



ESI Strategy of Korea

OSP

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Ministry of Trade, Industry & Energy
Office of Strategic R&D Planning

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* Data Reference = World : IEA, Korea : MOTIE

I. Energy Landscape of Korea



Korea and Energy at a Glance



Ministry of Trade, Industry & Energy
Office of Strategic R&D Planning

- Land Area: 99,720 km² (109th)
- Population: 49.0 million (26th)
- GDP: US\$ 1450 billion (13th)
 - US\$ 28,739 per capita (29th)
- Import Dependence: 96.0 %
 - Energy import : US\$ 178.7 bill.
 - Island with no Grid Connection

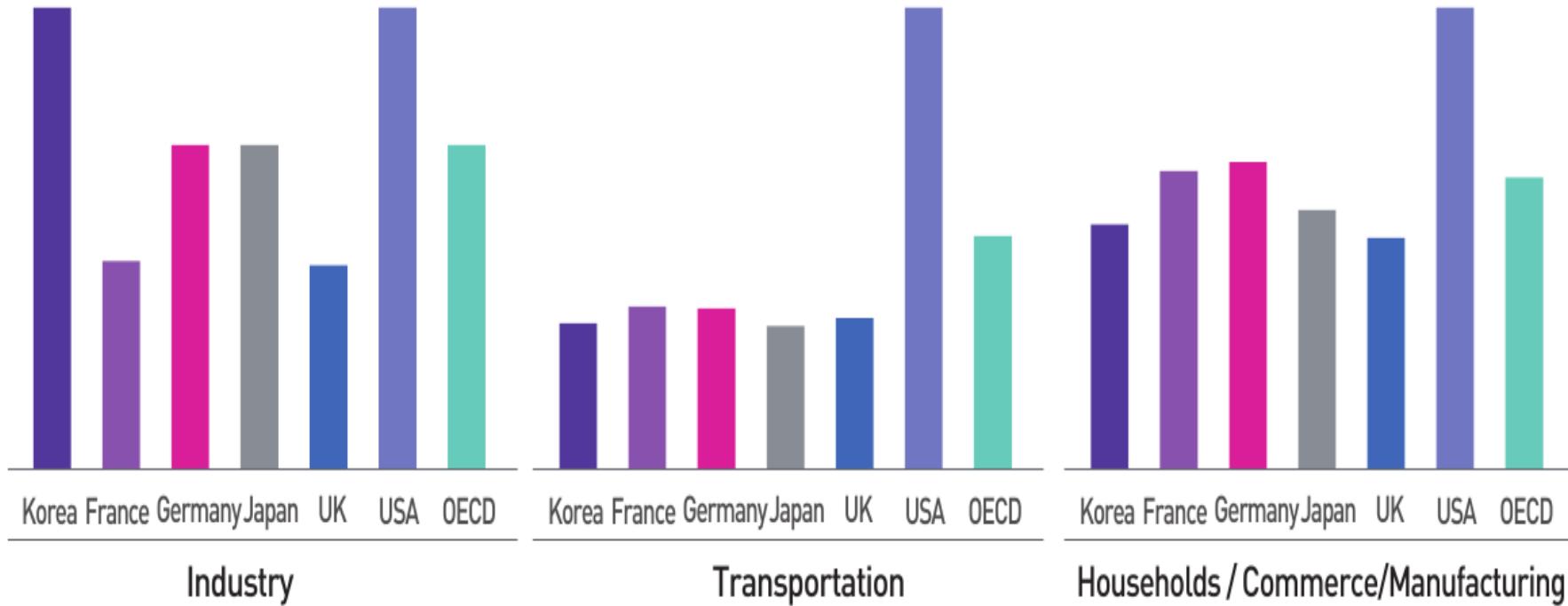


Korea's energy position in the world (2012)

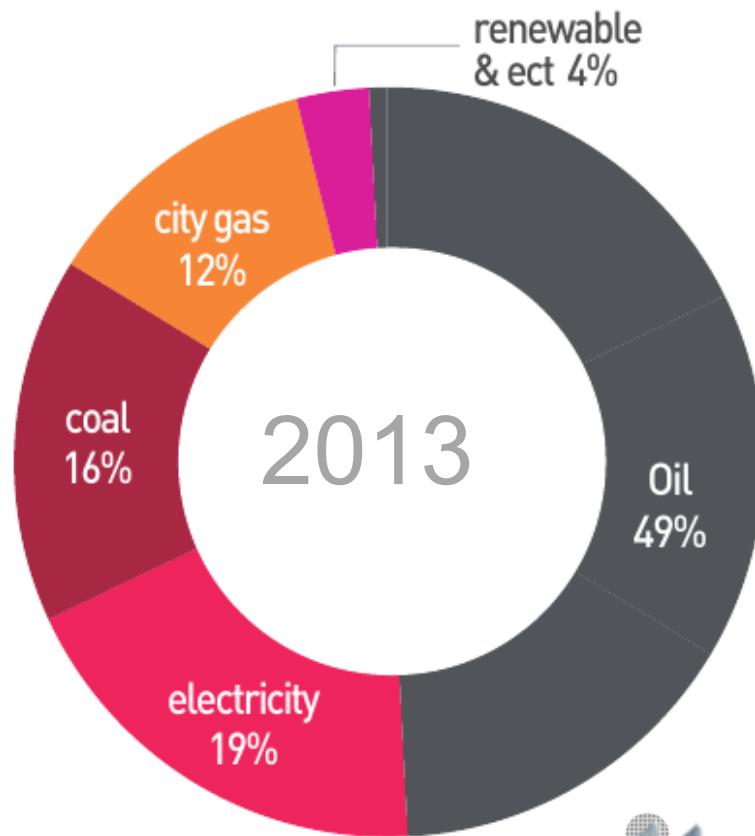
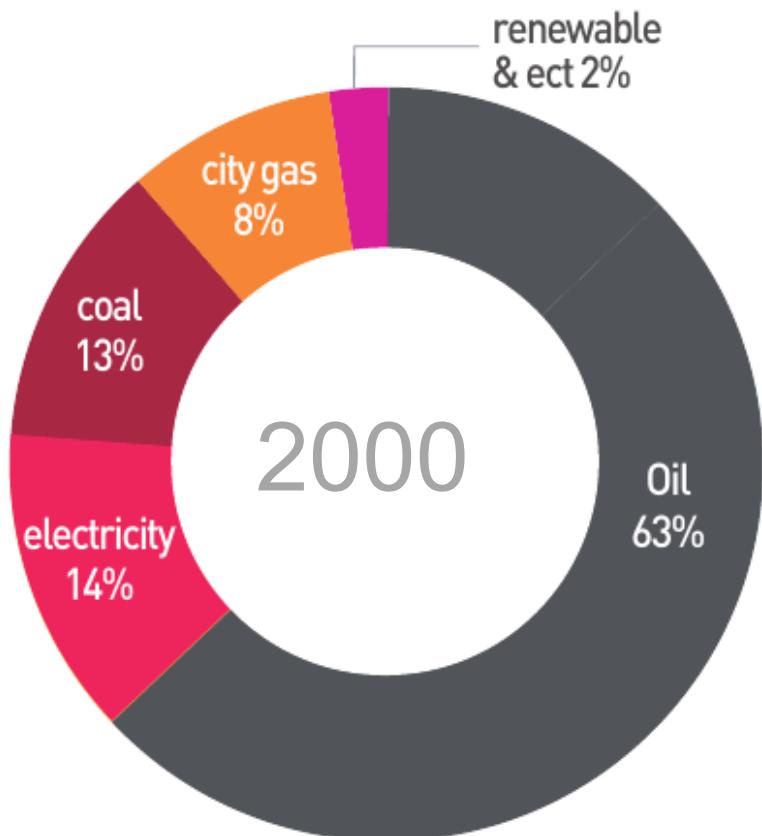


Rank	TPES	Net Crude Oil Importer	Net Natural Gas Importer	Net Coal Importer	Nuclear Elec. Producer
1	China	USA	Japan	China	USA
2	USA	China	Germany	Japan	France
3	India	Japan	Italy	India	Russian
4	Russia	India	Korea	Korea	Korea
5	Japan	Korea	Turkey	Chinese Taipei	Germany
6	Germany	Germany	USA	Germany	Japan
7	Brazil	Italy	France	UK	Canada
8	Korea	France	UK	Turkey	Ukraine
9	France	Singapore	China	Italy	China
10	Canada	Netherlands	Ukraine	Malaysia	UK

