

# Big Bang Time of EV & Grid Reconstruction Strategy Under the 4<sup>th</sup> Industrial Revolution

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# **I. Government Policy & EV Big Bang Time**

# The 3<sup>rd</sup> Energy Basic Planning, Gov't, Apr. '19.



## ➤ Energy Demand by 2040

(Million TOE)

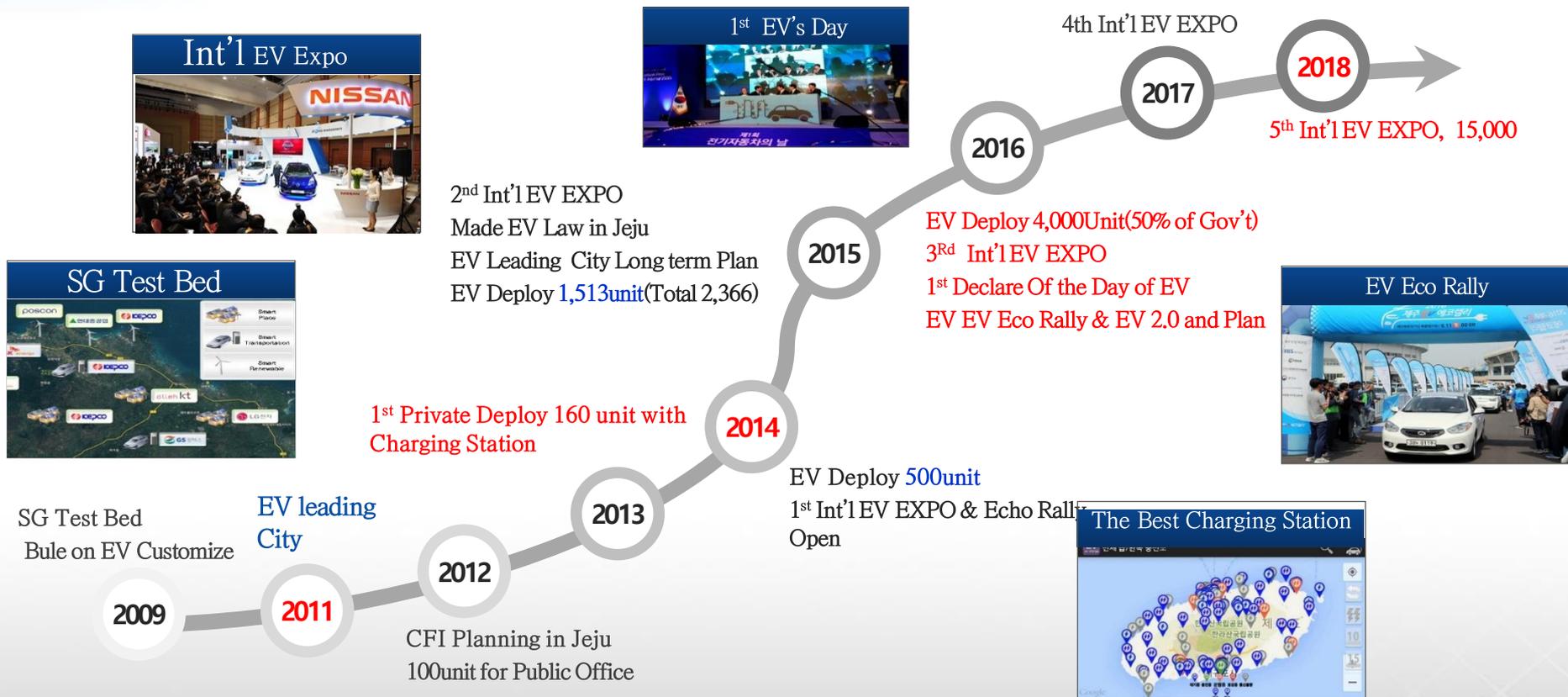
	Coal	Oil	Gas	RE	Power	Heat	Total
2017	33.2	61.4	23.7	11.8	43.7	2.3	176.0
2040	39.0	57.1	30.5	19.9	61.8	2.6	211.0

## ➤ EV & RE Targets by 2040

Electric Vehicle(M, 50%)		Renewable Energy(%)
BEV	HEV	
8.3	2.9	30~35

# EV Policy since 2009, In Jeju Korea

## ➤ EV Progress In Jeju

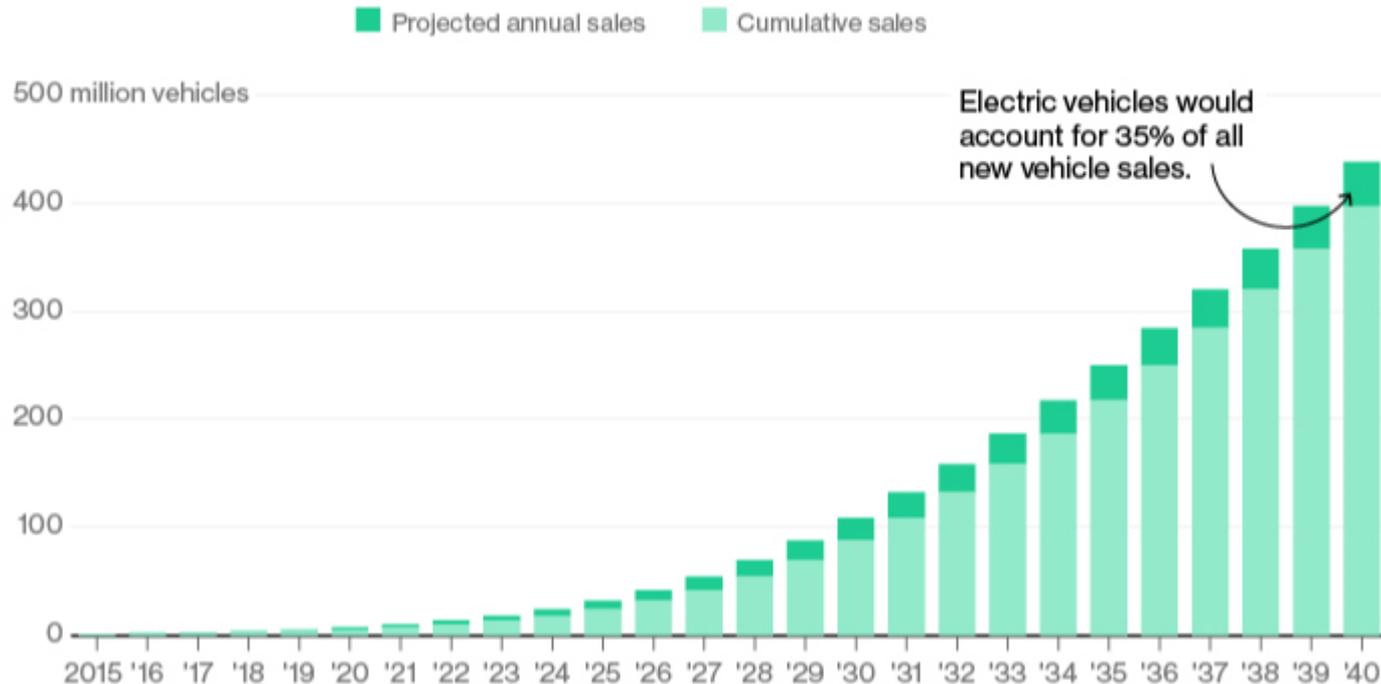


# Outlook of Global EV Market



## The Rise of Electric Cars

By 2022 electric vehicles will cost the same as their internal-combustion counterparts. That's the point of liftoff for sales.



Sources: Data compiled by Bloomberg New Energy Finance, Marklines

# EV Policy in Domestic & Overseas



## ➤ Regulation of Petrol Cars and Tax Policy for EV Customer

Country	Policy	Year	Regulation
Germany/ Israel	Restrict Petrol Cars	2030	Subsidy, Tax
USA	EV Obligation for 9 Province	-	“
Norway/Netherlands	Restrict Petrol Cars	2025	“
France	“	2040	Subsidy
England	“	2040	Subsidy(\$770m)
China	Tax for Low Efficiency Cars	Discussion	Subsidy, Tax

# EV Policy in Domestic & Overseas



## ➤ Status of Electric Vehicle(2017)

	USA	China	Germany	UK	France	Norway	Japan	Korea*	
Cumulative EV	762,060	1,227,770	109,560	133,670	118,770	176,310	205,350	25,920	
Sales EV('17)	198,350	579,000	54,560	47,250	34,780	62,260	54,100	14,710	
Public Charging Station(Unit)	45,868	213,903	24,289	13,534	15,978	9,530	28,834	5,612	
Area for Public Charger(km <sup>2</sup> )	214	45	15	18	34	34	13	18	
Incentive	₩10k	7,500\$	730	510	670	800	-	430	1,400
	Type	Tax	Subsidy	Subsidy	Subsidy	Subsidy	-	Subsidy	Subsidy

