

NAPSI (Northeast Asia Power System Interconnection) of KOREA

2019. 05.22

Dongil Lee



**Secretary General,
The Korean National Committee of CIGRE**



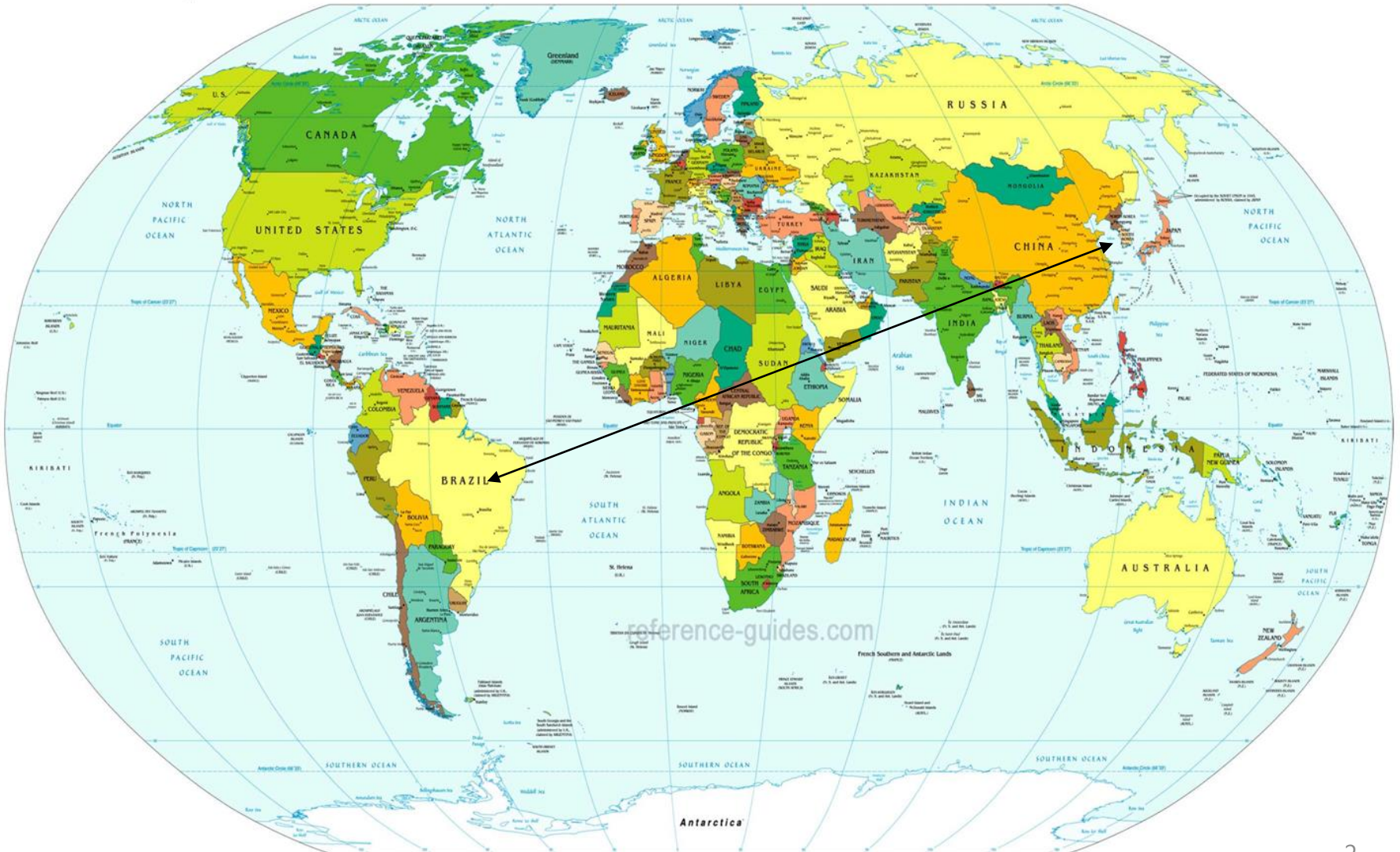


BRAZIL

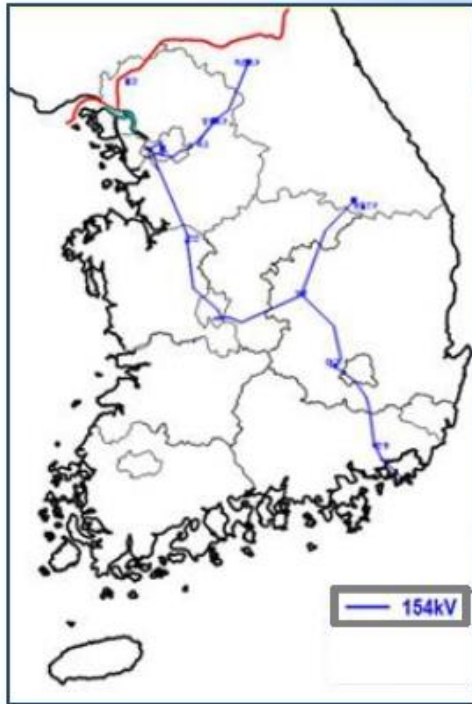
KOREA



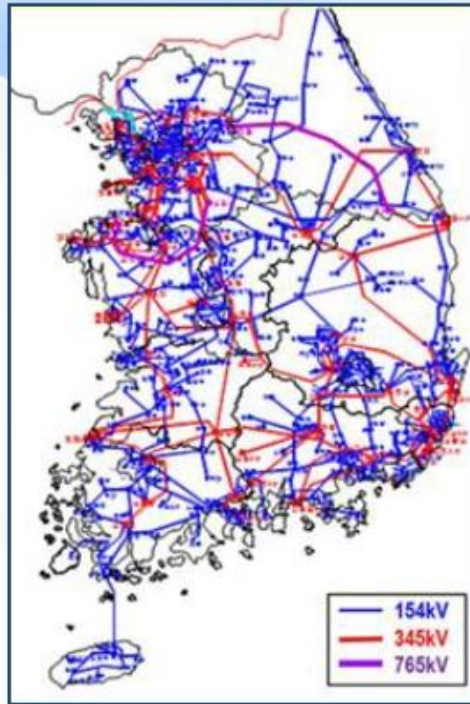
"A very short distance for good friends"



