



The Role of ICT in Developing Smart Grid: Practice in Jeju Test Bed

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I. Smart Grid Business Environment

1. Goal of Smart Grid
2. Power Industry Value Chain
3. Business Trend in relation to Smart Grid
4. Expected Transition in Power Industry
5. Utility's Requirements for Competitiveness

II. SK Telecom's Practice in Test Bed Project

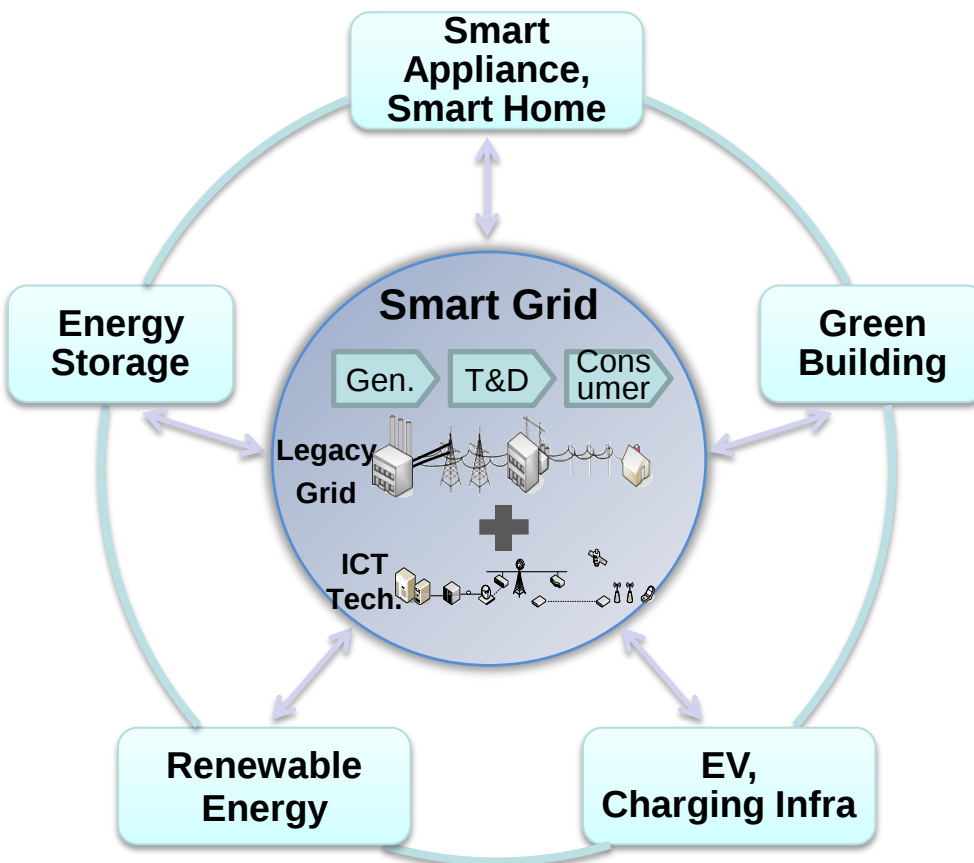
1. Test Bed Project Overview
2. Outline of SK Telecom's Practice
3. Key Tasks

III. Global Expansion Strategy

1. Goal of Smart Grid

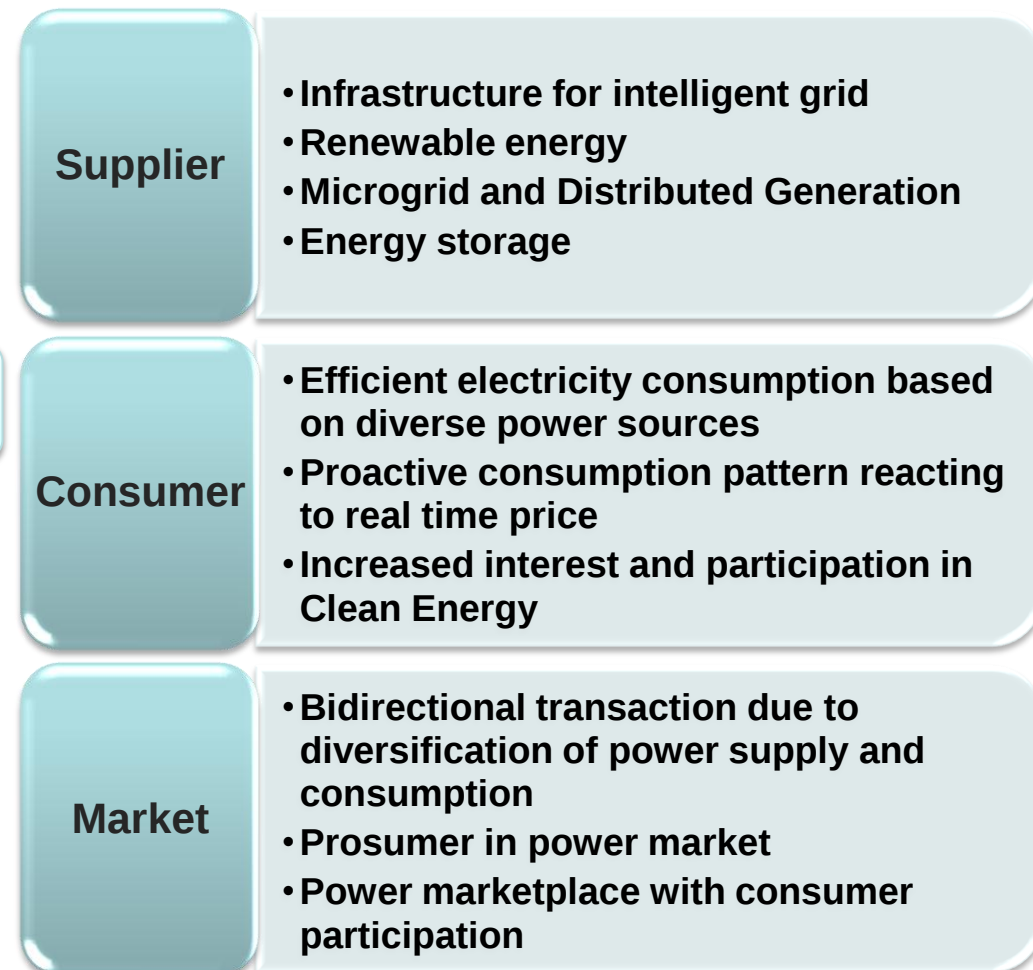
Smart Grid means advanced power grid coupled with two-way ICT. By enabling suppliers and customers of electricity to exchange real time information, Smart Grid improves energy efficiency