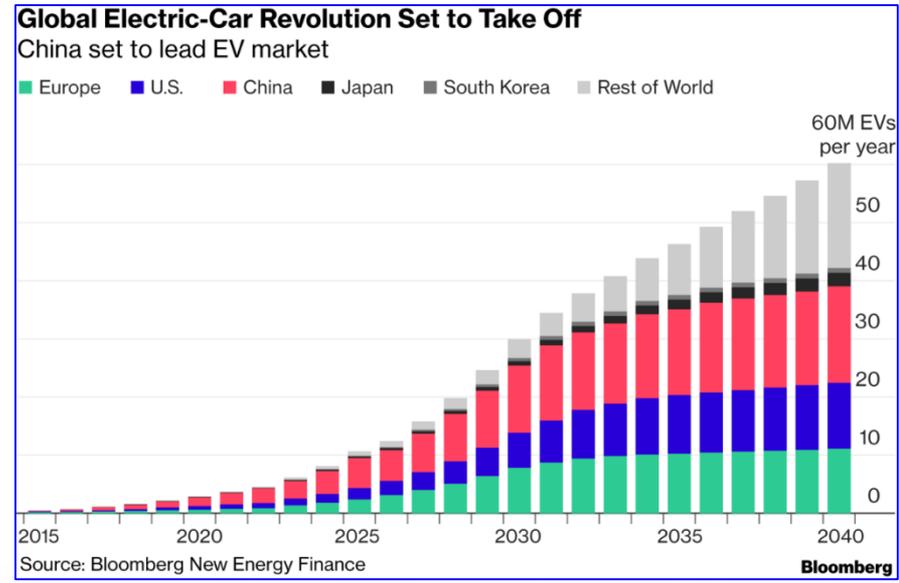
\* '18.12 Cumulative : 57,000

자료출처 : 석유협회

# EV Policy in Domestic & Overseas



## ➤ EV Outlook in the World



# Outlook of EV Big Bang by 2030



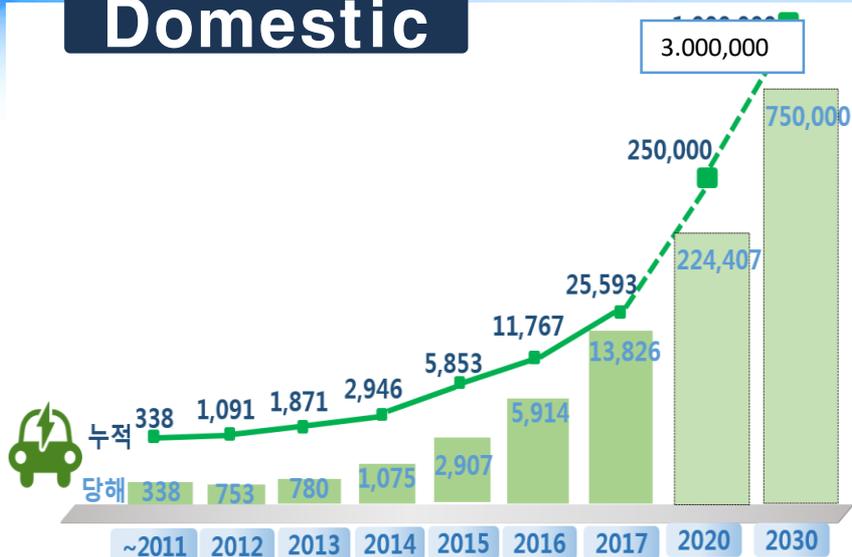
## ➤ EV Market (Unit: 10k)

	2014	2018	2020	2025	2030
<b>Petrol Cars</b>	8,402	8,470	8,540	8,100	6,920
<b>HEV. PHEV</b>	185	470	750	3,370	5,590
<b>BEV</b>	23	105	190	510	1,070
<b>FCEV</b>	0	5	10	40	220

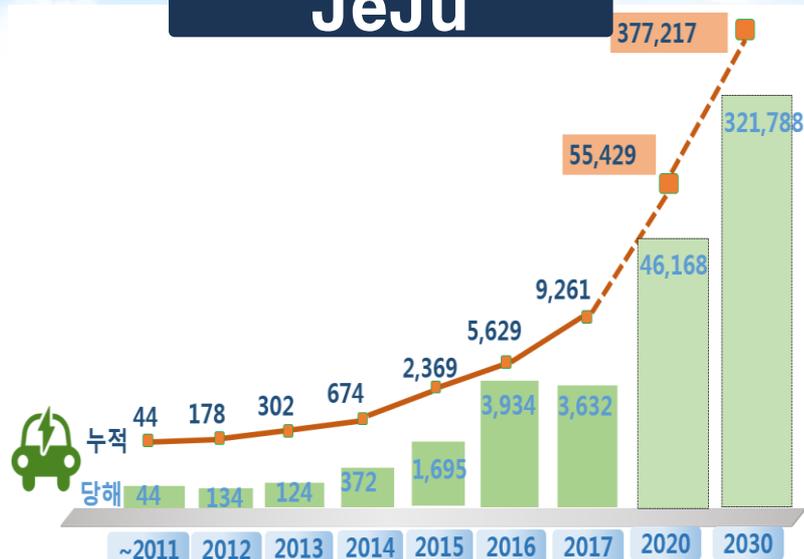
- 2010년 이후 전기자동차 보급은 폭발적으로 성장함.
- 2005년 천여 대 수준의 전세계 전기자동차(BEV+PHEV) 보급대수는 2014년 기준 200만대 벽을 돌파하여 201만대를 기록함.
- 특히 2016년 한해 동안 전기자동차는 75만 대가 판매되어 연간 사상 최고 판매기록을 갱신함

# EV Status and Outlook

## Domestic



## Jeju



### ■ EV : 1<sup>st</sup> EV Model launched at the SG test bed in 2011

– In Initial Stage, Blue On(Hyundai) 120km → Ioniq, Kona(200~400km/Charging, '18)

### ■ In Jeju EV Market Recorded 15,000, 2018. 36% in Korea

– According To CFI Plan will be changed 377,000, 100% by 2030

### ■ The Domestic Market grows 57,000 by the end of 2018

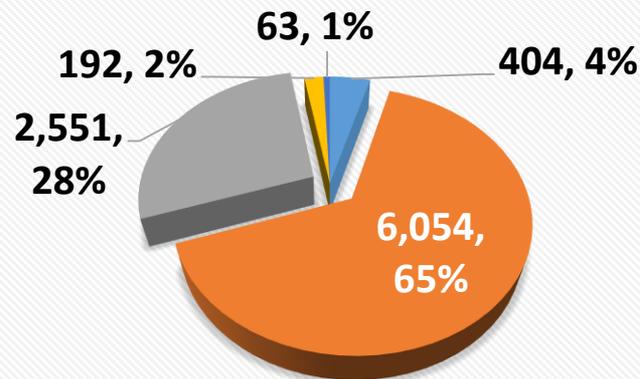
– Government will supply to EV 250,000 , 3,000,000 by 2025, 2040

# EV Buying Rate By Customer, 2017



Type	Public	Private	Rent Car	Taxi	Buses	Total
Cars	404	6,054	2,551	192	63	9,261
Rate(%)	4.3	65.4	27.5	2.1	0.7	100

