

KEPCO's Future Plans of Northeast Asia Supergrid

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1. General Status of KEPCO

KEPCO Group



AT a Glance

KEPCO since 1898

(As of Dec 2013)

Generation

[Installed Capacity]

Total of Nation

86.9GW

KEPCO & 6 GENCOs

71.6GW(83%)

Transmission

Line Length

32,455c-km

Substation Capacity

279,506MVA

Distribution

Line Length

446,113c-km

Assets

USD 140 billion

Sales (2013)

USD 47 billion

Gov. Share

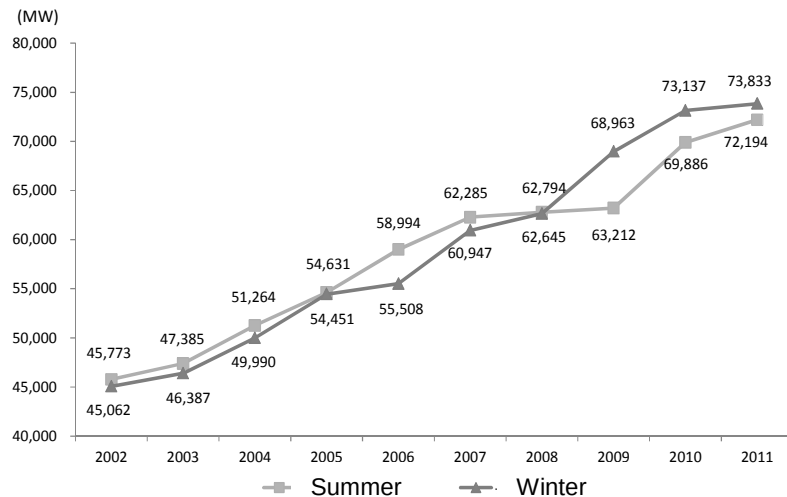
51%

Employees

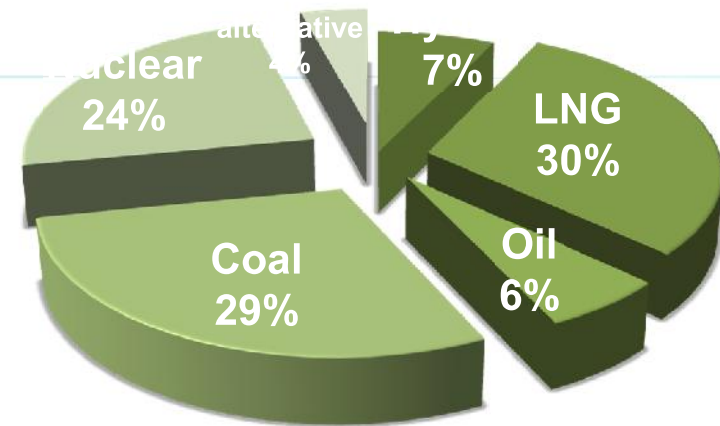
19,278 (person)

