# Smart Grid Experience & Next Step in Korea

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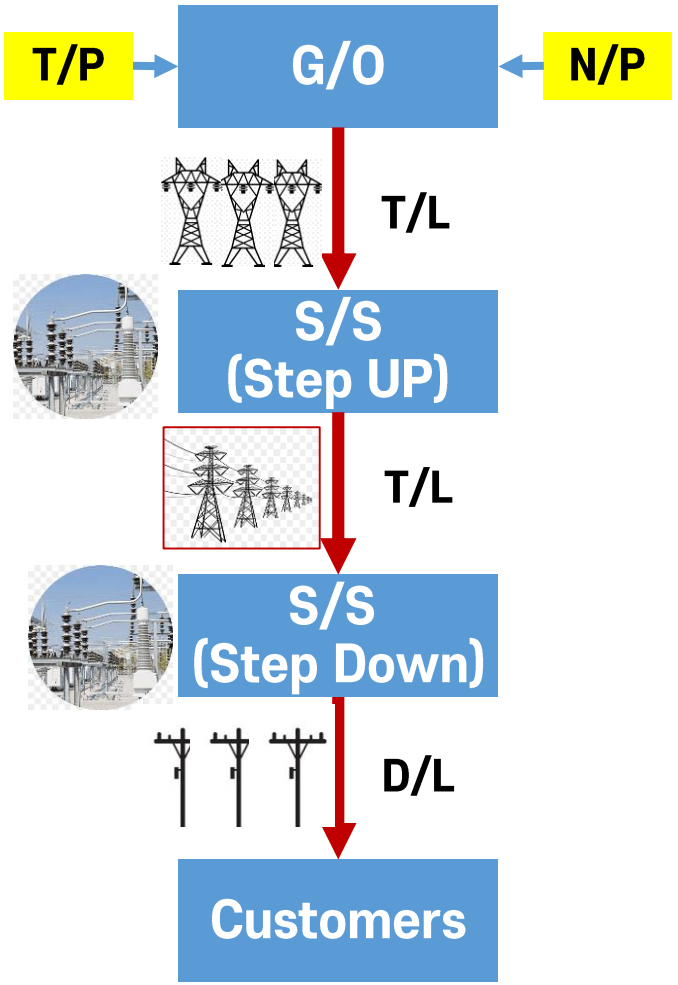
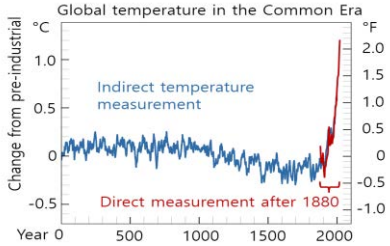
# Ⅰ. Developing Stage of Smart Grid in Jeju