Buying Rate By Customer, 2017

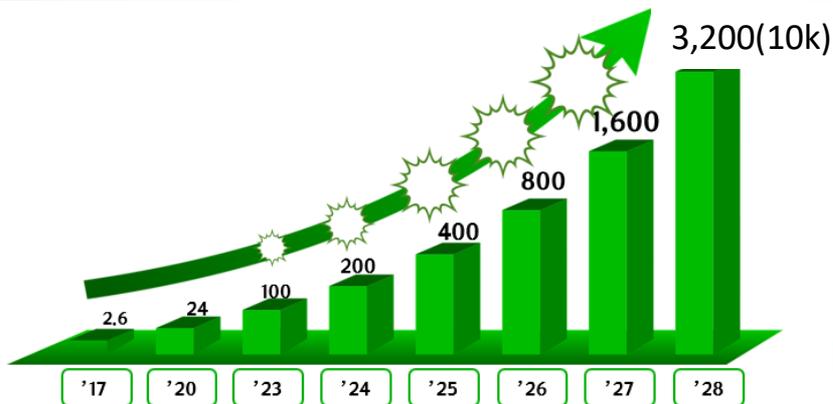


Public Private Rent Car Taxi Buses

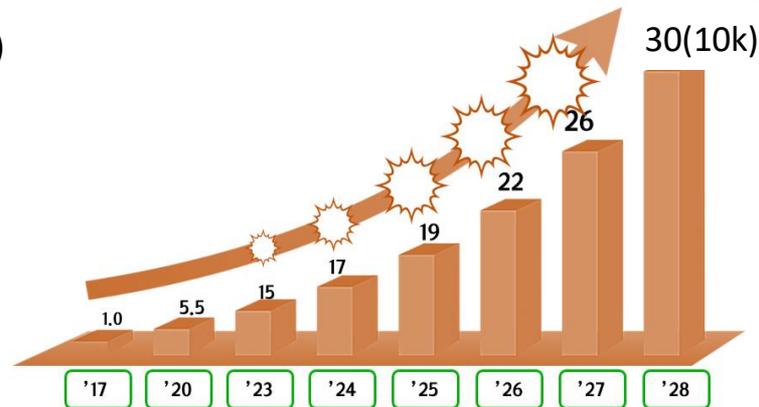
# Big Bang Time in EV and Huddles



### EV Big Bang(Korea)



### EV Big Bang(JeJu)



## Huddles

Smart Grid

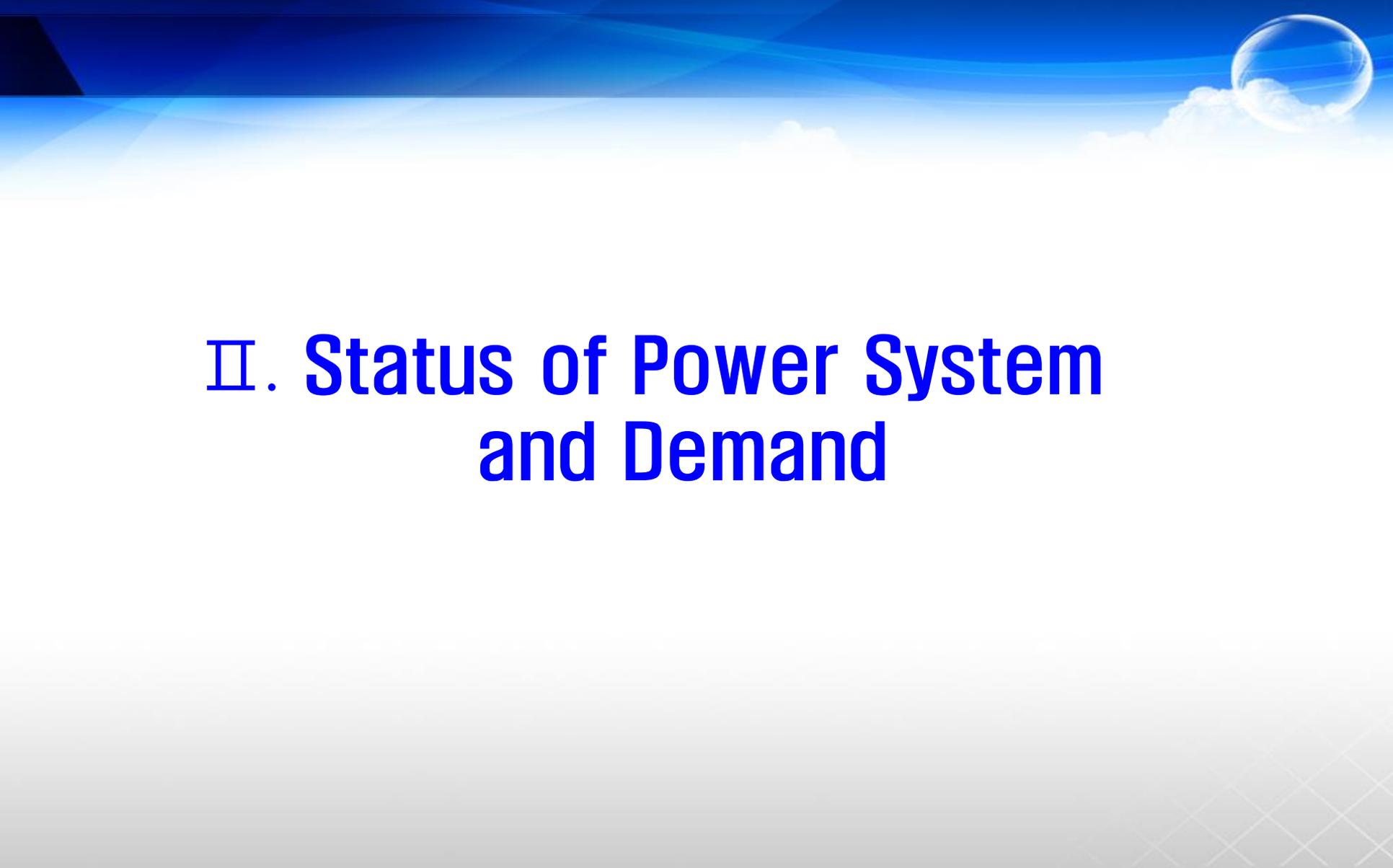
V2G

Charging Robot

EV Charging B/D

SG TOS and PPI

Fast Charging Tech



## **II. Status of Power System and Demand**

# Status of Power System & Business(2017, Kepco)



## Transmission & Distribution

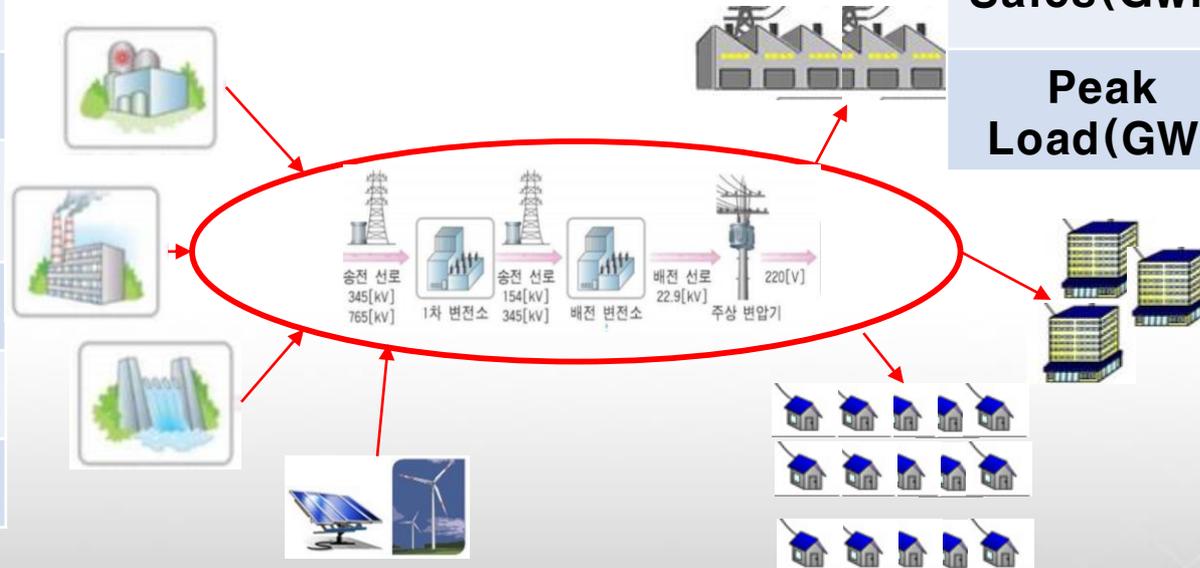
Type	Size
Transmission(c-km)	33,955
Substation Cap(MVA)	311,869
Distribution(c-km)	481,248

## Customer, Sales & Peak (Gwh, 2018)

Type	Results
Customer	23M
Sales(Gwh)	507,746
Peak Load(GW)	92.5

## Generation

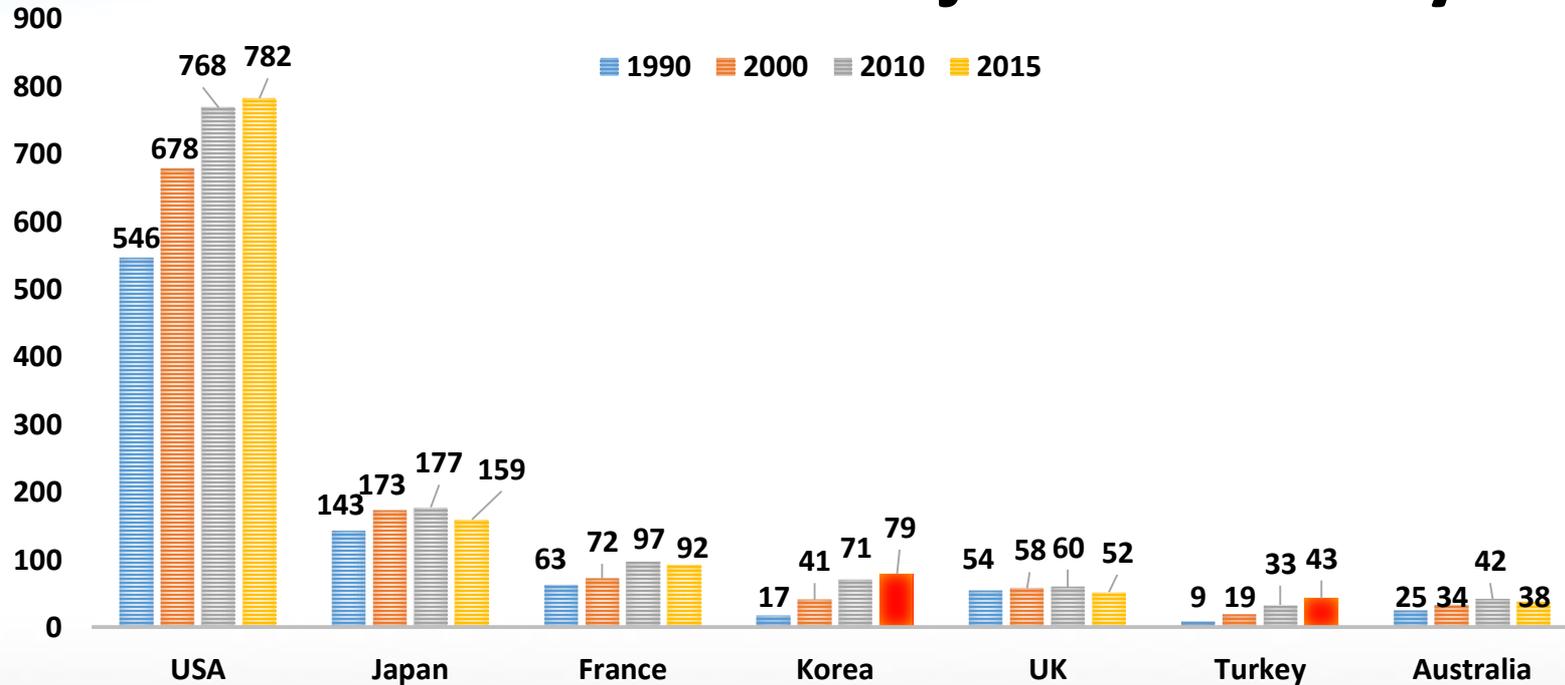
Type	Capacity
Nuclear	22.5
Thermal	41
Gas	33.8
Renewable	9.2
Hydro	6.5
Others	6.8
<b>Total(GW)</b>	<b>116</b>



