KEPCO's SG Biz Case and Micro Grid Project in Ulleung

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I Status and Background

1. KEPCO in Brief

Government

(51%)

KEPCO

(1USD=1,100KRW)

Total Assets	$133 billion
Revenues	$45 billion
Customers	20,475,899
Employees	19,278 persons

(As of Dec.31, 2013)

Generation Capacity & Peak

Year	'12	'13
Capacity (MW)	81,737	86,968
Peak (MW)	75,987	76,522

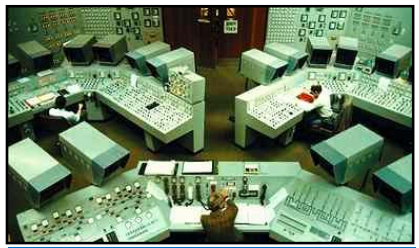
Domestic :
14 District Divisions
233 Branch Offices

Generation

84%

Transmission

100%



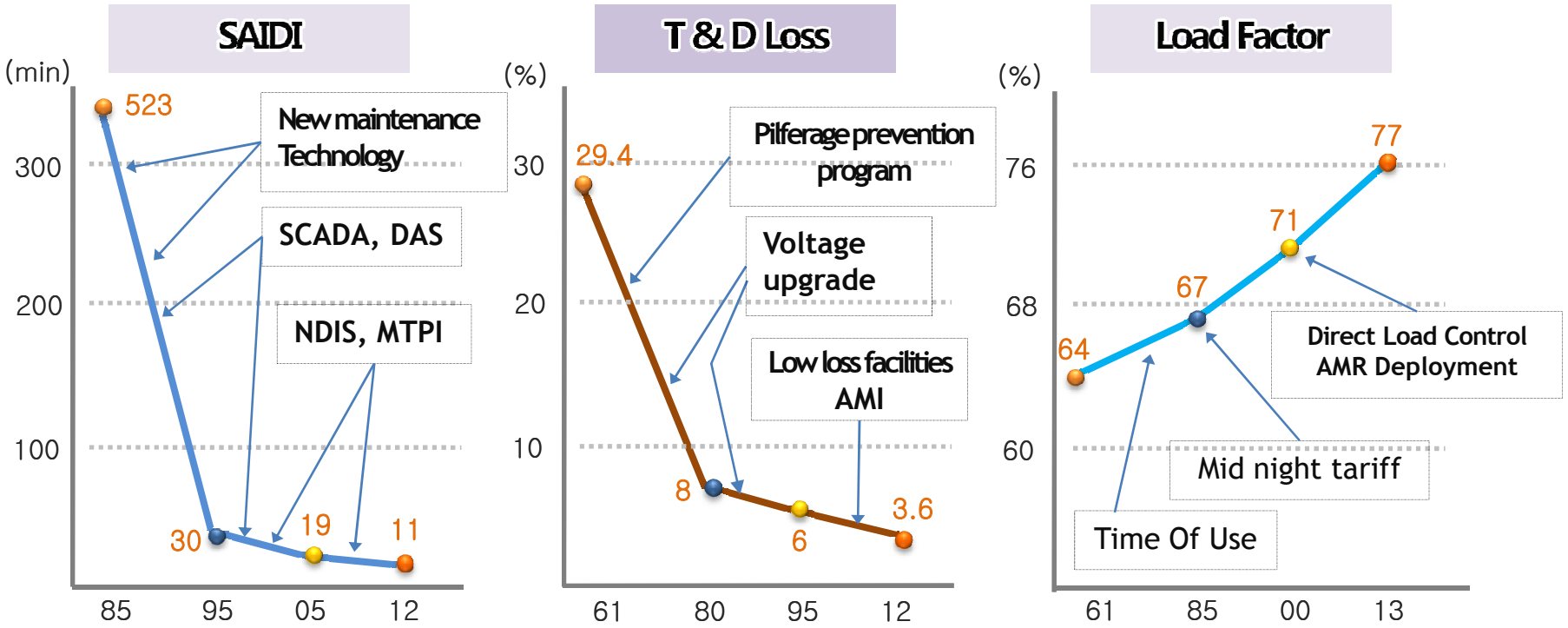
Distribution

100%

Power Sales

2. Status of KPI

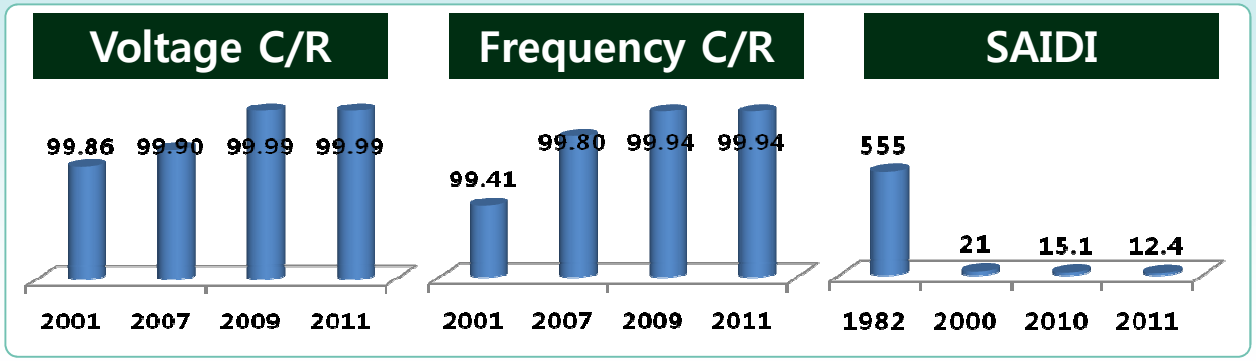
The Key Performances of KEPCO



☞ SAIDI : System Average Interruption Duration Index
NDIS : New Distribution Information System
MTPI : Maintenance Technology without Power Interruption

3. Power Quality and Operation System

Power Quality Improvement Saturation



Cost increasing compared to the effects of power quality improvement

Limits of Power Systems Interconnection

Operating by Separated System

SCADA

- Monitoring transmission line
- Substation equipment monitoring, protection, control