# 1 Why should Power Systems be Upgraded to Smart Grids?

## <Conventional Grids>



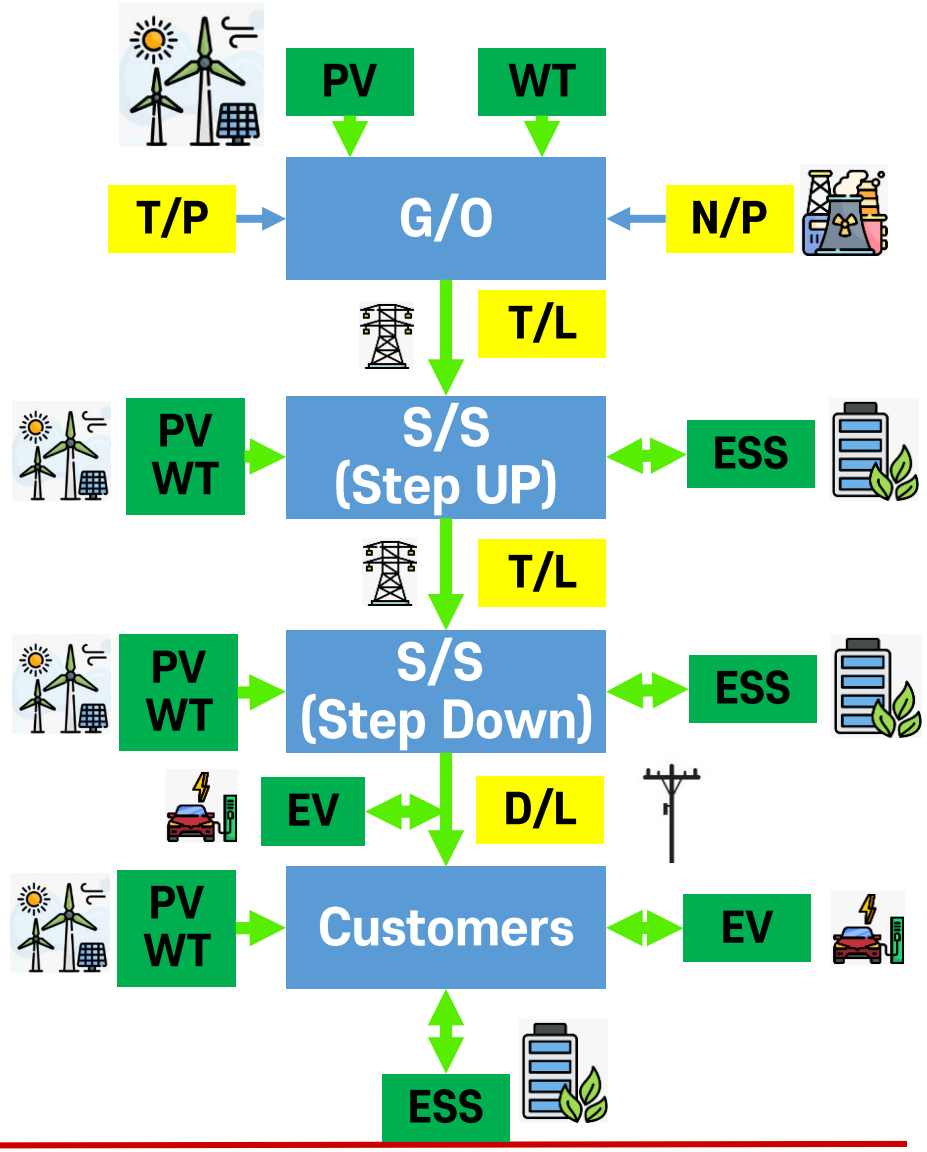

Global Warming

Climate Change

Climate Crisis

Climate Boiling


## <Smart Grids>



# Smart Grid Test Bed in JeJu

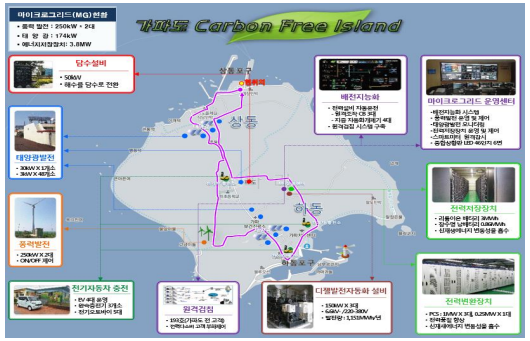
## Overview

| | | |
|---|---|---|
| Location | Jeju East-north Area | ▪ Technologies & Business Models<br>- 153 Technologies including AMI, EMS, EVC, ESS<br>- 9 Business Models including DR Management, EVC Service |
| Scale | 5Sector, 2S/S, 4DL, Customer 6,000 | |
| Partners | 12Group 168company | |
| Duration | '09.12 ~ '13.5 (42month) | |
| Budgets | $246.5M (Gov't $73,9m, KEPCO $23,9m, Private $148.7m) | |

| Sector | Major | Attended | Budget (b/₩) | Sector | Major | Attended | Budget (b/₩) |
|---|---|---|---|---|---|---|---|
| Smart Power Grid | KEPCO | 10 | 32.4 | Smart Transportation | KEPCO | 21 | 19.6 |
| Smart Place | KEPCO | 29 | 13.2 | | SK Innovation | 10 | 18..9 |
| | SKT | 23 | 27.8 | | GS | 10 | 14.5 |
| | KT | 19 | 33.4 | Smart Renewable | KEPCO | 16 | 17.5 |
| | LG | 9 | 23.2 | | Hyundai | 6 | 11.5 |
| Smart Elec. Service | KEPCO/KPX | 7 | 21.5 | | POSCO ICT | 8 | 13.0 |
| Total | | | | | | 168 | 246.5 |

# Initial Performances/Core Technology & BM

2009.10 EV Charging(Beginning)




2011.10 1st Gapa MG

2013 1St EVC+ PV+ESS

2014.2 1St Smart B/D MG


2015. 7 1St FR ESS

2016.10 1St SE Town

2016. 5 1St SE Town in Dubai

**Sharing of Developed New Business Models**

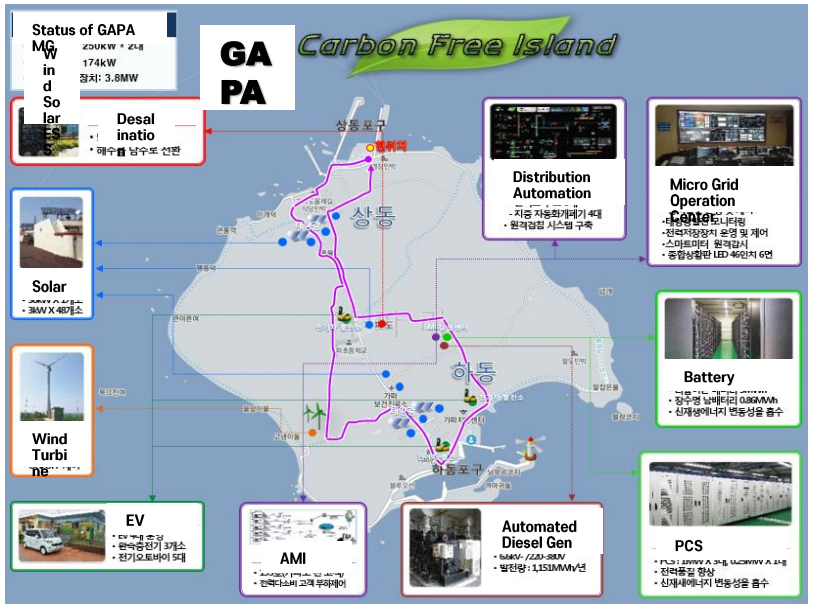
2016.10 1St SE Town in MD, USA, MOU

# The 1st Micro Grid of Gapa Island, '11~'12

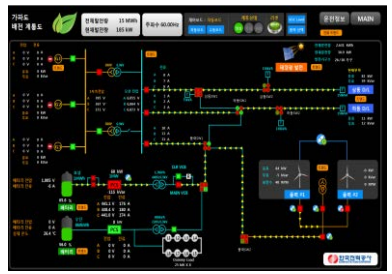
- Background : Jeju Prov. Developed with KEPCO on 'Gapa MG', 2011
- Goals: Establishing Independent MG using SG Test Bed Products

## MG Components

- ✓ Size : 0.85㎢ 300 people
- ✓ WT : 250kW X 2
- ✓ PV : 37 house
- ✓ ESS : 3.85MWh
- ✓ EMS Investment







**Gapa Island** has 7days on WT+PV+ESS including EV,AMI, DAS without Diesel

# Ⅱ. Maturity Performances after Smart Grid Test Bed

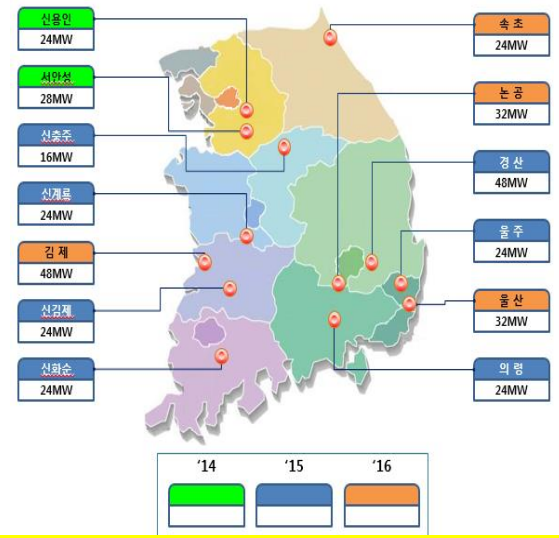
# Energy Storage System for Frequency Regulation