Power Supply & Demand of Korea

Peak Demand



Installed Generating Capacity



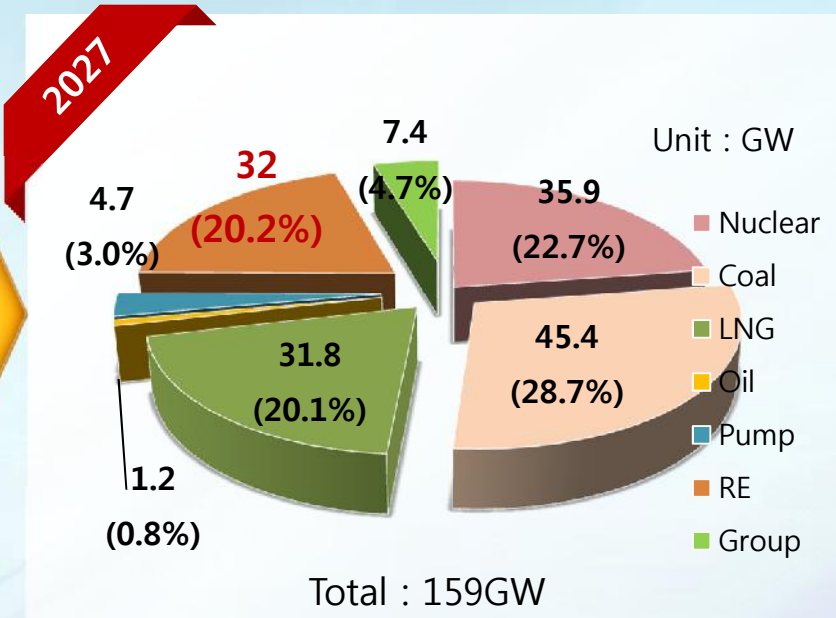
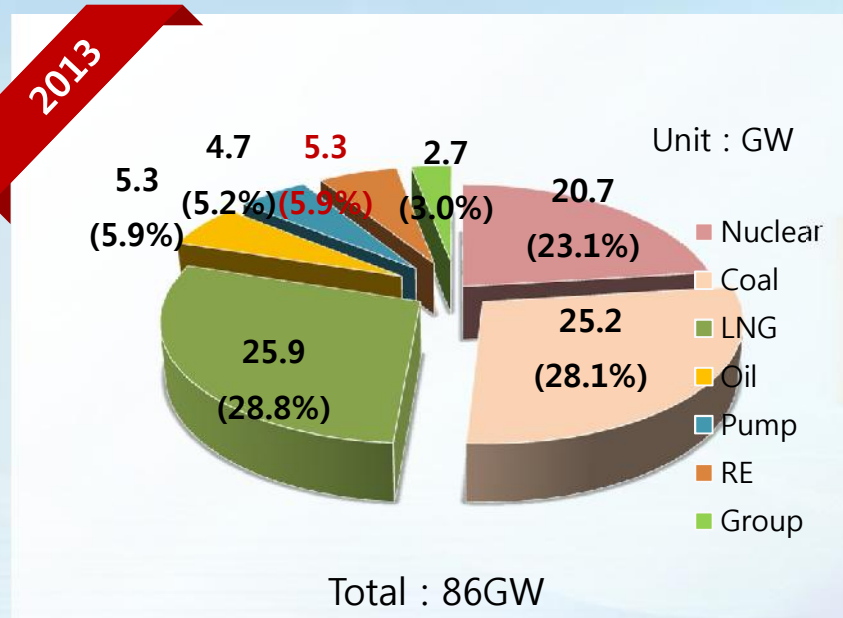
June 2013 Installed Generating Capacity : 86,969MW

- Peak demand occurred in the summer. But, It caused in the winter since 2009
 - Peak Demand of 2013 : 76 GW (Jan 3, 2013)
- Installed generating capacity is 86 GW in Dec 2013
 - Nuclear power and Coal power are responsible for 54% of load as base load

Energy Policy

6th National Long-term Electricity Plan (2013)

