Smart Grid in Korea
- a Green Growth Engine

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May 17, 2012
APEC, Quebec

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What we were..

What we did..

What we are..

What we learned..

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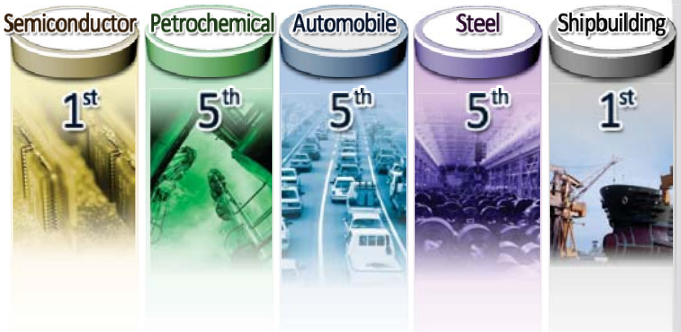
Economy Overview – South Korea

What we were..

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

- Key Industries and Global Ranking



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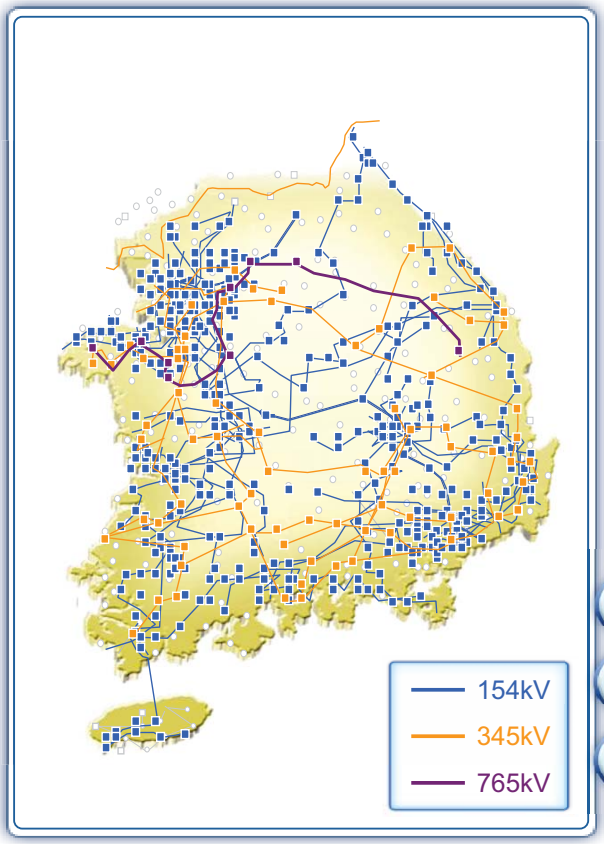
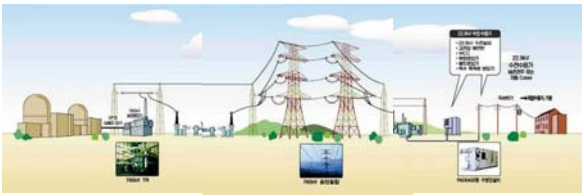
System overview in 2008

What we were..



- 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



- Rate of transmission & distribution loss : 4.01% (1st in the world)
- Blackout duration (SAIDI) : 16.08min (2nd in the world)
- Load factor: 76.6% (1st in the world)

※SAIDI: The System Average Interruption Duration Index

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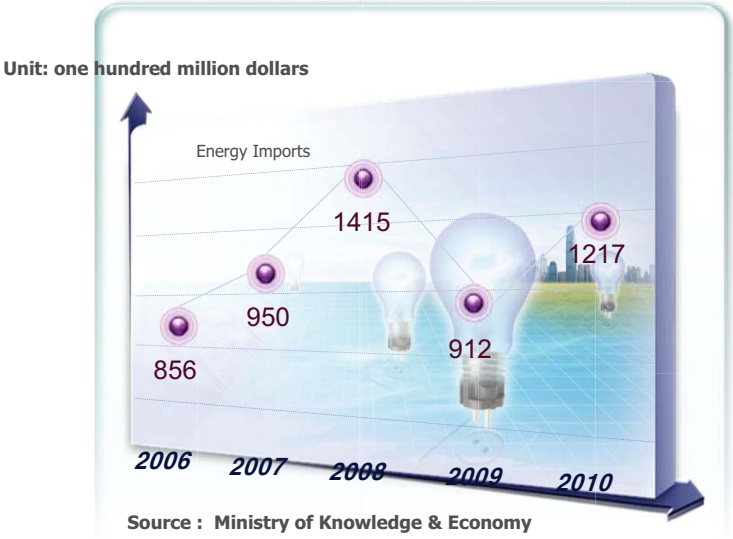
Energy dependency

What we were..

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

Energy Imports



Source : Ministry of Knowledge & Economy

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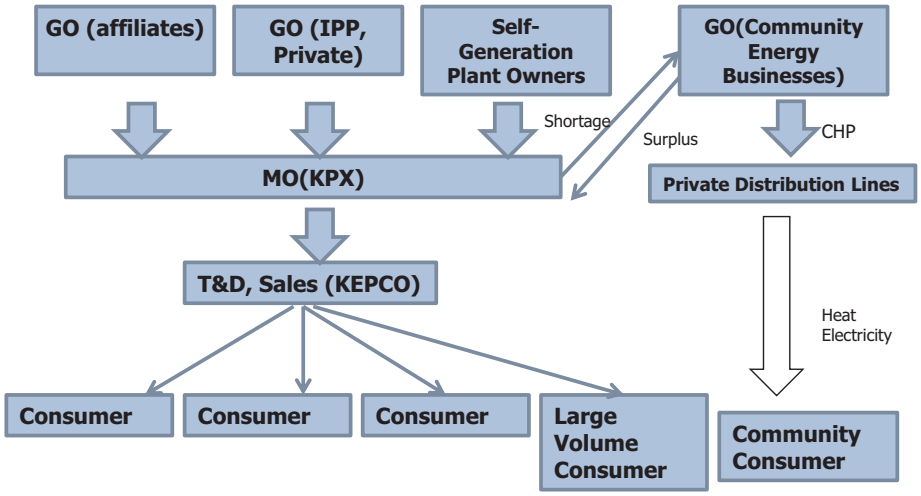
Electricity Industry

What we were..