2009 SG 150kW ESS Demonstration

**The First Time demonstrated ESS +EV Charging Technology, Developing Scale ESS for FR in Jeju Haeng-won**


2013 Jocheon S/S 8MWh Development

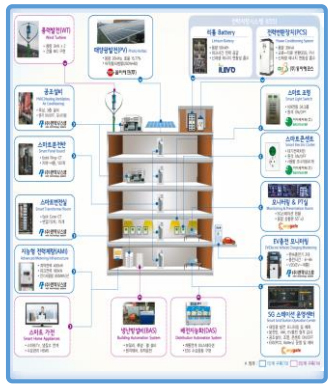
West Ansung/ Shin Yongin S/S
52 MWh 2015


**13 Area, Total 376MW within 3yr**

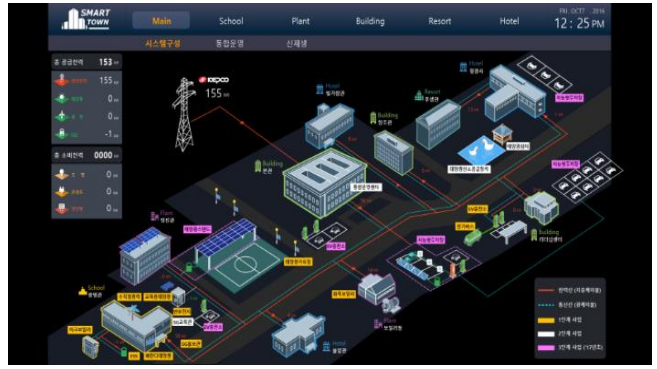
# Building MG & Smart Energy Town

## ➢ BEMS, ’13





## ➢ Smart Energy Town, ‘16



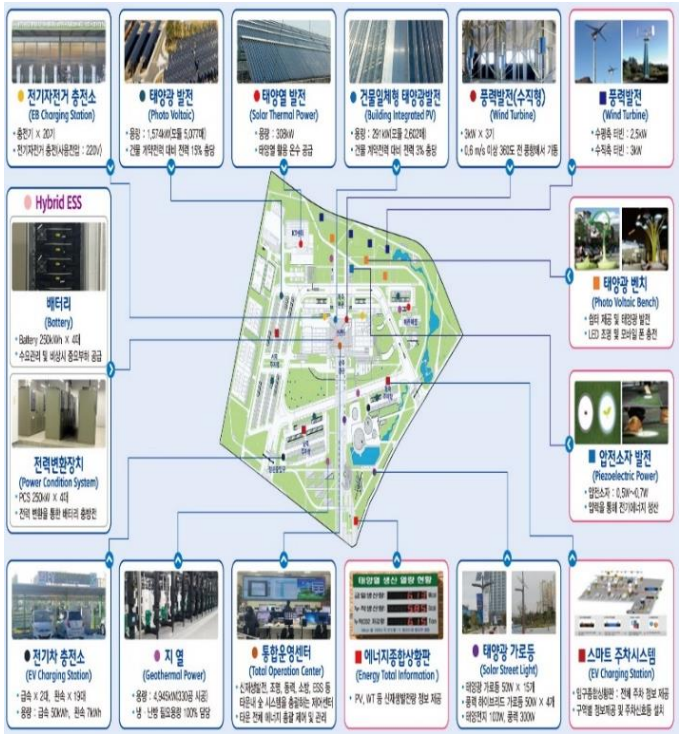
## ➢ AMI


**Effects**

- Peak Cut 10%, CO2 Cut 5%
- Power Consumption 10%,
- Oil Cost Save 10%

# Big Size Smart Town and Smart City

- **Smart Town: ’16.3 ~ ’16.12**
  - SGS : DER, BAS SI and Management
  - ESS(1MW) : Demand Management