Concept of Smart Grid



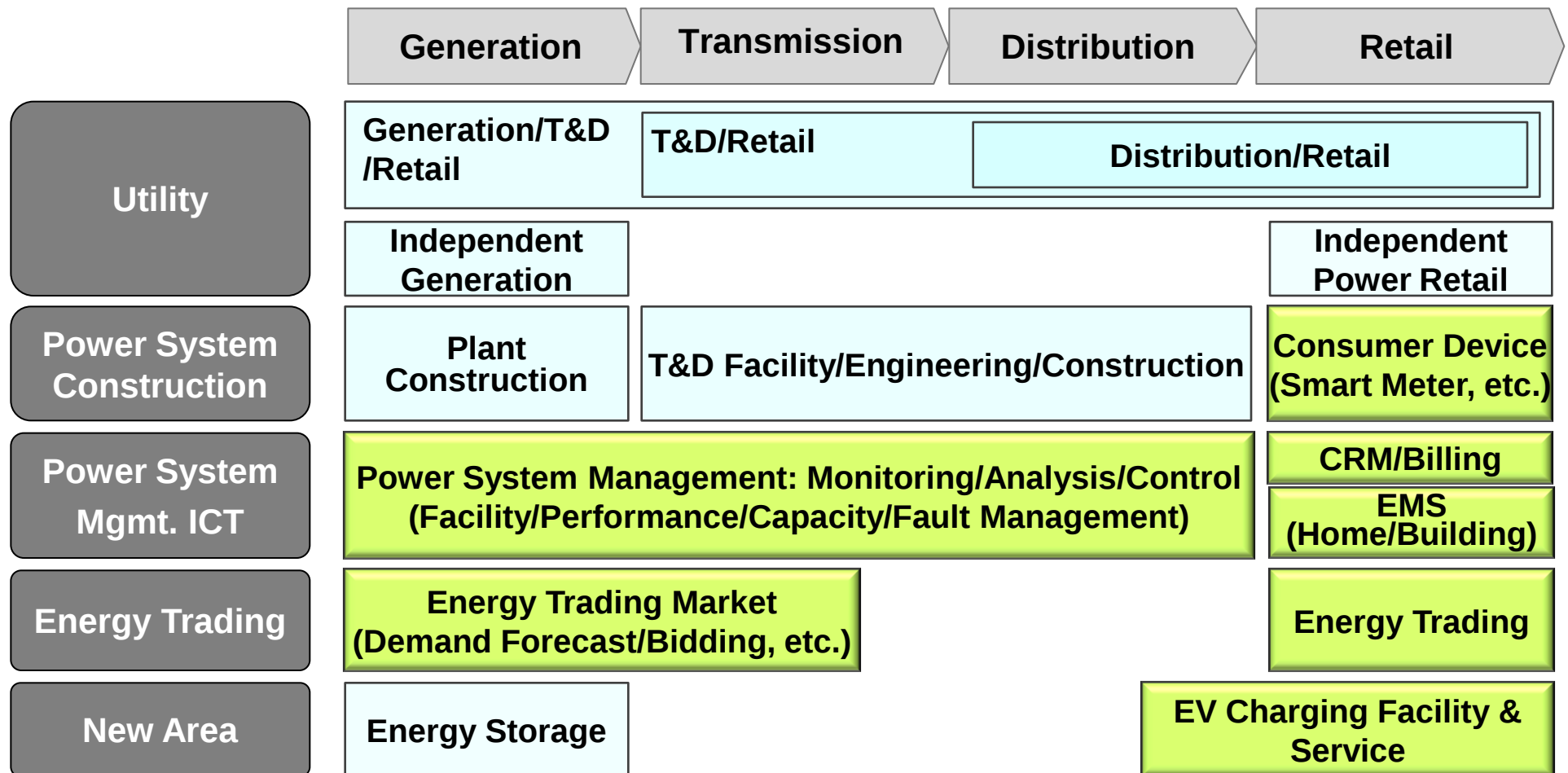
※ Gen.: Generation, T&D : Transmission & Distribution, EV: Electric Vehicle
DG: Distributed Generation, ICT: Information Communication Technology