Electric Power T/L in Korea



0.9 GW, 1965



90 GW, 2015

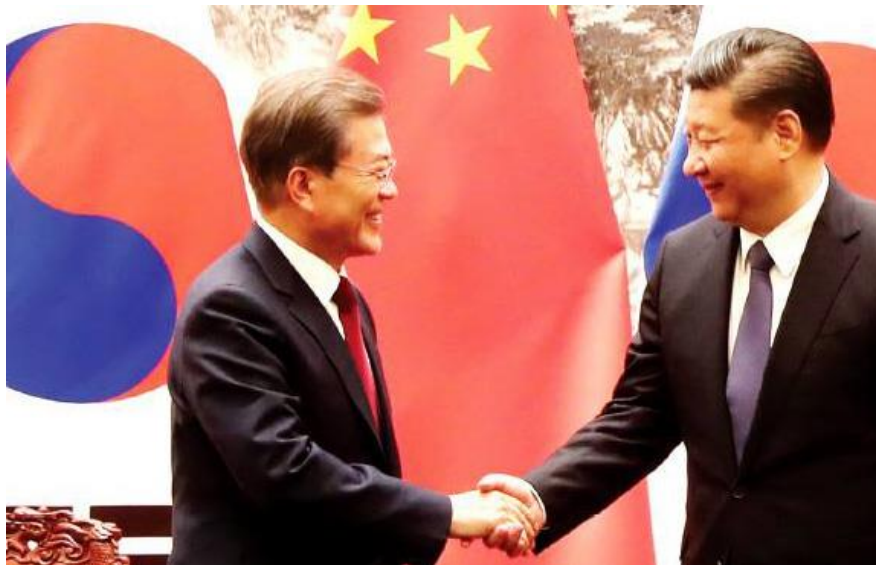
Super Grid Needs

- Electricity Swapping
- Increasing of Reliability
- Decreasing of Electricity Reserve Ratio
- Mitigate Public Issue in T/L Construction

117 GW, 2019

**Urgent Need of Electric Power Trade
between China and Korea**
Summit Meeting between Korea and China
(2017, 12. 15, Peking)

between South Korea and North Korea
Summit Meeting between South Korea and North
Korea
(2018, 4. 27, DMZ)

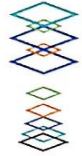


Super Grid in North East Asia

HVDC MOU between KIEE - CSEE

(Korea Institute of Electrical Engineers – China Society of Electrical Engineers)

<http://hvdc2018.org>



2018
High Voltage Direct Current
Conference in Korea

October 31(Wed) - November 2(Fri) 2018. Gwangju, Korea



Supported by

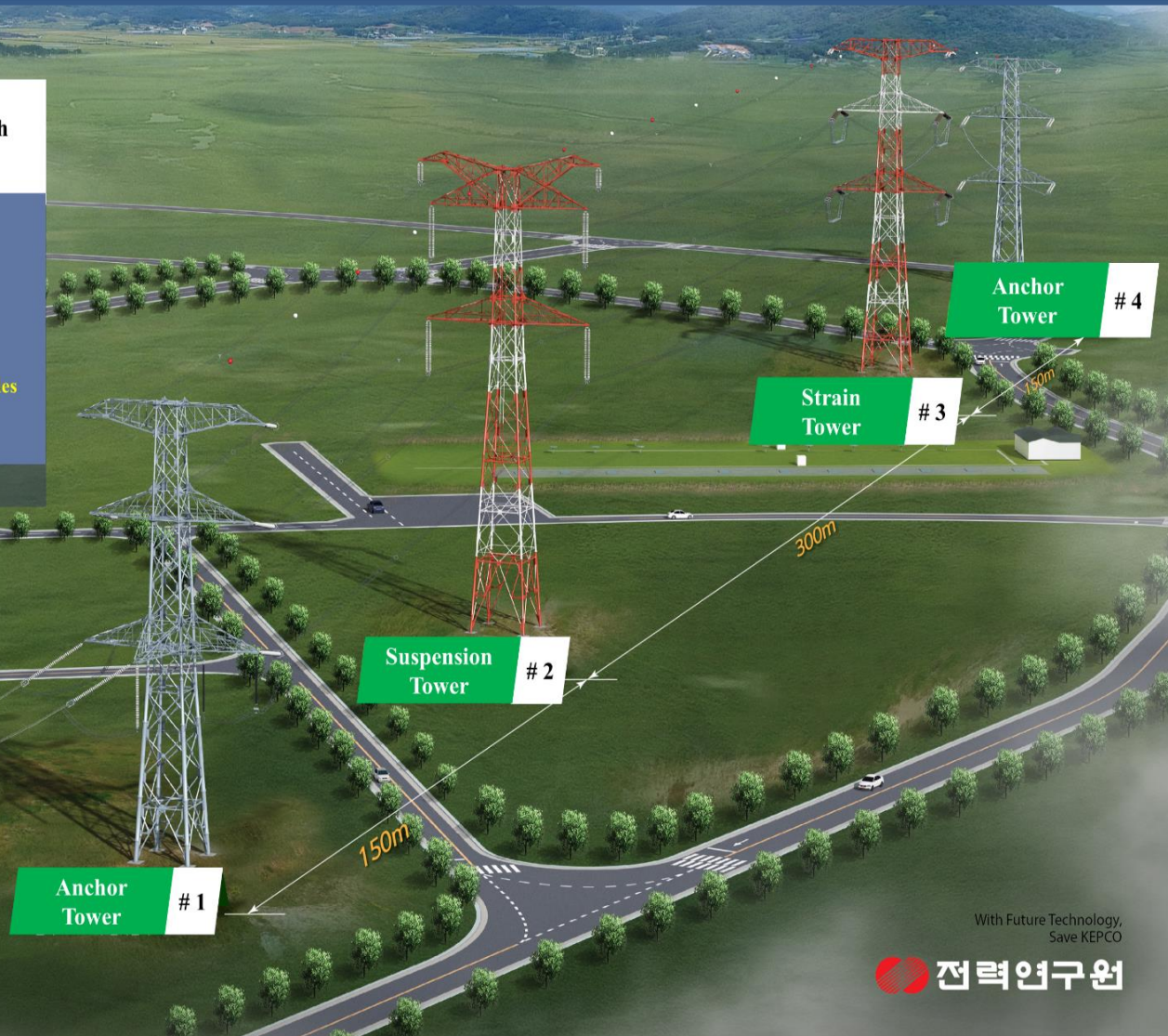
Sponsored by

KIEE-CSEE MOU
HVDC Conference Foundation and
Power Connection Co-Study
(2015. 10. Seoul)

KEPCO Developed Double Bi-Pole 500kV HVDC T/L with Return Conductor Overhead Line : 1st in the world (8 GW Carrying Capacity)