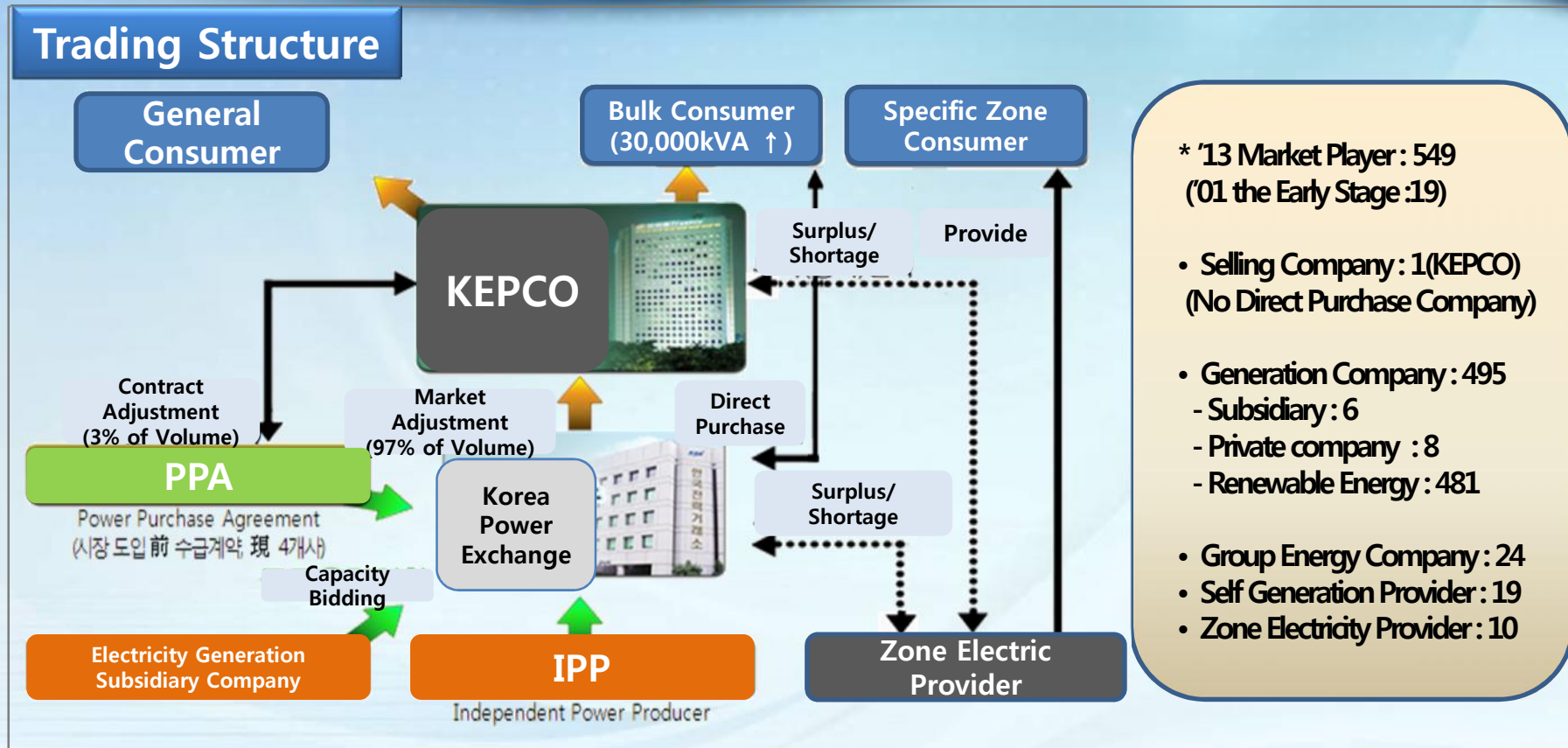
◆ Outlook of Power Source Mix



◆ Key Issues (2027)

- ① Minimize new power plant constructions through active demand management
- ② Maintain at least 22% power reserve ratio
- ③ More than 20% share of renewable in total generation capacity

Korean electricity Market



- **Mandatory Pool** : All transaction should go through the Power Exchange Market
- **Cost Based Pool**
 - Generation Competition Market based on the Generation Variable Cost
 - Supplement CP for inducing New Generation Facility

2. Overview of Supergrid



What is the Super grid?



- ④ Broad continental grid
for high capacity power transmission
- ④ Integration diverse energy sources
including renewable energy
- ④ Power trading between nations
(Peak share → Biz model)
- ④ Advanced grid
to overcome power shortage

Benefits of Super grid

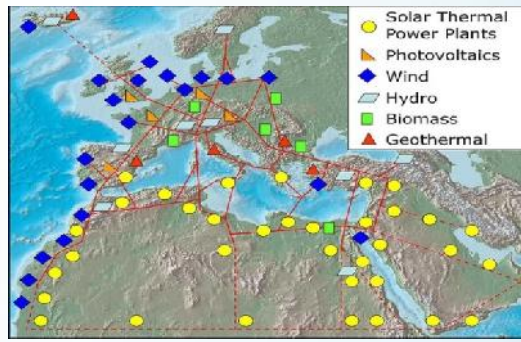
- **Diversity of Generation Plants**
- **Harmonize & Optimization of Power Mix**
- **Development of Renewable Energy**
- **CDM(Clean Development Mechanism) Project**
- **Asian Super Grid, Transfer of Bulk Energy, Trunk Line**
- **Global Electricity Trade Market using Ultra-HVDC System**
- **Stimulate of Energy Resources Development, Cost & Gas**
- **Decrease of Middle-East Energy Dependency**