Restructured from 2001

- KEPCO : TO, DisCo, LSE
- KPX (Korea Power Exchange) : SO, RTO, MO
- 6 KEPCO affiliated Companies : GenCo
- Other 7 IPPs

•TO: Transmission Owner
•DisCo: Distribution Company
•LSE: Load Service Entity
•SO: Service Operator
•RTO: Regional Transmission Org
•MO: Market Operator
•GenGo: Generation Company
•IPP: Independent Power Producer



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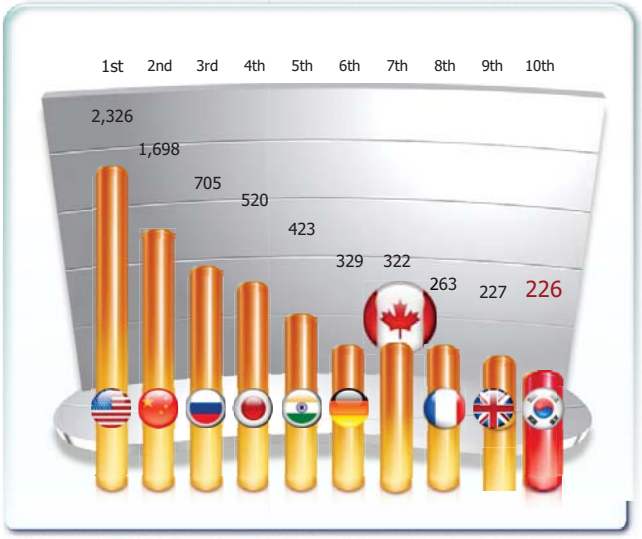
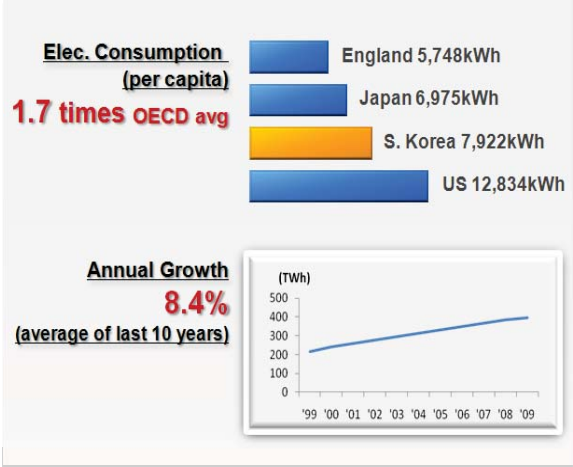
Electricity Consumption

What we were..

Global Energy Usage



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



"Electricity usage is increasing because of low price and easy access."

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Era of Energy, Environment

What we were..

GHG Emission by sectors

Source : MKE

"Korea is 1.6 times of OECD average GHG emission per GDP"

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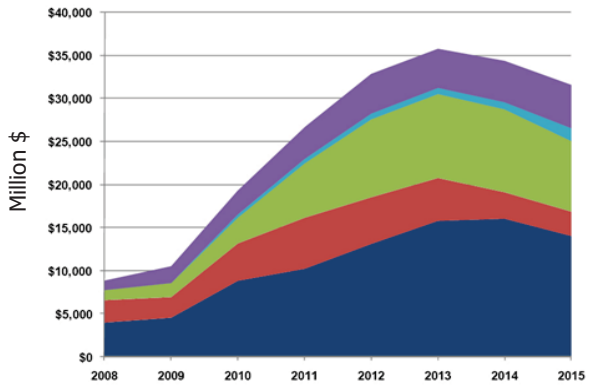
New Growth Engine

What we were..

Worldwide Smart Grid Market

World Market of Smart Grid by Applications : '08~'15)



Application	AGR ('09 ~ '13)
AMI	32.3%
EV management system	94.6%
Distribution Automation	80.8%
Substation Automation	27.7%
Transmission Upgrade	16.4%

Source : Pike research

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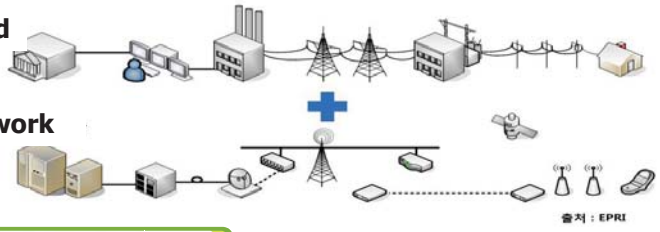
Convergence Technology

What we were..

Network Convergence

Existing Power Grid

IP-based ICT Network



Service Convergence

- Centralized Generation
- Experience-based OAM
- One-way Power Flow
- Remote Monitoring
- Flat-rate Pricing

•Real Time Delivery
•Broadband Connectivity
•Secured Integration
•Bulk Data Management

- Distributed Generation
- Real Time Data-based
- Multi-way Power Flow
- AMI + Broadband Internet
- Real Time Pricing

Device Convergence

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What we were..

What we did..

What we are..

What we learned..

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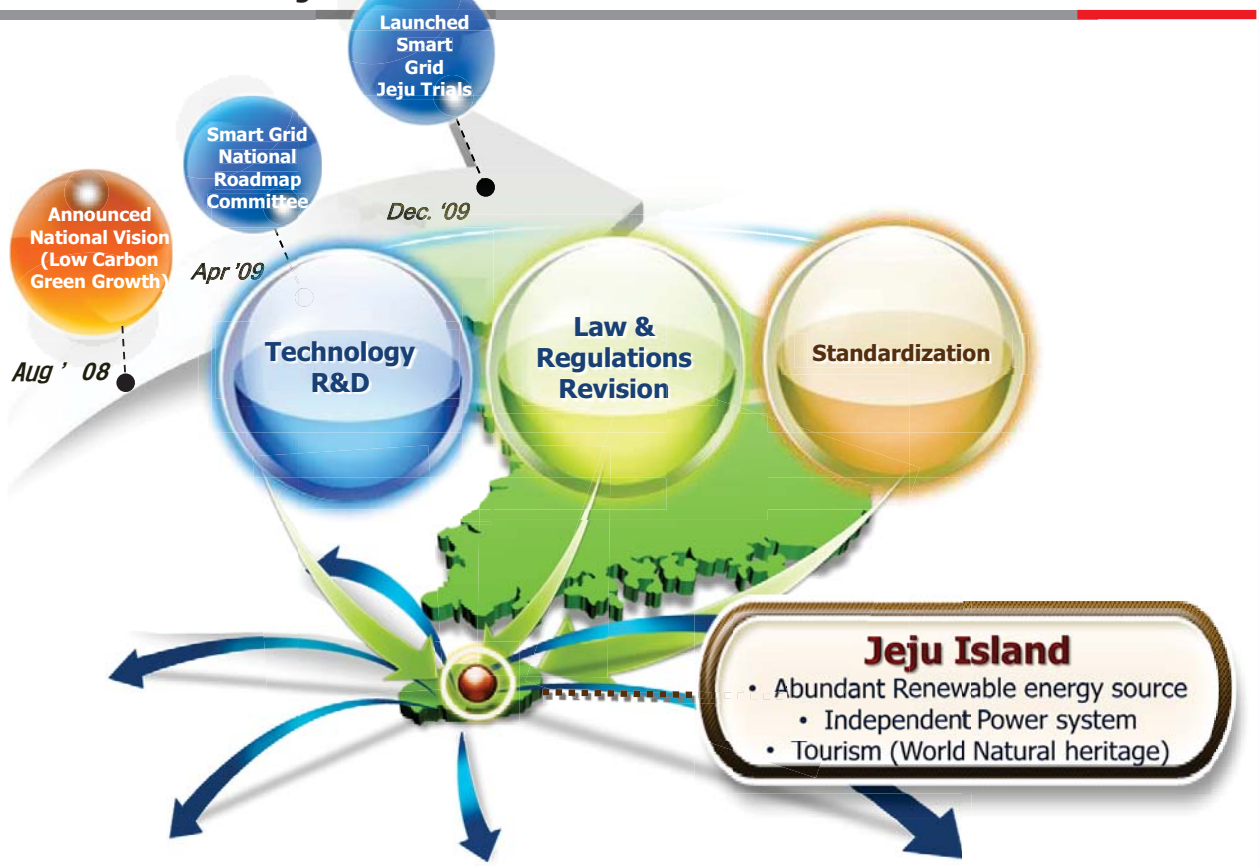
Field Trial in Jeju Island

