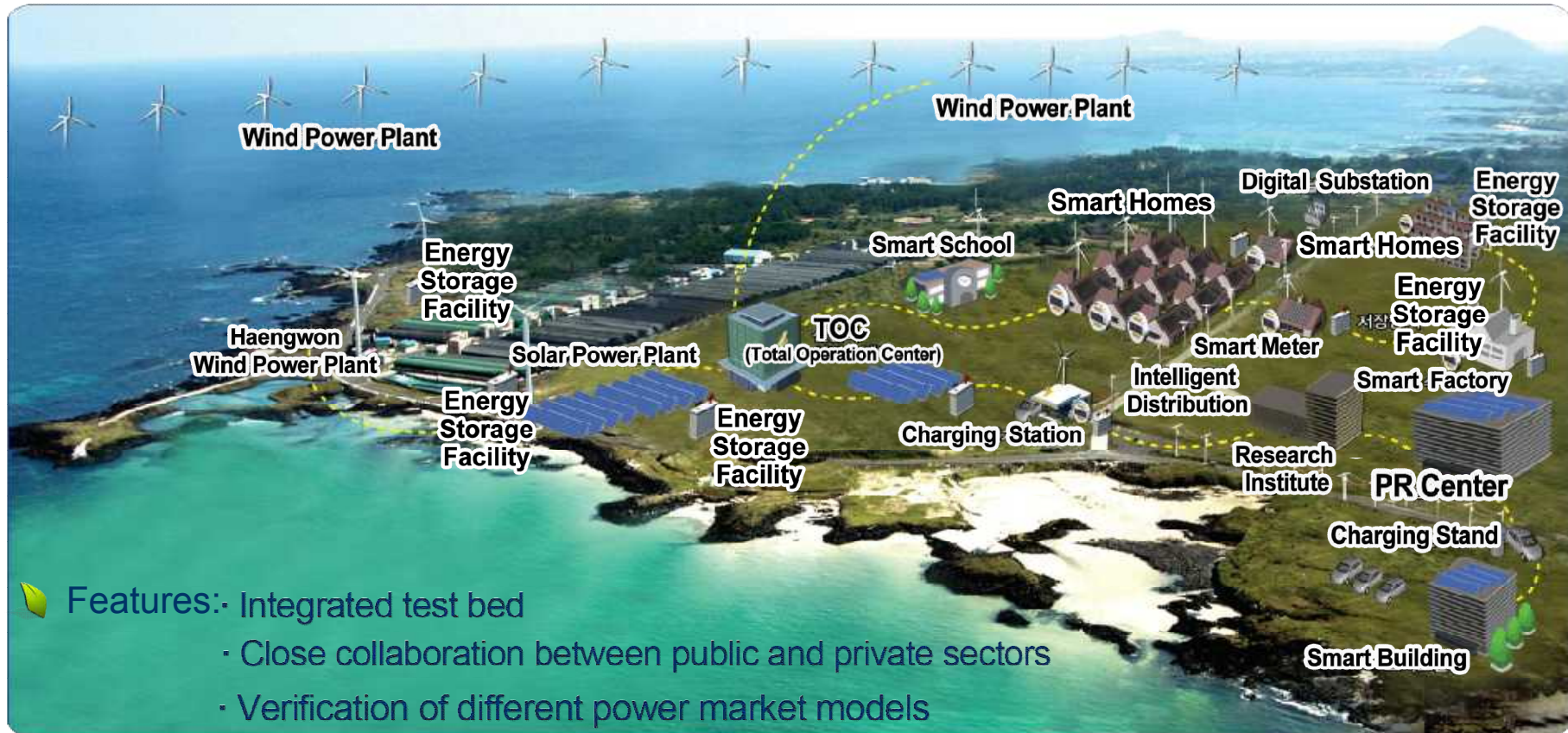
	Leads	Participating	Investment(Dollar)
Smart Place	SK telecom	Samsung electronics, Korea Cable TV, Jeju broadcast etc (29 companies)	Govt : \$ 5 million Private: \$ 25 million
	olleh kt	Samsung SDS, Samsung Trade, Rootech etc (14 companies)	Govt : \$ 4.7 million Private: \$ 30 million
	LG Electronics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

Characteristics 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)

Jeju Smart Grid Test Bed



- Features:
 - Integrated test bed
 - Close collaboration between public and private sectors
 - Verification of different power market models
- Participants: Korea Electric Power Corporation (KEPCO) plus automakers, telecommunications companies and home appliance manufacturers
 - Includes major companies such as LG, SKT, KT and Samsung
- Open to foreign companies