Supergrid Market Volume

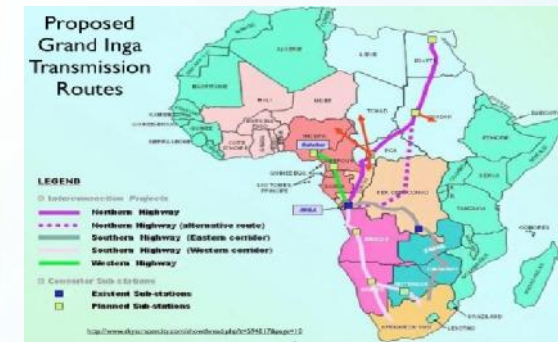
**Nord-Eu
(500GW)**



**Sud EU-Marghreb
(470GW)**

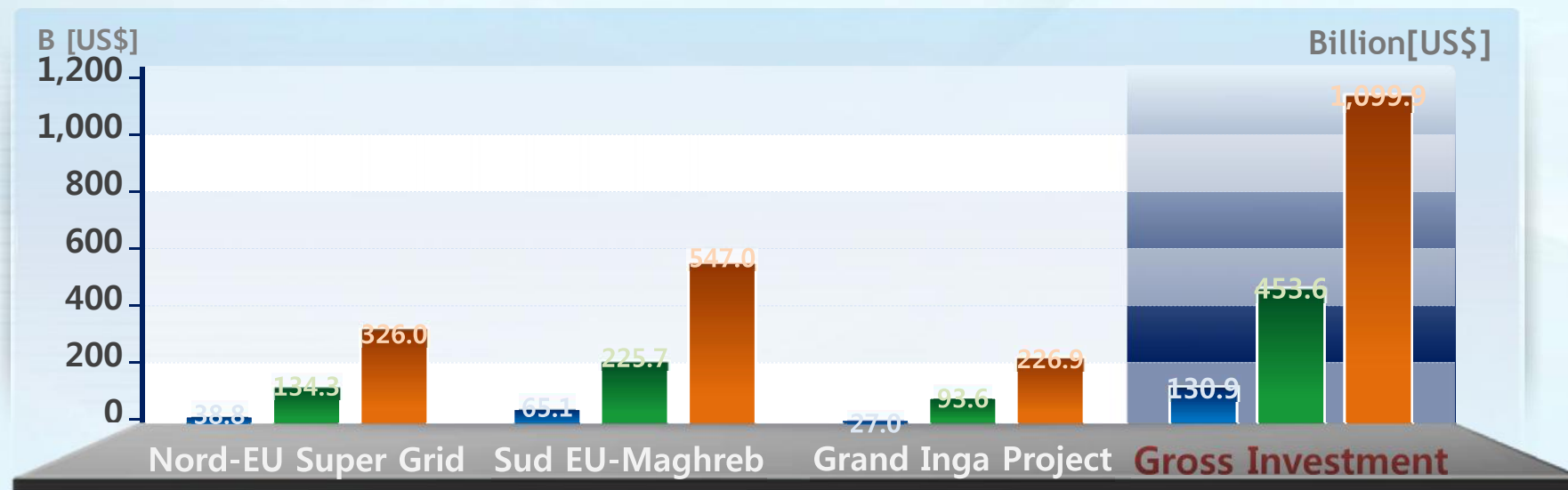


**Grand Inga
(100GW)**



Supergrid Investment

■ 1'st(2020) ■ 2'nd(2030) ■ 3'rd(2050)