Major Changes with Smart Grid



2. Power Industry Value Chain

As Smart Grid is being introduced, new business opportunities utilizing ICT emerge along with the whole value chain of power industry



※ T&D: Transmission & Distribution, EMS: Energy Management Service, EV: Electric Vehicle, Mgmt.: Management

 : ICT Business Opportunity Area

3. Business Trend in relation to Smart Grid

I. Smart Grid Business Environment

Various players are actively endeavoring to upgrade the grid, develop related equipments & solutions, build AMI network, and provide home energy management services

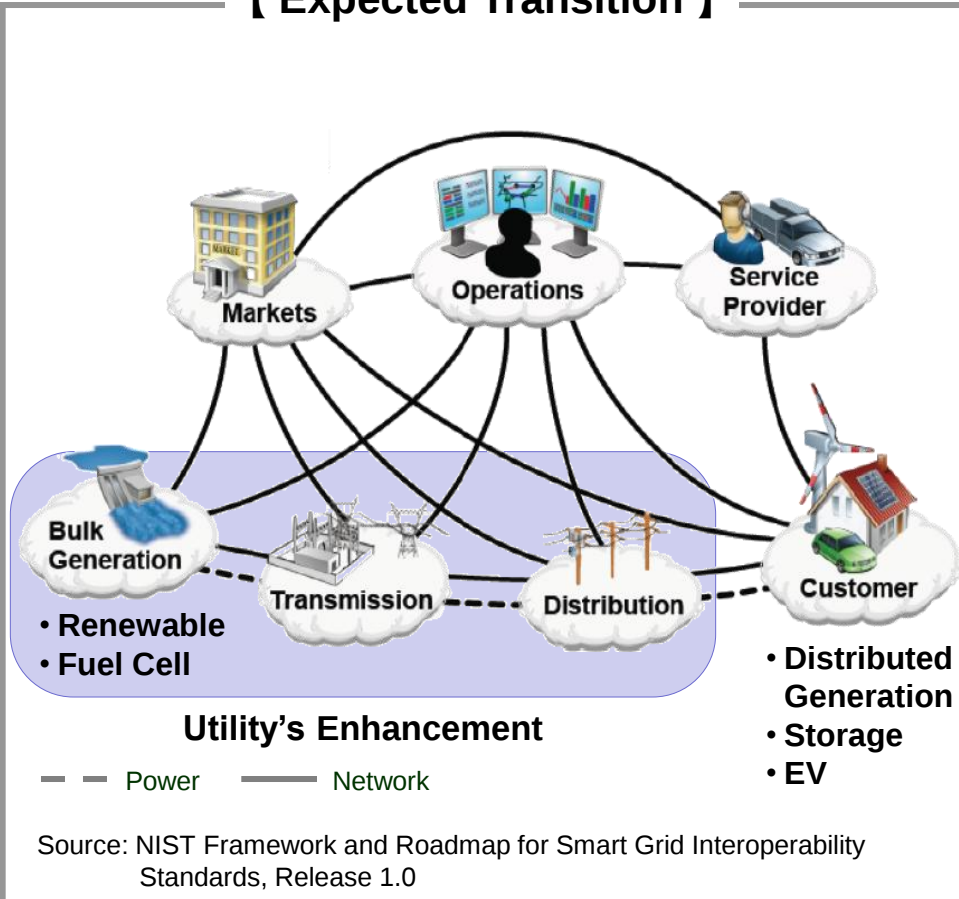
Type	Value Chain			Description
	GEN.	T&D	Con.	
Utility	○	○	○	• Provide home energy monitoring services • Connect utility facility with communication network and experiment V2G/Renewable technology • Implement AMI pilot project (Approx. 5 Mil smart meters in US)
Facility Manufacturer /Solution Provider	○	○	○	• Provide T&D automation and cost optimization solution for advanced T&D system • Provide solution for renewable generation & operation • Provide and implement PLC/ZigBee based Smart Meter and RF Mesh N/W based AMI solution • Commercialize H/W & S/W solution for utility's energy management • Offer network equipment with enhanced security functions
Telco			○	• Provide mobile N/W and develop technology for meter data transmission • Develop SIM card on smart meter for wireless network connection • Launch home energy mgmt. service over mobile and fixed network
IT			○	• Provide home energy mgmt. tool & service using web based cloud platform • Offer DR resource mgmt. service • Invest on Smart Grid technologies like Renewable and PHEV