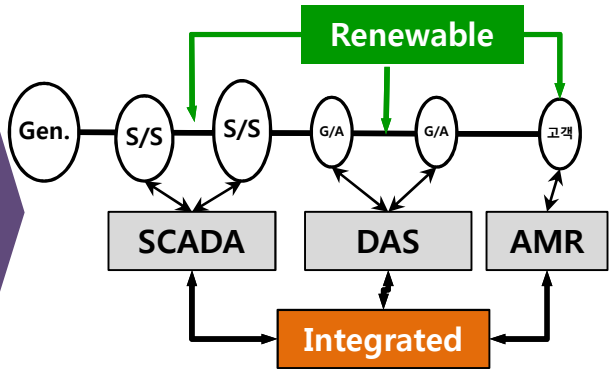
DAS

- Monitoring distribution, remote control
- Voltage management,
- protective coordination

AMR

- Automation Meter Reading
- Measurements of customer voltage

- Increasing renewable sources
- Power equipment deterioration
- Difficulty to expansion
- Necessity of integrated system

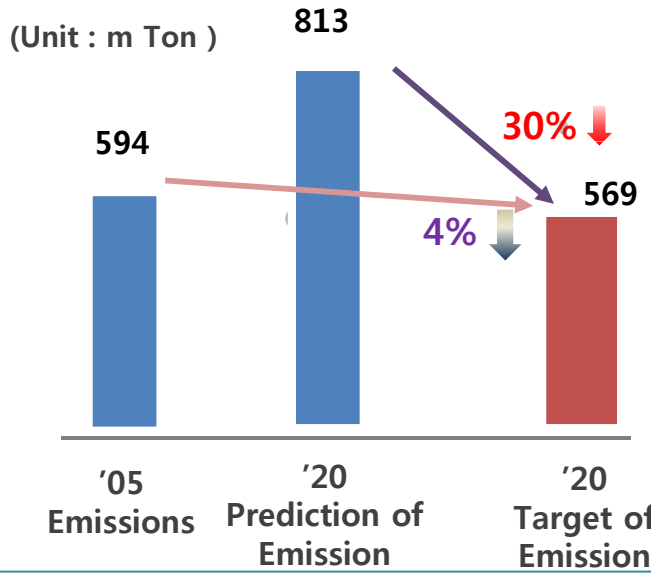


4. Changes of Power Industry in Korea

Carbon Dioxide Emission Reduction & Renewable Energy Expansion

National Target for CO_2 Reduction

- 30% Reduction from CO_2 Emission Prospect by 2020



Increase in Renewable Energy Supply by Introduction of RPS

- Renewable Energy Scale: 2%('12)→10%('22)

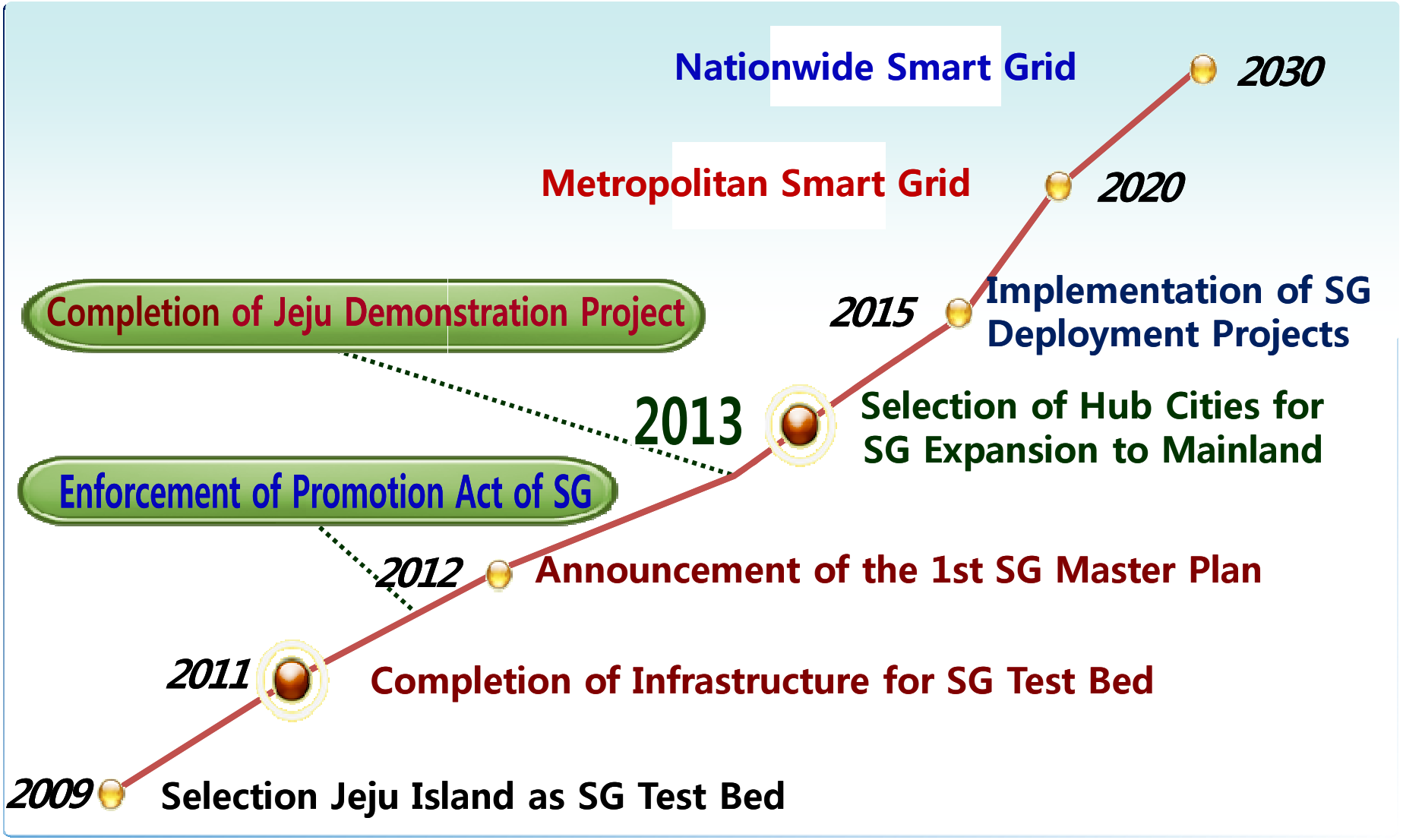
Year	'12	'14	'16	'18	'20	'22
ratio (%)	2.0	3.0	4.0	6.0	8.0	10.0

- Photovoltaic Scale: 200MW('12) → 1,200MW('16)

Year	'12	'13	'14	'15	'16
New (MW)	200	220	240	260	280
Sum (MW)	200	420	660	920	1,200

• RPS (Renewable Portfolio Standard) : Energy providers must supply and sell a certain percentage of produced energy by renewable energy, since 2012