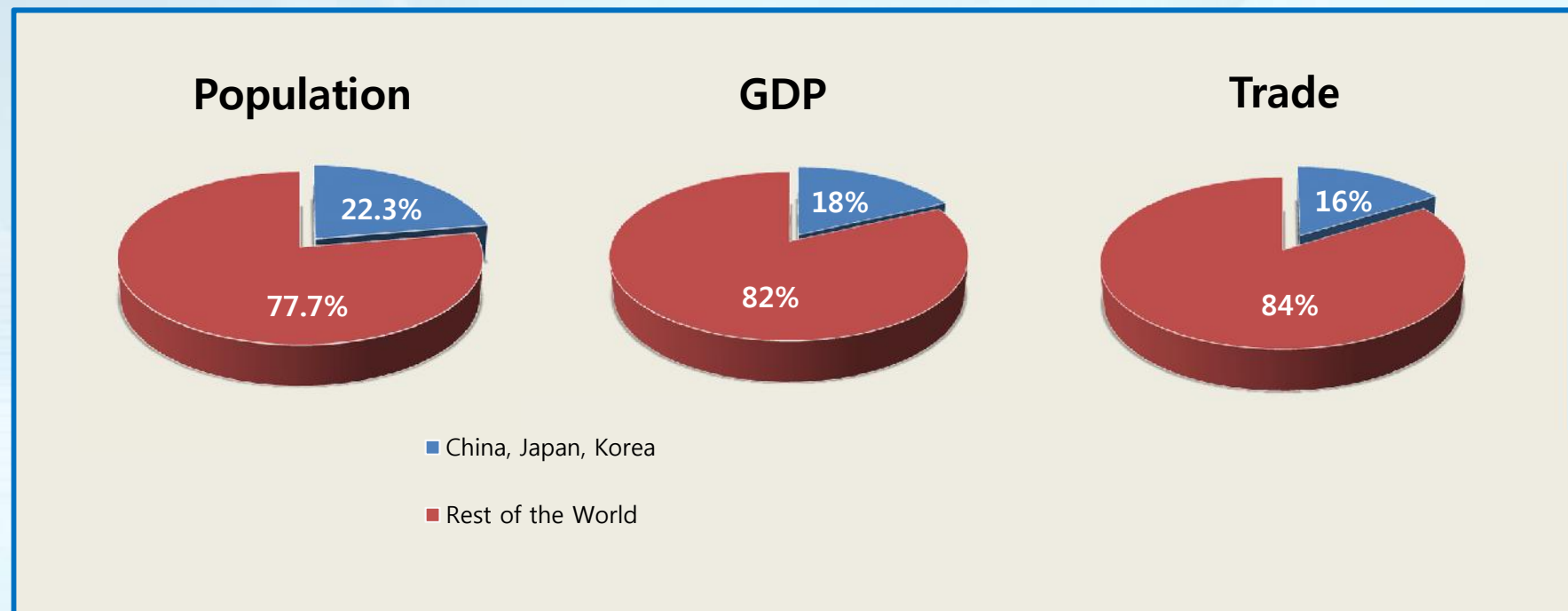


Status of NEA Supergrid

Nations	Generation Capacity (MW)	Transmission Voltage (kV)	Frequency (Hz)	Load Features (Peak)	Energy Resource	Price Index (Korea=100)
					Energy Consumption	
Republic of Korea	86,989 ('13)	765 345 154	60	summer winter	Poor	100
					Large	
Russia Federation	225,508	1,150 750 500, 330	50	winter	Abundant	50~70
					Small	
Japan	282,315 ('12)	500 275 220	50 60	summer winter	Poor	250~300
					Large	
China	1,0600,000 ('12)	1,000 750 500, 330	50	winter	Abundant	100
					Large	

Status of NEA Supergrid

- ◆ The North-East Asia region has sufficient conditions to make the SuperGrid.
- Emerging as a world best market (20% of area, population, GDP, trade in the world)
- The price gap, natural energy resource imbalance between nations
- Important factor for the valuation of NorthEast Asia SuperGrid

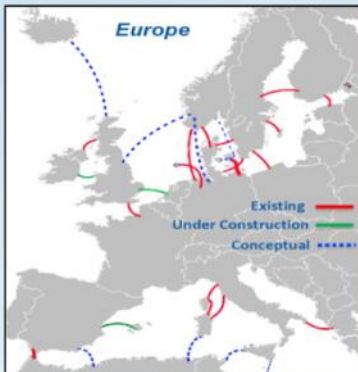


Source : General Cooperation Situation of Korea, China and Japan, 2010

Technical Feasibility

Technically Feasible !!!

Technical side



- HVDC Line : 2,090 km(China : Jinping ~ Sunan)
 - Capacity : 800kV, 7.2 GW, Operation Start : 2013
- Submarine HVDC Line : 580 km(Europe : Nor ~ Ned)
 - Capacity : 450kV 0.7 GW, Operation Start : 2008

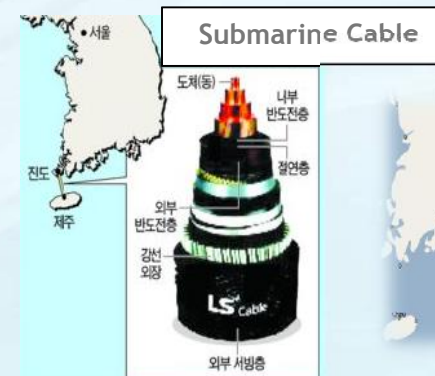
Source : Blank map of Europe.svg by Maix