# Peak of Major Country (GW, IEA '17)



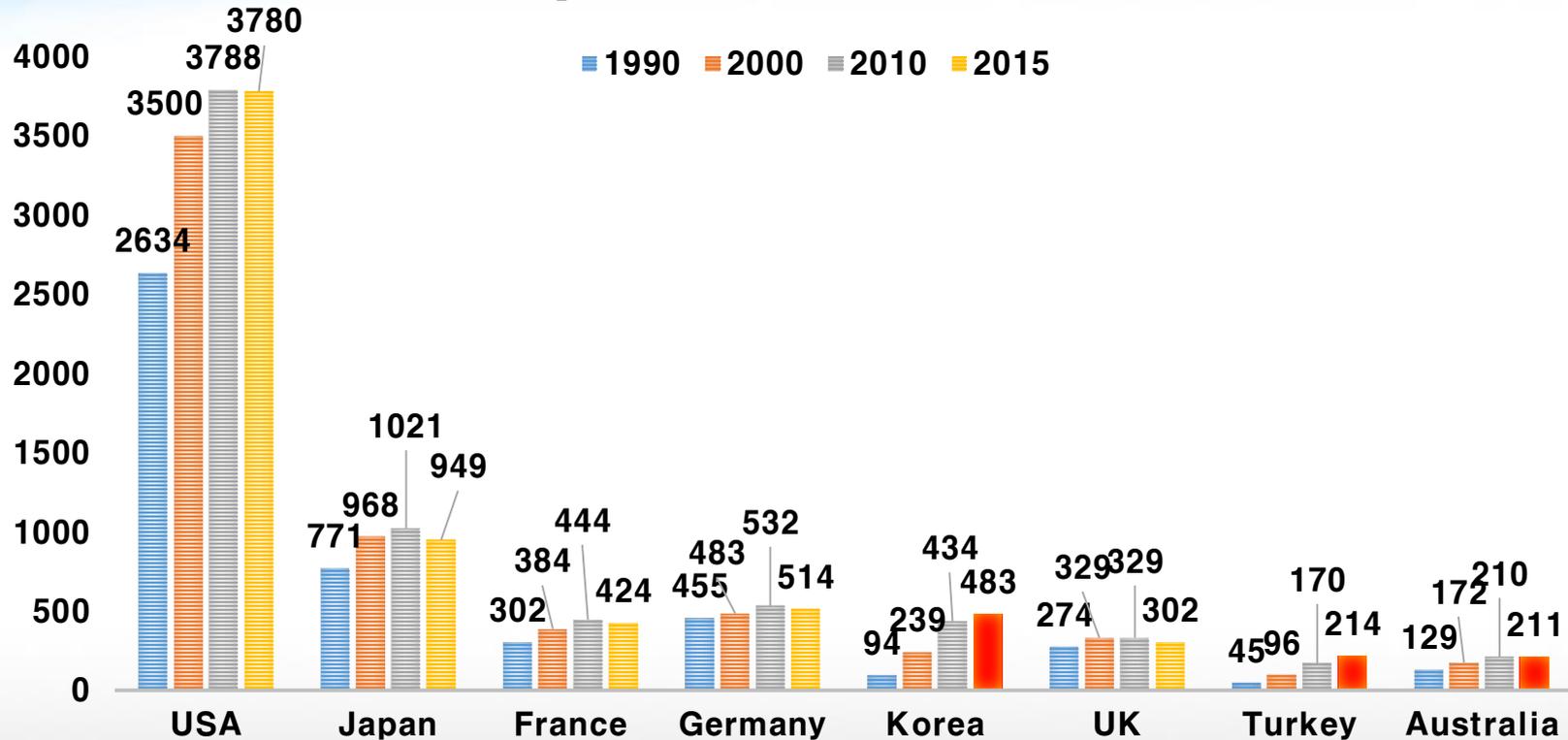
## Peak Trend In Major 7 Country



👉 Every Country Decrease the Peak from 2015 except Korea, Turkey

# Consumption of Major Country (Twh, IEA, '17)

## Consumption Trends with Renewable



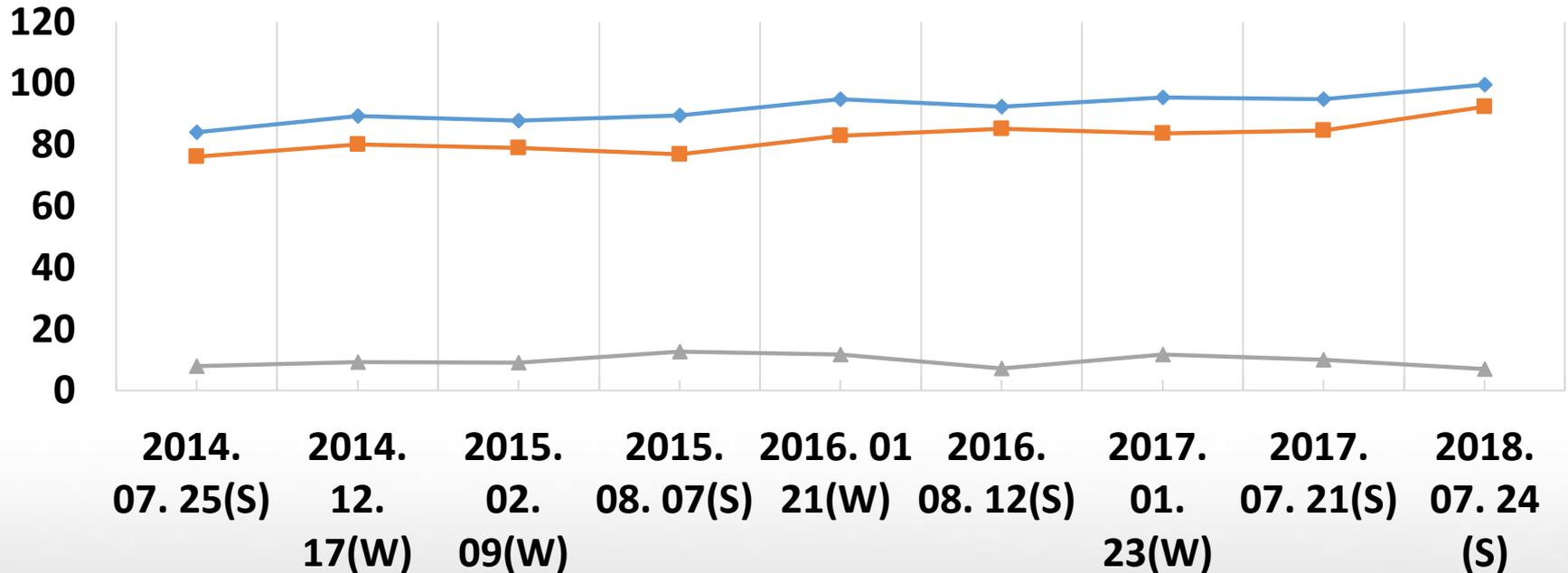
☞ Most of Country Decrease the Consumption from 2015 except ROK, Turkey, Australia

# Latest Peak During 5yr/( GWh)



## Peak Trend During 5Yr

—◆— Capacity —■— Peak —▲— Reserved



# Outlook of Peak Demand by 2030, (Gwh, KPX)



Year	2018	2020	2022	2024	2026	2028	2030
7 <sup>th</sup> Planning	91.8	97.3	101.8	105.2	108.0	110.6	113.2
Margins	5.5	6.4	7.7	8.3	8.9	10.0	11.3
8 <sup>th</sup> Planning	86.3	90.9	94.1	96.9	99.1	100.6	101.9

# Renewable Target & Rate by 2030



## ➤ Targets Capacity

Year	2017	2022	2030
GW	11.3	23.3	<b>58.5</b>

## ➤ Rate of Generation and Facilities

Year	2017	2022	2026	<b>2030</b>	2031
Generation (Twh/%)	34.4 (6.2)	58.3 (9.6)	89.5 (14.4)	125.8 <b>(20.0)</b>	126 (19.9)
Generating Facilities (GW/%)	11.3 (9.7)	23.3 (16.4)	38.8 (25.4)	58.5 <b>(33.7)</b>	58.6 (33.6)



# **III. New Challenge for Energy Business**

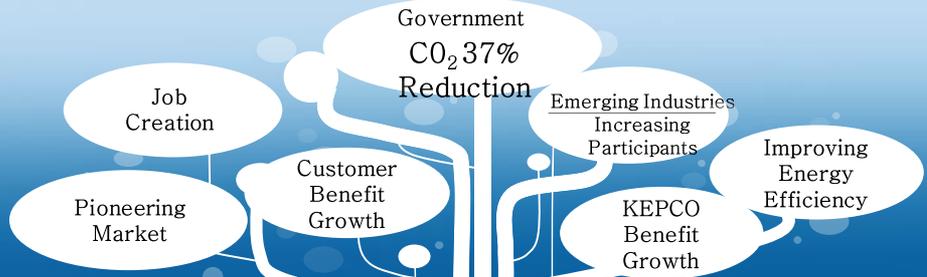
# New Strategy for Energy Business in KEPCO



VISION

Build the Response System to Climate Change & Promote the Innovative Energy Businesses

GOALS



STRATEGY



BUSINESS

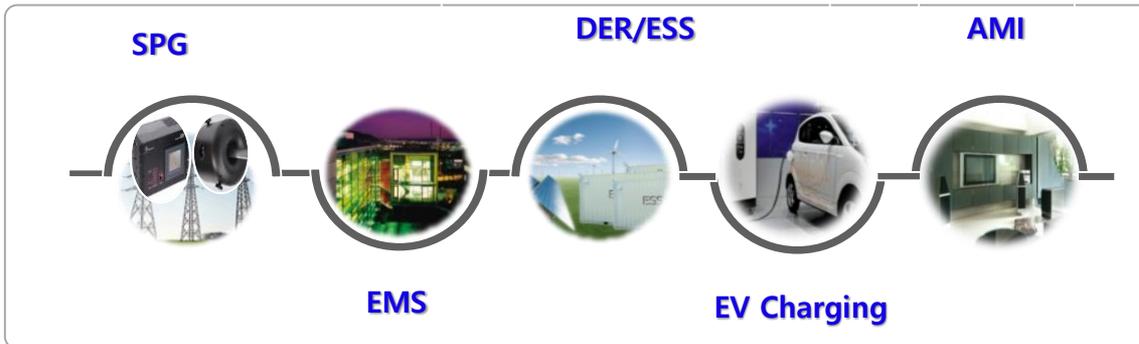


Biz-Area



# Smart Grid Test Bed in JeJU, 2009

- **Location** : Jeju North-east area
- **Scale** : 5 Fields, 2 S/S, 4 D/L, 6,000 Households
- **Partners** : 12 Consortiums (168 Companies)
- **Duration/Budget** : Dec. '09 ~ May '13 (42 Ms) / \$226.4 mill
- **Technologies & Business Models**
  - 153 Technologies including AMI, EMS, EVC, ESS
  - 9 Business Models including DR Management, EVC Service