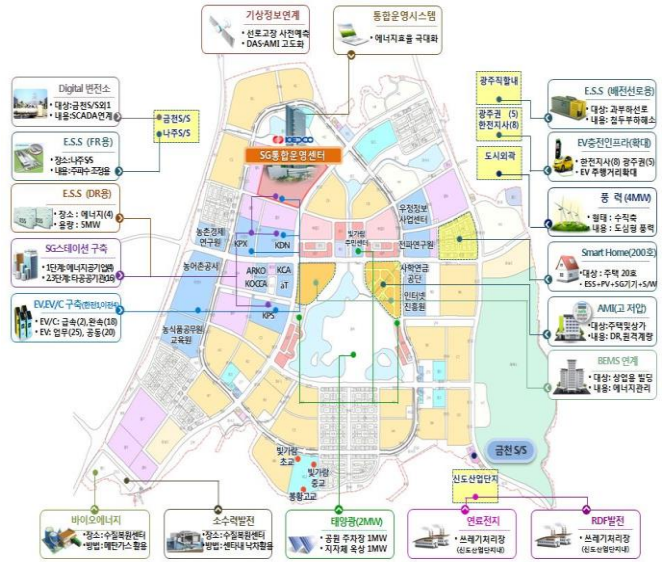



**Effects**

- Peak Cut 25%, CO2 Cut 5,070t

- **Smart City: ’16.12 ~**

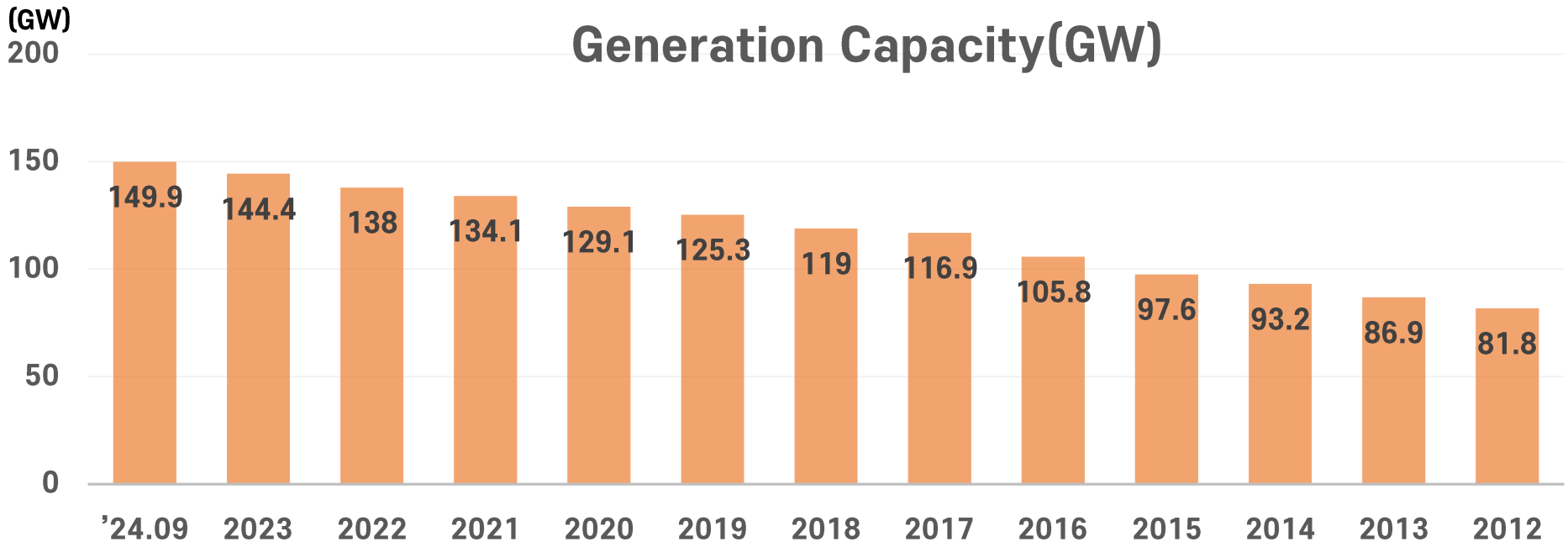
| DER(6MW), FC(20MW), Bio(20MW) |
|---|
| SGS(20B/D), ESS(30MW), Smart Home |
| EV(150), EV Bus(1), EV Charger(11) |




| Efficiency | Self Sufficient | $CO_2$ Cut |
|---|---|---|
| 15% | 30% | 32% |

# Accelerated Energy Transition Since 2012

## ➢ Generation Capacity




## ➢ Cap/yr

| Yr | '12 | '13 | '15 | '17 | '19 | '20 | '21 | '22 | '23 | '24. 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Cap | 690 | 1,080 | 2,538 | 5,062 | 10,505 | 14,575 | 18,161 | 20,975 | 23,943 | 26,077 |

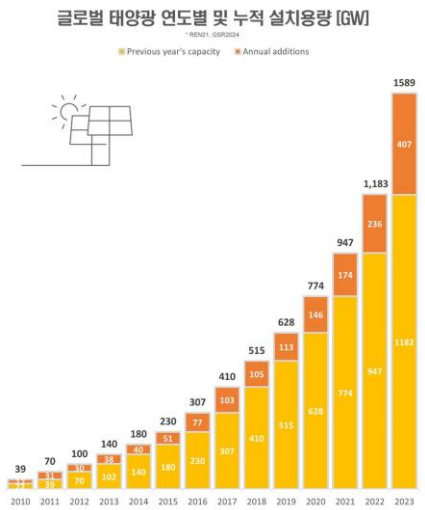
## ➢ Rate(%)

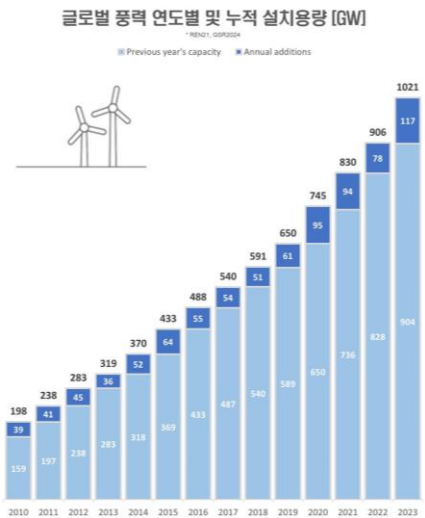
| Item | '12(GW) | '24.9(GW) | Rate(%) |
|---|---|---|---|
| NP | 20.7 | 26 | 126% |
| TP | 52.3 | 85 | 163% |
| RES | 8.7 | 38 | 437% |
| Total | 81.7 | 149 | 182% |