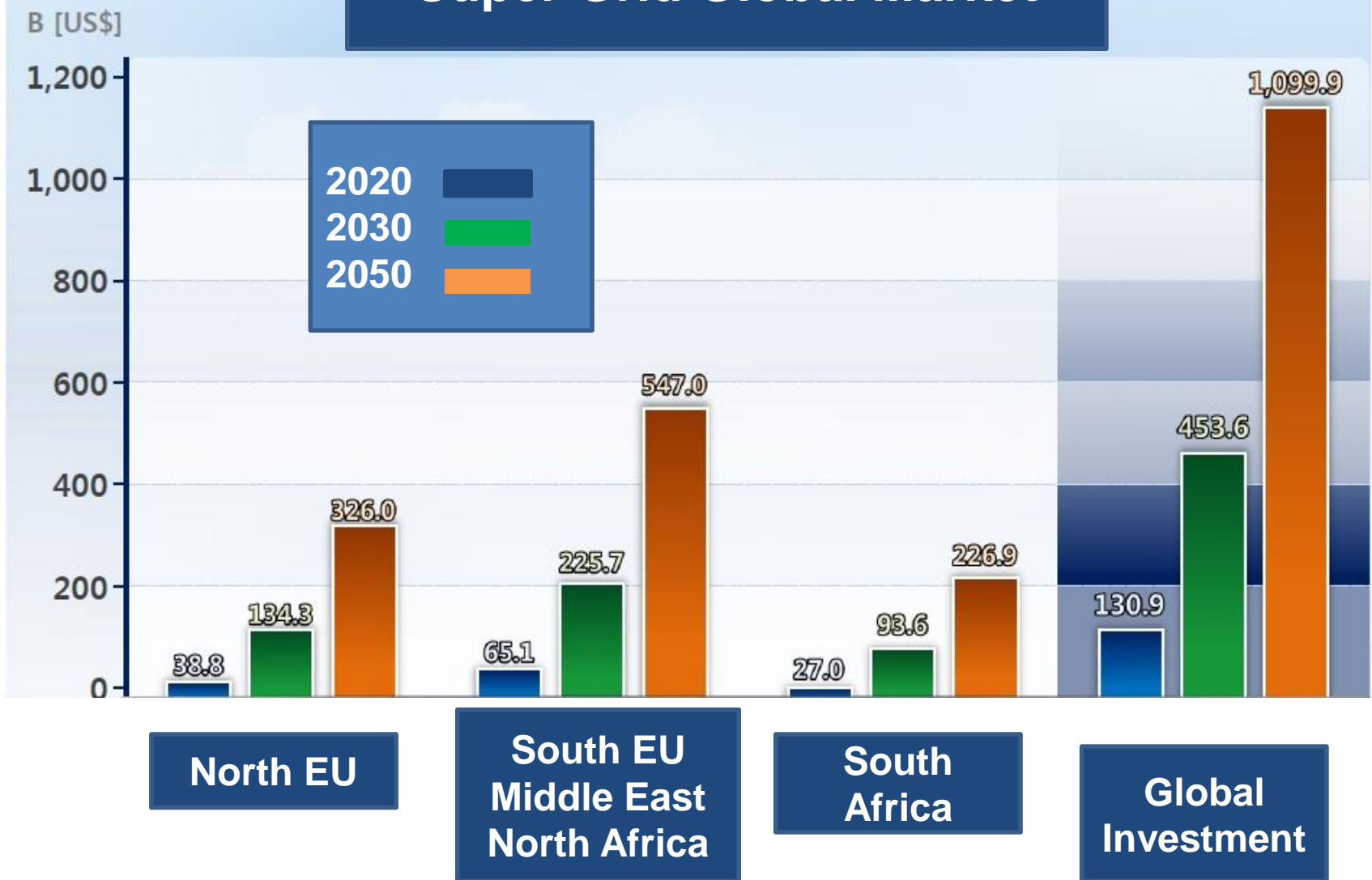
Full Scale Test for HVDC 500kV Double Bi-Pole with Return conductor Overhead Transmission Line

- Voltage : 500kV DC (4Pole-Positive, Negative Double Bi-Pole)
- Total Span : 600m (150m – 300m – 150m)
- Conductor
 - Pole Conductor : ACSR / AW Cardinal 480mm² × 6 Bundles
 - Neutral Conductor : HTACSR / AW Cardinal 480mm² × 3 Bundles
 - OPGW : AWS 200mm²