Results in 2017

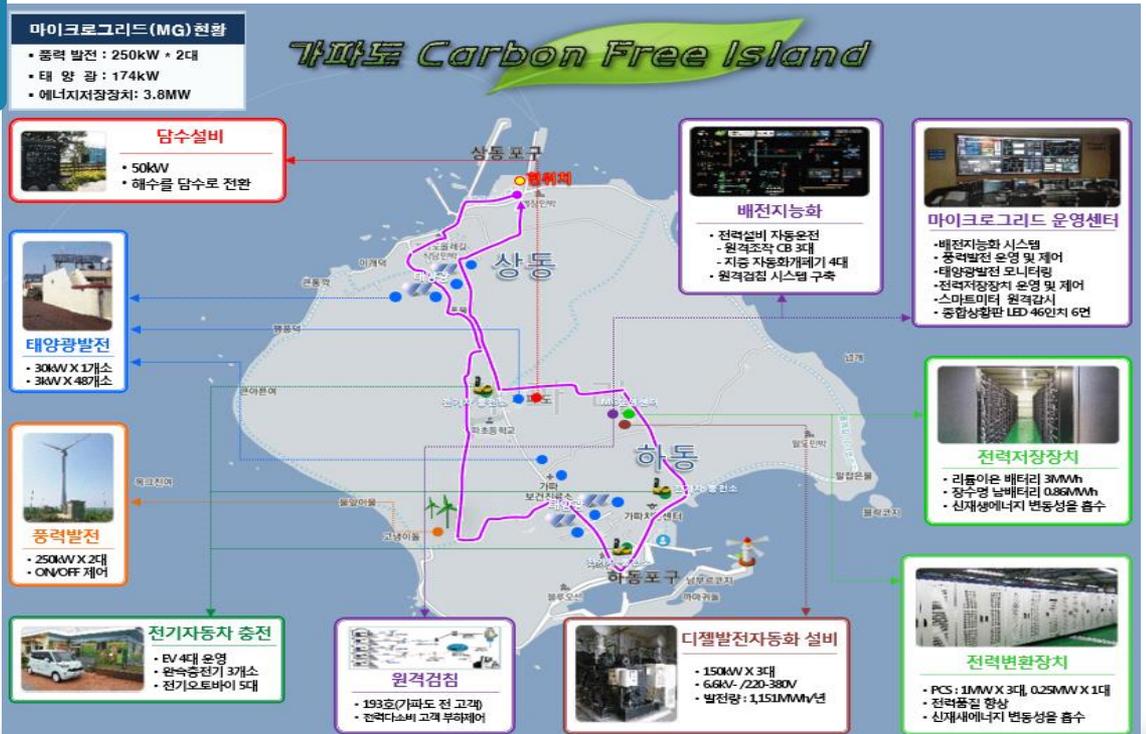
**SG Station 121**  
**F/R ESS 376MW**  
**AMI 4.45mil**

# Challenging to Develop CFI Pilot Project, 2012



- Background : Jeju Prov. offered KEPCO to Join 'Gapa CFI Project', July 2011
- Goal : Establish a Carbon Free Island (CFI) Pilot Project
- Strategy :
  - Phase 1 (11~12) : Basic Infrastructure
  - Phase 2 (12~14) : Stabilize System
  - Phase 3 (15~16) : Advanced OS

MG Components



Share, 2017

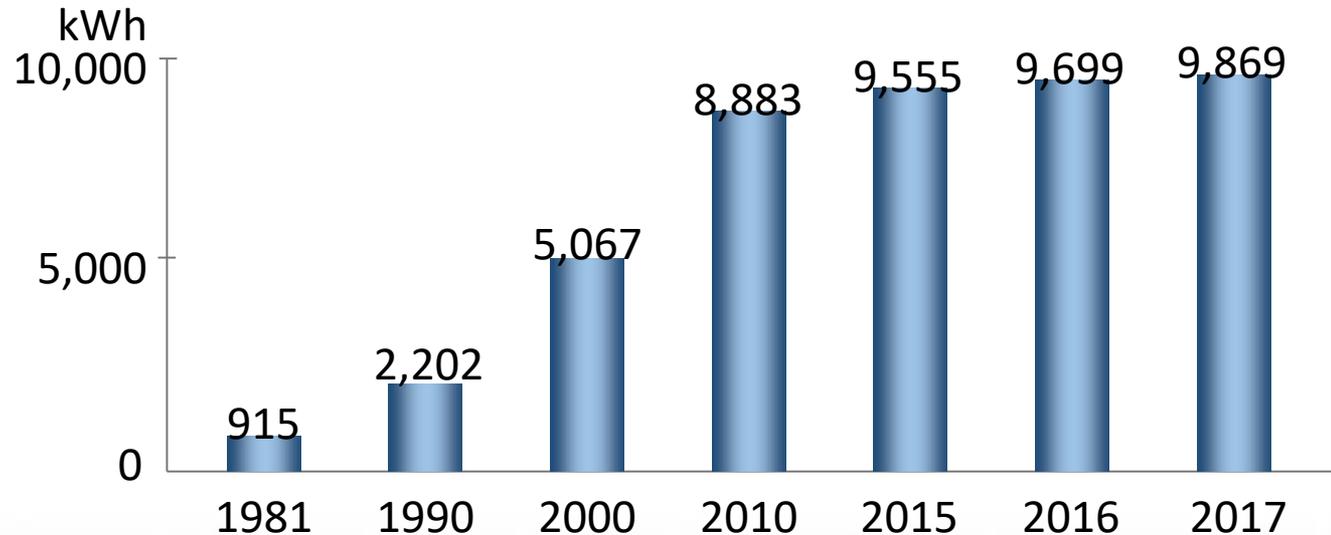


※ Gapa Island Diesel Zero, WT+PV+ESS longest 132h(about 6days) /

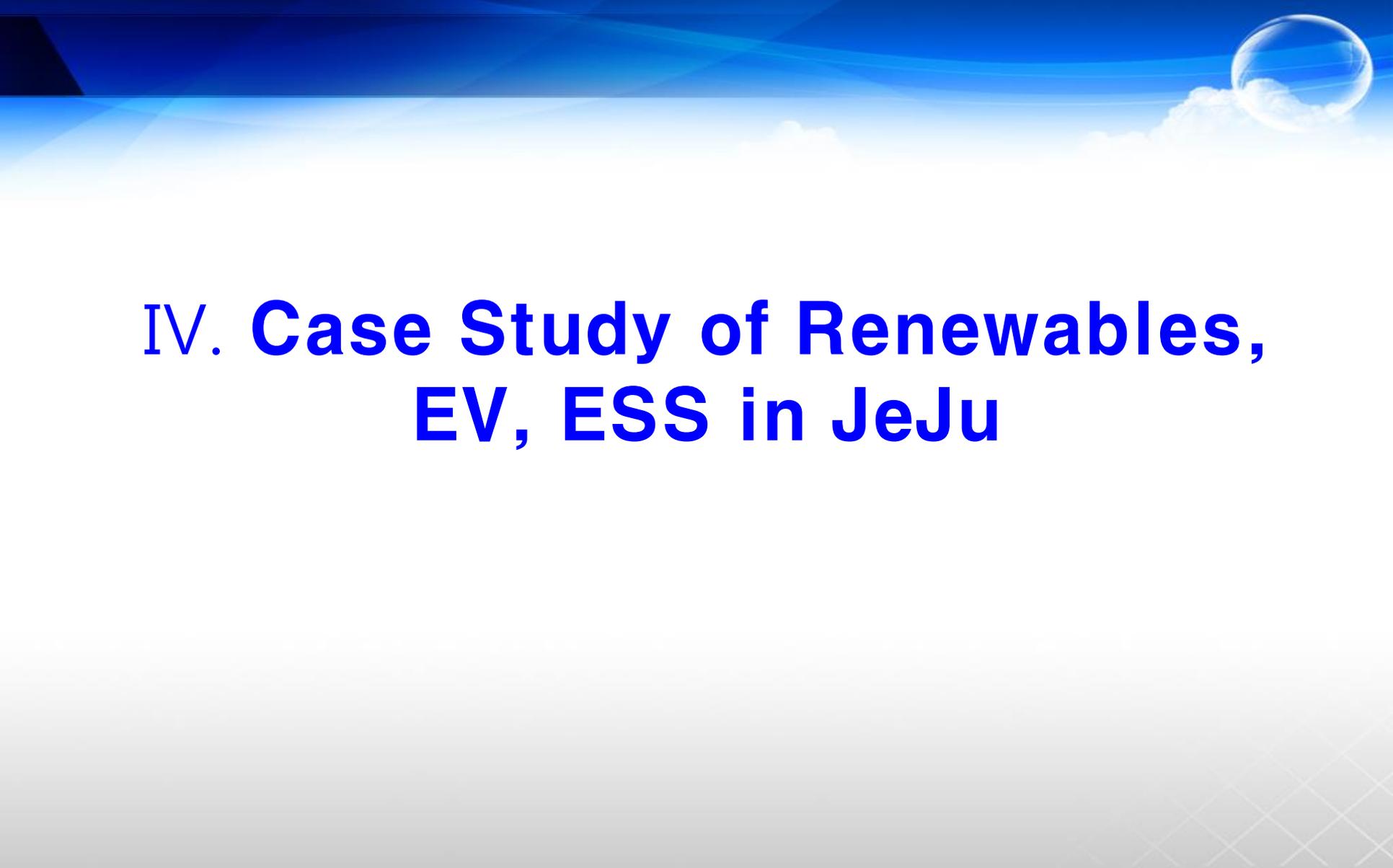
# Status of Power Consumption per Person



## Trends of Power Consumption



- **5 Times of Power Consumption Increased 1981 to 2000**
- **After 10years Rises Over 60%**
- **In the 3years the Consumption is almost same 2015 to 2017 → Efficiency of Home Appliance is more high and saturated new power customer.**



## **IV. Case Study of Renewables, EV, ESS in JeJu**

# General Status in Jeju



## Population & Customer

	Population (thousand)	Customer (thousand)	Renewable (MW)	EV	Peak (MW)
' 11	570	305	113( '12)	144( '12)	619
' 18.1	681	420	390( '17)	9,261( '17)	950
%	<b>19.5</b>	<b>37.7</b>	<b>245</b>	<b>643</b>	<b>53.4</b>

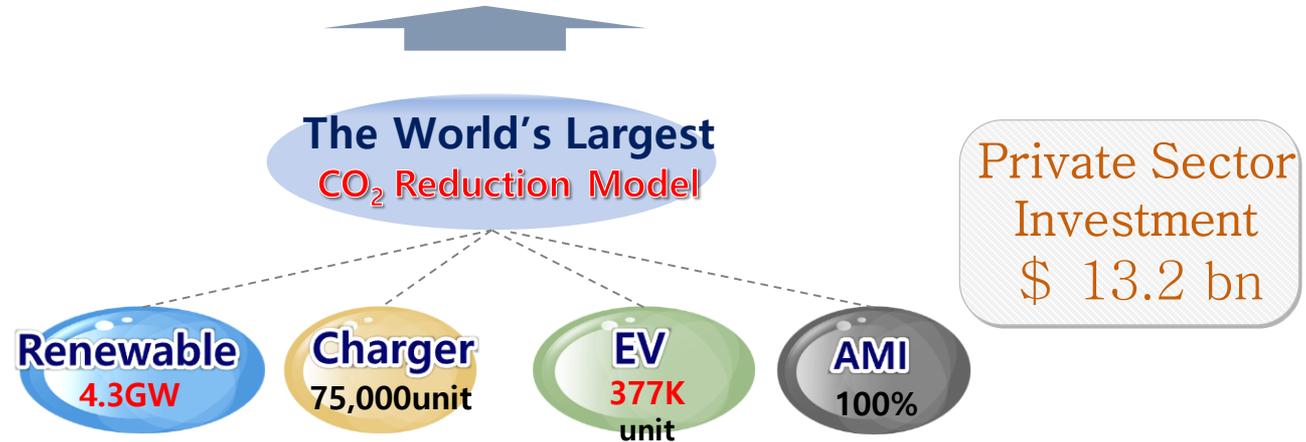
# CFI Vision and Goals in Jeju



VISION

Create Carbon Neutral Jeju, the Global Green City

CFI By 2030



Objectives

## Phase 1 (2014)

2014 CFI Test Bed

- Test-bed for CFI
- Gapa CFI Pilot Test



## Phase 2 (2020)

Infrastructure for CFI

- Expand Smart Grid
- Renewable (EV, WT)