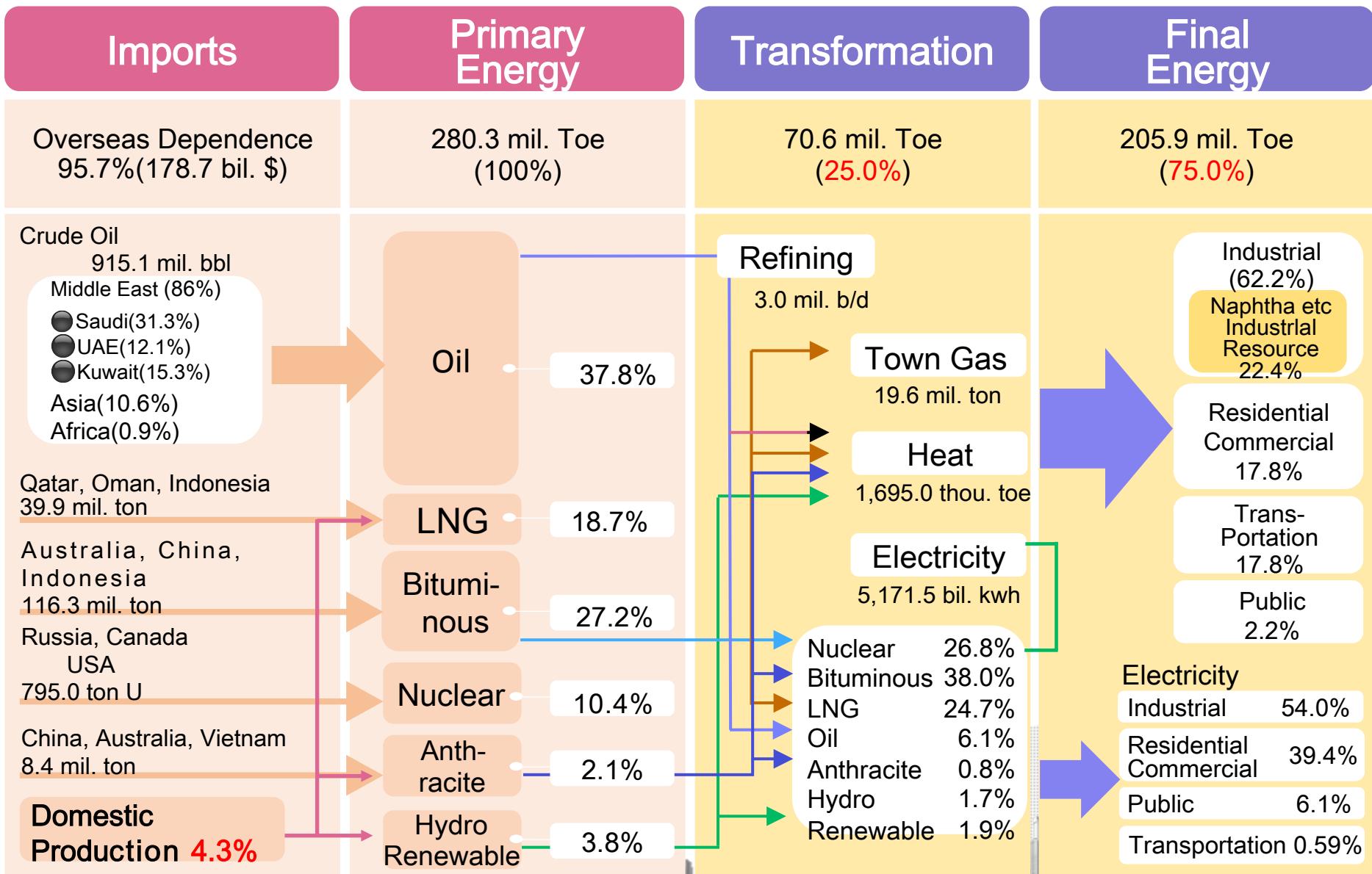
Per Capita Energy Consumption



Change in Energy Mix



2013 Energy Balance Flow



II. National Energy Master Plan



- **1960s** Establishment of a foundation for the energy industry
- **1970s** Overcoming the oil crisis
 - By building NPP under the oil-free policy
- **1980s** Stabilization of energy supply
 - To meet high GDP growth
- **1990s** Liberalization of the energy industry
 - To make competition mainly in electric power industry
- **Present** Promoting low- carbon economy
 - With renewables, CCS/CCT and demand management



Energy Consumption Forecast

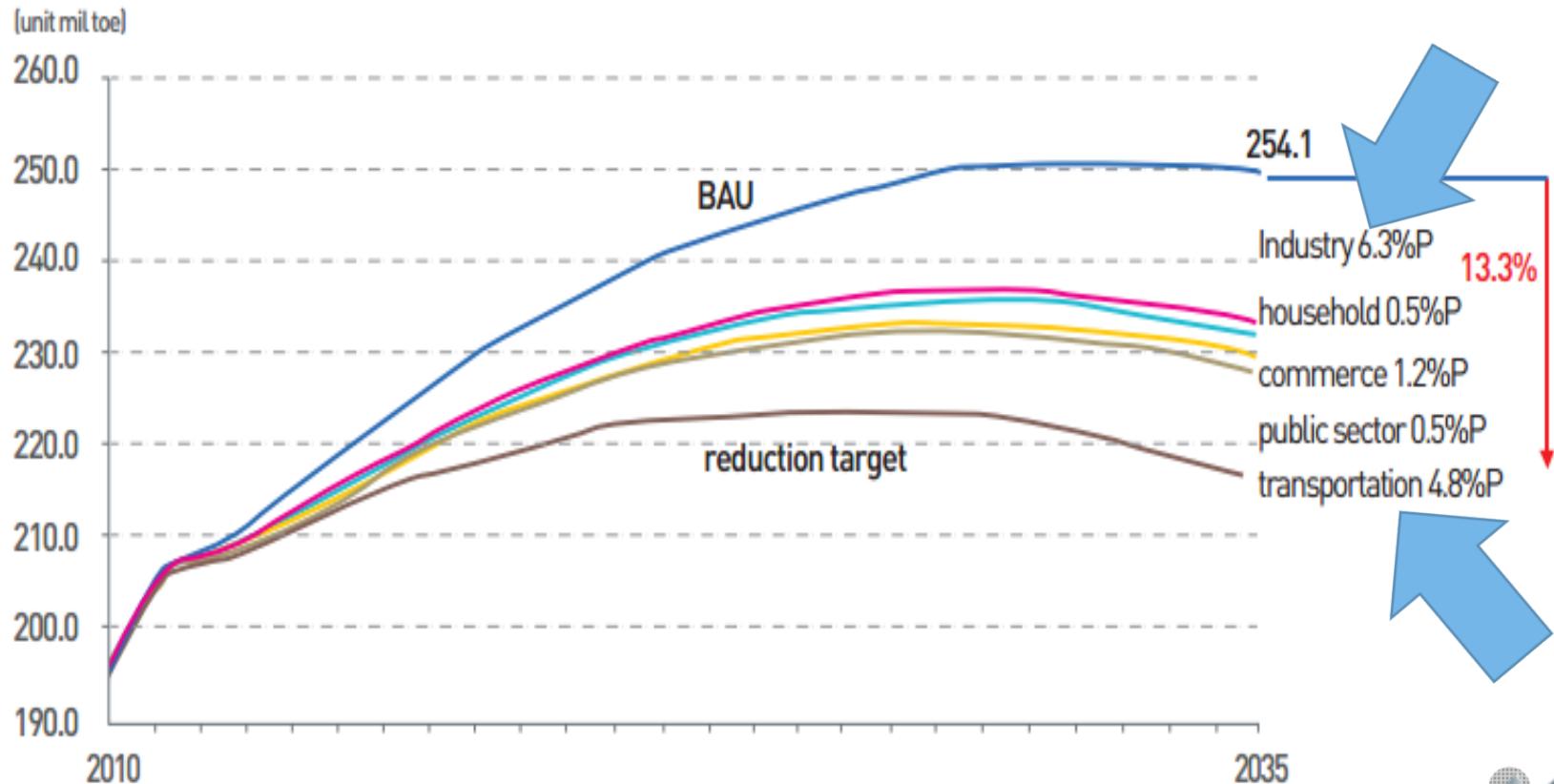


* (Unit: million toe)