※ GEN.: Generation, Con.: Consumer, V2G: Vehicle to Grid, N/W: Network, AMI: Advanced Metering Infrastructure, SIM: Subscriber Identification Module, PLC: Power Line Communication, H/W: Hardware, S/W: Software, PHEV: Plug in Hybrid Electric Vehicle, DR: Demand Response



Utilities will continuously empower themselves to remain competitive by enhancing efficiency of power generation and consumption. Diffusion of Renewable, DG, storage, and EV will spur emergence of new role players such as Markets, Operations, and Service Providers

【 Expected Transition 】



【 Transition Trend 】

Utilities' need to strengthen competitiveness based on intelligent grid

- Demand control capability to minimize generation cost
- IT capability such as CRM and Billing by coupling with communication N/W

Diversification of power source

- New generation sources like Renewable, fuel cell generation in compliance with RPS
- New power sources such as DG, storage, and EV

Emergence of diverse service providers

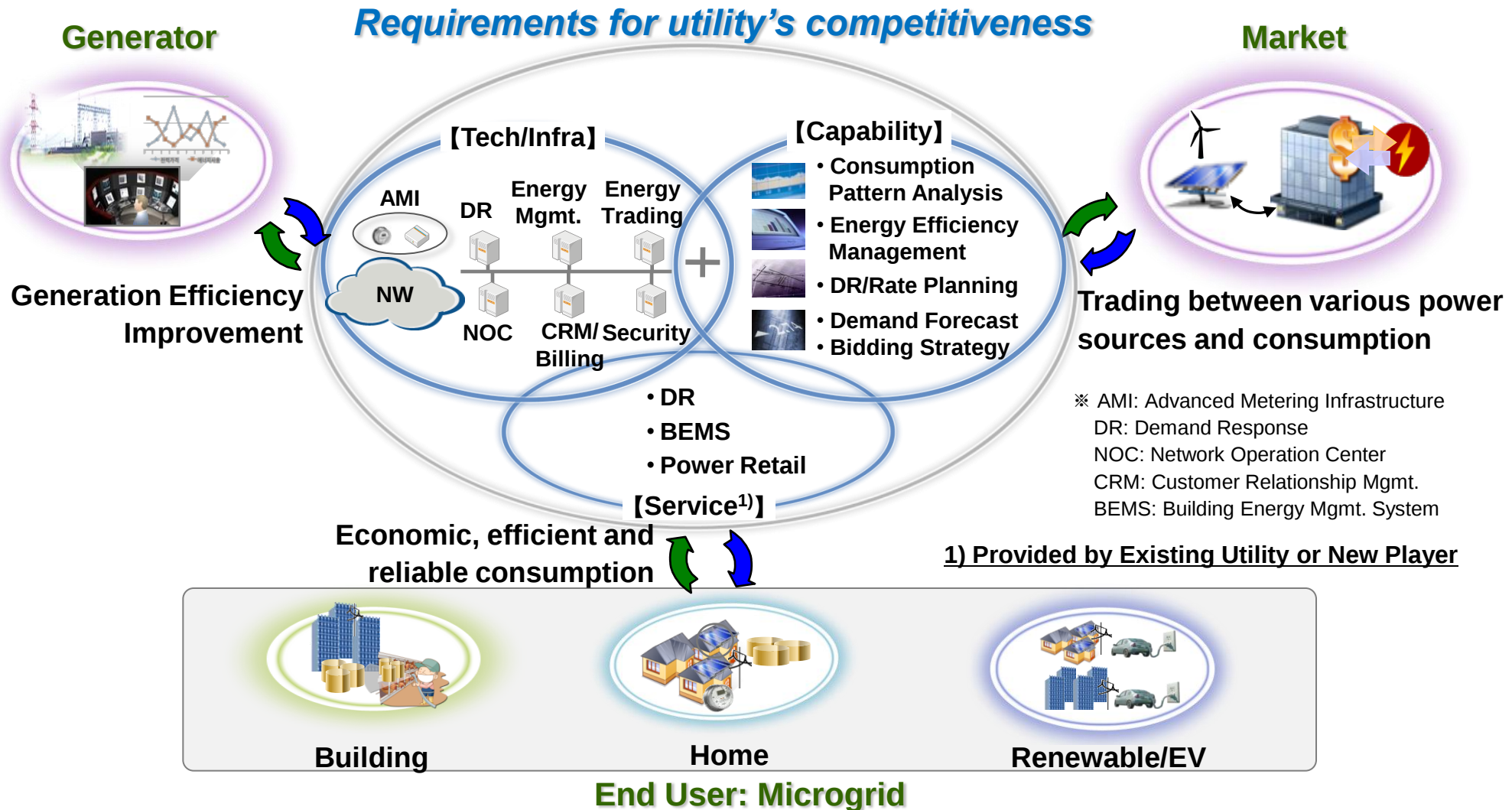
- Service providers with incentive BM for demand reduction
- Power retailer in specialized segment such as EV charging service

Implication

- Utilities need to strengthen their competitiveness using ICT in step with transition trend
- New players optimizing various generation & demand resources are expected to emerge