What we did..



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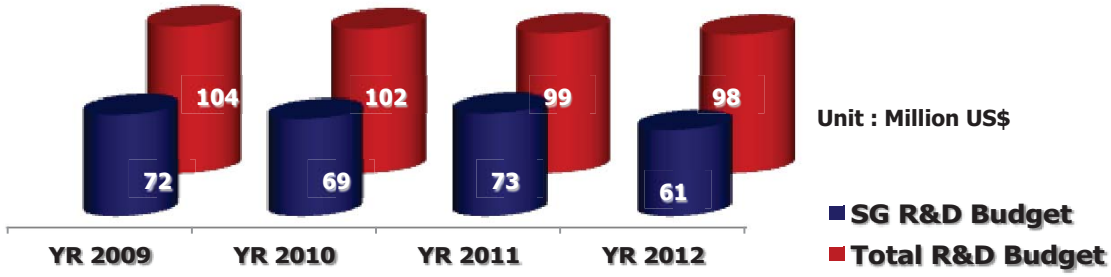
R&D Investment and New Rules

What we did..



Technology Evaluation

- Effectiveness valuation user prospective as well as technologies

Open Proposal

- Promote business model creation by new idea supportive trial

Competition

- Introduce competition system among consortia in trial domains

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Consortia

What we did..

	Leader	Participants	Investment(us$)
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 Transpor-tation	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 Renewables	KEPCO	KOSPO, Hyosung, LSIS etc (16 companies)	Govt : 4.7 million Private: 15.3 million
	HYUNDAI	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
Smart Power Grid	KEPCO	LS IS, KDN (KEPCO affiliate), wtc (18 companies)	
Smart Electricity Service	KEPCO KPX	Wooam Corp., Bitek,IC etc (5 Companies)	

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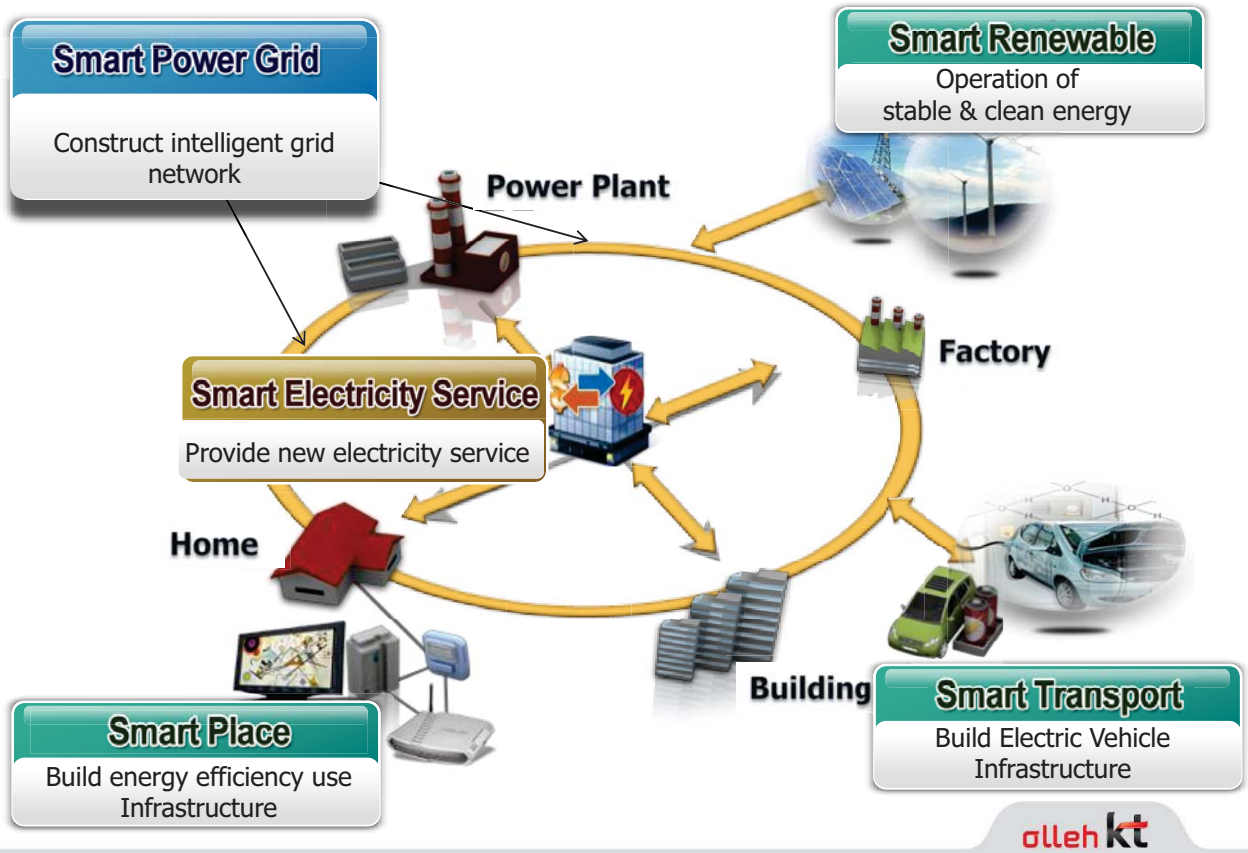
Five Domains

What we did..