Source	2011	2025	2030	2035	Average Annual Growth Rate (%)
Coal (share %)	33.5 (16.3)	37.4 (15.0)	38.8 (15.3)	38.6 (15.2)	0.58
Oil	102.0 (49.5)	109.1 (43.9)	105.1 (41.3)	99.3 (39.1)	-0.11
City Gas	23.7 (11.5)	32.5 (13.1)	34.4 (13.5)	35.3 (13.9)	1.68
Electricity	39.1 (19.0)	59.7 (24.0)	65.6 (25.8)	70.2 (27.6)	2.47
Heat energy	1.7 (0.8)	2.9 (1.2)	3.1 (1.2)	3.3 (1.3)	2.82
Renewable (non-electricity)	5.8 (2.8)	7.1 (2.9)	7.4 (2.9)	7.4 (2.9)	1.01
Total	205.9 (100.0)	248.7 (100.0)	254.3 (100.0)	254.1 (100.0)	0.88



Target By Sector



1. Transition to Energy Policies focused on Demand Management
2. Establish a Distributed Generation System
3. Improve Sustainability
4. Enhance Energy Security
5. Establish a Stable Supply System for Each Energy Source
6. Shape Energy Policy to Reflect Public Opinion



1. Demand Management



- ◎ **Policy objectives** : Reduce 13% in energy demand and 15% in electricity demand by 2035
- ◎ **Tax reform**: Adjust energy tax rates to reduce the imbalance between the consumption of electricity and other energy sources (Impose a tax on bituminous coal used for generation, offer tax incentives for LNG, etc).
- ◎ **Rate revision** : Revise the rate system to reflect environmental and social costs (e.g., refurbishment of nuclear facilities and the transmission network), apply different pricing for different types of use (e.g., progressive rate relief, pricing based on voltage), expand critical-peak pricing, etc.
- ◎ **ICT-based demand management** : Deploy smart grid (incentives for ESS installation, etc.) and energy management systems (revising standards for building design, etc.), invigorate the demand management market, etc.
- ◎ **Reinforcement of systems for each sector** : Improve average car mileage to the level of developed nations by 2020, zero-energy for new buildings by 2025, eliminate low-efficiency products from the market, etc.



2. Distributed Generation System



- ◎ **Policy objectives** : Supply more than 15% of power from distributed sources by 2035
- ◎ **Construct power plants minimizing transmission capacity** : Provide information on available sites for new plants in advance to minimize construction of ultra-high voltage transmission lines
- ◎ **Expand distributed generation** : Increase the contribution rate of DG such as integrated energy systems, renewable energy, and in-house generators
(current contribution rate : 5%)
- ◎ **Transmission network operation** : Develop integrated plans for generation and transmission, raise public acceptance through a review of high-voltage-DC transmission lines, and establish an independent body* to manage and supervise the power grid

* Responsible for monitoring and analyzing power grid operation, applying reliability standards, investigating and managing grid malfunctions, etc.



3. Sustainability Improvement



- ④ **Policy objectives** : Strengthen climate change response and Improve nuclear safety
- ④ **Apply GHG reduction technologies** such as USC and CCS, to thermal power plants as soon as they are available
 - * Applying USC to an aged power plant decreases GHG emissions by approximately 10% and raises efficiency approximately 4 percentage points.
- ④ **Improve safety** : Prioritize safety in the operation of nuclear power plants by expanding investment, improving management of aged plants, and fostering planned and preventive inspections to enhance nuclear safety on a large scale
 - * Continuous development of nuclear safety technologies to improve nuclear safety, stress tests for plants with extended lives, proactive maintenance of equipment in use for long periods of time, and extension of preventive inspection periods and its application
- ④ **Promote innovation in the nuclear industry** : Revise relevant systems and consolidate operational systems to introduce observation, monitoring, openness, and competition into the value chain of the nuclear industry
 - * Enact laws on nuclear regulation and supervision and form a government panel for the integrated administration of public nuclear facilities
- ④ **Develop energy technology** : Promote the development of key technologies to support stronger demand management, the expansion of distributed generation, etc.



4. Enhancing Energy Security



- ◎ **Policy objectives** : Build capacity for Overseas resource development up to 40% by 2035:
Reorient public enterprises toward high-risk areas and long-term investment, while private enterprises focus on areas with high market potential.
- * Shift the focus of public enterprises from M&As and share purchases to exploration and development activities and operating rights, expand support to encourage private investment and entrance into related industries, such as plant construction.
- ◎ **Policy objectives** : Raise the renewable energy deployment rate to 11 % by 2035
by extending deployment policies currently applied to electricity* to heat
and transportation and by implementing a private sector-driven
deployment system**.

* The RHO and the RFS systems, which are similar to the RPS in the electricity sector, will be introduced in the heat and transportation sectors respectively.

** Introduce a photovoltaic rental business ; provide incentives for projects invested in by local residents and with benefit-sharing mechanisms ; etc.



5. Stable Supply System



- ④ **Policy objectives** : Keep energy supply system reliable
- ④ **Oil** : Reduce dependence on certain oil exporting countries by diversifying oil import routes and improve the industrial structure by establishing a Northeast Asia oil hub
- ④ **Gas** : Respond aggressively to changes in the global market, such as the emergence of shale gas, and expand the supply infrastructure for domestic stockpiling
- ④ **Integrated energy** : Expand facilities and improve relevant systems to expand the rate of integrated energy as distributed power and make an effort to convert to a Low-cost structure
 - * Integrated energy : Heat and Power
- ④ **Electricity** : Construct of power plants in a timely manner, maximize the use of available generation resources to secure a stable supply capacity at times of supply-demand imbalance, etc.



6. Reflect Public Opinion



- ④ **Policy objectives** : Enhance the communication with people in energy policy making
- ④ **Respond proactively to energy-related conflicts** : Improve transparency throughout the process of establishing and implementing policies on the transmission network, spent fuel management, nuclear energy, etc.
- ④ **Improve energy welfare** : Introduce an energy voucher system in 2015, expand energy efficiency projects for vulnerable households, and eradicate welfare blind spots by expanding infrastructure, such as system revision
- ④ **Strengthen cooperation with local governments** : Conduct an assessment of the "Regional Energy Plan" for distributed generation and energy saving and incorporate the plan into the Budget

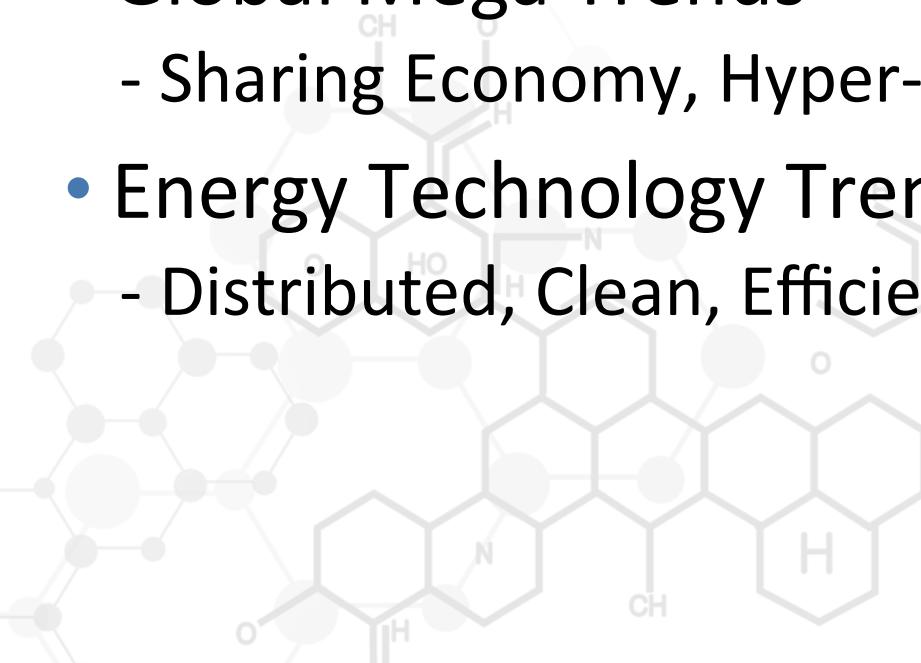
* Consolidate the institutional base : Improve the establishment process for regional energy plans ; ordinances related to regional energy policy ; establish local government energy commissions ; etc.