5. National Smart Grid Road Map



II Incubating SG Biz Models

SG Demonstration Projects in Jeju

Goal	To Develop Smart Grid into the Business Model and the Export-Oriented Industry
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 & stablization of output
Smart Elec. Service	· Development of various tariffs and service models

Results & Business Model

- Development & Test of 153 Technologies including AMI, EMS, Charging Infra, ESS
- Development of 9 Business Models including DR Management, EV charging Service (45 detailed models)

Smart Power Grid Devices	Smart Sensors, IED, Plug and play type Monitoring Device for DG, including next Generation Tech. of Power Grid	
ESS	Conjunction with DG, Development of Management Technology for Large Scale Battery	
EMS	Monitoring the Energy Flow and Verify a Optimal Control Technology	
EV Charging	Development of Quick ·Slow Charger & Making EV Communication Infrastructure	
AMI	Demand Response by Real-time Communication	
Grid Integration Technology	Connecting Micro-grid, Renewable, Electric Car Battery to the Power Grid and Allow Electricity to Transmit both Ways	

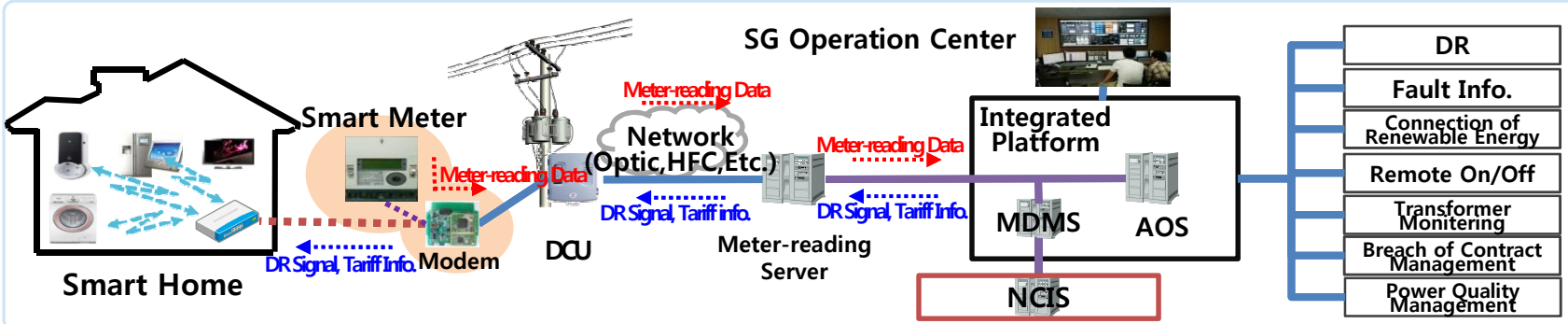
III Implementing SG Biz Models

1. AMI (Advanced Metering Infrastructure)

Key Performances

- **Controlling** Power Demand through sending Demand Response signal by Bidirectional Communication Network
- **Supporting** Utility's Businesses Such as Marketing and Distribution Area

Configuration



Installation Plan (Budget $1,562 million)

Item	'13	'14	'15	'16	'17	'18	'19	'20
Installation (10 thousand unit)	200	230	250	257	250	250	330	364
Cumulative Installation (10 thousand unit)	263	493	743	1,000	1,250	1,500	1,830	2,194

2. SGIOS and EV Sharing

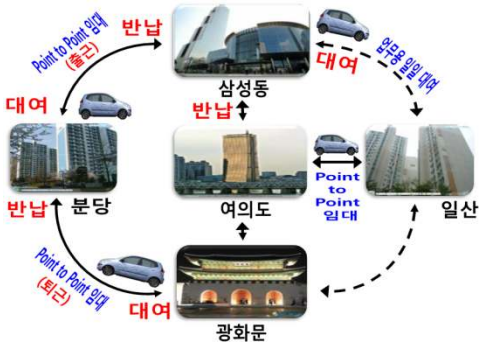
SG Integration Operation System

- Goal : Providing Information and Business Support using SPG Data
- Duration : '11.5 ~ '14.4 (36months)
- Budget : $15.5 million
- Main Development Contents
  - Building of Global Standard(CIM) based SG Total Platform
  - Development of Operation System that can Analyze, Adjust & Plan Transmission/ Substation/Distribution/NCIS

※ Demonstration at JeonNam ('13.10~'14.4)

EV Sharing Pilot Project

- Goal : Development of EV Sharing Business Model and Securing of Operation Technique
- Duration : '11.12 ~ '14.7
- Budget : $4.5million (Government $2.6M, KEPCO $1.2M & Etc.)
- Area : Seoul, Bundang, Ilsan
- Scale : EV 20EA, Charger 18 Unit



3. SG Station for Smart City

A New Business Model Built on Smart Grid Technology Test Bed in Jeju

Energy Management focusing on each item	→	Integrated and Optimized Energy Management