https://epsis.kpx.or.kr/

# Renewables, Now and Future by 2040

## PV 30times, WT 4.5times during 12yr




### 전국

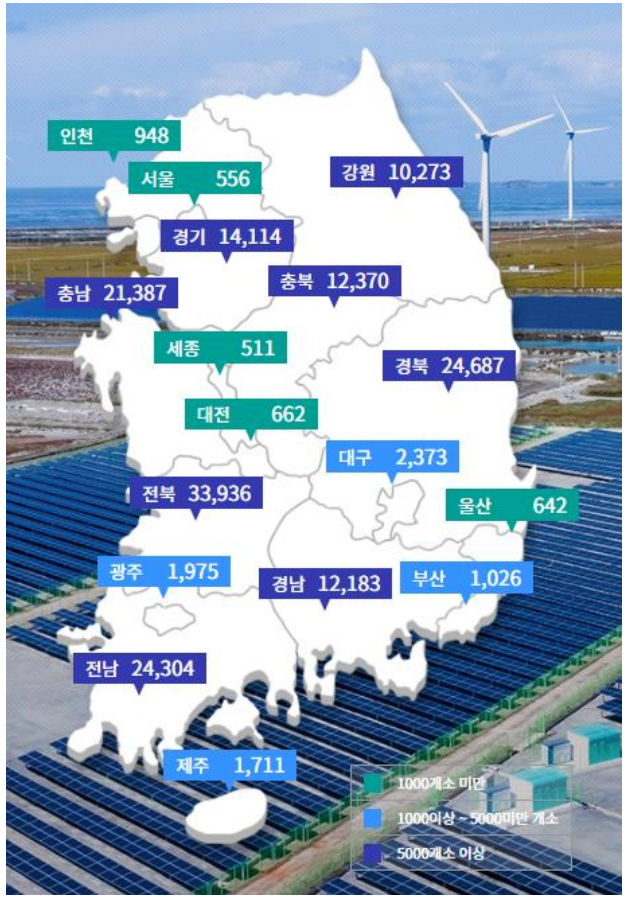
태양광 발전소개소 (*2024.09.23 기준)
**163,658** 개소

태양광 발전소용량 (*2024.09.23 기준)
**25,335** MW

연간 태양광 발전량 (**2023년도 기준)
**28,105,384** MWh

* 2024.09월 기준
** 23년도 발전량 : '23.01~12월에 해당
ⓘ 전국 지역별 RPS 발전소 개소

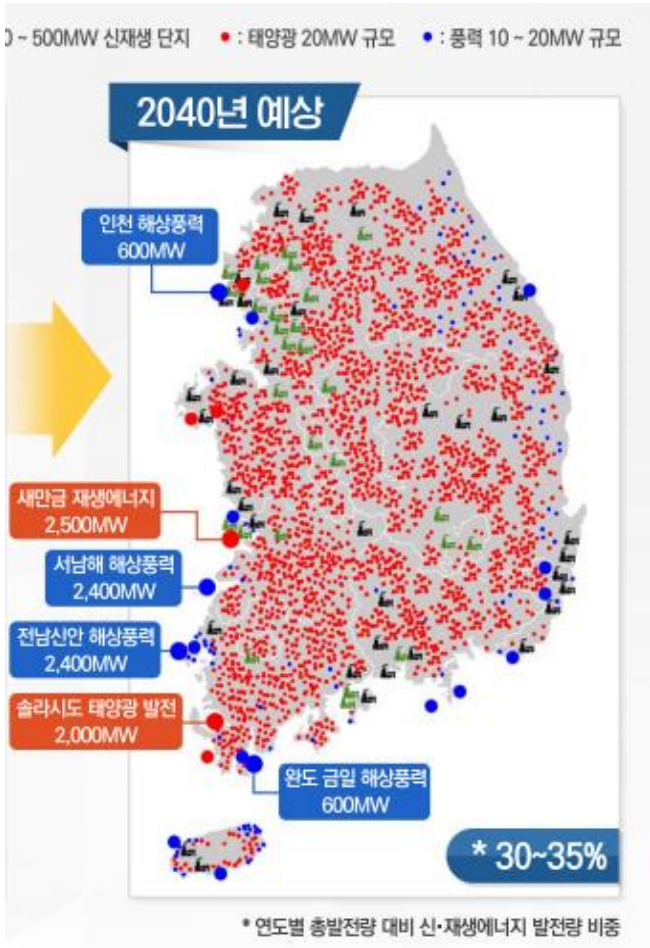

**2024.9**




https://recloud.energy.or.kr/main/main.do

## 10m PV's Site

**2040**



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# EV Models and Mileage & New Challenge

## 2022, 500km/1time charging ↑

'21.12/'23.10 Aito Huawei


'22/'24.3 Xiaomi SU7

'28.1 Apple Titan

'22.1/'24.1 Sonyhonda Afeela


2024, Cadillac Escalade iQ

2023 A6, AUDI

2025, Five Bentley

2023 i5, BMW 300miles

2024, Buick Electra

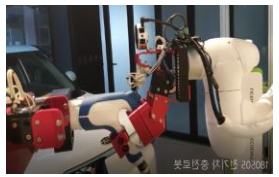
# ICE & Electric Vehicle and Chargers

➢ EV: 600,610/’24.6

| Item | 2010 | 2012 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ICE (10k) | 1,794 | 1,887 | 2,012 | 2,099 | 2,180 | 2,253 | 2,320 | 2,368 | 2,437 | 2,491 | 2,550 | 2,594.9 |
| EV (Unit) | ~1,091 | | 2,775 | 5,712 | 10,855 | 25,108 | 55,756 | 89,918 | 134,962 | 231,443 | 389,855 | 543,900 |
| Chargers | - | | - | - | - | 13,676 | 27,352 | 44,792 | 64,188 | 103,089 (‘21.11) | 205,205 | 505,309 |

2012

2024



➢ Policy of Local Gov’t

➢ New ICE Registration Restrictions :
- ✓ Jeju Government from 2030
- ✓ Seoul City from 2035

# Carbon Neutrality Goals & Performances

## ➢ Goals

| Year | 2018 | 2030 | | 2050 |
|---|---|---|---|---|
| | | Goals | Rate(%) | Rate(%) |
| Size(million ton $CO_2$eq ) | 727.6 | 291 | 40 | 100 |