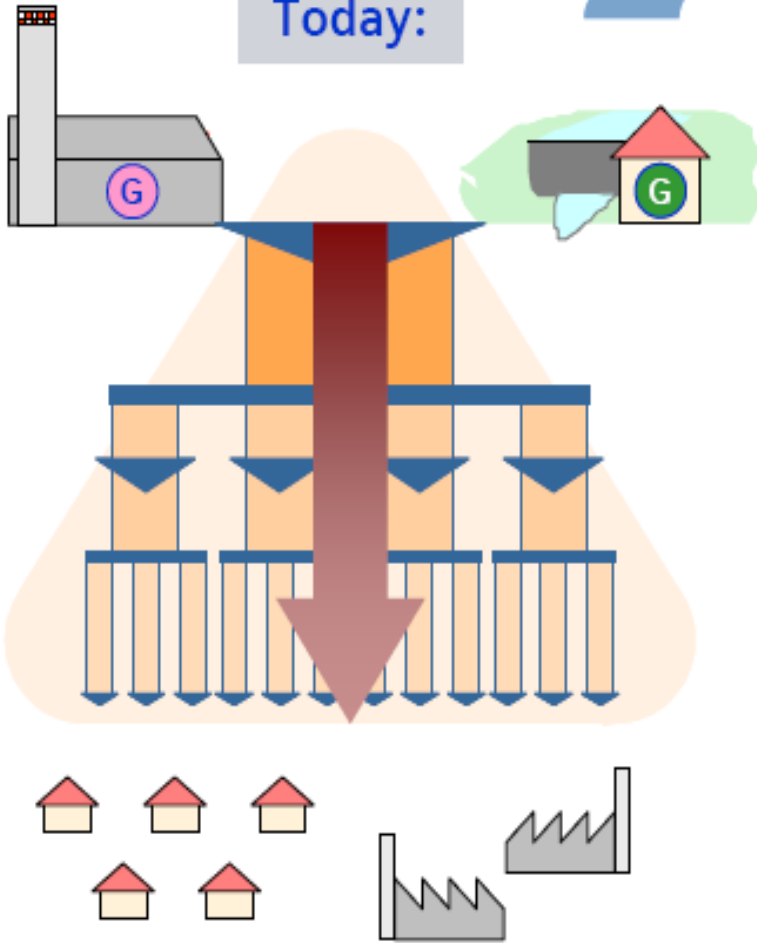


With Future Technology,
Save KEPCO

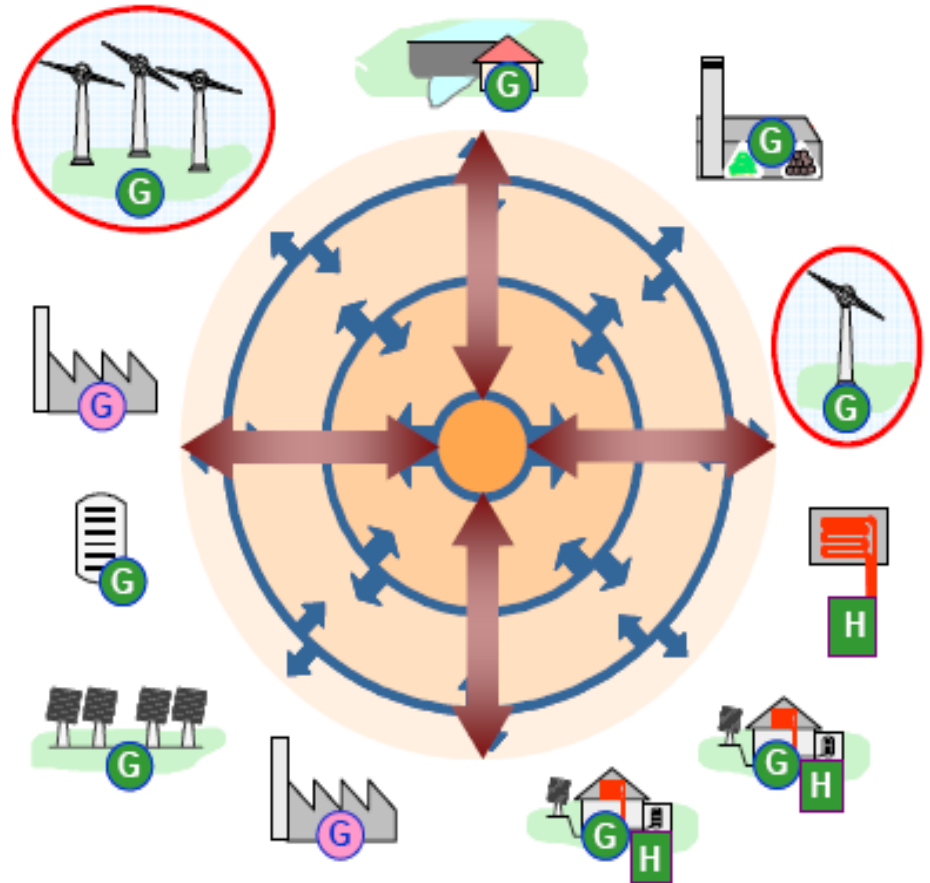
Super Grid Global Market



Today:



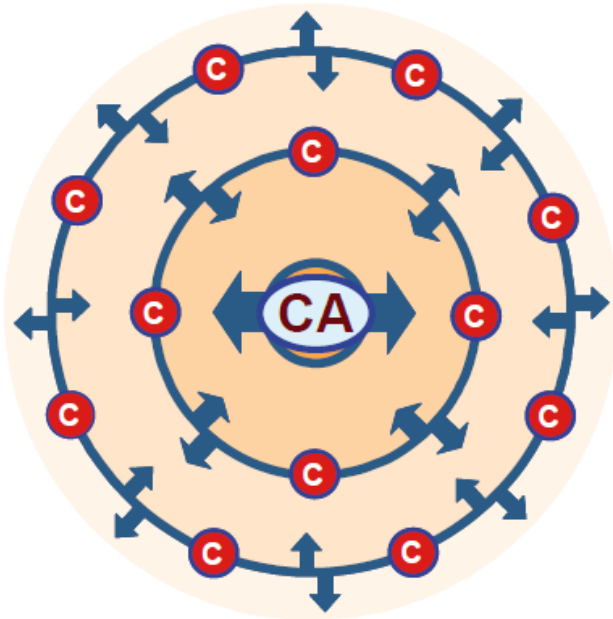
Tomorrow:



Load Flow will be "fuzzy"

Use of Dispersed Generation

“Micro Grid”



CA = Cell Agent

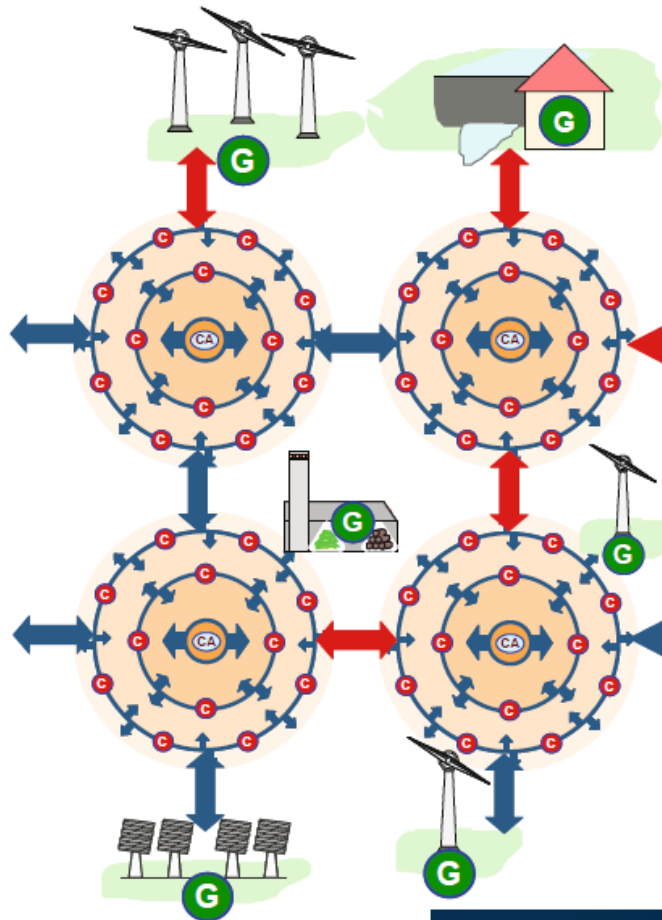
Storage

G + S = C Cell

Generation

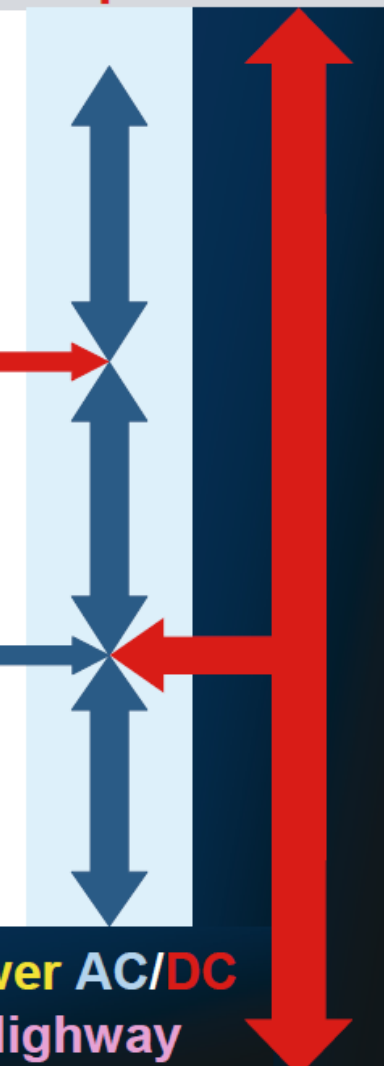
Virtual Power Plant

“Smart Grid”