Project Domain



Smart Place

 **Reduce energy consumption by installing AMIs in homes and buildings, and allow consumers to re-sell stored energy**

- Allow easy access of consumed electricity information via different media, such as internet, TVs, mobiles etc., and provide incentives
- Provide integrated service between electricity and telecommunication
- Connect all smart appliances to AMI and operate micro grid

Smart Transport

 **Develop a service model for EV Charging infrastructure and ensure system to minimize the effects that charging may have to the grid.**

- Develop business models for auto repair service, parking management, navigation, etc
- Develop charging infra using distributed energy and develop EV charging system.

Project Domain(Cont')



Smart Renewable

Development & Field Test of Power Stabilization Technology and Business Models in Jeju-Island

- ▶ Test different modes to improve the quality of stored renewable energy & operate micro grid

Smart Power Grid

- ▶ Deliver next generation network using Smart Grid as its basis
- ▶ Smart Grid will allow two-way communication between the supplier and consumer, and perform self-automated recovery system.

Smart Electricity Market

- ▶ Operate and establish a system that provides real time pricing for consumers and ensure high quality of electricity.

1'st Phase Progress Report

Demonstration Public Exhibitions

- ▶ Public consensus is necessary to implement nationwide Smart Grid
- ▶ Companies present & introduce Smart Grid prototypes/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



Korea's Trial and Error :

Big accomplishments; yet still areas for improvement



Technology disorientation

- **Mixed Technology**
- **Business oriented policy: Induced inflation in business model**

Unable to solve dilemma between Converged businesses

- **Incompetent convergence collaboration of information communication**
- **Only if we applied IT workforce 5 years ago...**

Weak leadership

- **Government policy/KEPCO's confused judgment on its business management**
- **Ever since, KEPCO has voluntarily abandoned its leadership**

Procedures for innovation and its progress speed

- **Counter procedure from that of U.S. (though it has parallel government initiatives)**
- **U.S. is accelerating into market penetration after establishing its infra and standard**
- **Korea preceded R&D first, then established infra**

Technology Track disorientation

- **Power IT version, converged BMs version, demonstration version, various simultaneous versions**
- **Dynamic application of limited supplies (Smart or Stupid?)**

Next Steps



System operation and verification

- **Deduce best practices from testing of 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 Promotion Act

- **Enact a law to stimulate Smart Grid and to help facilitate the execution of the national Smart Grid roadmap**

4. Smart Grid Promotion Act

Backgrounds



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 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 legislative constraints

- ▶ **Current** : Electricity Enterprise Act restricts convergence of businesses
 - Electricity Enterprise Act: Applied to generation, transmission/distribution and power exchange
- ▶ **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 that allows energy reduction, EV deployment and use of renewable energy.
- ▶ Formulated solid framework to facilitate enactment of Smart Grid regulations.
(i.e. National Smart Grid Roadmap and Jeju smart demonstration project)

Framework of Smart Grid Policy



Develop/Execute Primary Plan for Smart Grid (article 5, 6, 9)

- To develop/Execute comprehensive plan for the deployment of Smart Grid and for the fostering of correlated businesses
 - Primary Plan(5 yr) : Aimed at technology development, deployment , commercialization. standards, etc Enforcement Plan (annually) : Manage outcomes and coordinate plans annually
- To Develop periodic transitioning plan for technology deployment/replacement to ensure participation from electricity suppliers and users

Designation of Korea's Smart Grid Promoting Agency (Article 19)

- Article 19th under the primary plan for Smart Grid designates one relevant institution as Korea's Smart Grid Promoting Agency and requires the institute to execute governmental policies, oversee R&D, smart demonstration, deployment and ensure information security

Legislative Support and Application



Register business licensing for Smart Grid (article 12)

- ▶ Individuals wishing to initiate a business for managing and supporting of Smart Grid industry may register via Minister of MKE.
- The scope of work for Smart Grid business ranges from manufacturing of equipments, products, and providing correlated services.
- Business license registration standard will be based on presidential decree

Support Smart Grid Investment (article 14)

- ▶ The article provides a basis for companies to receive subsidy in the case that they are making business investment for the benefit of the public
- Plan to finance through utilizing Electric Power Industry Basis Fund, Treasury of Energy Resource and National IT Industry Promotion Agency Fund

Select Smart Pilot City (article 18)