Source : GRENA TEC

Constructive side(Submarine)

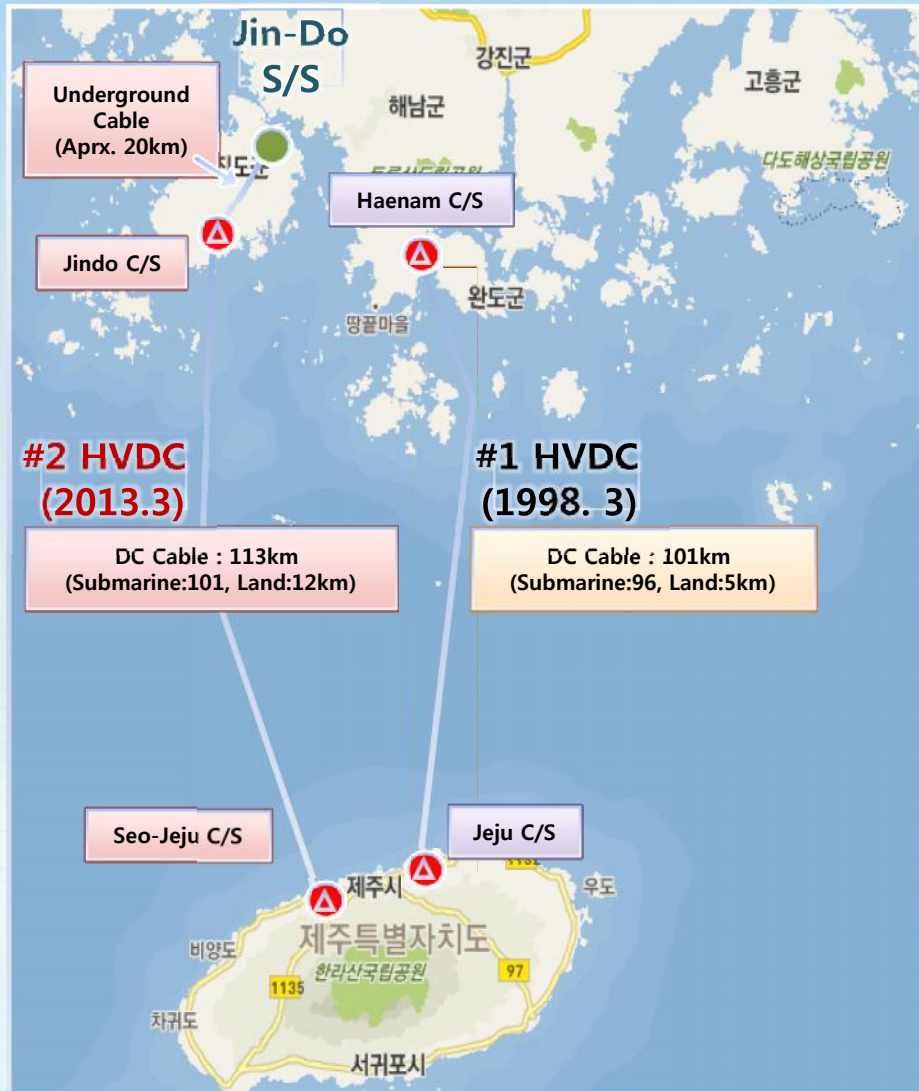
- Maximum Water Level
 - Korea(Jeju Island) : 110m
 - Japan : 260m, Europe : 540m



Source : KEPCO



KEPCO' HVDC Project(Jeju Island)



◆ Jeju #1 HVDC Project

Capacity : 300MW (150MW X 2lines)

Voltage : DC $\pm$ 180 kV

Commercial Operation : 1998. 3

◆ Jeju #2 HVDC Project

Capacity : 400MW (200MW X 2lines)

Voltage : DC $\pm$ 250 kV

Commercial Operation : 2013. 9

◆ Jeju #3 HVDC Project

Capacity : 200MW (200MW X 1lines)