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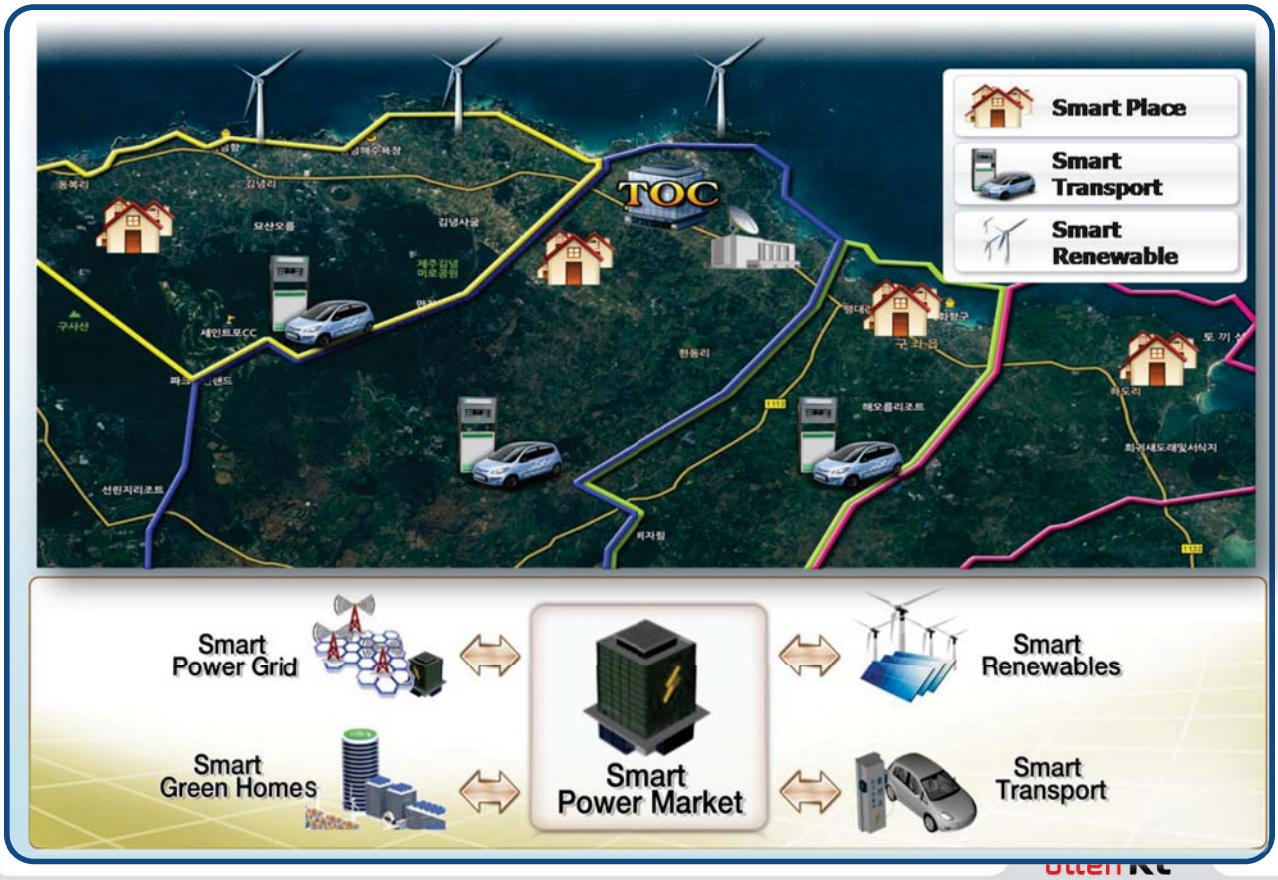
Trial Sites

What we did..



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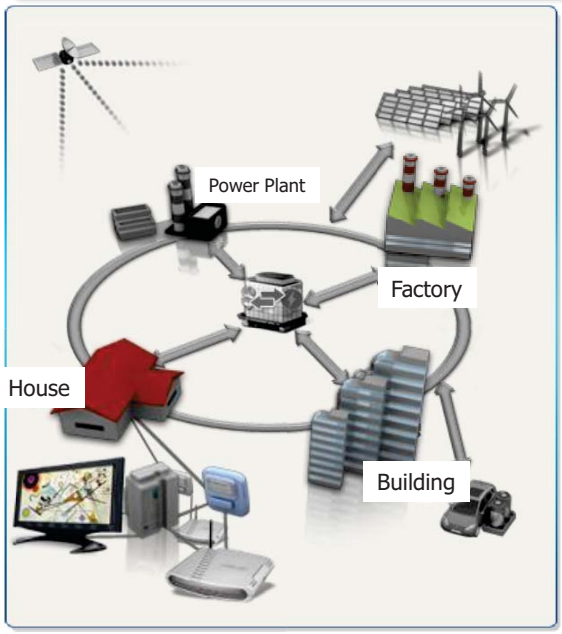
Domain 1 - Smart Place

What we did..

Objectives

- To increase energy efficiency and reduce energy use via AMI
- To control energy use via two-way communication energy management System



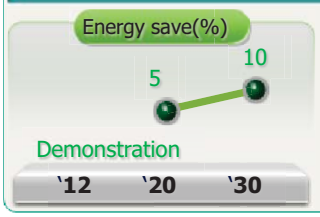
Key Technology Deliverables

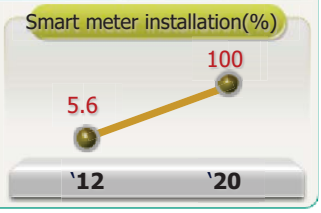
- Develop AMI and set standard (2012)
- Develop system to connect DR with the grid (2020)

Business Model

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

Goals by Critical Index





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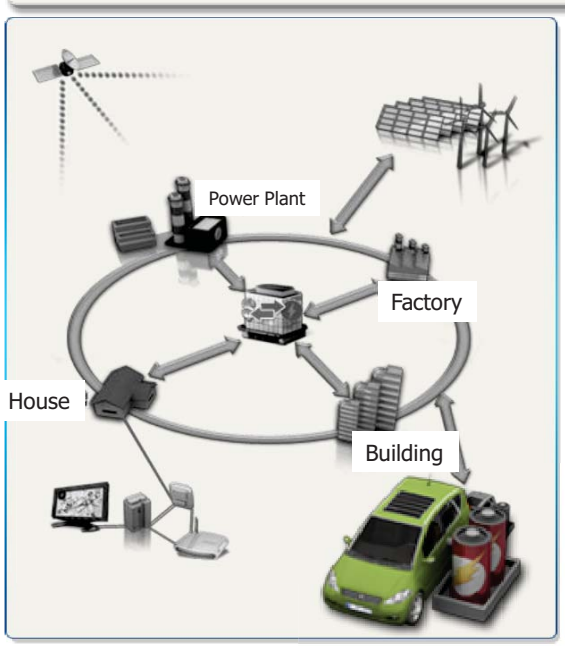
Domain 2 - Smart Transportation

What we did..