III. Energy Technology Development Plan



- National Agenda : Creative Economy
 - Energy Business Development, Job Creation
- National Energy Master Plan
 - 6 Major Tasks
- Global Mega Trends
 - Sharing Economy, Hyper-Connected, Zero-Energy
- Energy Technology Trends
 - Distributed, Clean, Efficient, Safe, Smart



Vision Structure



Ministry of Trade, Industry & Energy
Office of Strategic R&D Planning

Sustainable Energy System

Energy Business Creation

Energy Technology Innovation Architecture

Supply Side Program

Demand Side Program

Black-Swan Program



Target Technology



Supply

Trans.

Demand

Supply Side Program

High Eff. Clean Coal



Safer NPP



Next Gen Fuel



Strategic Res.



Renewable Hybrid/
Offshore Wind



CCUS



Advanced TR/DS



Demand Side Program

Smart Home/BD



Smart FEMS



Smart Micro Grid



Demand Control ESS



Nega-Watt System



Innovative Gen.



Wireless Tr.



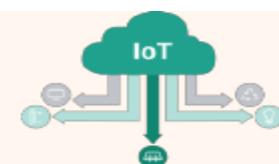
Innovative Conversion/
Storage



3D Printing
Manufacturing



Energy IOT + Big Data

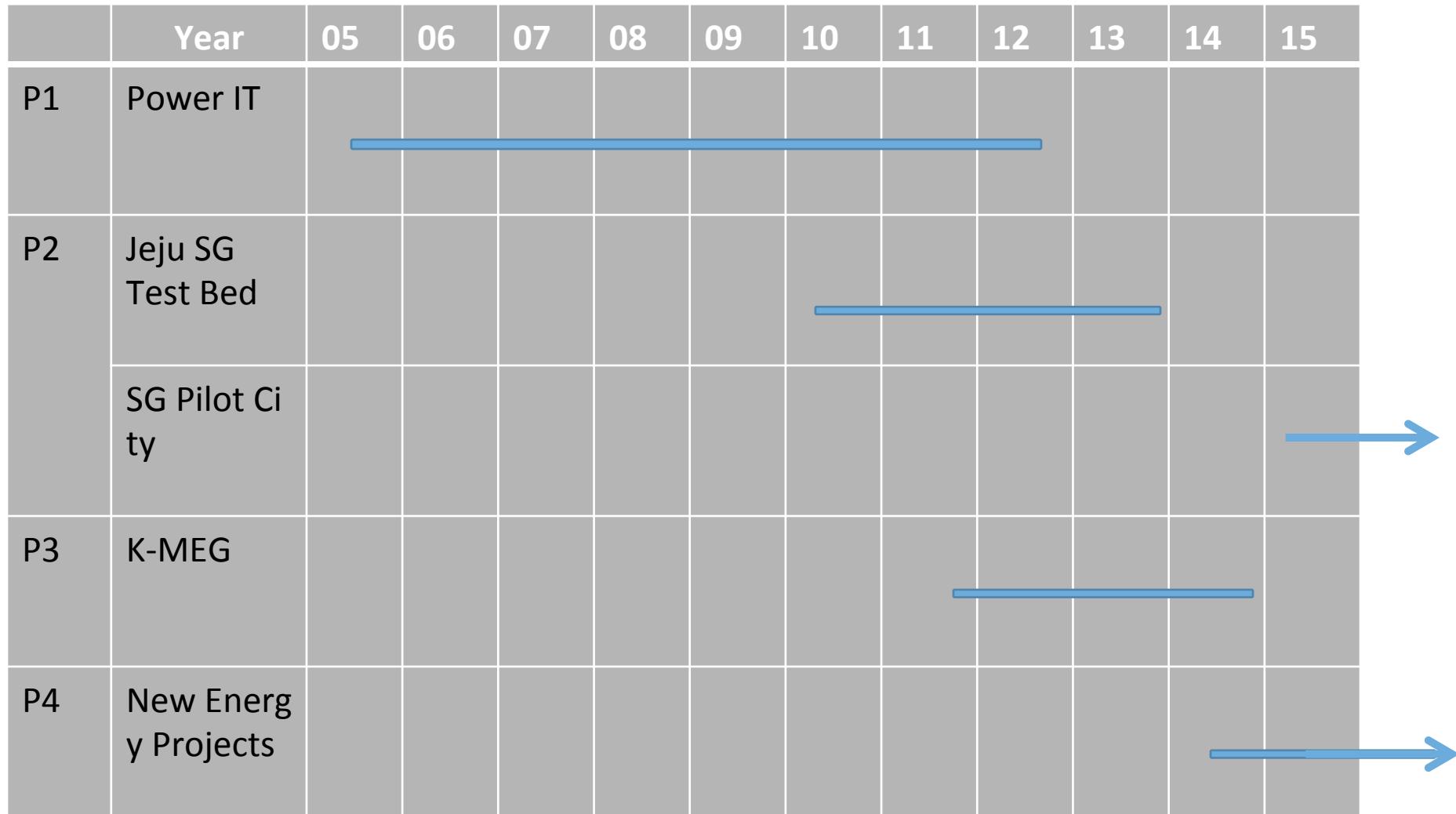


Black Swan Program

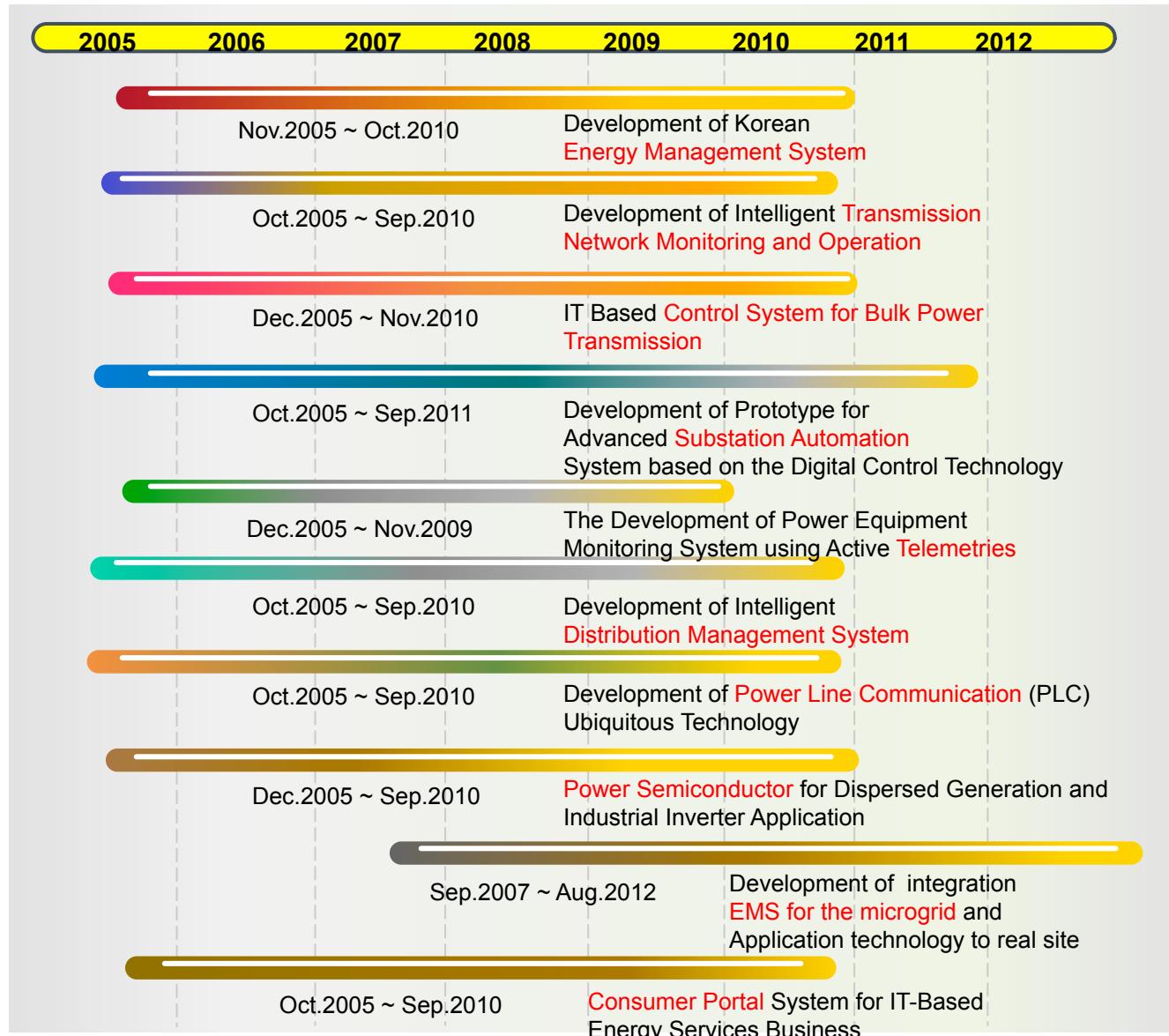


IV. ESI Projects Overview

ESI related Projects



P1 : 10 Power IT Projects



Technology
Development
Integrating
Electric Power
And
ICT

Goal

Integration and Verification of SG technologies

Duration

Dec, 2009 ~ May, 2013 (42 months)