* Considering HVDC or Gas Plants

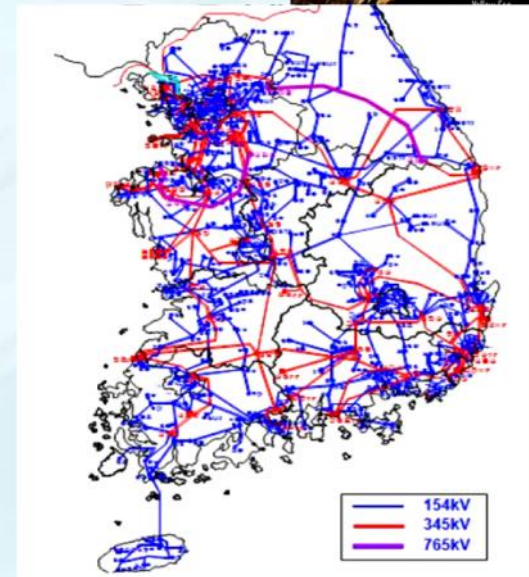
3. KEPCO's NEA Supergrid



Why KEPCO is interested in Supergrid?

◆ Solution to grid problems by Peak sharing

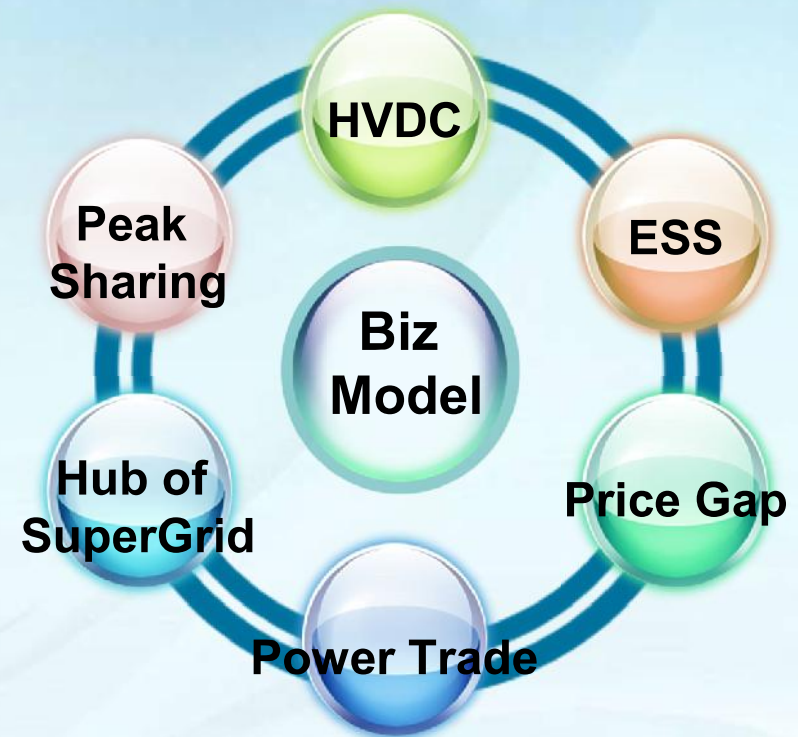
- The Korea is isolated grid like the Japan
- High Load Density & Condensed Power System
- Unbalance of Supply/Demand in SEOUL
Metropolitan Areas (Over 42% of Total Load)
- Fault Current Problem
- Transmission Congestion Problem
- Power System Security & Stability Problem