Objectives

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



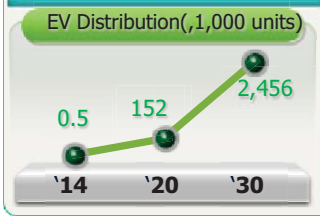
Key Technology Deliverables

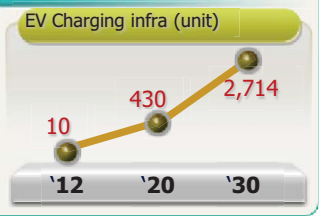
- Develop EV parts and materials (2012)
- Develop Vehicle to Grid system and ICT service (2020)

Business Models

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

Goals by Critical Index





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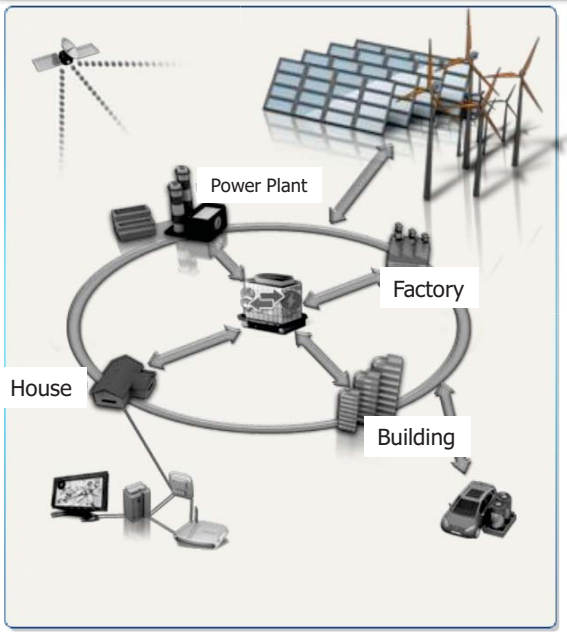
Domain 3 - Smart Renewables

What we did..

Objectives

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



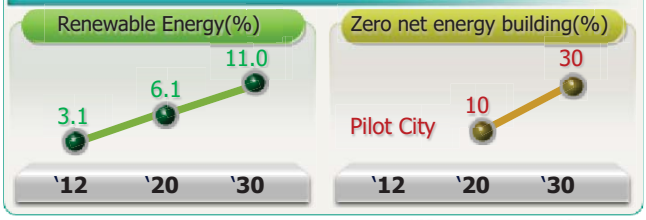
Key Technology Deliverables

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

Business Models

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

Goals by Critical Index



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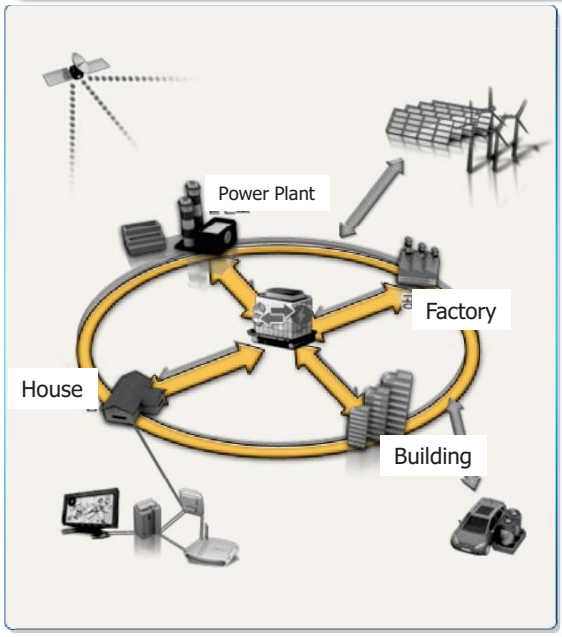
Domain 4 - Smart Power Grid

What we did..

Objectives

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



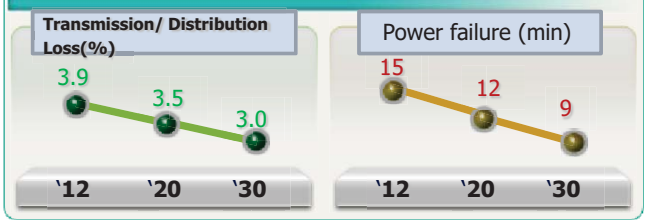
Key Technology Deliverables

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

Business Models

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

Goals by Critical Index



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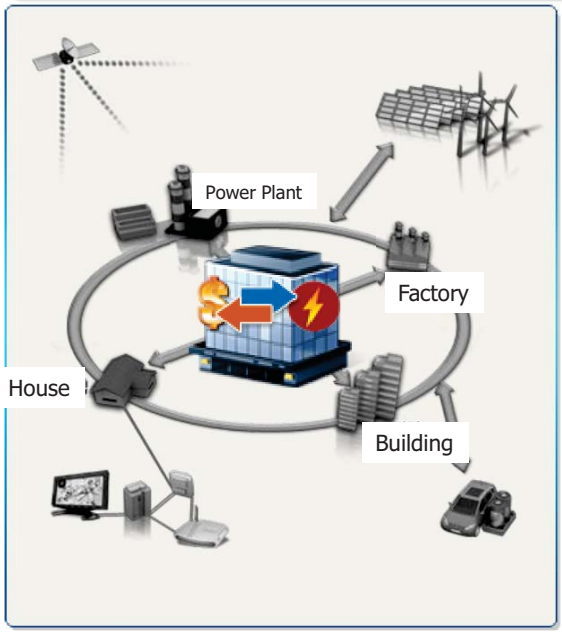
Domain 5 - Smart Electricity Service

What we did..