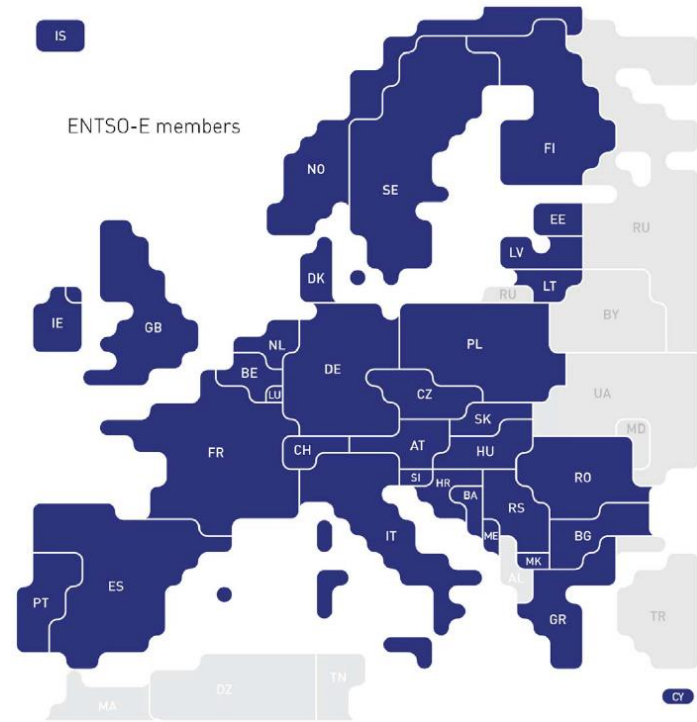
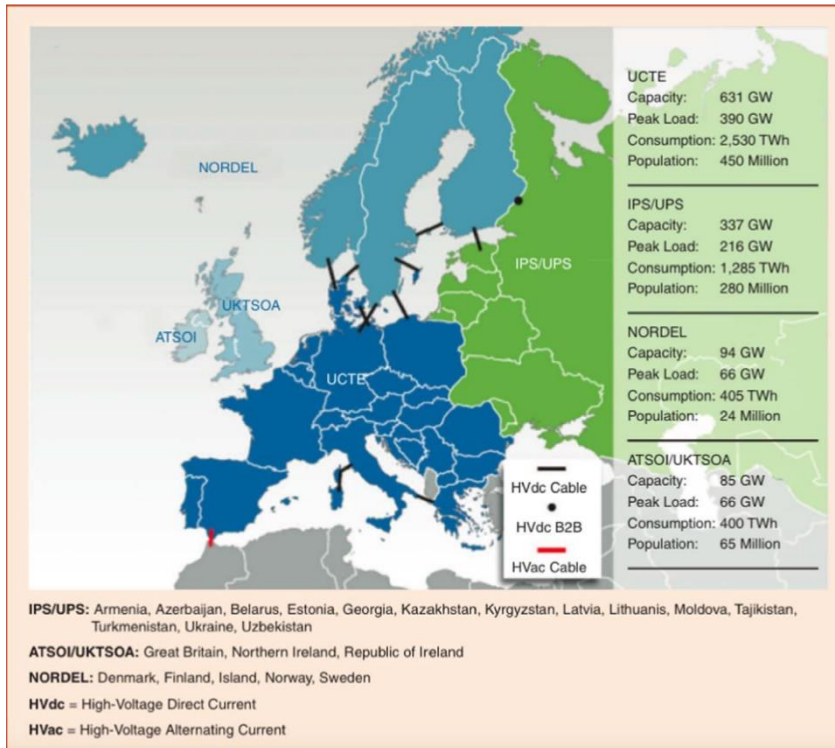


AC DC

“Super Grid”

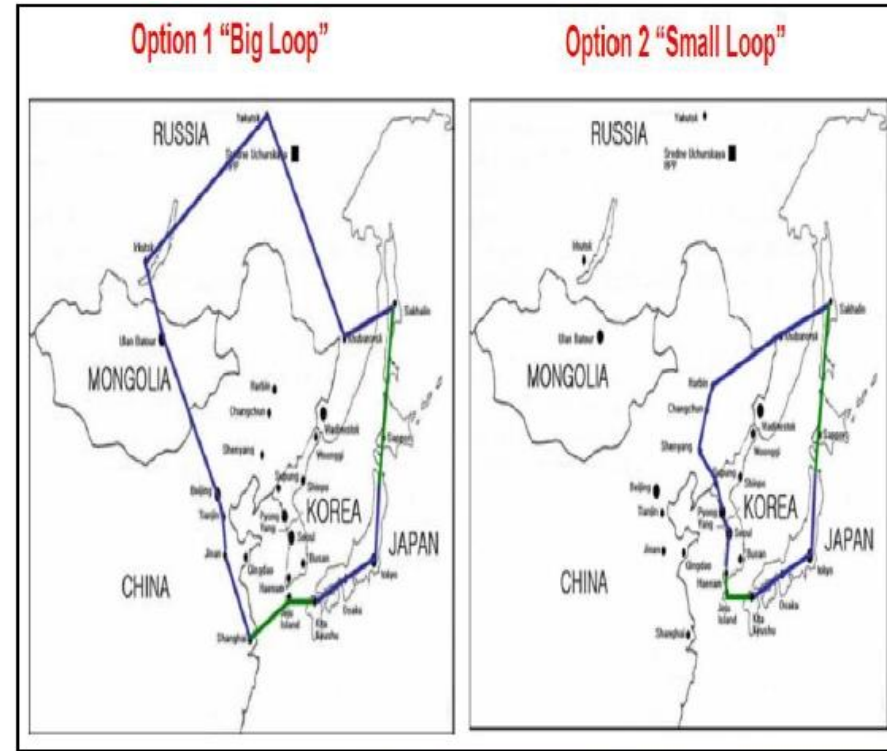
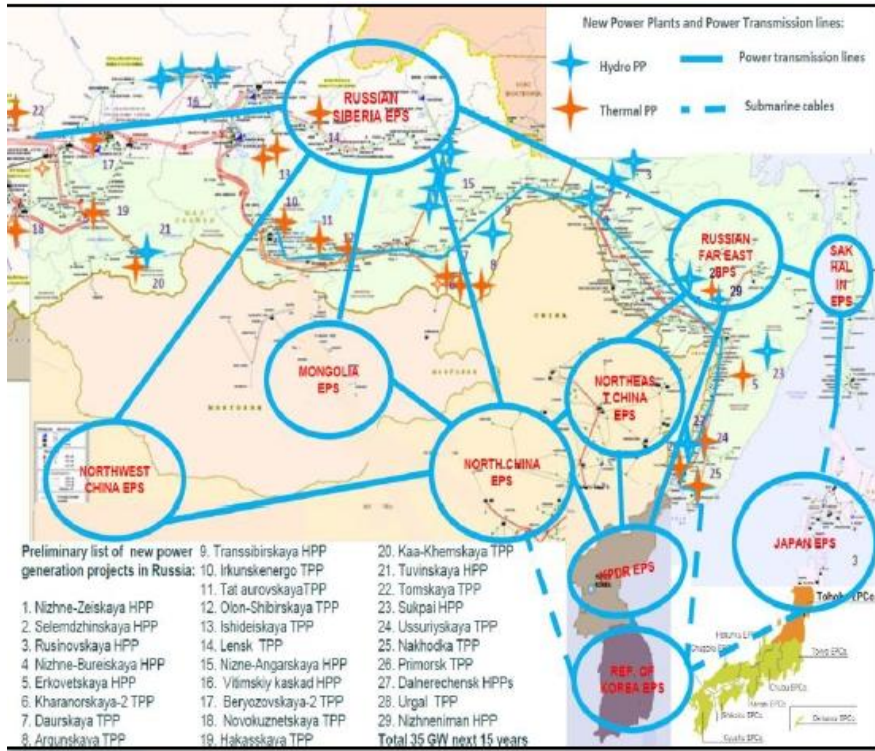