Outline of NEA SuperGrid



More dense cooperation is needed
between **North-East Asia Nations**



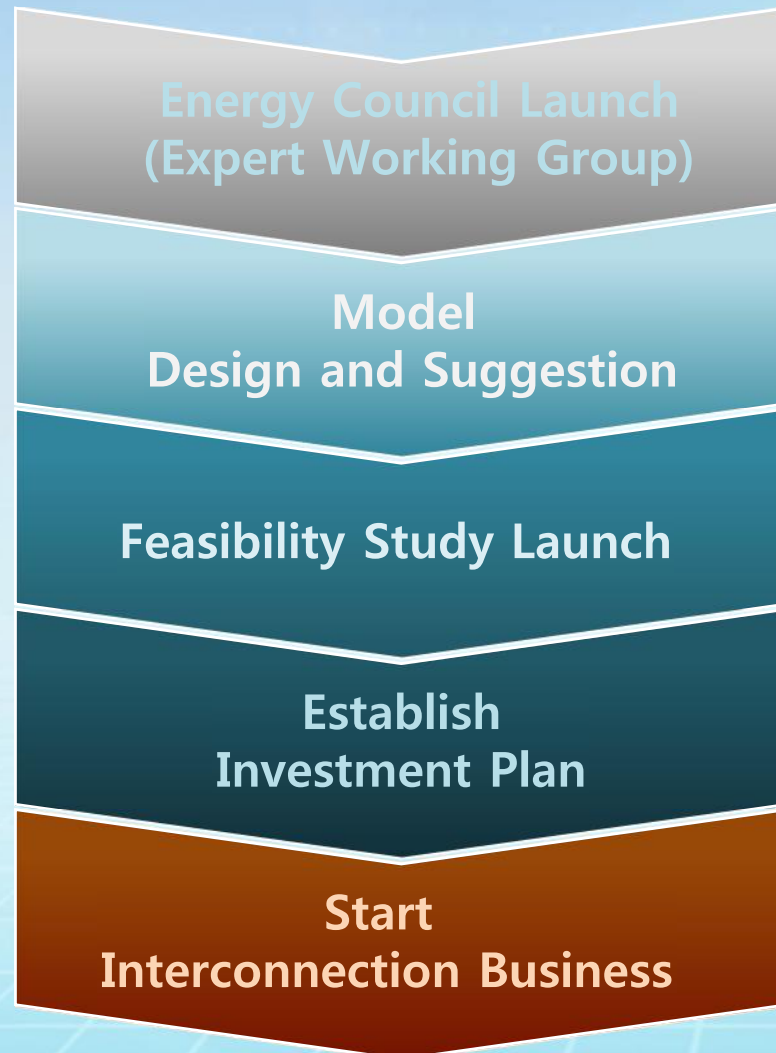
Creating various types of
Business Model

Why KEPCO is interested in Supergrid?

- **Rich Resources(Russia, China) vs. Poor Resources (Korea, Japan)**
- **High Demand (Korea, China, Japan) vs. Surplus Electricity(Russia)**
- **New Power Plants Approvals Issue(Korea, Japan)**
- **Large-Scale Energy Resources Availability(Russia, China)**
- **Different power peak demand**
(Japan : Summer, Korea : Summer & Winter, Russia : Winter)

Economy	Effective use of natural resources, flexible selected power generation's location
Environment	Utilization of eco-friendly resources, new NRE power plants development
Reliability	Mutual power management for blackout and power qualities control
International Cooperation	Expanding South and North's exchanges and possible cooperation

Plan for the North- East Super grid



- ⦿ Consideration long-term period and uncertainty of business
- **Phased and practical Approach**
- ⦿ Promotion after constructing Energy council between nations
- **Government and electric company**
- ⦿ Essential to attend a expert group
- **Technique, economy and policy**

4. KEPCO's progress



KEPCO's Plan

Research-focused **Base Step**
('14~'15)

Pre-feasibility
Study

International
Co-operation

Business
Strategy

Pilot
Project

Business Promotion **Preparatory Step**
('16~'20)

IDEA → PLAN → ACTION

KEPCO's Plan



1. Korea-Russia Interconnection

- Abundant Resources of Russia

2. Korea-Japan Interconnection

- The Nearest Distance to Connect

3. Korea-China Interconnection

- Various Routes to link

Korea-Russia

Project Outline

- Expected Path : Vladivostok~ North-Gyeongdo (through North Korea)
- Connection System : HVDC 500~800kV

Progress

- On-Going pre-feasibility Study for Korea-Russia Grid Interconnection
- The MOU was signed while the Russian president was visiting Korea (kick/off on 17. Dec)

Consideration

- Uncertainty of pass through the special territory
- Agreement by 3 parties

Other Interconnections

Korea-China

- Path : Incheon ~ submarine
~ eastern part of China
- Distance : 350km
- Capacity : About 3GW
- Grid System : HVDC 500kV
- Interested in Joint Research on
Power Grid Interconnection

Korea-Japan

- Path : Busan ~ Fukuoka
- Distance : 250km
- Capacity : About 2GW
- Grid System : HVDC 500kV
- Mutual concern were discussing
Expansion to governmental
business after non -
governmental co-operation

5. Conclusion & Suggestion



Conclusion & Suggestion

- Benchmark similar overseas cases
- Risk analysis and mutual - benefits review
- Consider many obstacles (regional characteristics)
- No technical problem for construction, operation experience.
- Project financing
- Expert council among Northeast Asia countries.
- Mutual understanding between both governments