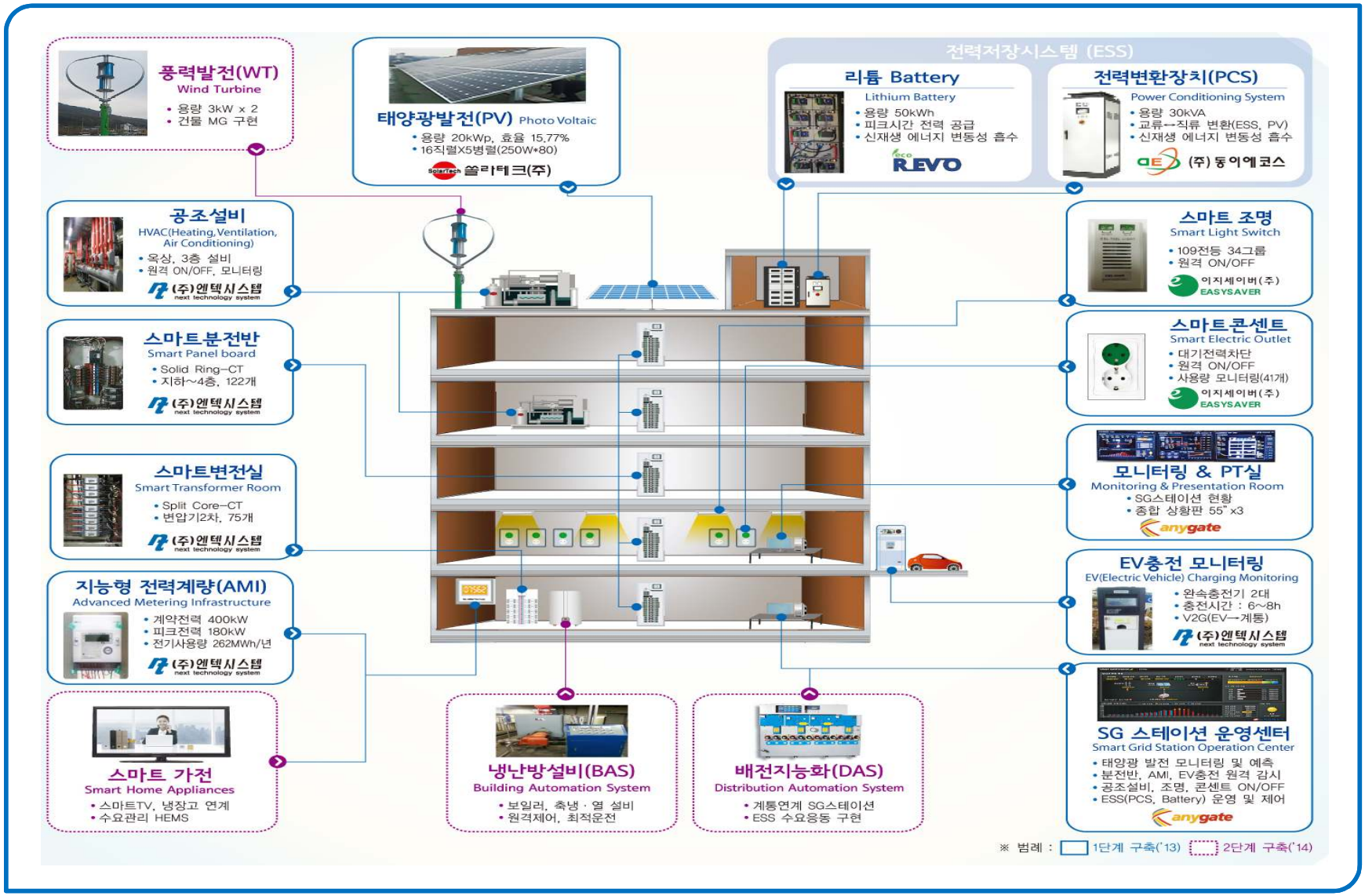
Project Pilot Project of the Smart Grid Station

Period Oct. 25, 2013 ~ Dec. 23, 2013 (60 days)

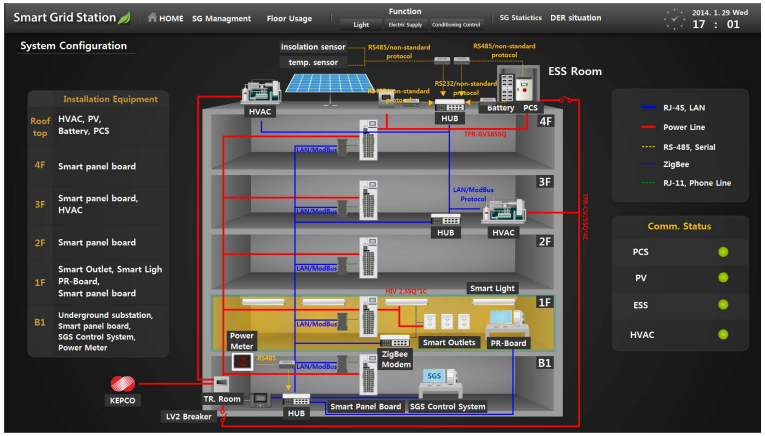
Subject Trial Application to KEPCO's Guri-Namyangju District Head Office Building

Goal Optimized Energy Management of Smart Grid-Based Building

Layout of Smart Grid Station

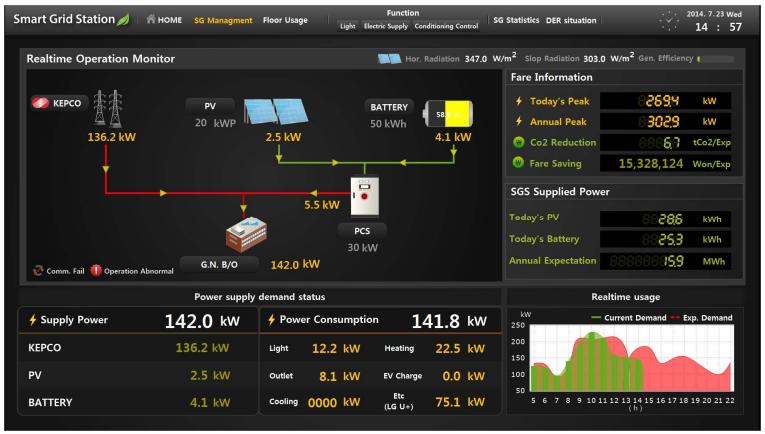


SGS Operation System



System Configuration

Power Demand Control



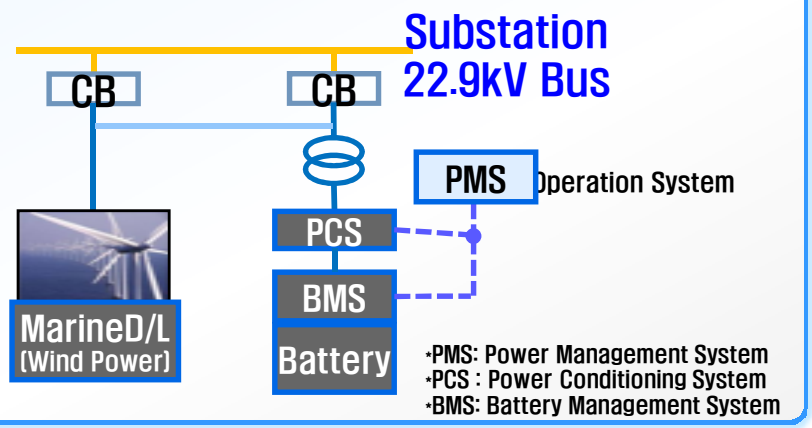
Realtime Operation Monitor

Analysis & Record

4. ESS Management Technology

Key Functions	Demand Mgt., Load Leveling, Stabilization of Renewable Energy
Scale	4MW/8MWh Li-ion Battery
Duration /Budget	2011. 7 ~ 2014. 6(3 years) / $24.1 million
Partners	KEPCO, Samsung SDI, Hyosung, KPX, Etc.
Location	Jeju 154kV Jocheon Substation (Currently in Operation)