Objectives

- To encourage TOU pricing with consumer participation
- To promote on-line system for power exchange and derivatives



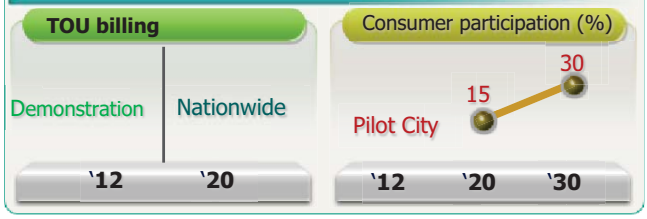
Key Technology Deliverables

- Develop real time pricing and demand response system ('12)
- Develop on-line power exchange system (2020)

Business Models

- Customer based power providers
- Diverse power derivatives are expected to emerge

Goals by Critical Index



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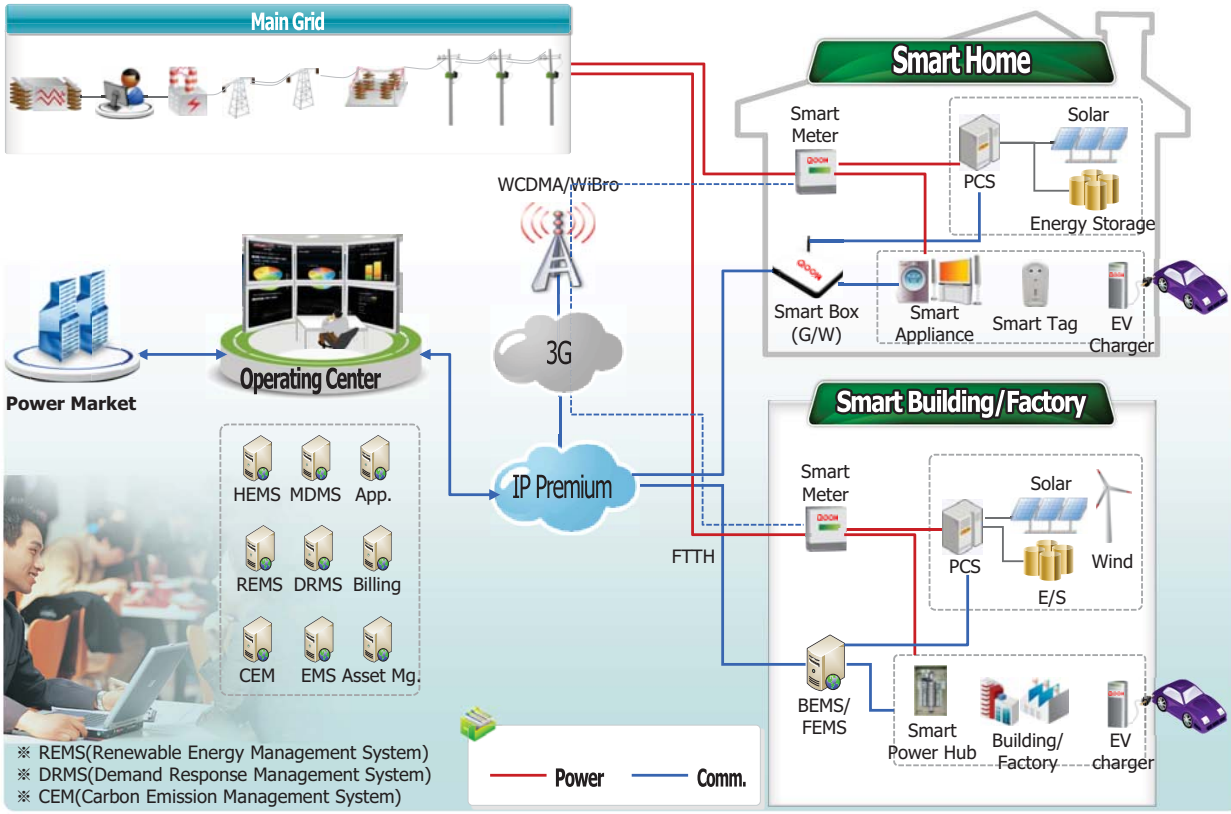
Architecture – KT Consortium

What we did..



※ REMS(Renewable Energy Management System)
※ DRMS(Demand Response Management System)
※ CEM(Carbon Emission Management System)

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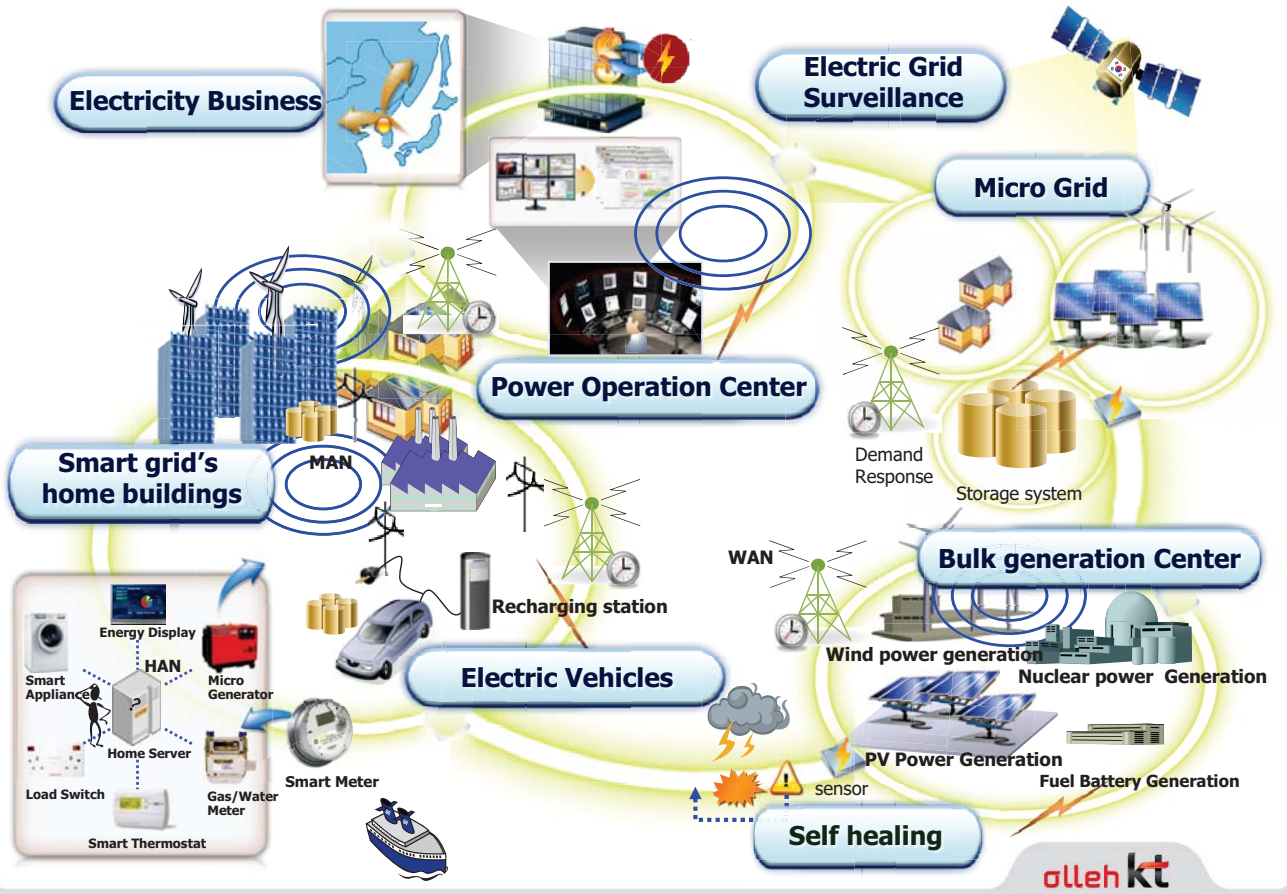
Future Test-bed Layout

What we are..