Budgets

About 240 million dollars

Scale

2 Substations, 4 Distribution Lines,
Around 6,000 Households



5 sub-projects of Smart Grid

Smart Power Grid

- Real-time monitoring & control for intelligent T&D power system

Smart Customer

- Enhancing energy efficiency through demand response
- Two-way information exchange between consumers and suppliers

Smart Transportation

- EV charging infrastructure
- Control center for charging infrastructure

Smart Renewable

- Connection of renewable energy to the grid
- Power quality compensation & stabilization of output

Smart Elec. Service

- Development of various tariffs and service models

Technology Verification



AMI, EMS, Smart Appliance

- Real-time information exchange between consumers and suppliers that optimizes electricity supply and demand through technology development and trial operation

AMI, EMS, Smart Appliances



EV Charging Infrastructure

- Development of quick and standard charging service and delivery of various services for the electric vehicle infrastructure communication

EV Charging, V2G



Energy Storage System

- Conjunction with distributed generation, develop a management technology and discharge and charging technology for high-capacity battery charge that have different capacity and usage

Microgrid, ESS,



Grid Integration Technology

- Connecting Microgrid, electric car battery to the power grid and allow electricity to transmit both ways
- Transmission, Distribution Technology Development



Demand Response

- Depending on the changes of the electricity rates in real-time consumption, test a system that consumers are able to induce and adjust the electricity consumption freely

DR price market

Overview

Program	: Korea-Micro Energy Grid (K-MEG)
Administration	: Ministry of Trade, Industry & Energy (MOTIE)
Program Leader	: Samsung C&T
Participants	: About 80 members
Program Budget	: Approx. 80 mil. USD
Program Period	: Jul. 2011 ~ Sep. 2014

Objectives

Development of Advanced Energy Solutions & Business Models

Implementing	ICT	EMS (BEMS)
	Smart Grid Technologies	DER & Various Energy Resources
	Building Automation	Renewables
	Demand Response	Cyber Security, etc.

- Fitted for building(s), building complexes, communities, cities, off-sites
- Up to 30% energy efficiency improvement (savings)

Custom Modeling w/ Micro Energy Block (MEB)

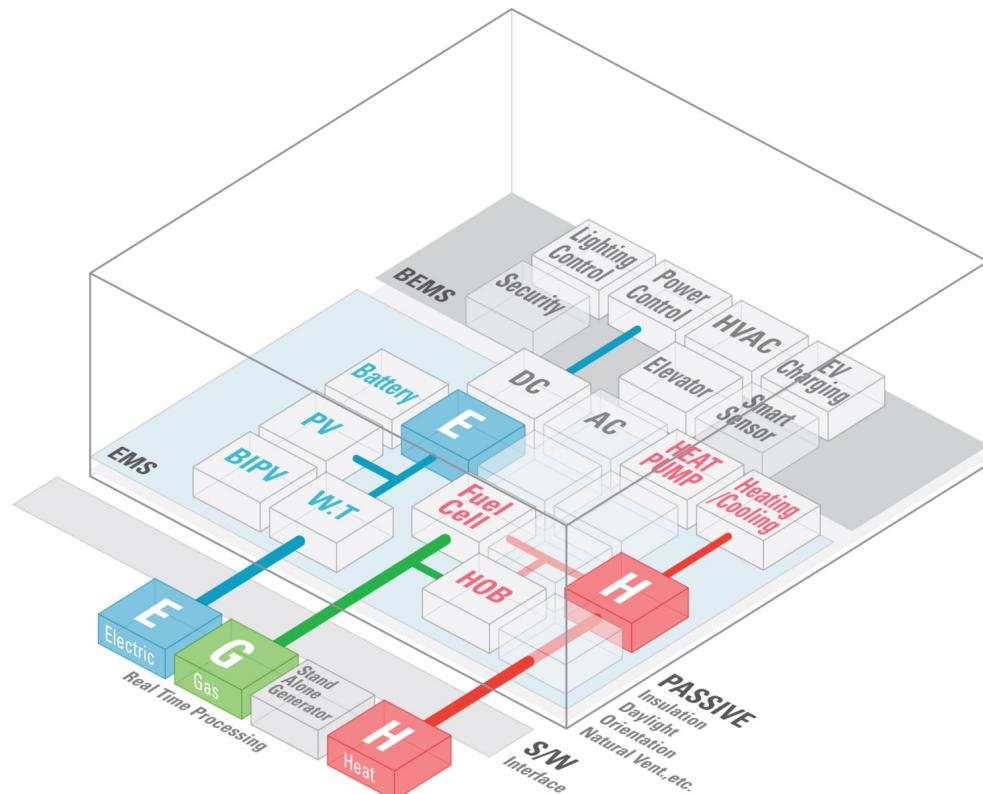
- ICT-based Energy Management/Operation
- Optimizing Energy Supply & Consumption

Operated on MEG OS

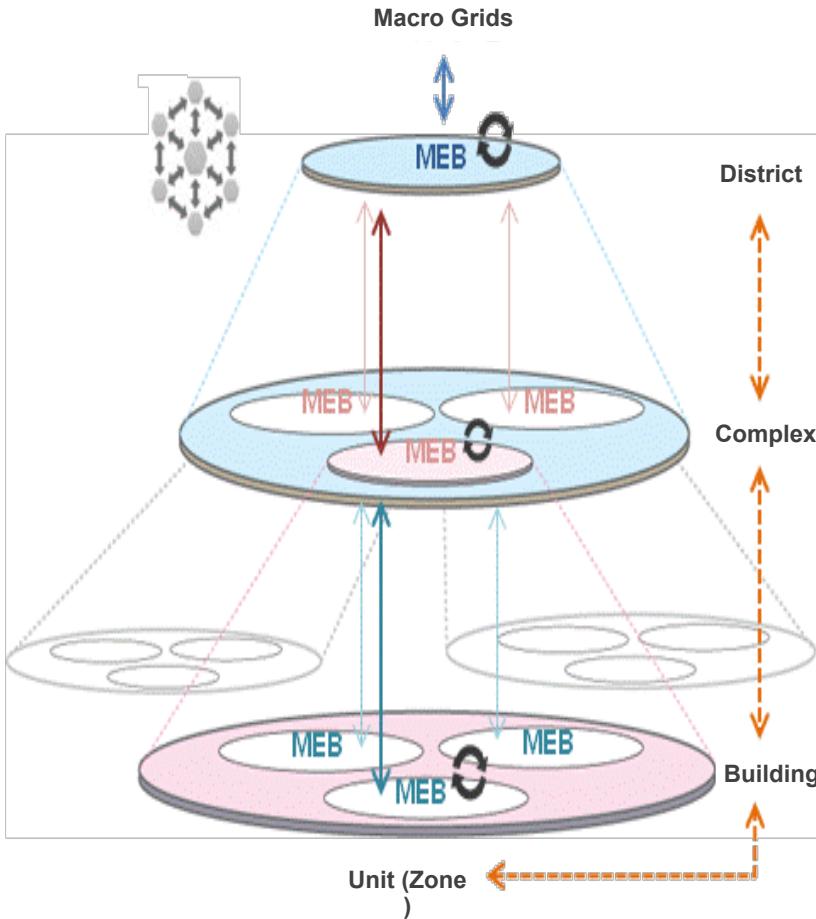
- Big Data Management

Features:

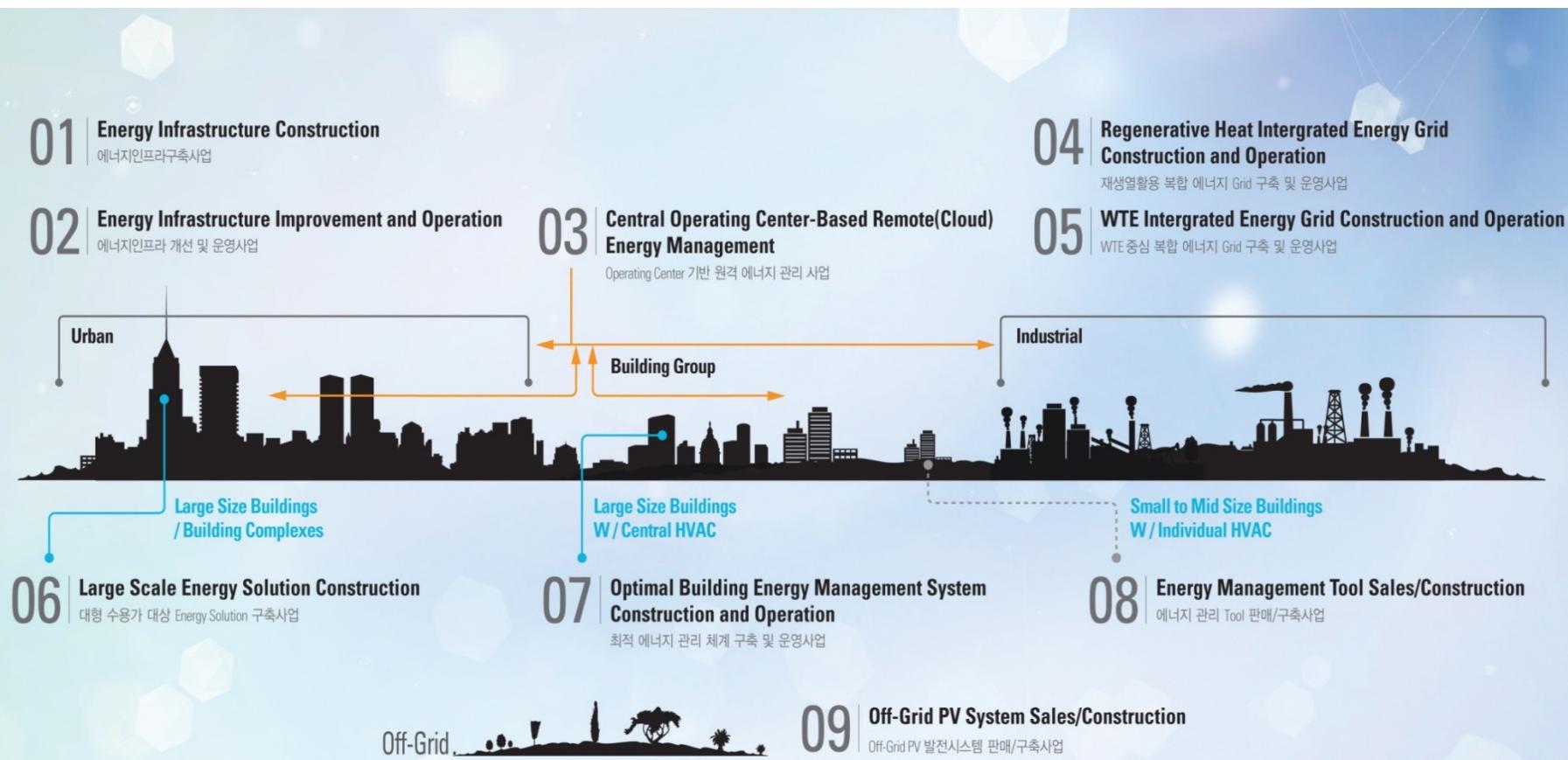
- Open Interface
(Plug & Play, Interoperable)
- Autonomous
- Self-aware
- Self-diagnostic
- Reactive/Proactive
- Hierarchical
- Scalable



K-MEG Concept



9 MEG Biz Models

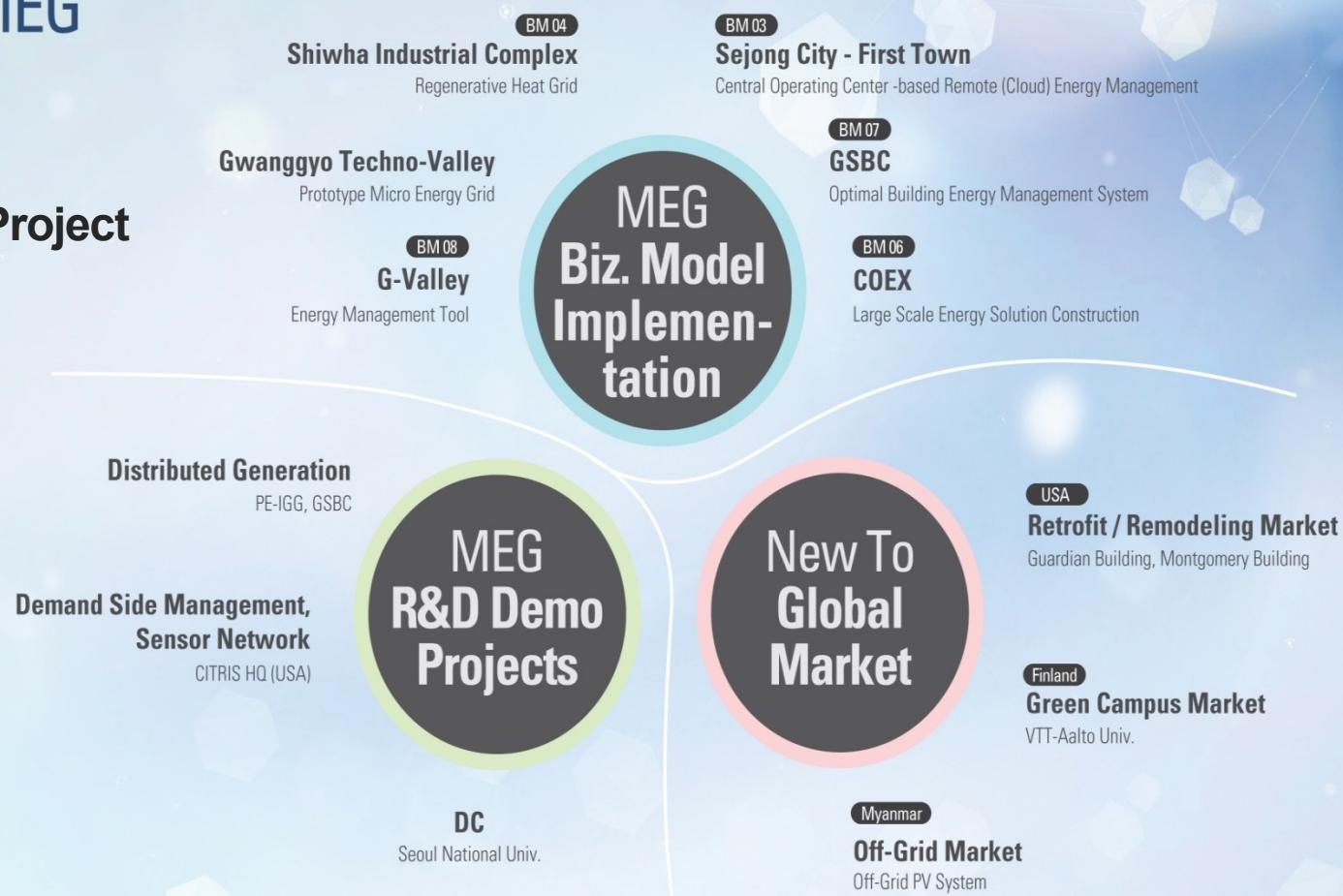


MEG Global Initiative

Global K-MEG Projects

12 Initiative Project s

- 7 Domestic
- 5 Overseas

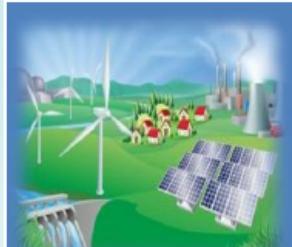


P-4 : New Energy Projects



P-4-1 : Off Grid Island

In Operation



Gapa Island

Area/
Population

0.85km² / 281

Customers

193

Configuration

WT+PV+ESS+AMI

Feature

Carbon Free
Island
(Korea's First)

Status

Operating

On the Way



Deokjeok Island

22.97km² / 1,919

1,000

WT+ PV+ ESS + EMS
+ Geotherm

Ecology Energy
Independent Island
(Stabilization, Optimization)