Configuration



Image

5. ESS for F/R – Pilot Project

Installation Sites

	Site #1 Seo-Anseong S/S	Site #2 Shin-Yongin S/S	Total
Installed Capacity (MW)	28	24	52
Participating Companies	PCS : 2 Battery : 2	PCS : 2 Battery : 1	7

Locations

345kV Seo-Anseong S/S (28MW)

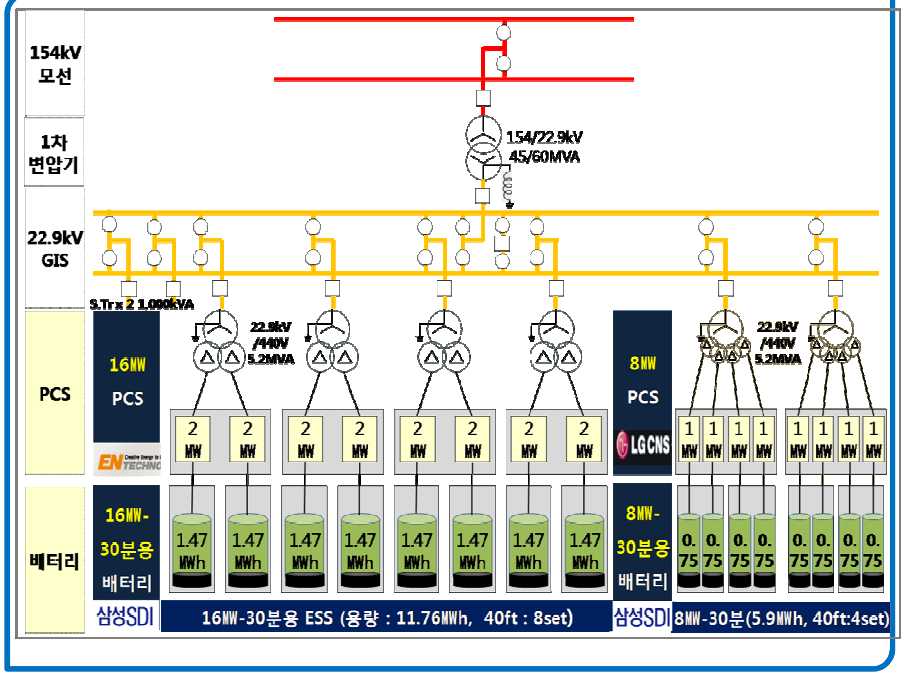
345kV Shin-Yongin S/S (24MW)

5. ESS for F/R – Pilot Project

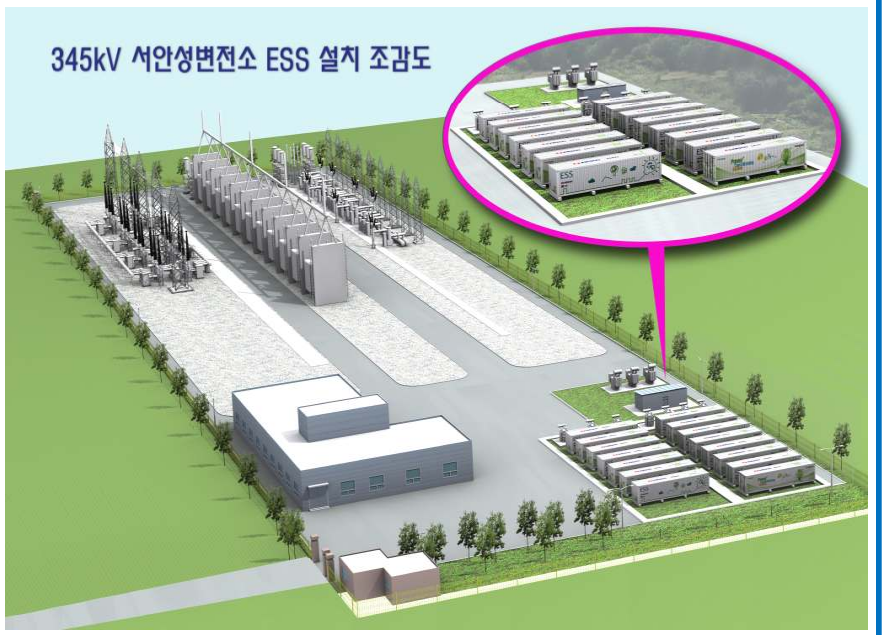
Schedule

Sep. '14	Sep. ~ Nov. '14	Nov. ~ Dec. '14	Jan. '15~Jun
Start Construction	Installing Grid Connected Facility(M.Tr, CB)	Installation ESS	Test & Operation