5. Utility's Requirements for Competitiveness I. Smart Grid Business Environment

To remain competitive by offering new services, utilities need to obtain network infrastructure and relevant platforms supported by ICT as well as various business capabilities





With a long-term goal of constructing nation-wide Smart Grid infrastructure, Korean government and private companies initiated Smart Grid Test Bed project in Jeju Island

The Project Overview

Entity

- Administrator: Korean government (MKE)
- Participants: Over 150 companies from various industries

Goal

- Construction of state-of-the-art Smart Grid reference site
- Early commercialization of Smart Grid technology

Period

- Total 42 Months: '09.12.01~'13.05.31
 - 1st phase: '09.12.01~'11.5.31 (18 Months)
 - 2nd phase: '11.6.1~'13.5.31 (24 Months)

Funds

- Matching fund between the government and participating companies
- Government contribution: ₩37 billions

※ MKE: Ministry of Knowledge Economy

Location and Size



Location & Size

Location

- Gujua-eup, Jeju Island

Size

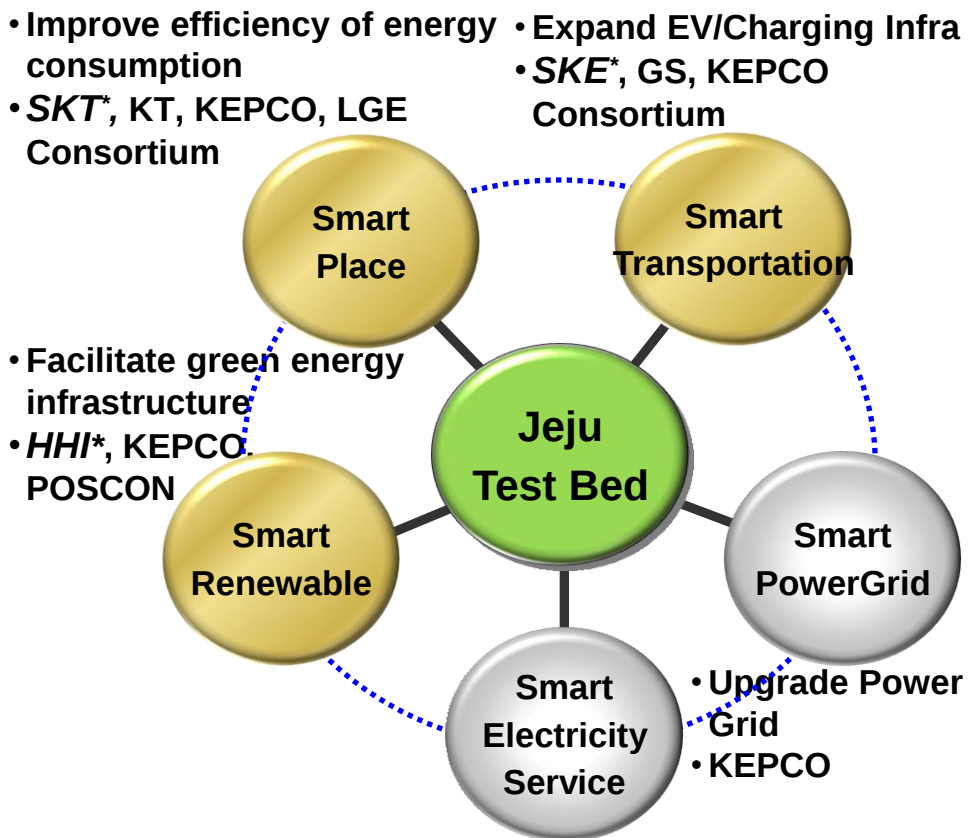
- Total number of Test Bed households: about 3,000
- 2 substations and 4 distribution lines

Note

- Utilizes existing wind farm for the Test Bed project

Smart Place, Transportation, Renewable, PowerGrid, and Electricity Service are in progress for the project and SK Telecom is leading and participating in three areas

Test Bed Areas



* SK Telecom leading or participating consortium

Key Tasks in each area

Smart Place	• Improve energy consumption efficiency - Consumer rate design and DR - Efficient generation/storage/retail by consumer
Smart Transportation	• Enhance EV and charging infrastructure - Establishment & upgrade of charging infra - Network based monitoring and control of EV operation information
Smart Renewable	• Experiment Renewable energy technology - Experiment of solar & wind generation, storage, and control - Connecting micro-grid with main power grid
Smart PowerGrid	• Upgrade T&D system - Intelligent distribution & digitalized substation - T&D real-time monitoring for wide area
Smart Electricity Service	• Operate energy trading market - Various bi-directional power trading service - Total Operation Center(TOC) in test bed



SK Telecom is going to acquire necessary technologies and capabilities, verify business models, and apply global requirements to Test Bed in order to gain competitiveness that is required to enter the real market in the future

Real Market Entry

Tech/Capability
/BM

Global Reference

Tech/Capability Obtainment

- Obtain technology & capability required for competitiveness in the transition environment
 - Technology: AMI, EMS, Billing, Trading Algorithm, etc.
 - Capability: Demand forecasting, optimal bidding strategy, rate/incentive analysis & design