Ulleung Island

72.9km² / 10,673

7,932

WT + PV+ Hydro +
Geotherm + ESS + EMS

Green Energy
Independence Island
(Economic feasibility
+ Supply reliability)

Planning

P-4 : New Energy Projects



P-4-2 : Distribution MG

- Smart DMS field operation : Grid connected 6 islands nearby An-Jwa
 - Field test period : 2012.10~2015.09
 - 2012.10~2014.12 : Construction of field test site
 - 2015.01~2015.09 : Field test and obtain track records

①RT Analysis and Optimization

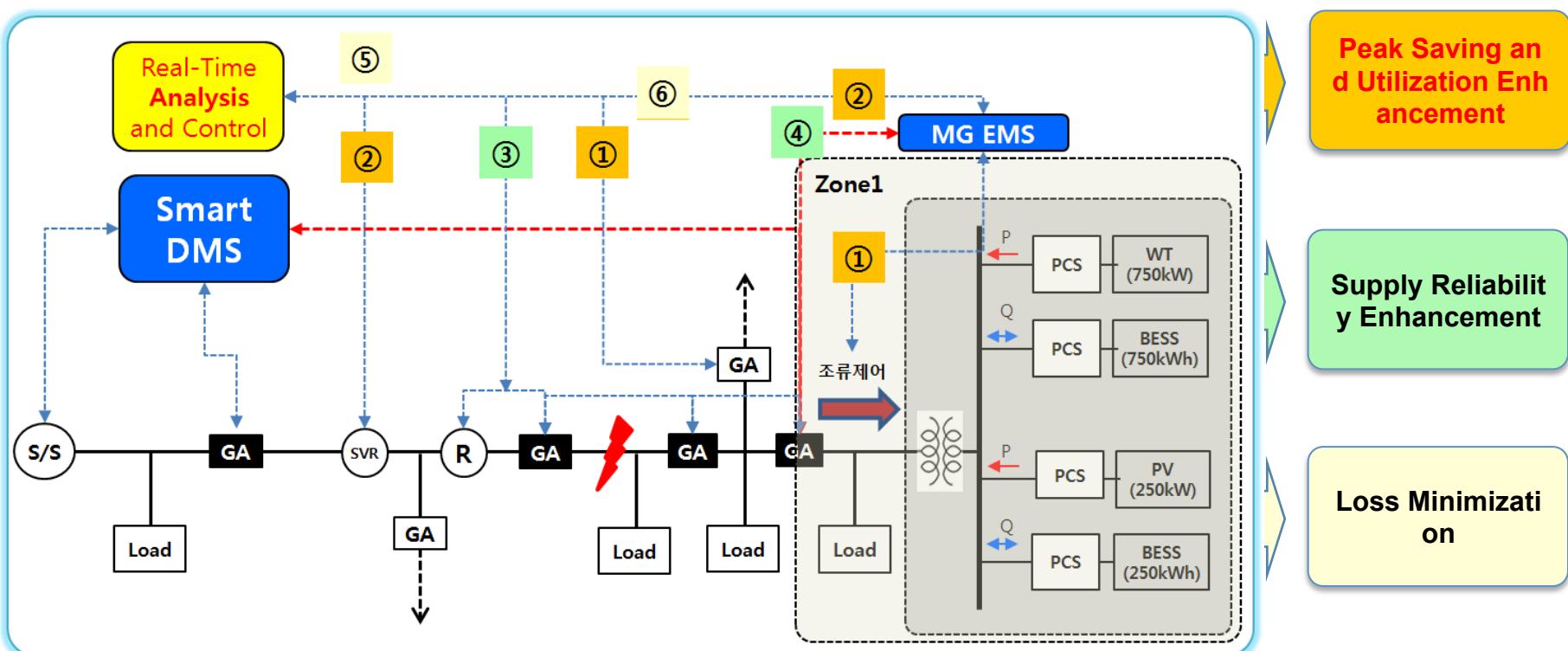
③Self Healing and Restoration

⑤CVR(Conservative VR)

②Control between DMS/ MG

④MG Independence Operation

⑥Optimal Load Arrangement



P-4-3 : Overseas MG

- Project Title
 - Distribution Microgrid in Penetan.
- Period : Mar.2015~Feb.2017
- Budget : 3.8 million\$
- Partner : KEPCO, Power Stream
- Target area: [Ontario, Canada](#)
- Research Contents
 - Development of **Distribution MG** for North America
 - Installation & Field Test
- Expected Effect
 - **MOA for 10Million\$ export(July)**
 - PR of KEPCO's technology