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Jeju Phase 2 (June '11 ~ May '13)

What we did..

Smart Place	• EMS Development interworking with TOC • Expansion of HH with AMI Infrastructure/ PV • EMS platform, DR solutions implementation & Trial • Smart Metering service, MicroGrid for Building • Consumer participating DR service design
Smart Transportation	• Complete charging infra, Cost effective charging system • V2G service simulation • Operation system & security
Smart Renewable	• Forecasting system for Wind Renewables • Inverter manufacturing, certification and evaluation • Design and Implementation of Operation system for Stable Output operation of renewable energy plants

※ TOC : Total Operating Center, AMI : Advanced Metering Infrastructure), DR : Demand Response, V2G : Vehicle to Grid

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New Dedicated Organizations

Korea Smart Grid Institute (Aug 2009)
http://www.smartgrid.or.kr

Smart Grid Standardization Forum
http://www.sgstandard.org

Korea Smart Grid Association (May 2009)
http://www.k-smartgrid.org

Korea Smart Grid Standards Coodinator (May 2010)
http://www.kscodi.or.kr

What we were..

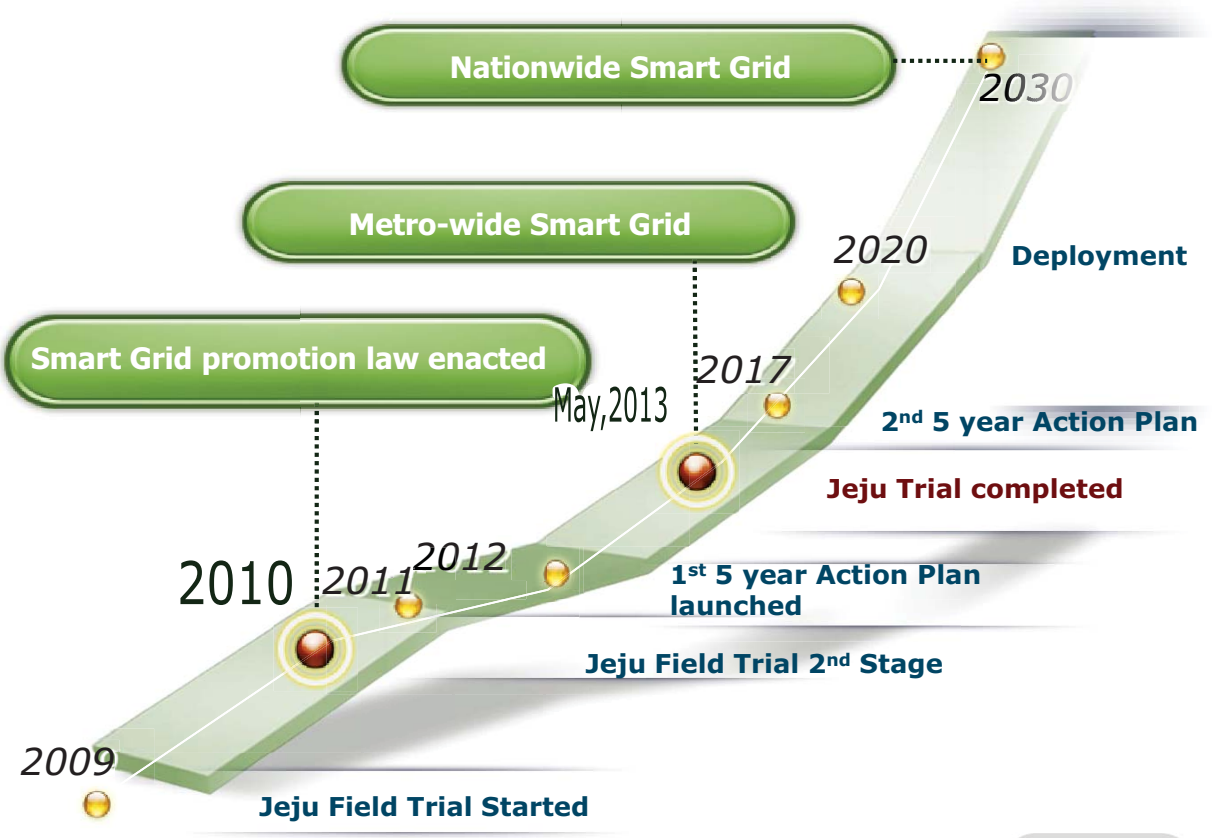
What we did..

What we are..

What we learned..

Roadmap by MKE

What we are..



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Smart Grid Promotion Law

What we are..

Backgrounds

Needs for Systematic & consistent Smart Grid Business promotion

Limitation of current regulation and systems

Promoting Integration of power infrastructure with IT for co-growth

Legislation

- Set up Smart Grid Implementation Action Plan (5 year span)
- Smart Grid Service Provider Registration
- Subsidies for Smart Grid Private Investment
- Dedicate Areas for Smart Grid Implementation
- Certification & Standardization

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Deregulation and open Market

What we are..

1st Five Year Plan

Categories	Actions
Tariff Policy	▪ TOU Pricing for High Voltage consumer ▪ Introduction of Optional CPP for large loaded companies(2012) ▪ Various optional tariffs for low voltage consumers (2014)
DR Management	▪ Introduction of intelligent demand management business('12~'13) ▪ Plan to Foster "Dedicated DM Operator" (2013)
Market Opening	▪ Provide EV Charging provider with Power Seller/Reseller license (2012) ▪ Open Wholesale market and introduce competition (2013) ▪ Open Retail market in Pilot cities (2014)
AMI Deployment	▪ Enlarge the provision (2012~) ▪ AMI provision plan for Community Building, Obligatory for new building ▪ R&D of Integrated metering system for Electricity/Water/Gas/Heat (2014~)
EV Charging Infra	▪"Roadmap for EV Charging infra" (2012) ▪ 3000 Charger for Government Offices (2012) ▪ Government Subsidies for private charger builders (2013~) ▪ Management system for charging infra (2013)
ESS	▪ Add "Energy Storage service provider" in Dedicated Law ▪ Financial Aids for ESS implementation ▪ Replacement of Backup generators(Diesel) with ESS ▪ Total Capacity 0.2 Mwh(~2016)
Pilot Cities	▪ Select 7 Pilot cities in 7 Regions ▪ Build AMI, ESS, EV Charging Infra for 7 cities ('14~)