Bulk Power AC/DC
Energy Highway



1. UCTE (Union for the Coordination of Transmission of Electricity)
2. NORDEL (Northern Europe)
3. UKTSOA (United Kingdom Transmission System Operators Associations)
4. ATSOI (Association of the Transmission System Operators of Ireland)
5. ENTSO-E (European Network of Transmission System Operators)

APEC 2012 (Vladivostok) Proposal by Russia EN+Group



Russian Electric Power → China, Korea, Japan

Asian Paradox

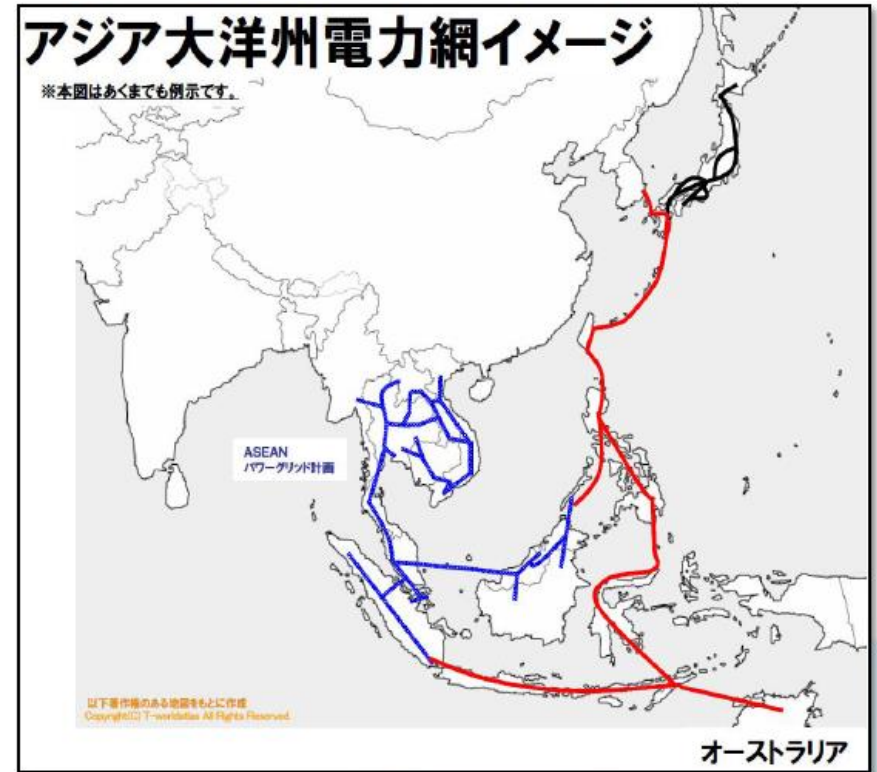
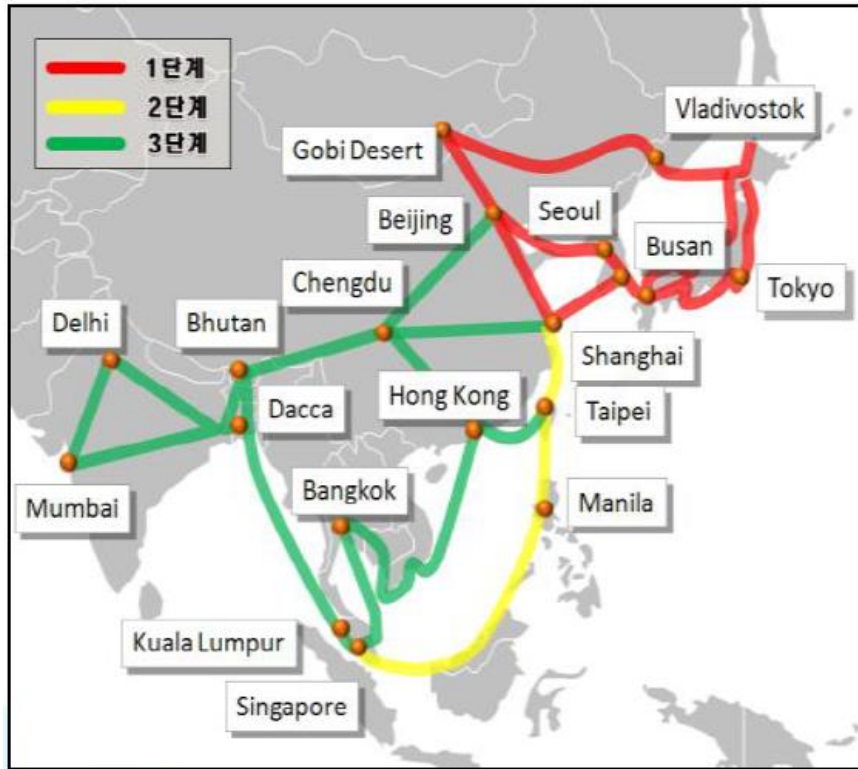


Need Cooperation in Super Grid
Neutralizing Tension among North East Asian Countries
20% in Global GDP & Population

Super Grid in North East Asia by South Korea Proposal



Super Grid Proposal by Japanese (Soft Bank)



**Energy Security
No Nuclear Power**

Super Grid Proposal by China



**CIGRE 2012
China-EU
<HVDC>**

China-Korea

HVDC Power Transmission

- ❖ CEO of SGCC suggested **New Power Silk Road** plan at 2012 CIGRE Paris Meeting
- ❖ Power line interconnection between China and Europe
 - By **$\pm 1100\text{kV}$ HVDC** transmission line with **5,635km**
 - Using wind power generation in Gobi desert & Mongolia Area

* SCGG(State Grid Corporation of China)