Components



Bird-Eye's view



6. MG System for Isolated Island

- **Target**

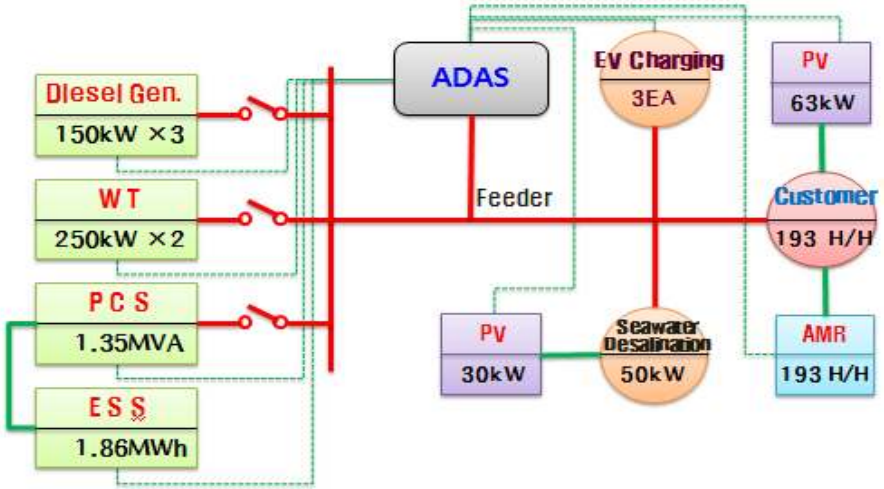
  Replacement Diesel Generation

  to Renewable Energy and Smart grid

- **Duration** : Nov. 2011 ~ Oct. 2013 (2years)
- **Partners**

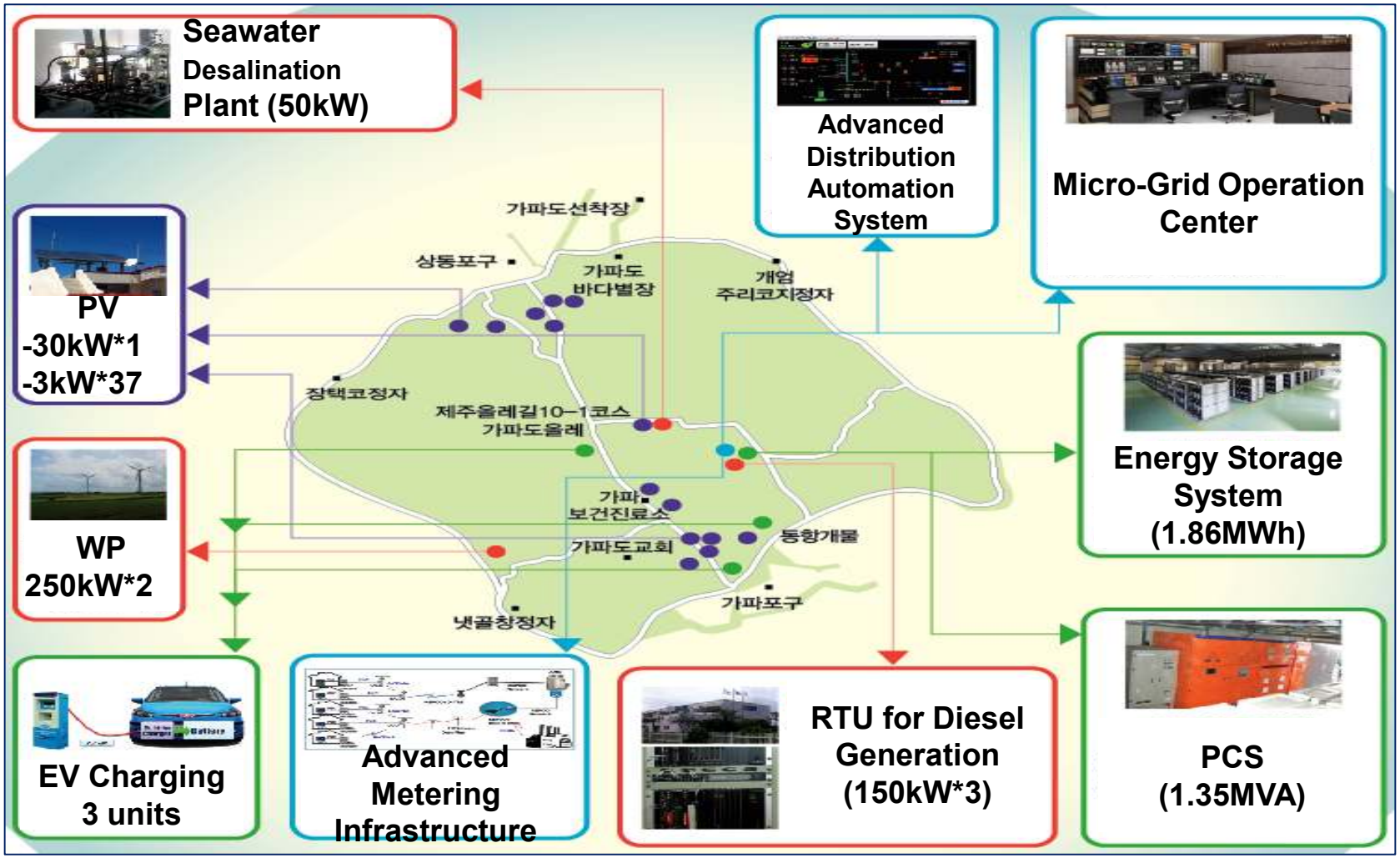
  KEPCO, Jeju, KOSPO, Woojin, Shin-kobe co.

- **Location** : Gapa Island in Jeju
- **Configuration**



6. MG System for Isolated Island

Components



Ⅳ MG Project in Ulleung Island

1. Status of KEPCO's Micro Grid Project

	In Operation	On the Way	
			
	Gapa Island	Deokjeok Island	Ulleung Island
Area/ Population	0.85km^2 / 281	22.97km^2 / 1,919	72.9km^2 / 10,673
Customers	193	1,000	7,932
Configuration	WT+PV+ESS+AMI	WT+ PV+ ESS + EMS + Geotherm	WT + PV+ Hydro + Geotherm + ESS + EMS
Feature	Carbon Free Island (Korea's First)	Ecology Energy Independent Island (Stailization, Optimization)	Green Energy Independence Island (Economic feasibility + Supply reliability)
Status	Operating	Project Started	Planning

2. Overview of Ulleung Island

General

Area	Population	Customers	Main Industry
72.9㎢	10,673	7,392 *	Agriculture, Fishery, and Tourism

* General(58.3%), Residential(17.6%), Industrial(11.5%)

Tourism Demand

· 415,000('12), 450,000('13) ➡ 745,000('30), Average Annual Increase 3.3 %

Administrative District (28)

Town	Area		Village
	km²	(%)	
North	24.30	33.4	9
West	27.20	37.3	8
Ulleung	21.39	29.3	11
Total	72.89	100	25

3. Power Facilities of Ulleung Island

Power Plants

Namyang Diesel (10,500kW)

Chusan Hydro (700kW)

Jeudong Diesel (8,000kW)