•*TOU, Time of Use : Differential Tariff for Season/Time of Day
•**CPP, Critical Peak Pricing : Impose high rates upto 3 to 5 times in Critical Peak Hours

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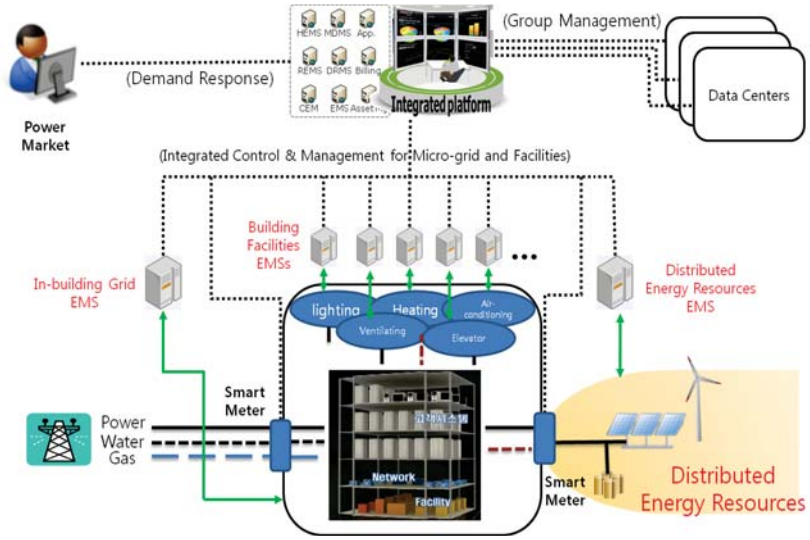
New R&D

What we are..

KMEG: Korea Micro Energy Grid

Nationwide Micro-grid Management : Energy generation, delivery & consumption
- Samsung C&T (Construction) & KT (ICT)
- Investment : Government (70M USD), Firms (330M USD)



▸ Based on Integrated Management Platform,
1) improve energy efficiency,
2) implement distributed energy resources (Power, Heat, Gas, etc.), and
3) interact with energy market through demand response, FMS, BEMS.

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What we were..

What we did..

What we are..

What we learned..

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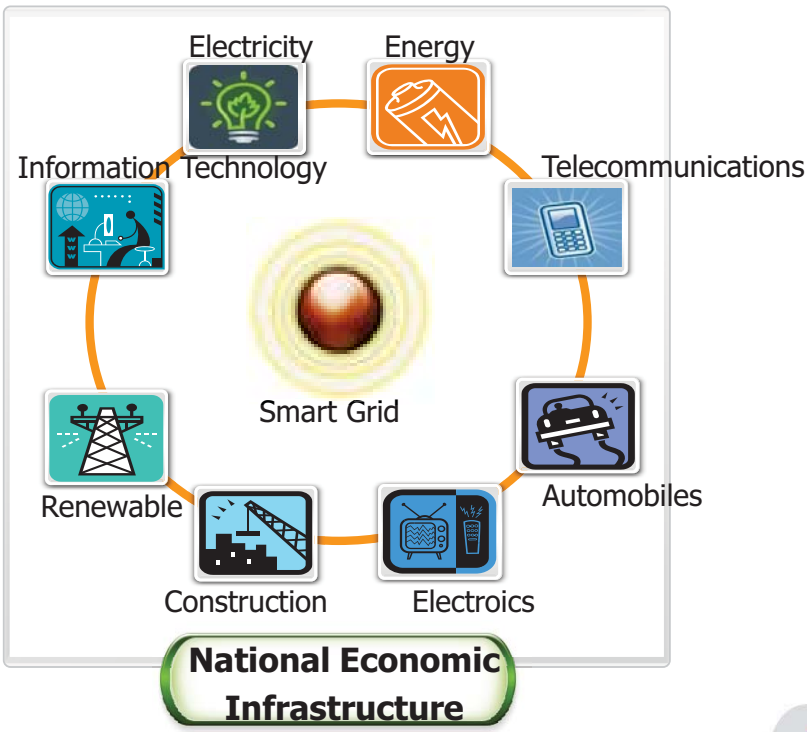
Smart Grid - New Growth Engine ?

What we learned..

- Smart Grid : achieved only by ICT convergence which led into new business opportunities
- Effective Energy / GHG emission saving technology proven



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Obstacles

What we learned..

Holdbacks Against Early Deployment

- Regulation (for Smart Grid Trials)
- Skeptical Eyes of Stakeholders
- Low Consumers' Participation (Weak Impact on Residential Consumer)
- Lack of Business Models
- Reluctance of Market Player with Vested Interest
- Lack of Private Investment Attraction
- Low and Uniform Pricing
- Low Incentives for Private Investment
- Too Many Technologies Options vs. No Technology

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Implications

What we learned..

Solutions for Early Deployment

- Deregulation for Market Entry, Competition
- Dedicated Joint (Gov + Private) Organization for Smart Grid Planning
- Government's consistent Will and Driving Force
- Promotion to Provoke Participation
- R&D Competition and Incentives
- Discover DR Resources and setting up utilization plan
- Introduction of Various Pricing (TOU , CPP , Sliding Scale on Oil Price)
- Technology vs. Behavior (Habits)
- Budget for Operation for DR Market
- Make most of Other Industry Technologies
- Voluntary Competition among Local Autonomous Governments
- Network Security & Data Privacy Preparation

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Smart Grid – National Roadmap

Vision and Goals of Korea's Smart Grid

Vision

Pave the way for low carbon, green growth through a Smart Grid

Goals by phase

- Build a Smart Grid Test-bed **2012**
- Build a Smart Grid across metropolitan areas **2020**
- Build a nationwide Smart Grid **2030**

Five implementation areas

Smart Power Grid	- Build a monitoring & control system of the power grid - Build a failure prediction & automatic recovery system of the power grid
Smart Place	- Distribute nationwide smart meters - Build an automated energy management system
Smart Transportation	- Build a nationwide charging infrastructure - Build an ICT-based electric vehicle operating system
Smart Renewable	- Create a large-scale renewable energy generation complex - Develop large capacity energy storage devices
Smart Electricity Service	- Develop a various pricing system - Develop consumers' electricity trading system

Effects from introducing smart grid system nationwide by 2030

Creation of	Reduction of GHG	Reduction in energy imports	Increase in smart grid related exports	Creation of smart grid-related demand	Reduction in construction costs of new power plants
50,000 new jobs	230 Million t	47 Trillion won	49 Trillion won	74 Trillion won	3.2 Trillion won

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THANK YOU

FOR YOUR ATTENTION !

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