NAPSI

**(Northeast Asia Power
System Interconnection)**



MINISTRY
OF
ENERGY



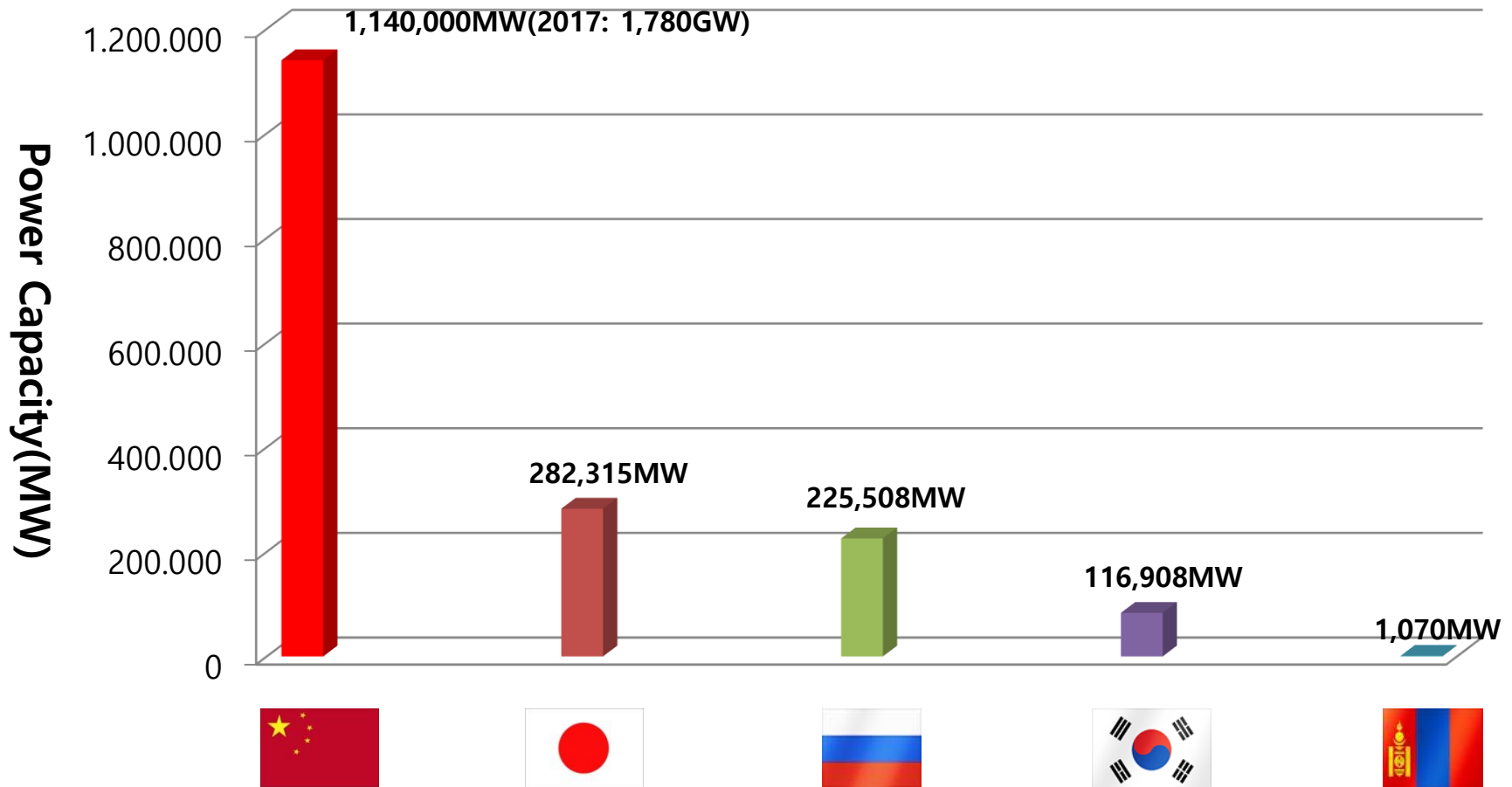
STRATEGY FOR **NAPSI** (NORTHEAST ASIA POWER SYSTEM INTERCONNECTION)

EDF TECHNICAL ASSISTANCE TO MONGOLIA
ADB PROJECT

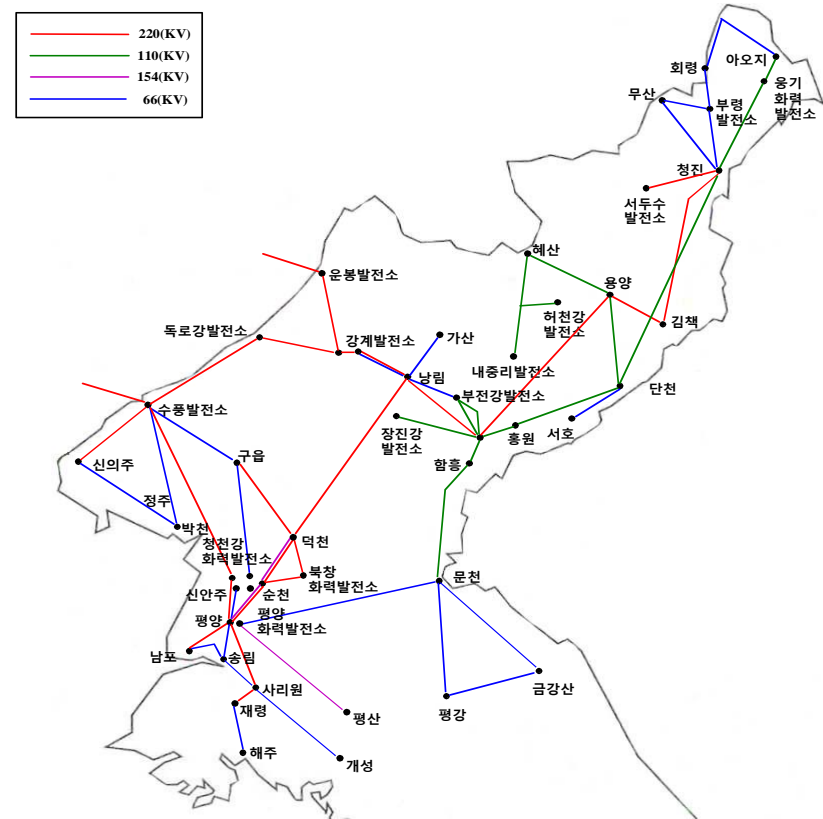
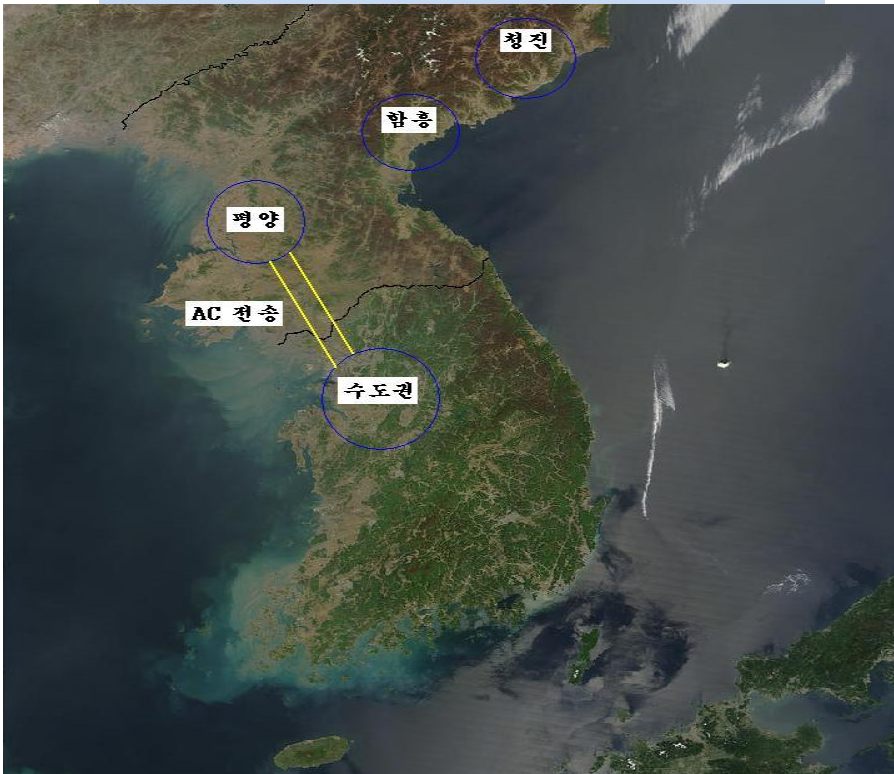
(2017, 10 – 2019. 6)
PHILIPPE LIENHART EDF

