WORLD BANK GROUP | KOREA GREEN GROWTH TRUST FUND | Ministry of Economy and Finance | Jeju 제주특별자치도 Jeju Special Self-Governing Province

CFI Demonstration Experience in Jeju :
Best Practice for Jeju's efforts and achievements to build a carbon-neutral society

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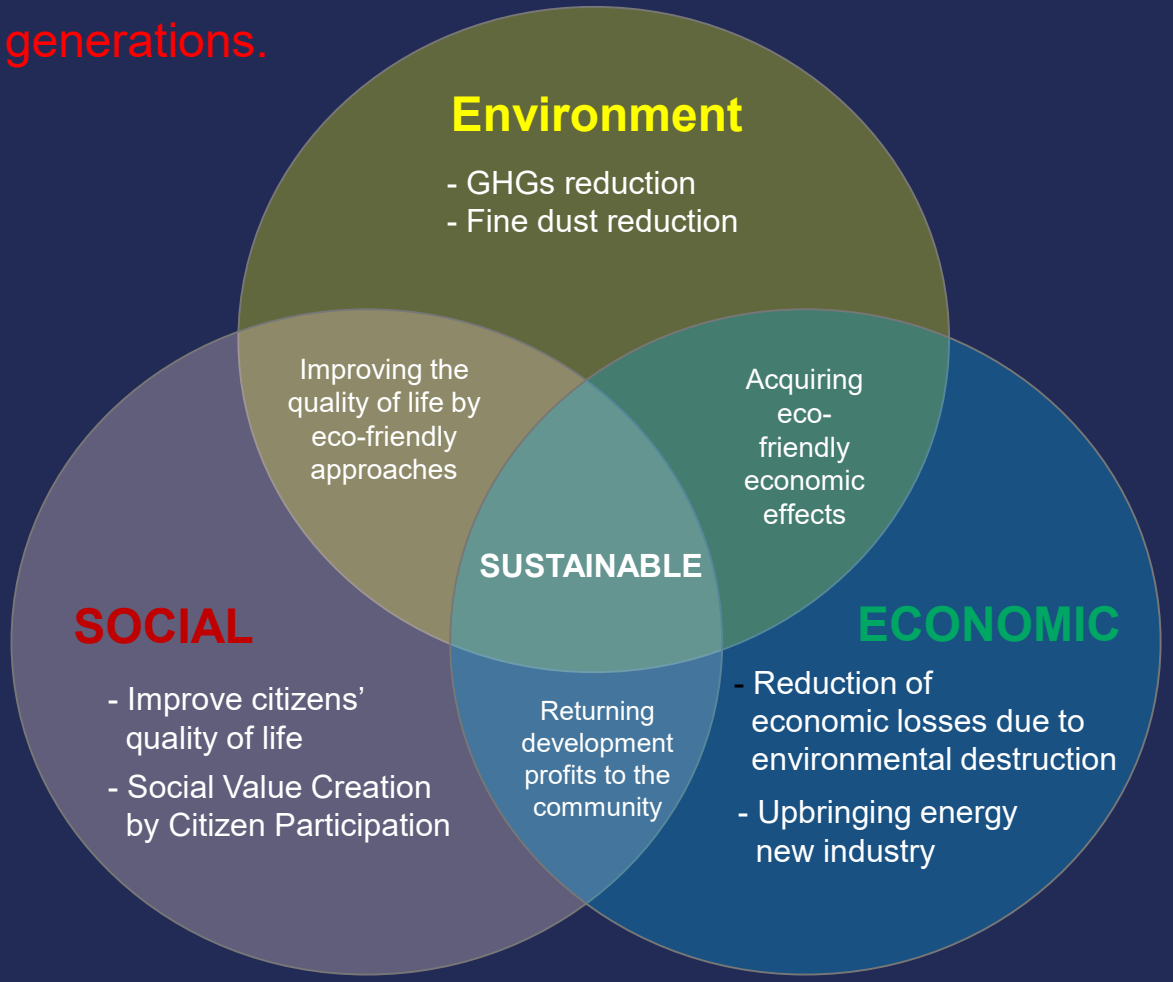
Carbon Free Island JEJU 2030

The Carbon-Free Island 2030 (CFI 2030) initiative will transform the city of Jeju into a net-zero hub utilizing state-of-the-art technology including renewable energy, electric vehicles (EVs), smart grids and microgrids. Started in 2012, The promotion of CFI 2030 holds great significance in that Jeju has presented a vision for leading the future as the forefront of South Korea's carbon neutrality frontier.

CFI Design Direction for Sustainable Development

Jeju's CFI 2030 energy transition began with concerns for the environment and the future.
aiming to provide environmental, social, and economic value and sustainability for future generations.