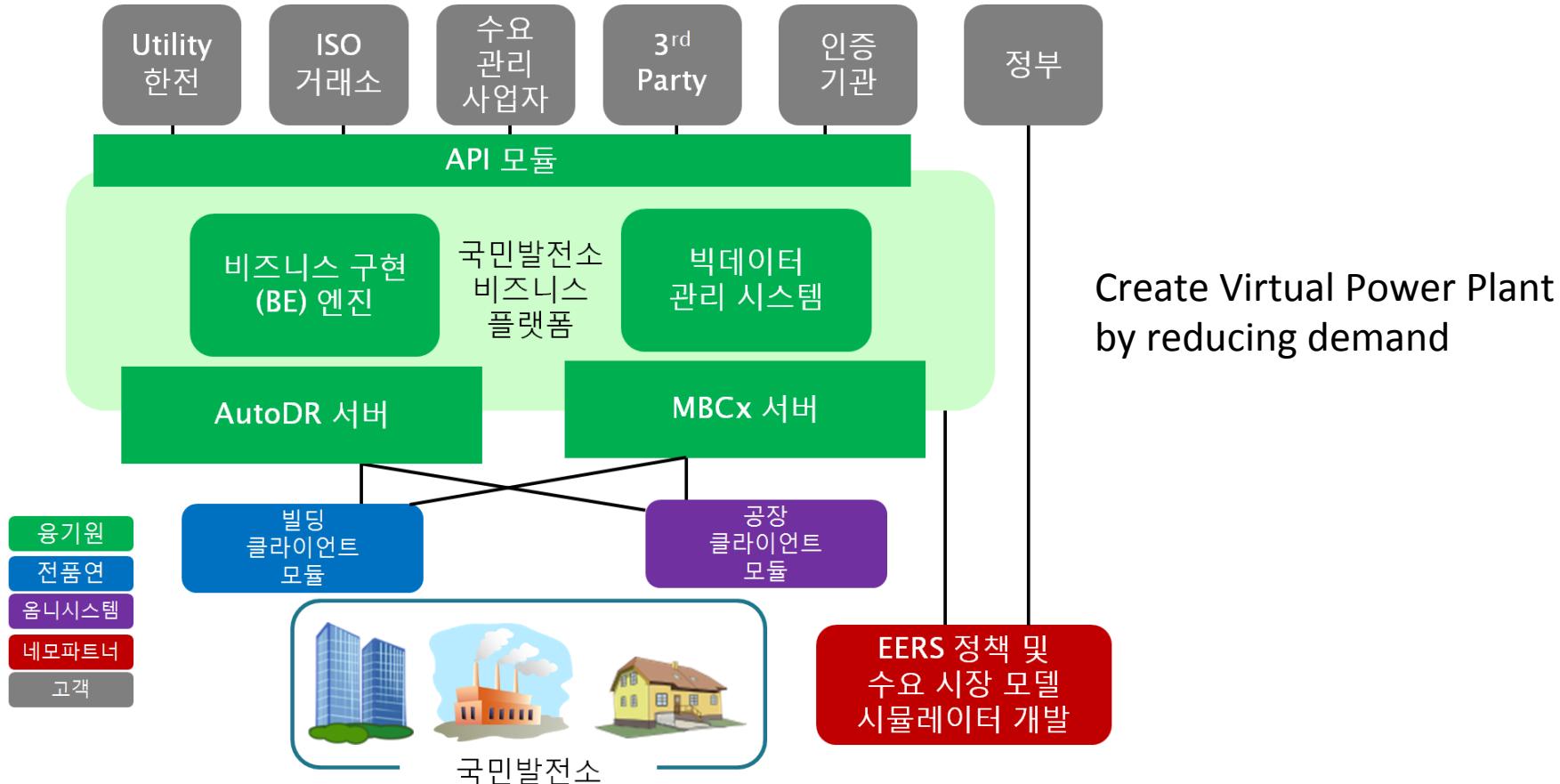


P-4-3 : Overseas MG

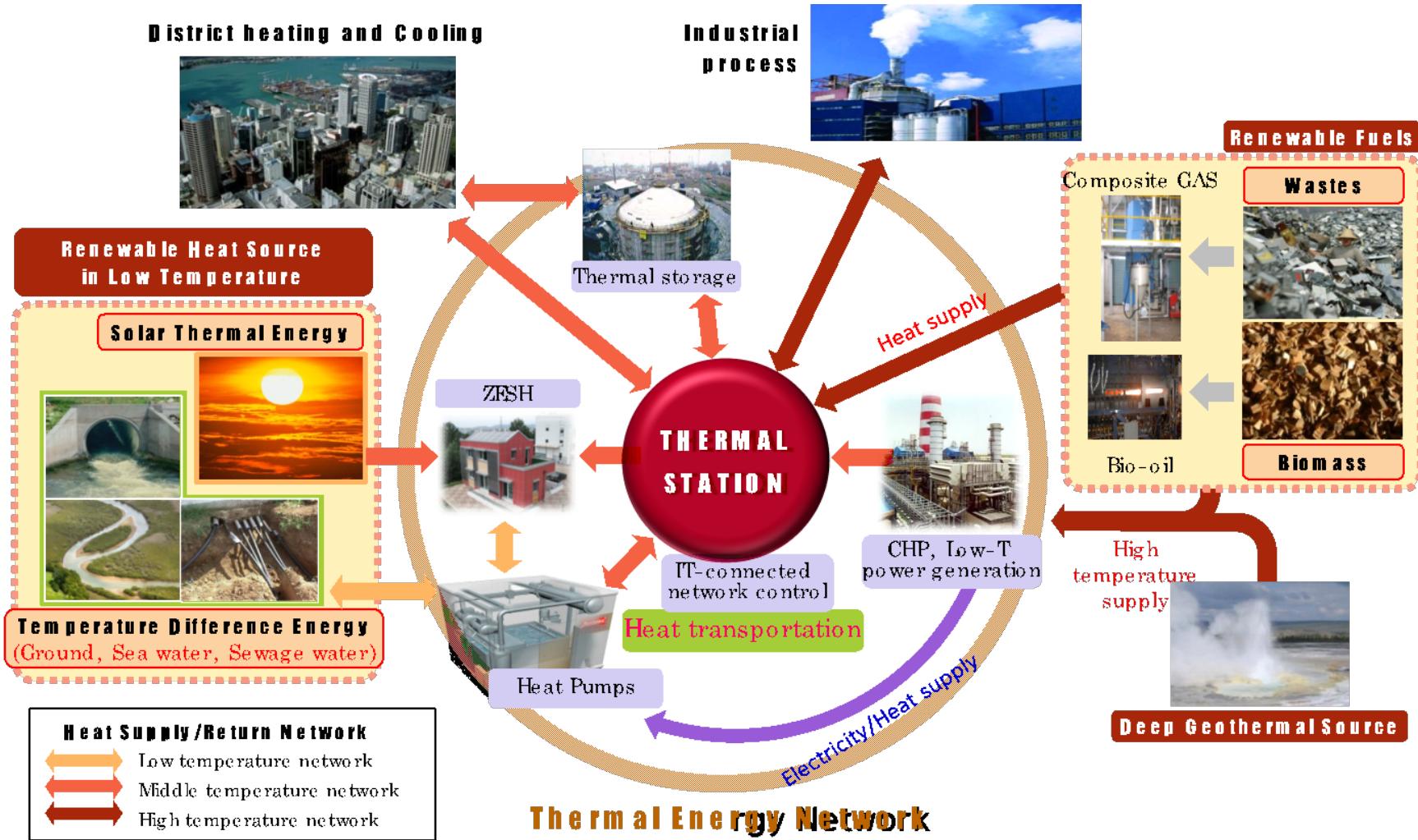
- Project Title
 - Rural Electrification in Africa
- Period : Dec.2014~Nov.2015
- Budget : 1.3 million\$
- Partner : KEPCO, Uam Corp.
- Target area: [Mozambique, Africa](#)
- Research Contents
 - Development of [Electrification MG](#) for Africa
 - Installation & Field Test
- Expected Effect
 - [Find a market for Africa area](#)
 - PR of KEPCO's technology



P-4-4 : Virtual Power Plant



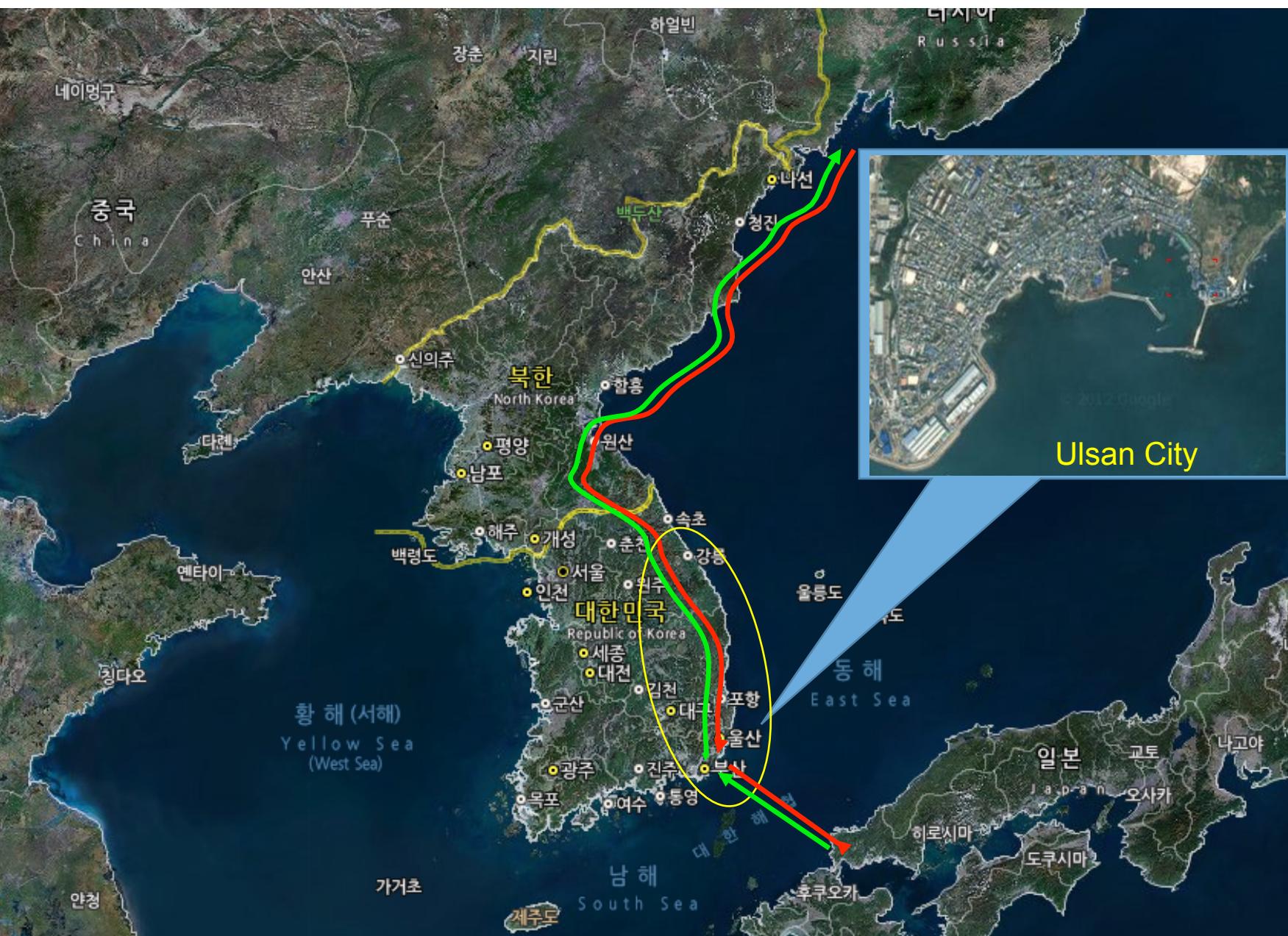
P-4 : Thermal Network (Planning)



P-4 : Ulsan Energy Hub (Planning)



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P-4 : Ulsan Energy Hub (Planning)



Thank You 감사합니다



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