## ➢ Performances

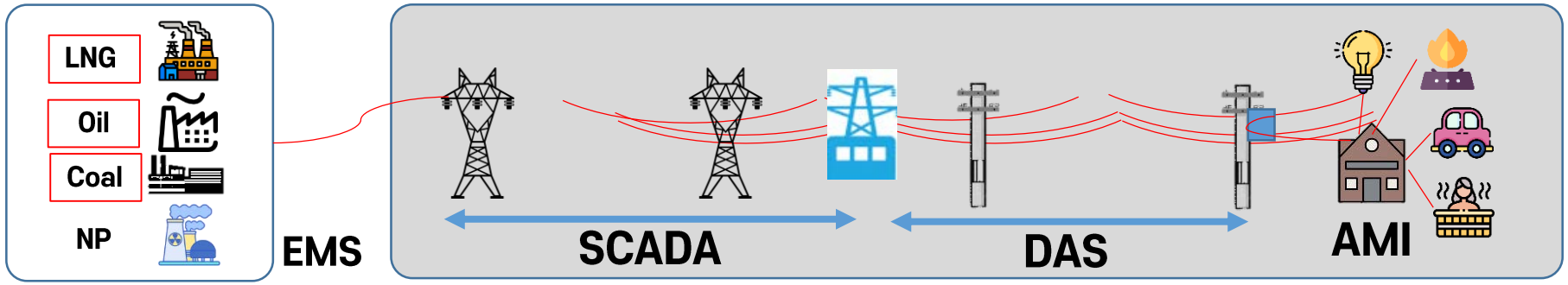
| Item | PV('12/'24)('24.9) | ESS('22.12) | EV/Charger('24.6) |
|---|---|---|---|
| Site/Unit | 163,658 | 2,784 | 606,610 |
| Cap/Unit | 690MW/25.3GW | 10,166MWh | 304,309 |

## ➢ Fire Incident Involving EV & ESS

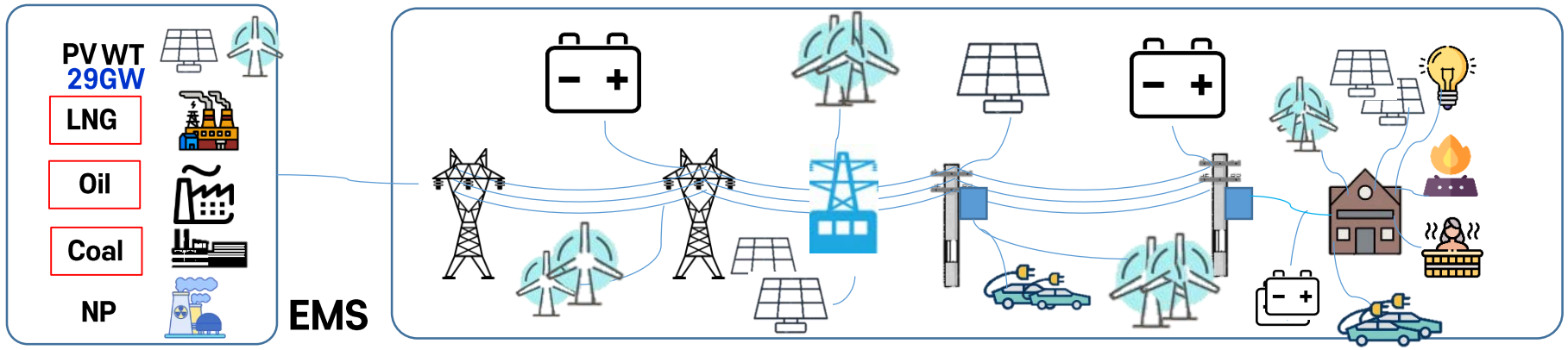
| Item | Fire(unit) | Durations |
|---|---|---|
| ESS | 55 | '17~'24.6 |
| EV | 187 | '18~'24.6 |

# Smart Grid System by 2030

**Before 100Yr BM**

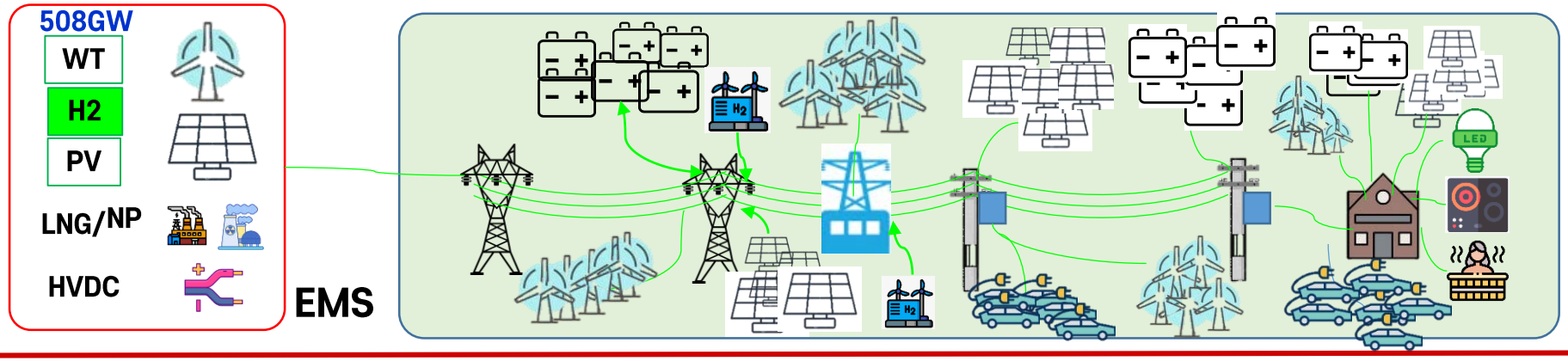



**2024 Now**




G/O 149GW
-RES 29GW
EV 600k

**2030 ~ 2050 Future**




10m PV's Site,
- RES 508GW
EV 20m Unit

Smart & Digital Grid

# Ⅲ. Hurdles and Strategic Next Steps

# Carbon Neutrality & Electrification

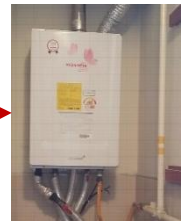
(2024Yr)

(Industry)

(power22m+A10m)

(Gas cooking 20.53m)

(ICE 26m)



(Gas Heat 20.5m)

(power22m+A10m)

(Induction cooking 20.53m)

(EV 25m)


(P2Heat 20.5m)

(2050Yr)


(Industry)