- ▶ If necessary, smart pilot city will be selected for the wide deployment and dissemination of Smart Grid; government will manage portion of the required expense
- The selection standard and process will be in accordance with the presidential decree

Legislative Support and Application (Cont')



R&D Support (article 10)

- ▶ Provide administrative, financial support regarding technology development, demonstration, policies and workforce development

International Collaboration (article 11)

- ▶ Provide technological and resourcing support regarding international standard, R&D collaboration to help domestic companies to penetrate into international market

Technology Verification and Standardization (article 15, 17)

- ▶ Enforce technology verification and technology standardization to secure safety of Smart Grid and its compatibility with related equipments and products

Compiling, applying and securing information



Compiling personal information for Smart Grid (article 22)

- ▶ Compiling private information for Smart Grid cannot occur without the consent from the information provider
- ▶ Information provider can request access and deletion of his/her personal information; the information holder is required to take appropriate action

Sharing of Smart Grid information (article 23)

- ▶ To provide efficient service for grid users/consumers, a service provider can request to share/access collected information from another service provider
- ▶ Request to share information should be carried out, if not, appropriate action will be taken by the Minister

Ensuring optimal use of information (article 24)

- ▶ The minister of MKE advised to enact a legislation that includes procedural and standard regulation for optimal and appropriate use of collected information.

Compiling, applying and securing information(Cont')



Ensuring information security for Smart Grid (Article 26)

- ▶ Smart Grid business operator must install information security system to prevent illegal information exposure.
- ▶ The minister of MKE can enact information security guidelines which are to be abided by business operators.

Securing compatibility for Smart Grid (article 28)

- ▶ The minister of MKE may advise business operators on technology standard, information access, service interconnection to ensure compatibility of Smart Grid.

Securing Smart Grid Information and Preventing violation(article 25, 27)

- ▶ The minister of MKE will take measures to protect Smart Grid from outside source intrusion
- ▶ No individual has the right to access, manipulate, demolish, expose Smart Grid or take other violating actions without permission or justified reason

The Significance of Enacting Smart Grid Promotion Act



Smart Grid Promotion Act coordinates smart grid roadmap, demonstration and pilot city

- ▶ **Smart Grid Promotion Act allows technological and institutional continuity 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 promotion act will provide solid foundation for smart grid related businesses and induce greater investments.**

5. the Strategic Implications of Korean Smart Grid

KNOWLEDGE
SHARING PROGRAM



Political attempt to converge businesses

● Integrate global competitiveness with power grid

Construction
Zero Carbon city
development/
Renewable
energy

Electronics
Smart
appliance

TELCO
U-city

Power Grid
Intelligent
Distribution

Transportation
EVs

● Problems and Pending Issues

- Urgent needs for state of the art application development
- Demand-oriented power system/Supply chain for industries of heavy electric equipments
- Korea's Strength: Best power and telecommunication infra(but lacks other capabilities)
- Utilizing our strengths: Simultaneous cooperation using solid platform
- Strategic issues: World's first state of the art application service/smart phone reader service development

6. Suggestions for Saudi Arabia

Sharing Smart Grid Experience



Power Facilities Investment Planning

- Continuous expansion of the power facilities including upgrade for the existing facilities (e.g., Substation Automation based on the IEC61850)
 - Korea's Strong IT technology is based on this plan

Power Facilities Deployment Plan in Korea

	2009	2024
Transmission and Distribution Line [Unit : C-km]	239,406	263,296
Number of Substation [Unit : Number]	705	920
Capacity of Substation Facilities [Unit : MVA]	247,352	325,032

- Well experienced in power facilities technologies
 - DIS(Distribution Information System) is in service since 2001
 - DAS(Distribution Automation System) is in service since 1997



Will contribute to the expansion of Saudi Arabia's power infrastructure and be pleased to share our experience & solution with you

Sharing Smart Grid Experience



Driving Strategy into Action

- Selection of the bright future project, promotion of active participation in bidding
- Constructive preparation to growing demand for the electric power equipment and material

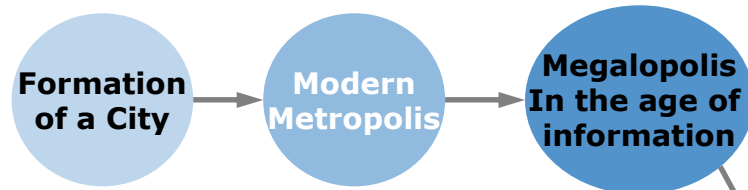
Business Model

- Smart demand management model
- Renewable energy remote operation model
- Smart transmission/distribution model
- Broadband digital communication model
- Transmission/distribution ICT System model
- Smart Grid integrating operation system model
- Electric Vehicle(EV) model