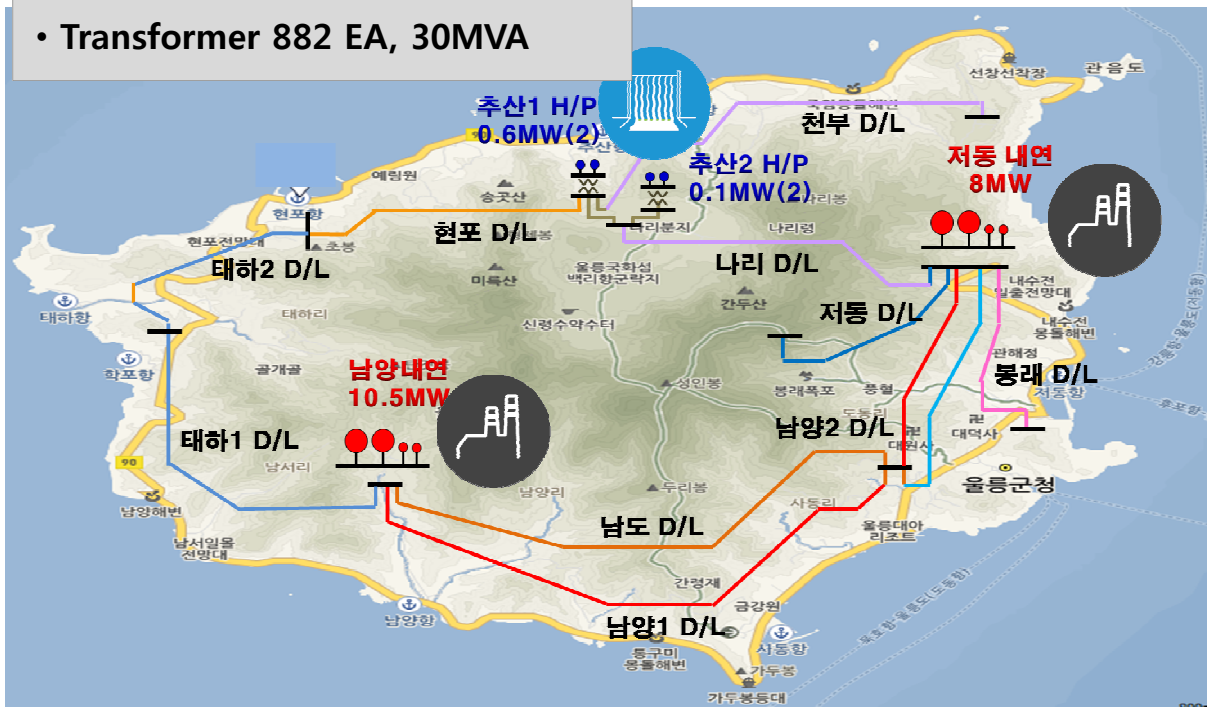
PV (217kW)

※ PV is installed on the 21 customer's house roof-top (not connected to grid)

Contents		Capacity (kW)	Ratio (%)
Diesel	Nam Yang	10,500	54%
	Jeo Dong	8,000	41%
Renewables	Hydro	700	4%
	PV	217	1%
Total		19,417	100%

Distribution Facilities

- Distribution Grid : 10 D/L 124km
- Transformer 882 EA, 30MVA



Power Load Status('13)

Capacity	Max	Average	Min
19.4 MW	10.9 MW	7.1 MW	4.9 MW

Operating Margin('13) : 19 million $ Deficit

4. Main Issue of Ulleung Island

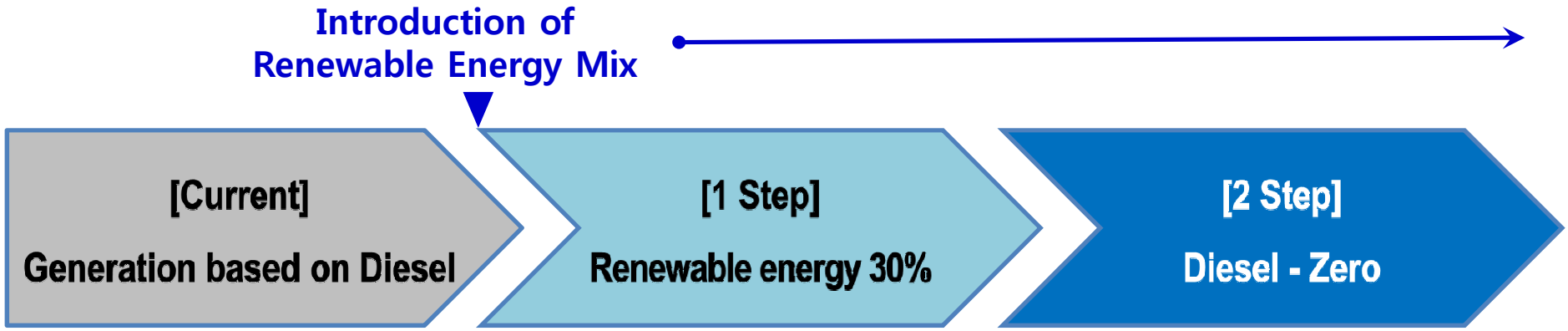
- **Increasing Power Consumption by Tourists**
  - · Tourists Explore Ulleung Island
  - · 450,000 Tourists in 2013 and 700,000 Tourists are expected in 2030
  - · Need to Construct Large Scale Accommodations with Supporting Facilities
- **Payment of the High Cost to Produce Electricity by Diesel Plant**
  - · Lower Sales Price than Production Cost
  - · Annual Amount of Deficits : 19 Million Dollars (‘13.12)
  - · Sharp Increase of Generation Cost According to International Oil Price
- **Environmental Pollution and Increasing CO_2 Emission**
  - · Diesel Plant, Automobile, Fishing Vessel’s Gas, Increased Garbage

Diversify Energy Resources into Green Energy

5. Strategy

1. Building Isolated Eco-Friendly Island ➡ Replacement Diesel Generation to Renewable Energy
2. Production of Electricity below Current Generation Cost ➡ Optimization for Energy Mix
3. Increase of Residents' Acceptance through Tourism ➡ Reduction of Environmental Impact
4. Foundation of SPC(Special Purpose Company) ➡ Minimization of Investment Risks
5. Construction Step by Step and Verification of BM ➡ Minimization of Errors