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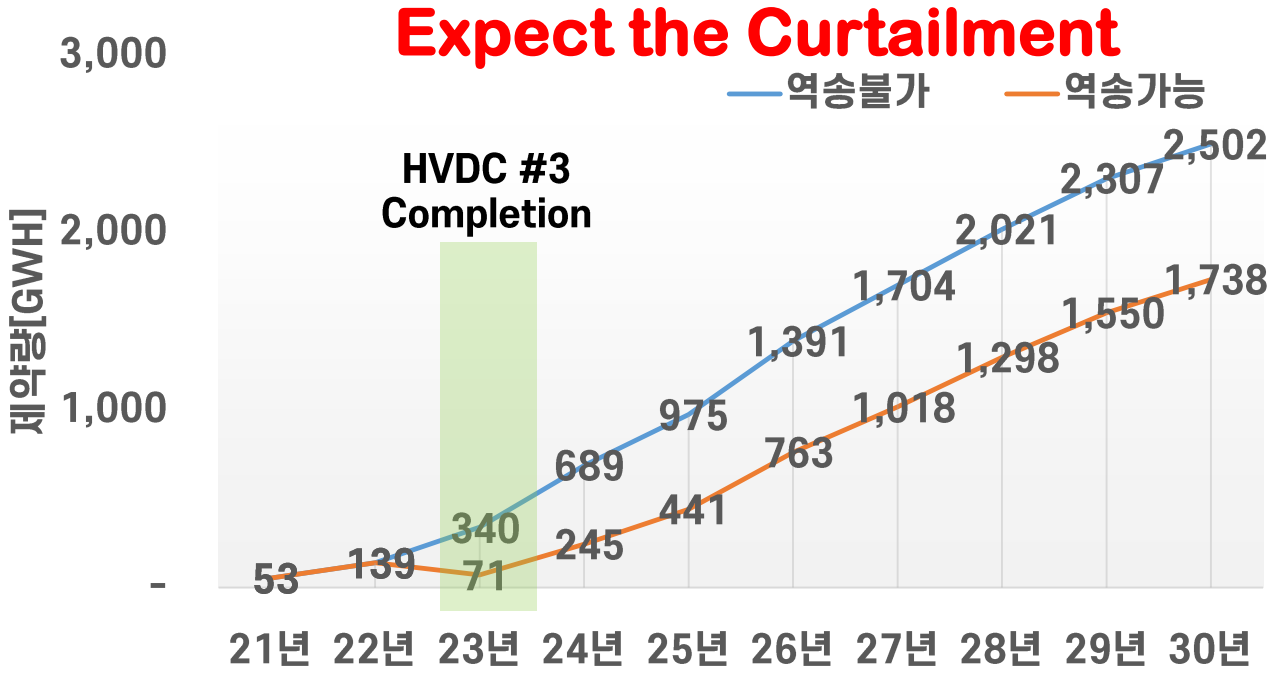
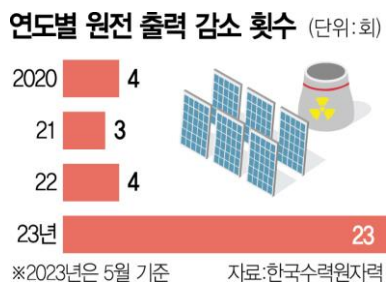
# Renewables and Curtailment Issue in Jeju

| Schedule | 2030 Renewable(GW) | 2020 Capacity(GW) | Total Gen Capacity (GW/'19) | Peak (GW, '19) | Curtail Rate(%) |
|---|---|---|---|---|---|
| Jeju CFI | 4.085 | 720MW | 2.0 | 1.0 | 3.9 |
| Gov.t | 58/78('34) | 20.1 | 129 | 90.3 | - |