Convergence Model : Green Smart City from u-City

- Korea's U-City model originally stems from the convergence of ICT and construction industries, this concept is now evolving into ICT + Construction + Energy + Medical + Education convergence concepts known as the **"Green Smart City"**

- ◆ Urban Development in General



- ◆ Metropolitan Area Development in Korea



- ◆ Change in National Economic Growth Engine

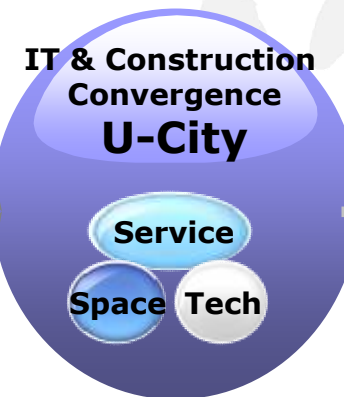


Policy Drive of National Government
[the Ten IT Convergence Strategy]

Basic Act on Low Carbon
Green Growth

Technology & Ecology
Convergence

**Green
Smart City**

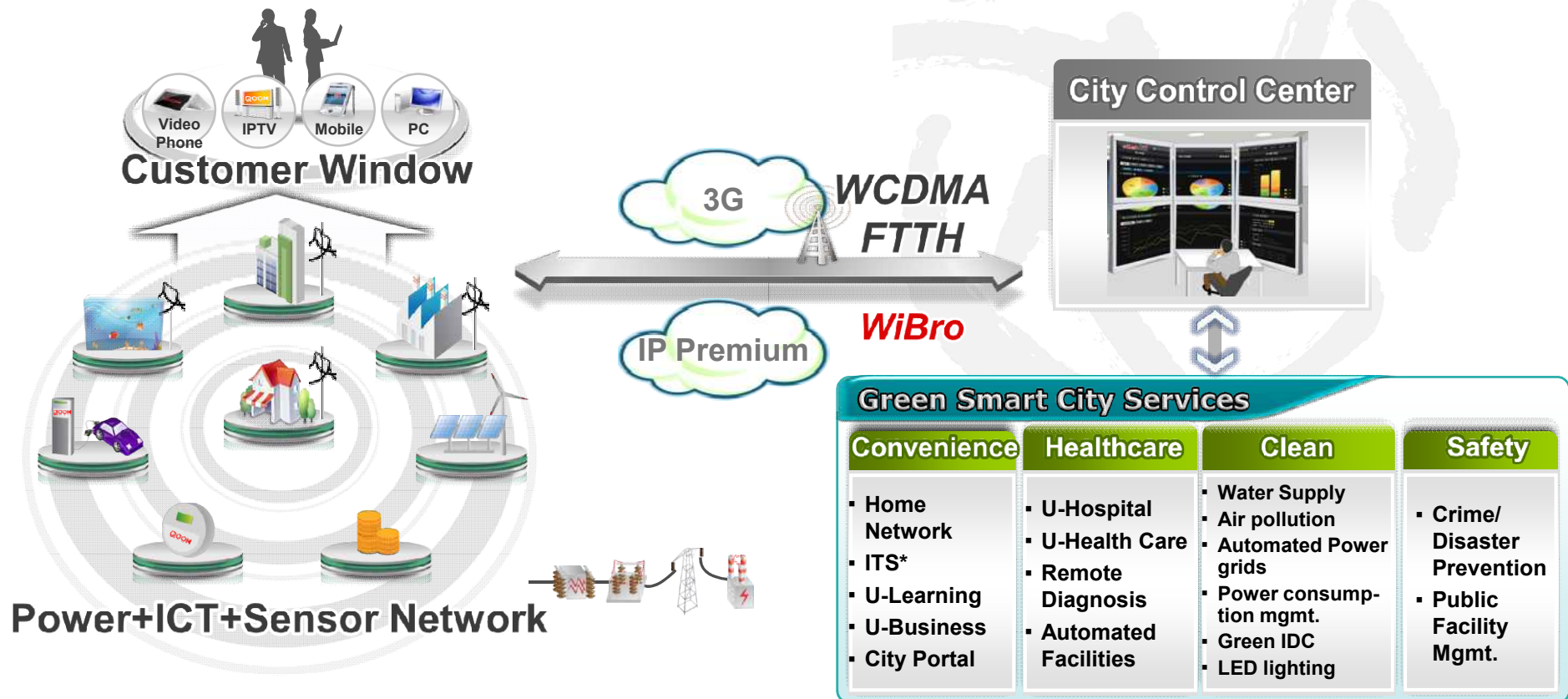


Pressure for
Green Growth

Law on U-City enacted
(2008. 9.29)