6. Project Target

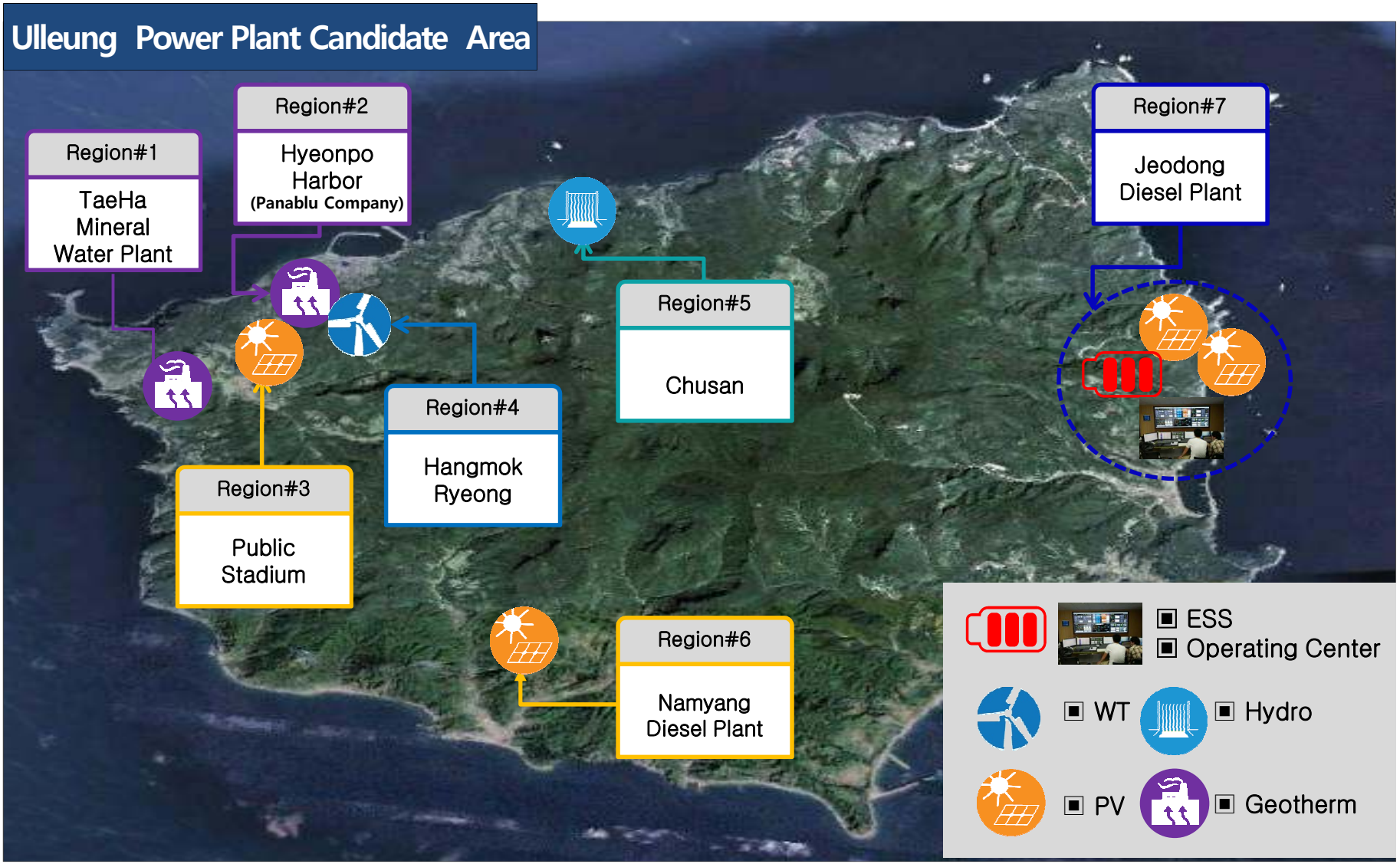


- 2 Diesel Power Plants
  + Fishing Vessel
  + Automobile
- → Emission of Pollutants

- Minimization of Jeodong Diesel Power Generation
- →Renewable Energy 30%
- Green Energy Combined with ICT (ESS+EMS)

- Minimization of Namyang Diesel Power Generation
- →Utilization of Geothermal & Feul Cell
- Mix with Local Infra in harmony
- → Green Energy Island

7. Layout of MG in Ulleung Island

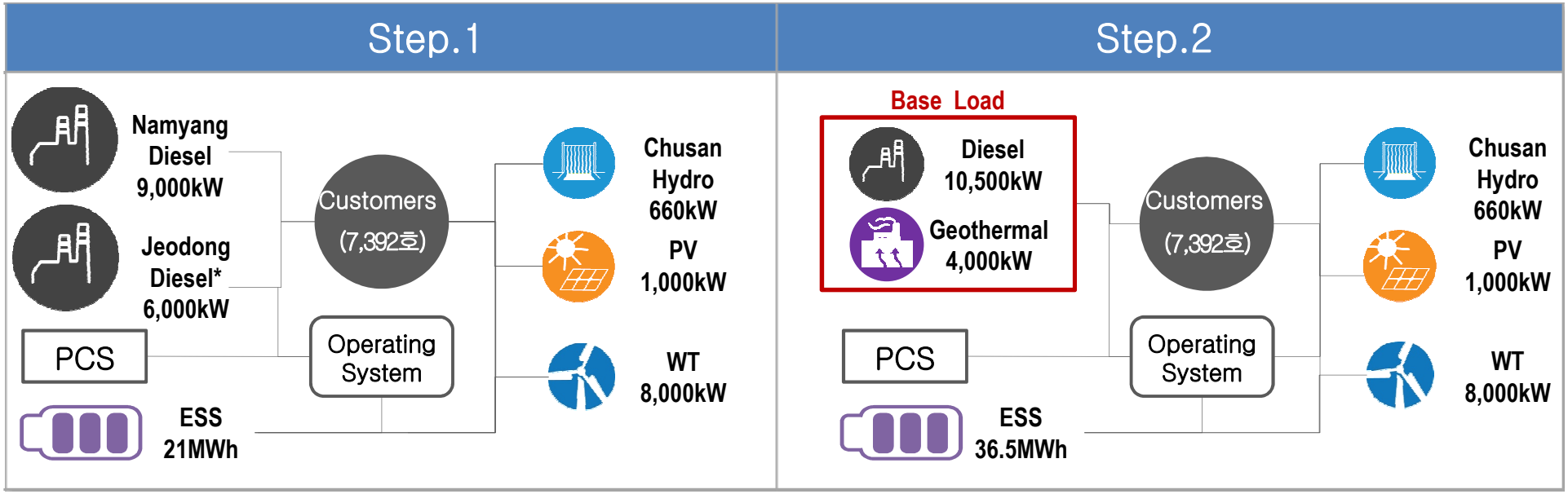


8. Road Map for Ulleung Project

As-Is (MW)	
Diesel	Hydro
18.5	0.7

To-Be(MW) : Step.1 ('15~17) / Step.2 ('18~20)						
Step	Diesel	Hydro	WT	PV	Geothermal	ESS (MWh)
Step. 1	15.2	0.66	8.0	1.0	0	21
Step. 2	10.5	0.66	8.0	1.0	4.0	36.5

- **Step.**2(Diesel Zero) : The power load exceeding average power usage is supplied by the ESS
- Introduction of the fuel cells, geothermal (base load power generation) for district heating, diesel zero



9. Expected Benefit

- Utilization of Renewable Energy for CO_2 Emission Reduction and Prevention of Global Warming Based on Government Policy
- Securing a Future New-Growth-Engine through Integration of Various Technology
- Collaborative Partnership with Small & Medium sized Companies for New Market Creation

THANK YOU FOR YOUR ATTENTION!!

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