Business Model Verification

- Verify feasibility of executable business models by linking to energy trading market in Test Bed
 - Verify customer's receptivity and price sensitivity on DR, BEMS, and power retail BM

Global Reference Securement

- Continuously apply global market's requirements to Test Bed
 - Identify pain points of global entities
 - Apply global market's requirements for technology & BM development in Test Bed

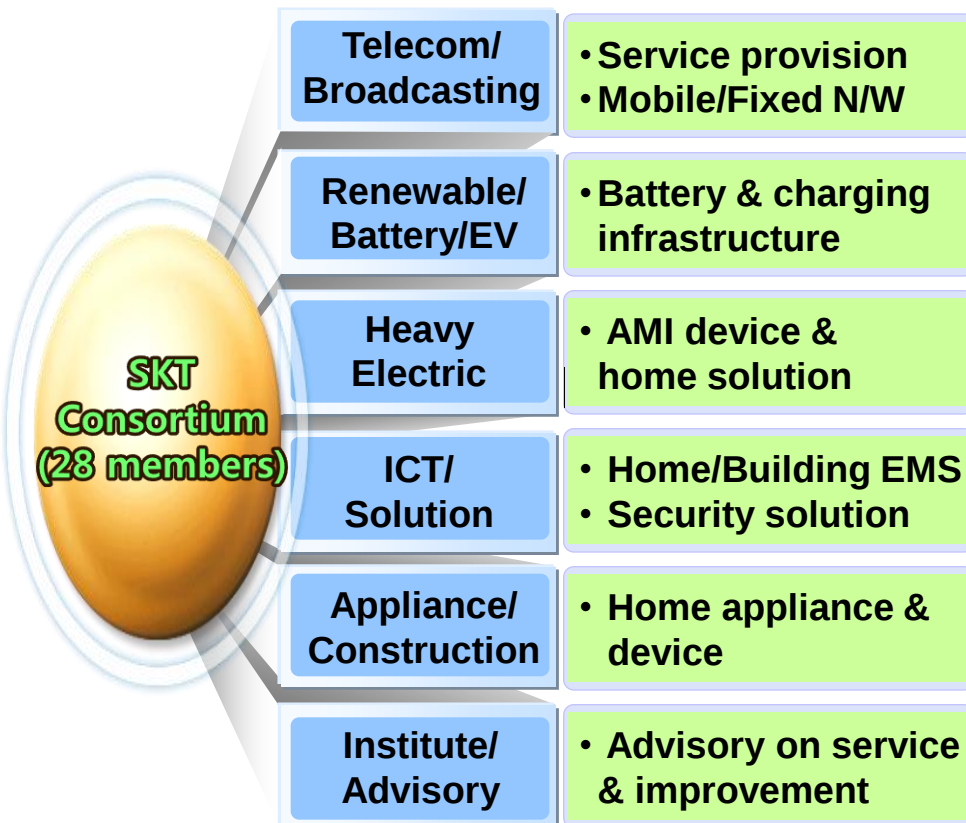
Preparation for Real Market through Jeju Test Bed Project



SK Telecom is leading a consortium of 28 companies from various industries. The consortium provides five different settings for 1,000 households to test various BM/services

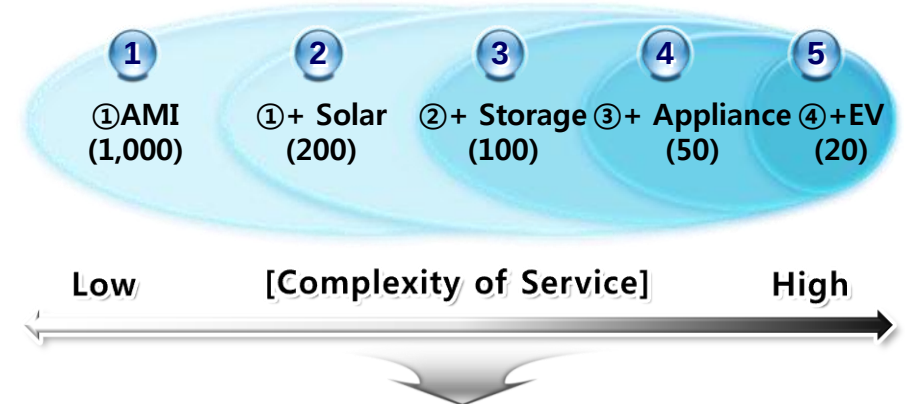
Role of Participants

- SK Telecom is leading a consortium of 28 companies for Smart Place



Test Bed Size & Settings

- Number of household: 1,000
- Provide and manage various facilities/devices such as AMI, Solar cell, Storage, Smart Appliance, EV



Expected Outcomes

- Detailed analysis of customer needs and consumption patterns in each segment
- Elaborate verification of services/BM
- Offering of diverse test results