## Phase 3 (2030)

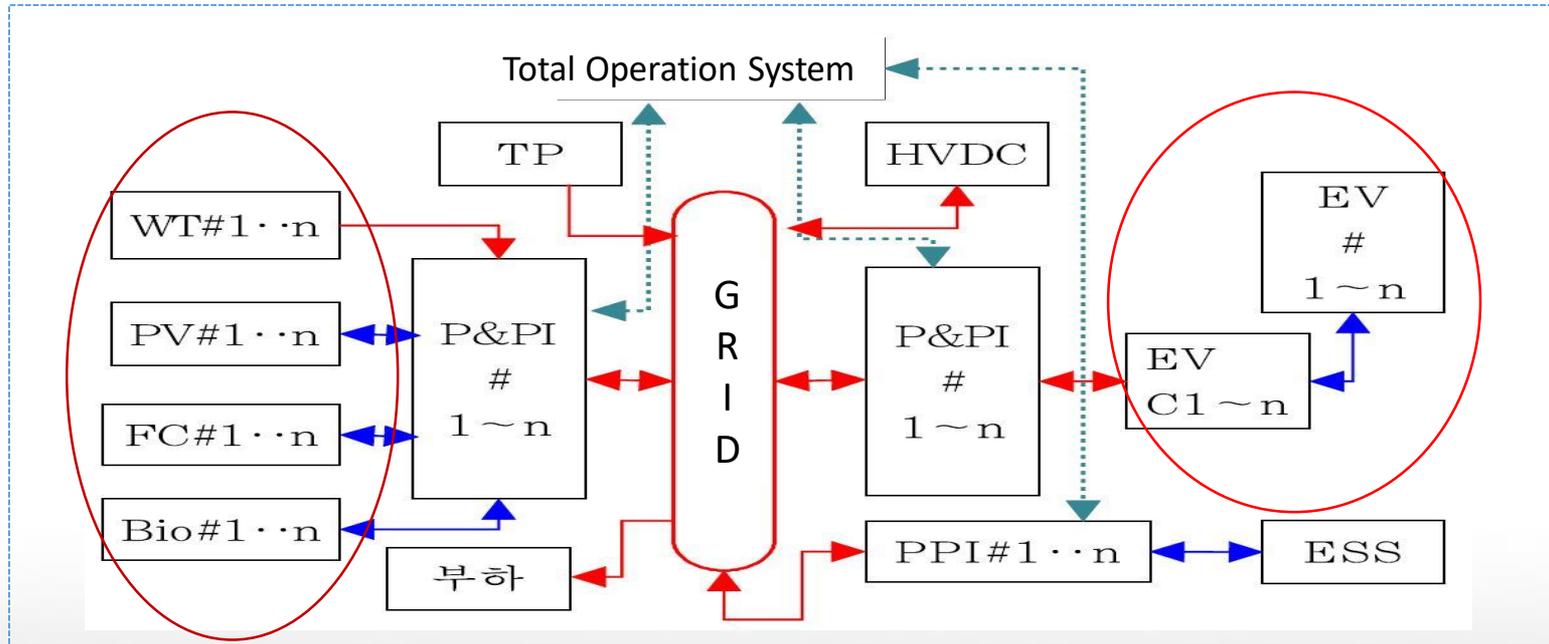
2030 CFI

- Smart Grid of whole Area with  
Renewable Energy and EV

# Rebuild for Coordinating of Renewables and EV in Jeju



## Renewables And EV, V2G System Operating Logic



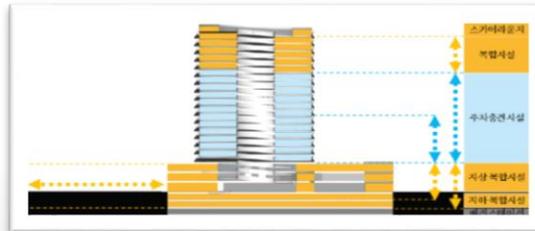
# Intelligent EV Charging & Parking Building System



EV Charging & Parking B/D	EV Total Services	Others
Multi-charging, V2G, ESS, Renewables,	Show Room, Rental, Maintenance, S/C	Shopping Mall Cafe, Facilities

## Intelligent EV Parking Bldg. Roadmap (~'17.11)

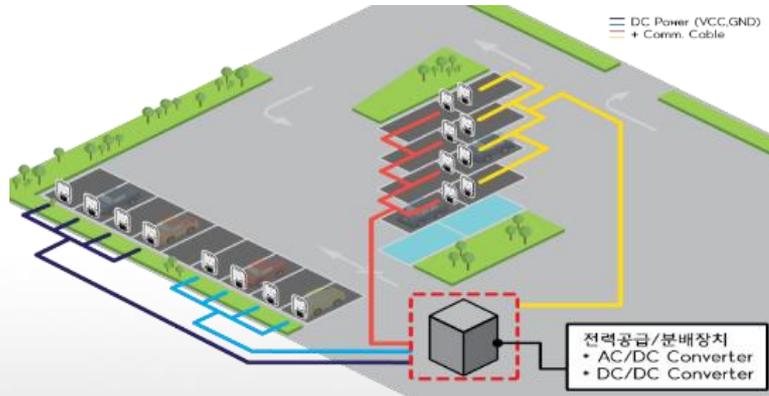
Planning Stage : Budget 40BKRW



# Intelligent Multiple EV Charging System



- **1:N Integrated Charging Sys By Intelligent Power Control Sys.**
  - ▶ **Integrated Power Control + Fast/Slow + Sequential Charging+ V2G**
  - ▶ **Scale/Site : 20 EV Charging at the Same Time/ JJHQ**
    - **Stage1) Build 20 EVC, Stage2) Build 50 EVC**



Current		New System
<ul style="list-style-type: none"><li>▪ Charging type : 1 to 1</li><li>▪ Single Charge, No control System</li></ul>	➔	<ul style="list-style-type: none"><li>▪ Charging type : 1 to N</li><li>▪ Sequential Charging, V2G</li></ul>



# Renewable Gen. in Jeju



## Renewable Gen.

- PV, WT, Bio, FC, etc. 4.3GW
- Renewable Rate : (WT) Ave 22.9%, Max/Min 8Times  
(PV) Ave 12.9%, Max/Min 3times

Power  
Stabilization

124MW in '13 → 407MW in '17  
3.5 times more in 4 years



2.5 times than '13



12 times than '13



4 times than '13



# ESS with Renewable Energy(2017)



## ✎ Main Renewable Energy & ESS Cap.

Types	WT	PV	Bio	Waste	Small Hydro	PPA	ESS	Total
Site	21	409	3	2	2	1	6	437
Capacity (MW)	272.8	120.2	6.0	2.2	0.46	4.9	50.8	406
Rate(%)	67	29.9	1.4	0.4	0.1	1.2	-	100

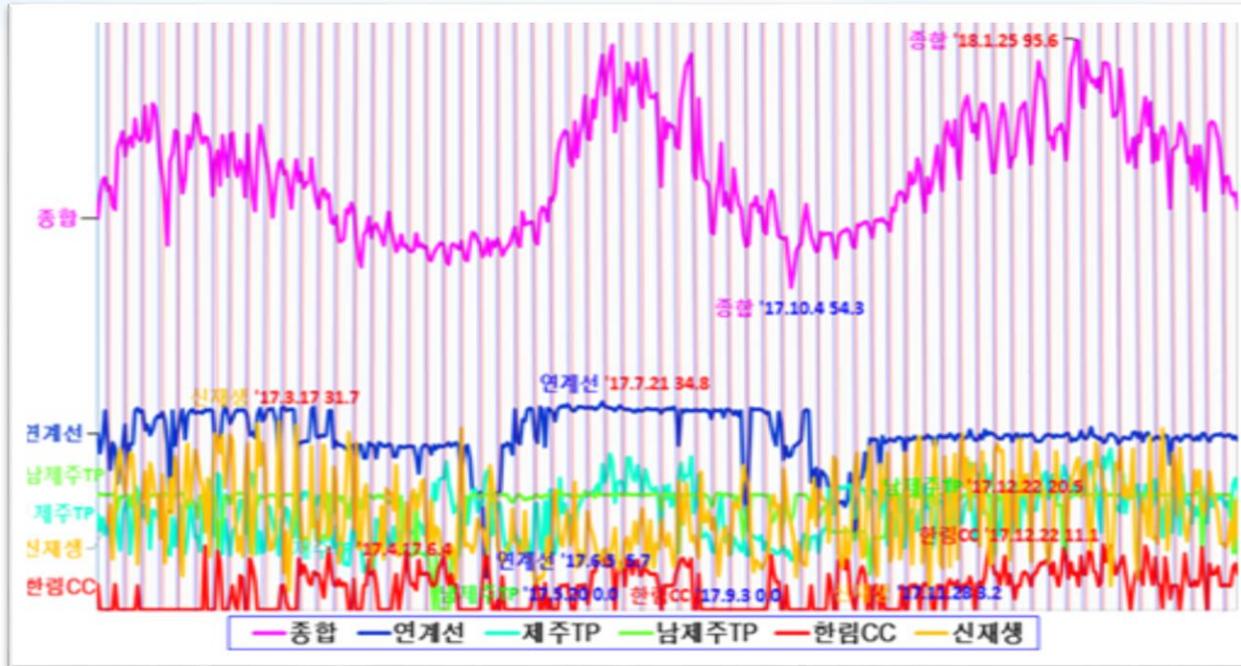
✎ WT and PV took 96.9% among the entire renewables

## ✎ Operation of ESS

✎ ESS connected with WT, was stored Power and Resupply to Peak time towards Grid for improving benefit.