Power Capacity in North-East Asia

❖ Power Capacity in Korea, China, Japan, Russia, and Mongolia



Korean Peninsular Power System Interconnection Plan



- Power System Interconnection Between North Capital, Pyongyang and South Interconnection
- (North Korea)
Gen. Capacity 7.3GW
Hydro Generation 70%

- (South Korea)
Gen. Capacity 116.9GW
Nuclear 40%, LNG Gas 30%,
Coal Generation 20%,
Solar + Wind Generation 7%
- Multi-terminal HVDC
+ VSC HVDC

Need of Northeast Asia Power Interconnection

❖ **Benefits** of power system interconnection

- **Electricity exchange (swapping)** between countries according to increasing power demand and difficult to construct new power plant
- **Avoiding of black out** by exchanging electricity during peak demands
 - * **Rolling black out : 15th Sep. 2011(Korea)**
- **Peace cooperation mood** in this area
- **Boosting economy growth** in this area

Why North-East Asian Power Interconnection

❖ Asian Super Grid : **Electricity arbitrage trading**

- Korea-Russia: $\Delta P = \$0.04/\text{kWh}$
- Korea-Japan: $\Delta P = \$0.16/\text{kWh}$



NAPSI Benefit by Electricity Swapping

❖ Comparison of Electricity Price between North-East countries

Country	Electricity Price	Difference
Korea	0.09 USD/kWh	0
China	0.12 USD/kWh	+0.03 USD/kWh
Japan	0.25 USD/kWh	+0.16 USD/kWh
Russia	0.05 USD/kWh	-0.04 USD/kWh

Super Grid in North East Asia On-Going Feasibility Studies



Vladivostok-Seoul
800kV, 1,300 km
\$ 5 Billion
EN+, Skol-Tech

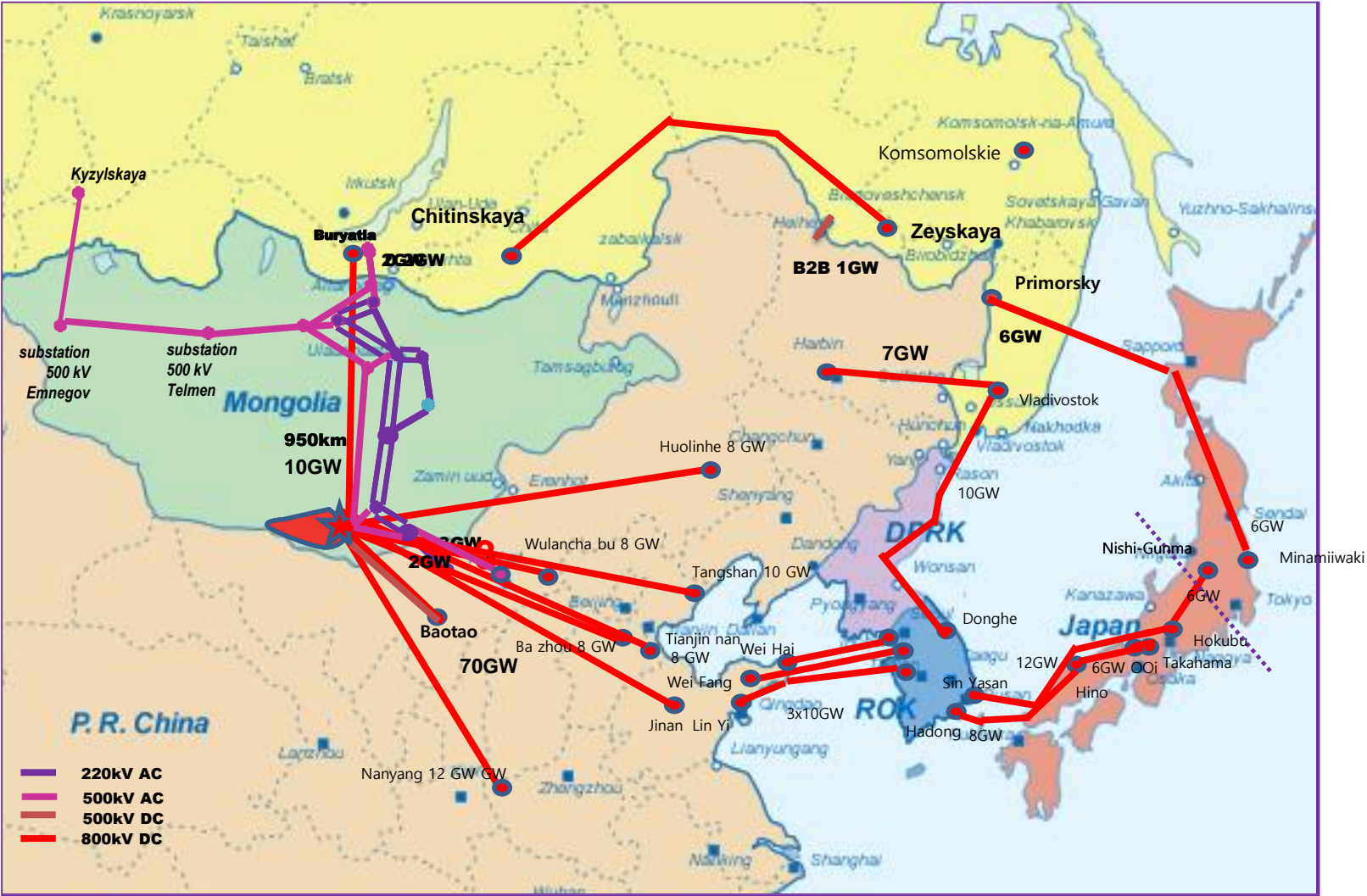


Fukushima-Southern Korea
500 kV, 230 km
Submarine Cable
\$ 2.5 Billion
Soft Bank



Tsingtao-West Korea
500 kV, 350 km
Submarine Cable
\$ 4 Billion
CEPRI and Shanxi

ADB PhaseIII:2036+ Gobi RE base to reach 100GW



All Together, Create Future

Dongil Lee(李 東 一)

Electric Power Research Institute



Seoul National University

Present Status of South Korea

- Installed capacity / Peak demand: **116,908 MW / 92,250 MW**
 - The lowest T&D loss (**3.44%**)
 - The shortest outage duration (**10.8 min.**)
 - Electrification rate (**100%**)
 - Voltage regulation compliance ratio (**100%**)
 - Frequency regulation compliance ratio (**99.9%**)
 - The world's highest annual load factor (**77.6%**)
- The Asia's **FIRST** in 765 kV transmission system:
 - **Outdoor full GIS type S/S** (2002)
 - **Double circuit 765 kV T/L** (2001)