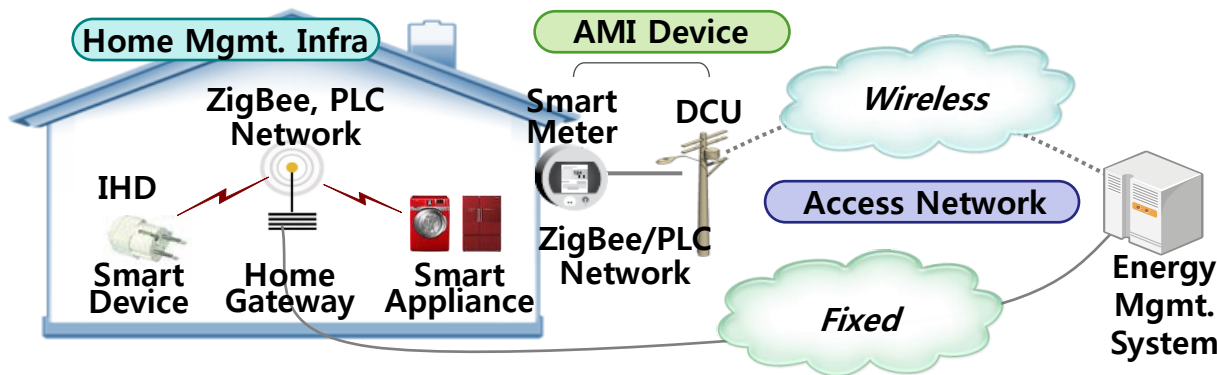


Obtaining technology/capability, developing BM, and applying global requirement are practiced in Phase 1. Verifying BM & securing business operational competency will be pursued in Phase 2.

		1 st Phase		2 nd Phase	
		1 st Year(~10.5)	2 nd Year(~'11.5)	3 rd Year(~'12.5)	4 th Year(~'13.5)
Obtaining R&C	Tech.	•AMI, HAN •HEMS, NOC •Security	•Power trading algorithm •BEMS •DR algorithm •Solar generation mgmt. •Billing system	•Upgrade technology developed in the 1st phase •DR adaptive appliance control	
	Capa-bility	•Wireless NAN/HAN design	•Demand forecasting & optimal bidding •Rate planning •DR program design •Metering data analysis	•Consumption pattern analysis •Segmented service design •Analysis & improvement of rate/DR program •Optimal transaction of excessive power •Building energy mgmt./reduction consulting	
Verifying BM			•DR, BEMS, Retail BM Verification		
Global Requirement		•Identify and apply global requirements	•Develop & apply global requirements to Test Bed	•Commercialization and continuous application of global requirements	
Focus on building Test Bed infra & obtaining R&C in accordance with global requirements				Focus on BM verification and commercialization for global market	

※ R&C: Resource & Capability, AMI: Advanced Metering Infrastructure, NAN: Neighborhood Area Network, HAN: Home Area Network, HEMS: Home Energy Mgmt. System, NOC: Network Operation Center, BEMS: Building Energy Mgmt. System, PCS: Power Conversion System

To secure optimized ICT solution and capability for real market by a reliable ICT infrastructure which includes AMI integrating ZigBee, PLC, cellular, and wired network technologies



※ IHD: In-Home Display, PLC: Power Line Communication, DCU: Data Collecting Unit

Major Challenge

- Optimize and monitor network performance to deal with a massive amount of data while maintaining stability of current grid
- Obtain interoperability and security in compliance with global standards

【 Key Tasks 】

Technology

AMI

- **Dual Path technology for AMI by utilizing wireless/fixed network with reliability**
 - Wireless: ZigBee, W-CDMA
 - Wired: PLC, IP network(HFC)
- **AMI device development**
 - Smart Meter/DCU with network interface

HAN

- **ZigBee technology in compliance with global standard (Smart Energy Profile)**
- **Smart device development**
 - Gateway, IHD, Smart Socket/Switch, etc.

Capability

Wireless Network Design

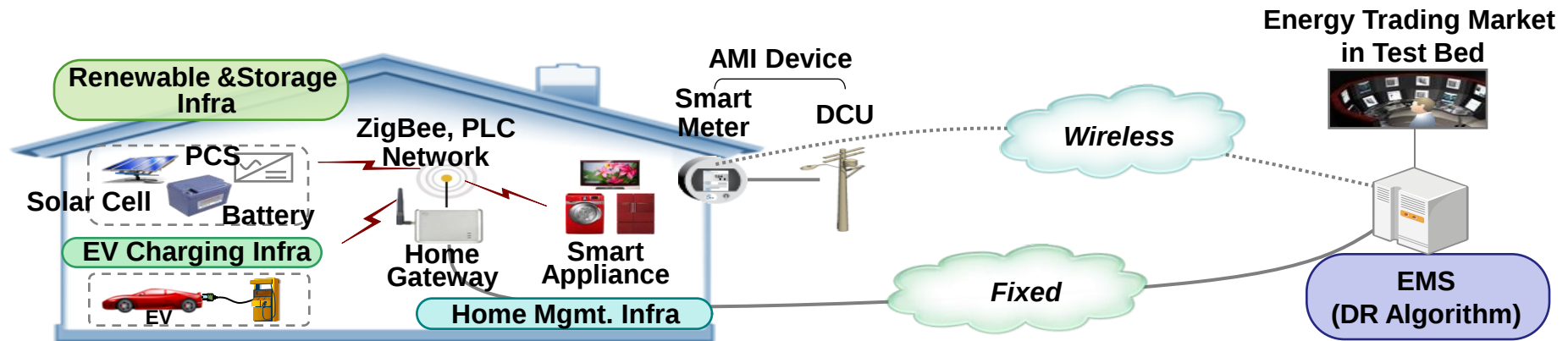
- **Wireless N/W design/engineering for AMI**
 - N/W structure & coverage design considering ZigBee RF signal strength and data traffic
 - N/W engineering suitable for field condition