# Operational Pattern of Sources in JEU & Forecast

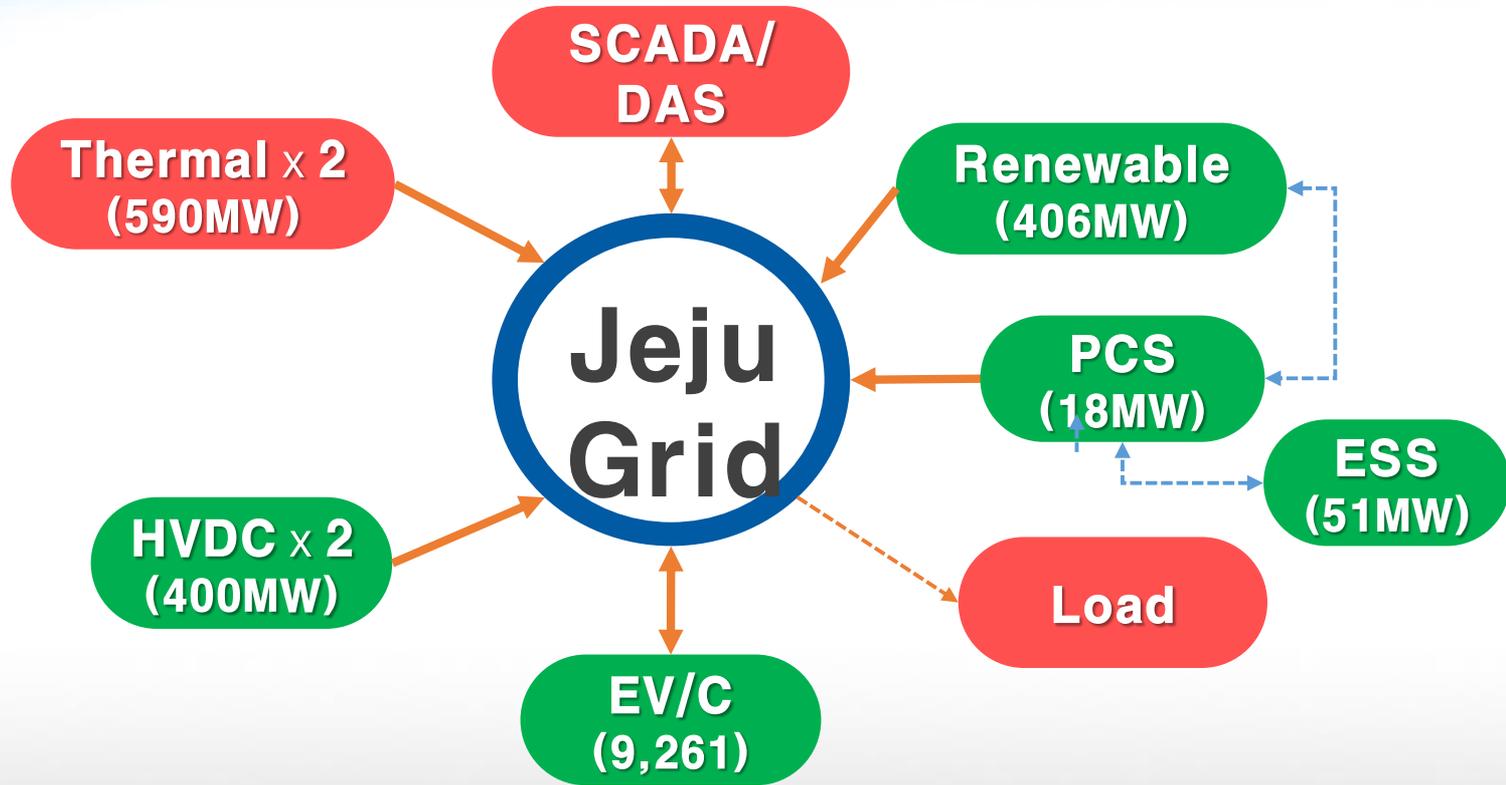
## Operation pattern of Sources



## Power Characteristic

- (Load Curve)'17.1~'18.6(17Months) / (Peak)'18.1 0.95GW, (Low)'17.10 0.54GW
- (HVDC) Supply to Jeju is static (Every Spring, Winter is decrease /
- (PV) Strong Up-down Depending on Weather

# JEJU Power Grid LINK





**V. New Energy Business  
Portfolio under 4<sup>th</sup> IR**

# Signals of 4<sup>th</sup> Industrial Revolution



## Key factor of 4<sup>th</sup> IR

√ Attention to the Essence of the IR in the past

√ Expectation of Physical, Biological & Digital Convergence

Robot

AI

Unmanned Aviation

3D Printing

Big Data

Nano

√ Energy Revolution according to consumer needs

1<sup>st</sup> IR

- Cheap wool, coal and steel wire

2<sup>nd</sup> IR

- TV, Refrigerator, Cars

3<sup>rd</sup> IR

- PC + Internet at home

3.5<sup>th</sup> IR

- Smartphone + App, Lte

4<sup>th</sup> IR

- Intelligent Appliances, Electric cooking, EV

# Smart City Biz-Model in Jeju and Operation System



- Gov., KEPCO's New Energy Policy and Int'l Trends
- Strategy for Jeju, CFI by 2030 and Related Biz-Model
- Introduce Biz Result based on SG and Gapa MG Island
- World's first CFI operating system