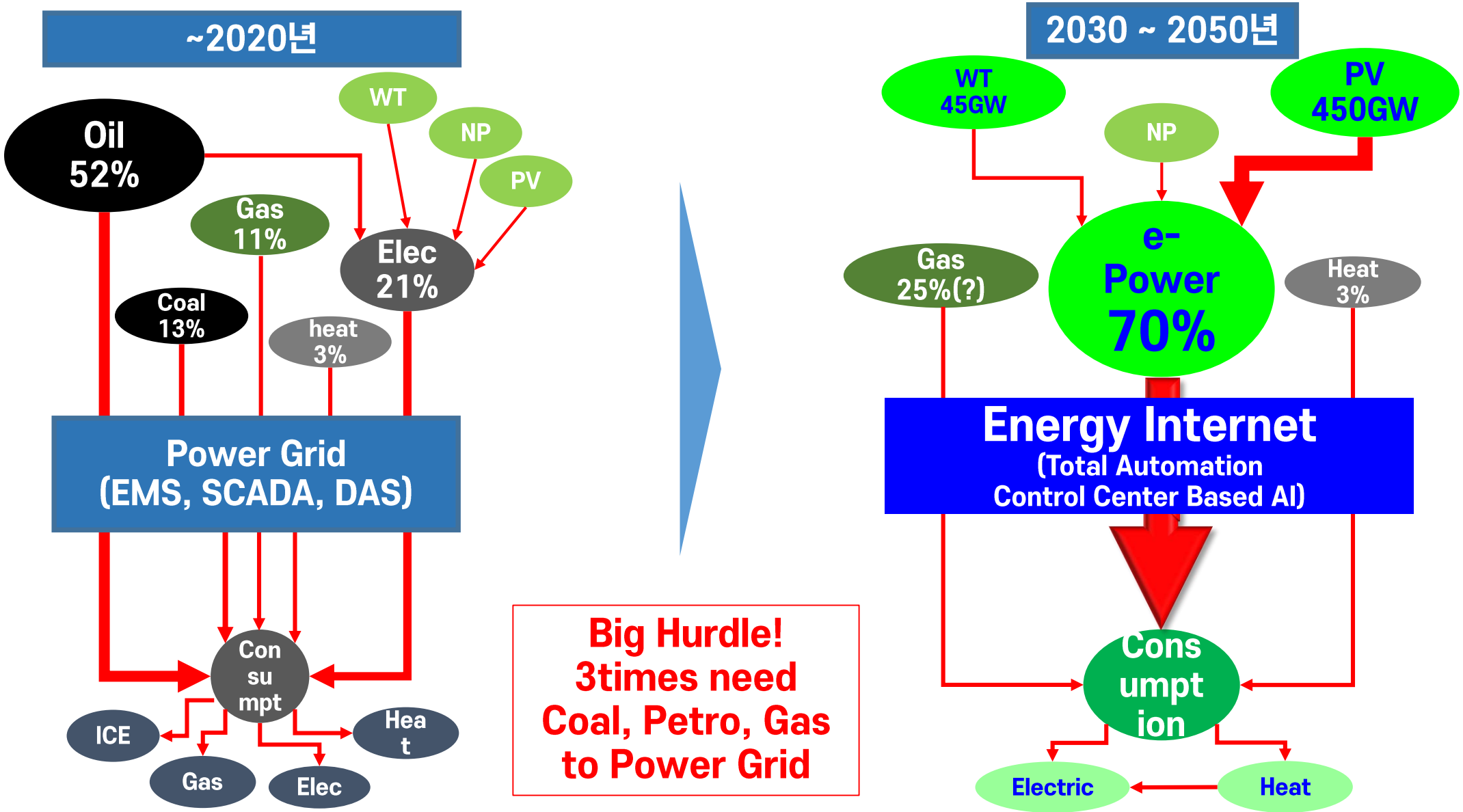
## ➢ Jeju




## ➢ Nation wide


# Big Hurdles for Electrification by 2050



# 11th Policy and Technical Issue with Climate Crisis

**Wind Turbine**
Adopt or Not

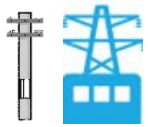
**Photovoltaic**
Adopt or Not

**Electric Vehicle**
Adopt or Not

**LNG Thermal Plant**
Adopt or Not

**Choice or Not for Climate Crises**

**HVDC System**
Adopt or Not



**Smart T&D Substation**
Adopt or Not

**Smart Customer**
Adopt or Not


**Energy Storage System**
Adopt or Not

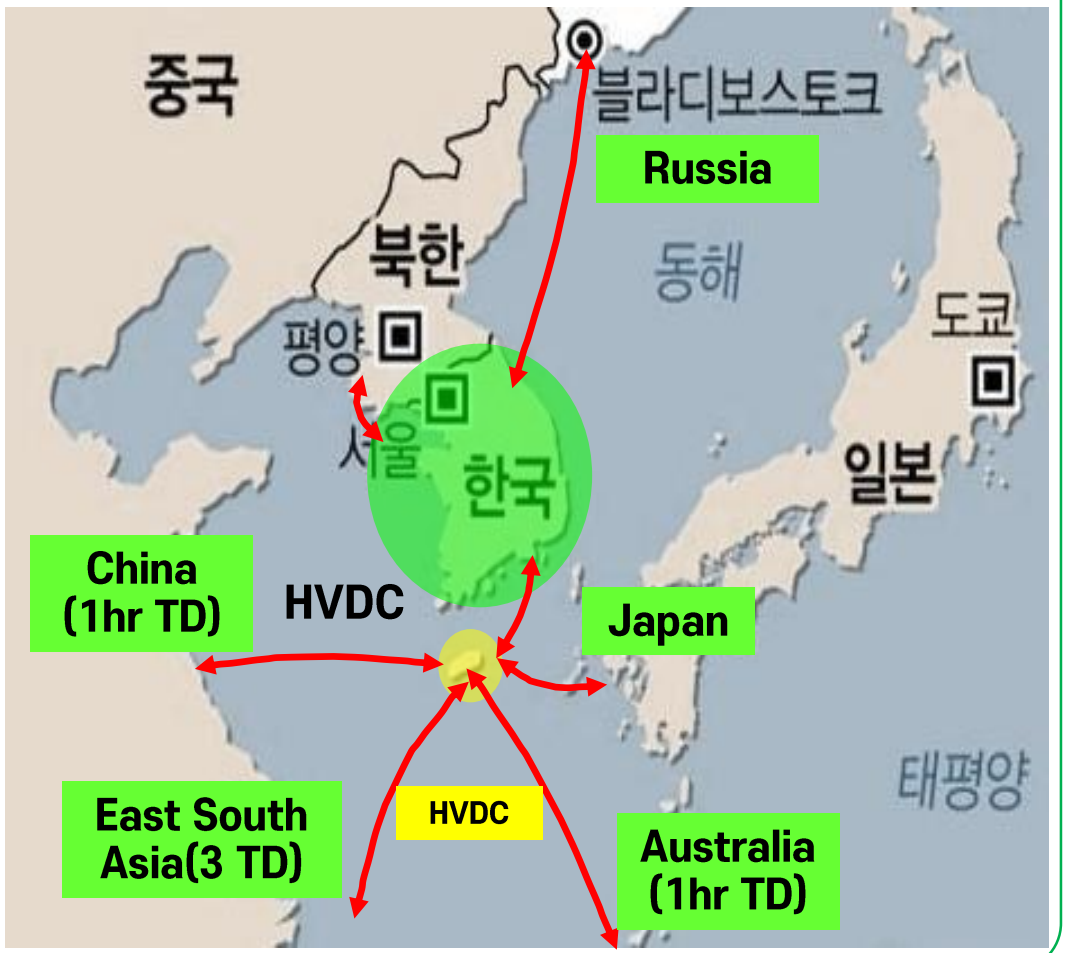
**Smart Energy City/TACC**
Adopt or Not

**Hydrogen Transition**
Adopt or Not

**Prepare to 4th Industrial Revolution and Global Warming**

# Proposals for Asia Energy Belt

## Asia Energy Belt Image




## < Strategy >

- **1Step: 2030**
  - Jeju CFI & RE300
  - Completion EV100 Model
- **2Step: 2035**
  - Built Asia Net Zero Model
- **3Step: 2035~2040**
  - Global Network Cooperation
- **4Step: 2050 NetZero**
  - 508GW Expansion

# Thank you for Your Attention!
# Q&A

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