Convergence Model : Smart Grid based Green Smart City

- The '**City Control Center**', implemented based on ICT infra platforms will manage energy, ecology, education, medical and city infrastructures



* Intelligent Transport System

Convergence Model : Korean Capabilities in ICT and U-City



World class ICT infra implementation and operation

- **16 million** households with internet connection (93% of total households), **49%** of households supplied with **FTTH** connections (cf. global average : 11%)
- Wireless mobile phones : **50 million** users (102% of total population)
- World's first case of **WiBro** commercialization
- **More than 20 thousand Wifi Service Zones**

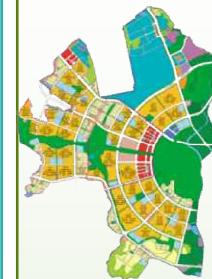
- **World's most advanced Internet penetration rates and service quality**
(source: University of Oxford)



World's first U-City implementation

World's first U-City; Dong-Tan U-City

<Project summary>



- Location : Hwa-Sung, Dong-Tan city
- Area : 9,037K㎡ (903.7ha)
- Population : 120,730, # of households : 39,825
- Implementation date : KT('06.1~'09.1), Operations : KT ('09.2~)
- Budget : 40 Million USD
- Service : Crime Prevention, Offering Transportation Information & Traffic Control, Remote meter reading of waterworks, Monitoring of under-ground facilities such as drain pipe, electric and gas supply etc
- U-City Implementation Results (source : Korea's Ministry of Land, Transport and Marine Affairs)
 - B/C(benefit/Cost) ratio(2011) : **1.57**
 - **Operation cost reduction : 2.9 million USD(annually)**

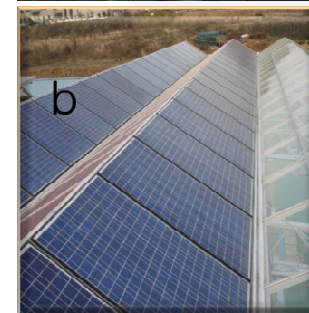
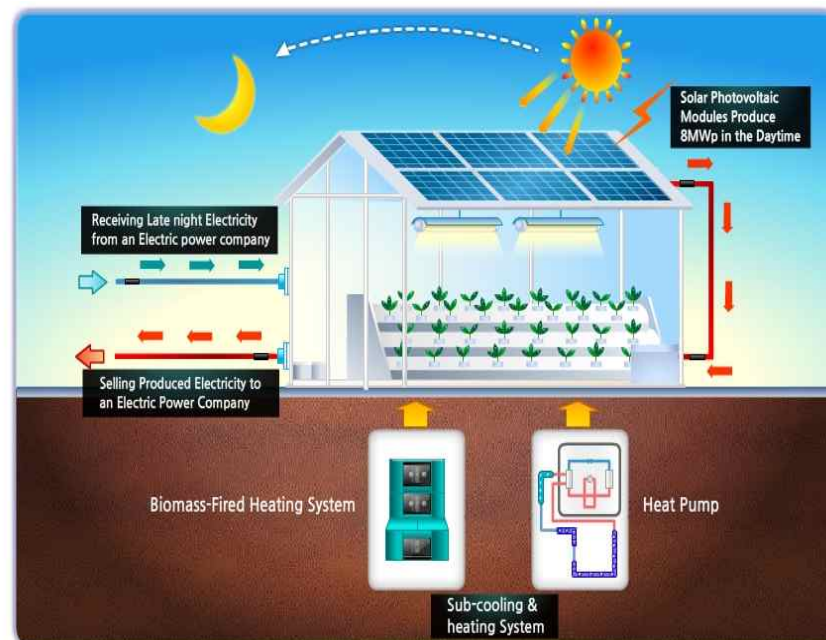
New Business Opportunities : Smart Greenhouse

the abundant amount of sunlight
huge daily temperature difference
in the Middle-East area

Photovoltaic Modules
Heat Pump



Grid-Connected Automated Glasshouse



Thank you