Metering Data Analysis

- **Real time metering data management and analysis**
 - Reliable real-time (every 5 min) metering data collection / statistics management
 - Consumption analysis capability



To achieve energy consumption efficiency by securing DR technology and program analysis/design capability along with storage control technology and optimal operation capability for renewable



【 Key Tasks 】

Technology

DR Operation Tech.

- **Incentive/price based DR algorithm**
 - Incentive based DR: automated load control DR(PCT)
 - Price based DR: CPP, TOU
- **Optimal control technology on power consumption of DR adaptive appliances**

Solar Cell/ Storage Control

- **Bi-directional power flow mgmt. and control between PCS and grid**
- **Battery charging/discharging mgmt. & control through BMS**

Capability

DR Program Design & Analysis

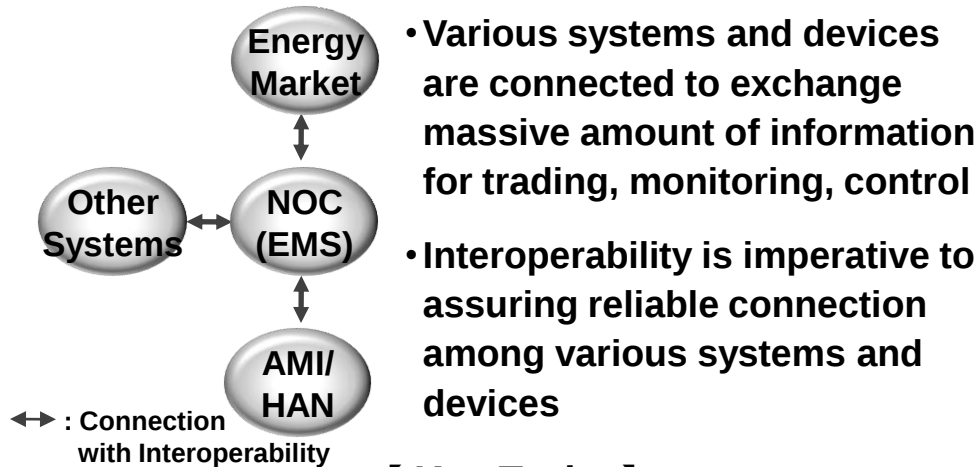
- **DR program design on the basis of consumers' consumption pattern**
- **DR program effectiveness analysis**

Optimal Solar Operation

- **Forecasting solar generation efficiency and cumulating relevant data**
- **Optimal mgmt. of solar power reflecting customers' consumption pattern**

To maintain interoperability among various systems and devices by adopting relevant standards to each interface, and assure security by applying security solutions against expected threats

Interoperability



【 Key Tasks 】

- | | |
|-------------------|---|
| NOC~Energy market | • IEC/ISO CIM Standard |
| NOC~Other Systems | • HTTPS+SOAP over Internet |
| NOC~AMI | • ISO/IEC Standard based Proprietary protocol |
| AMI/HAN Interface | • ZigBee/PLC
• Smart Energy Profile Standard |

Security

- Protecting system and information is key to the proliferation and success of Smart Grid business

Security Threats

- External electronic intrusion
- Malignant code
- Leakage/modification/destruction of critical information
- Unauthorized control
- Copy/modification of AMI device

【 Key Tasks 】

- | | |
|----------------------|---|
| Security Solution | <ul style="list-style-type: none"> • Adoption of security solutions for protection, encryption, and authorization - Firewall, IPS, NAC, Anti-DDoS, VPN - Data encryption, PKI authorization - Secure OS, DB security solution |
| Monitoring & Control | <ul style="list-style-type: none"> • 365/24 operation of security monitoring and management |

SK Telecom will expand Smart Grid business into global market, leveraging technology/capability obtained from Test Bed combined with prior experiences in implementing global business

United States

- Power Grid enhancement business
 - Integration of ICT for enhanced power efficiency is the major challenge of US power industry
 - SKT is currently identifying utilities' pain points and building partnerships with utilities/vendors

China

- Market entry leveraging Smart City Business
 - Diverse business opportunities for Smart Grid are being developed in conjunction with on-going Smart City project in China

Domestic

- DR/BEMS Business targeting Commercial & Industrial area
 - SKT is pursuing ESCO BM which enables integrated management of multiple buildings based on NOC (Network Operation Center)

Tech/Capability

BM Verification

Global Requirements

Jeju Test Bed Project

Thank You !