2030 Jeju CFI Power Grid Operation Sys(DER+EV)



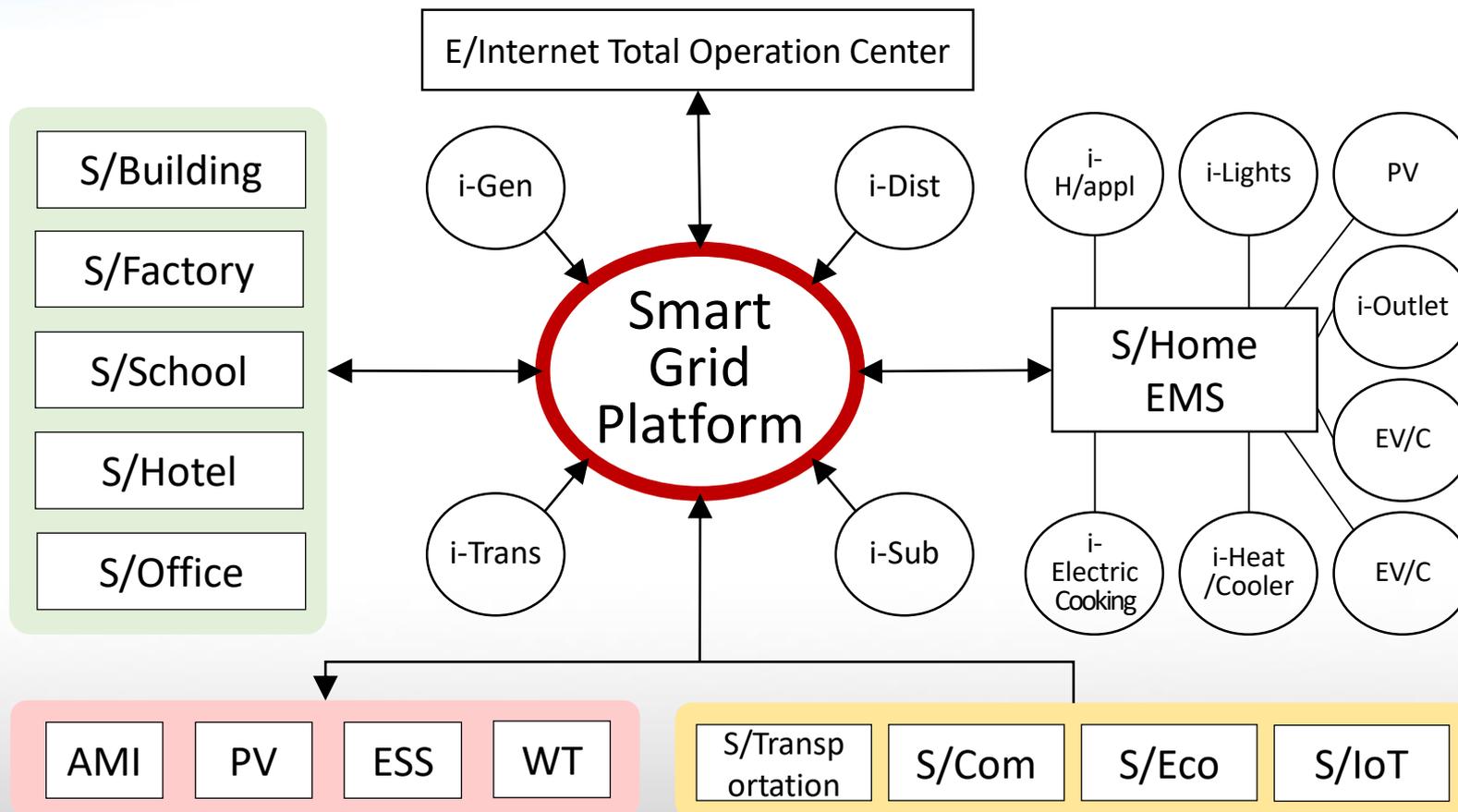
**LINK**

Smart Town System Configuration

# Smart Grid Platform for Smart City & Operating



## Smart City Component based on SG Platform



# CFI Operation System in Jeju by 2030

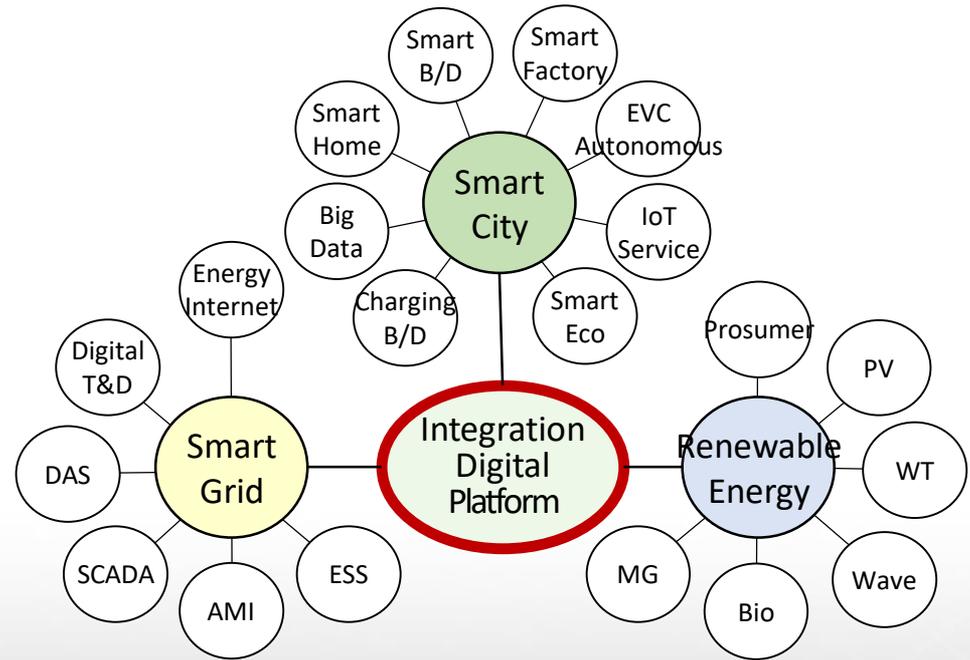
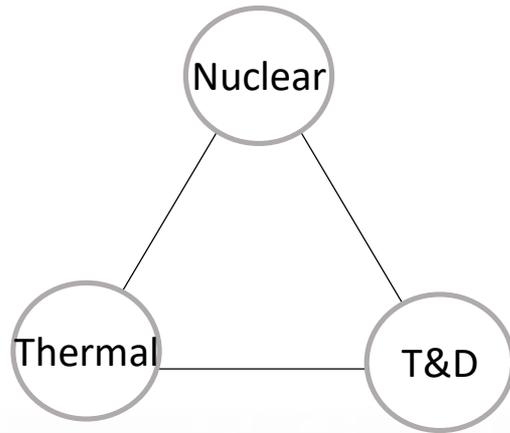


# Energy Business Portfolio for 4<sup>th</sup> IR



Change the Conventional Biz-Model to New One for 4<sup>th</sup> IR

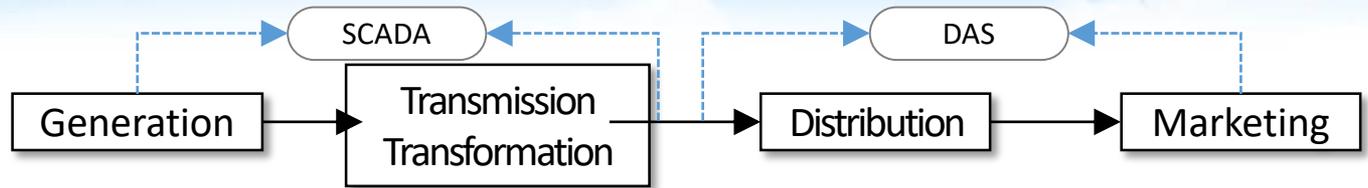
■ Smart City, Smart Grid, Renewable make Various New Business Model



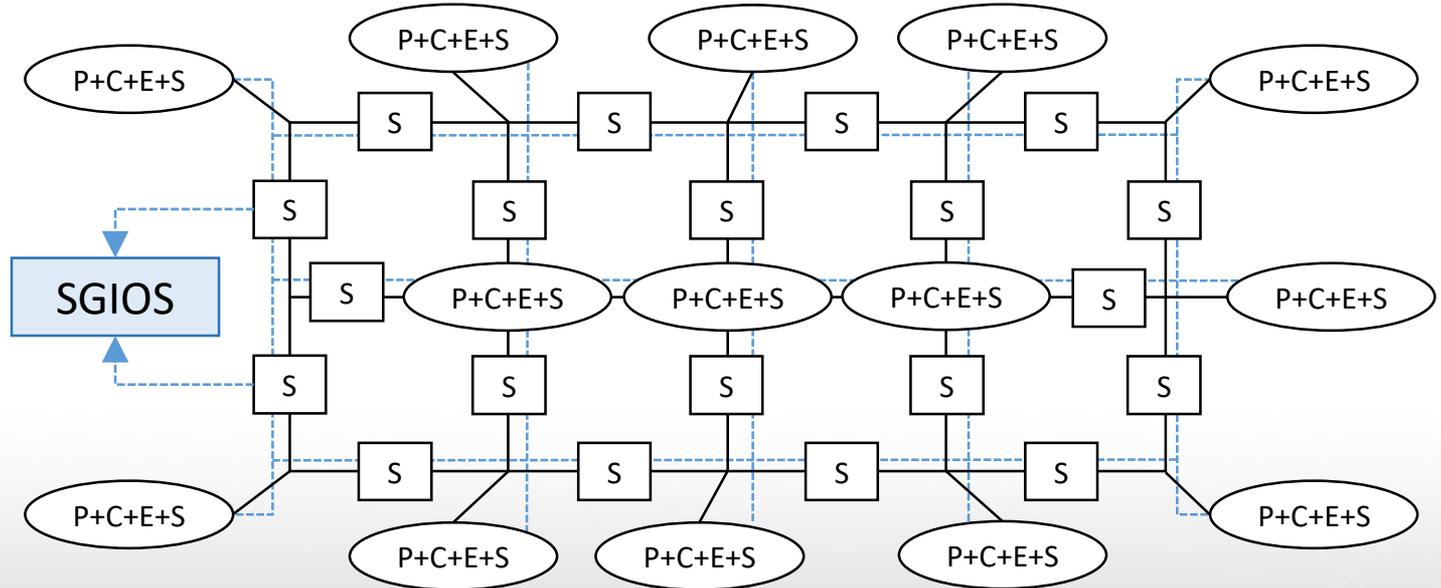
# Reconstruction Strategy New Intelligent Power Grid



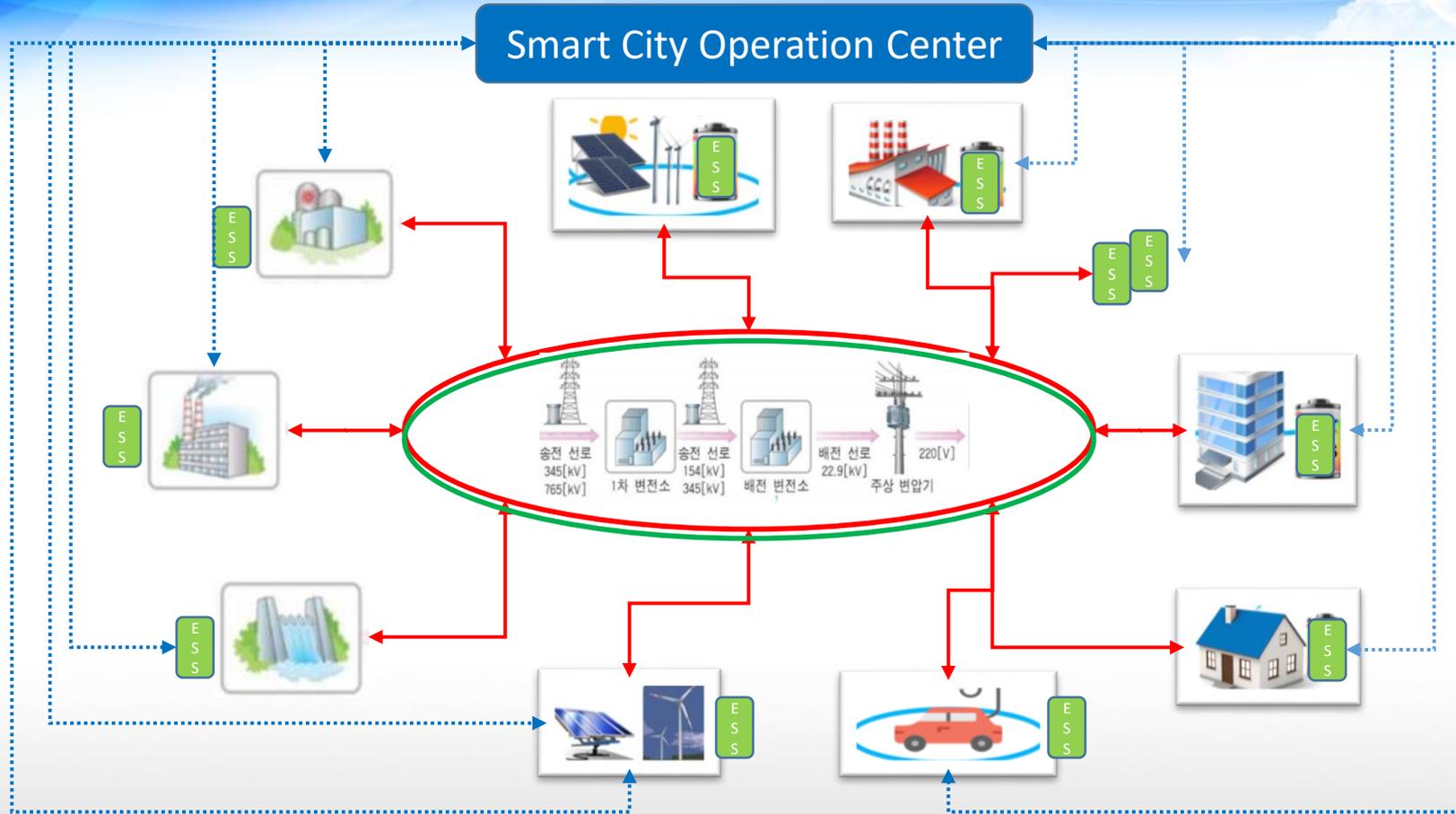
**Traditional Grid**



**4<sup>th</sup> IR Grid  
= Smart Grid**



# Smart Grid Configuration with New Resources





**Thank you for Your Attention!**  
**Q&A**