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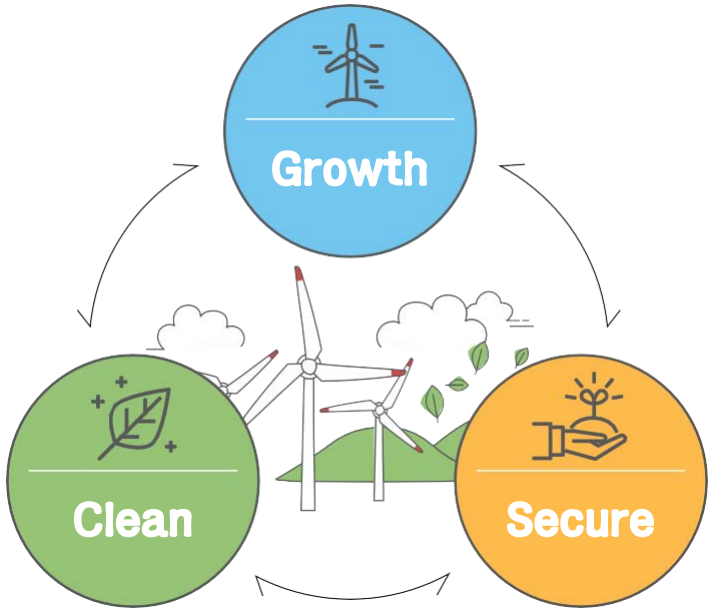
Carbon Free Island JEJU by 2030

Core Value



2030 Policy Targets

1. **Meeting the island’ s power demand**
   Installing RE facilities (4,085MW)

2. **Introducing EVs (377,000)**

3. **Upgrading energy DR**
   Increasing energy efficiency

4. **Creating new energy industries**
   (Creating 74,000 jobs)

Relative to 2030 GHG emissions

CO^2 emission **4,203,000** ton → **34% Reduction** → CO^2 emission **2,779,000** ton

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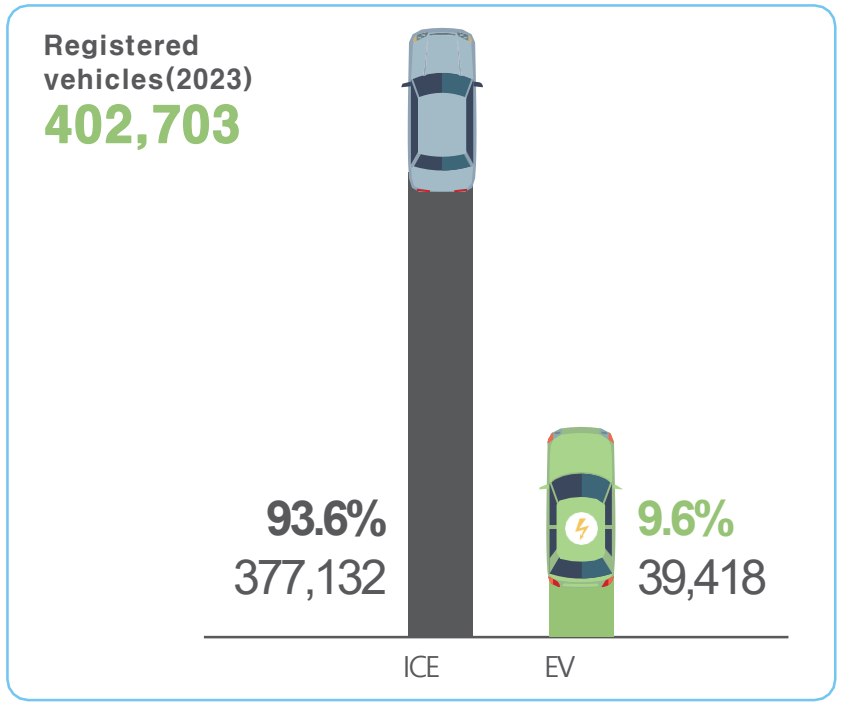
Wind of Change, Decade-long Challenges

Transition to a Clean Mobility (Reducing GHG emissions 60,883tCO²eq)

First in ROK to roll-out 30K EVs

✓ **39,418** EVs on the road,
9.6% of total vehicles

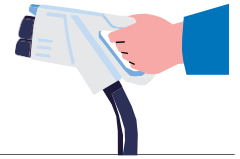
전국 1 위



Front & End EV industrial ecosystem

✓ **Ubiquitous charging infrastructure**

- 76 chargers per 100EVs

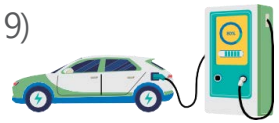


✓ **Circular business for EV**

- Launched the EV Battery Industry Center (2019)

✓ **After market business model**

- Special District for EV Charging (2019)
- Tent. Approval by the Primer Minister (2021)



✓ **Advancing +DR with public chargers** (2021)

- 1,000 participating citizens
  Incentive : 100 KRW/kWh

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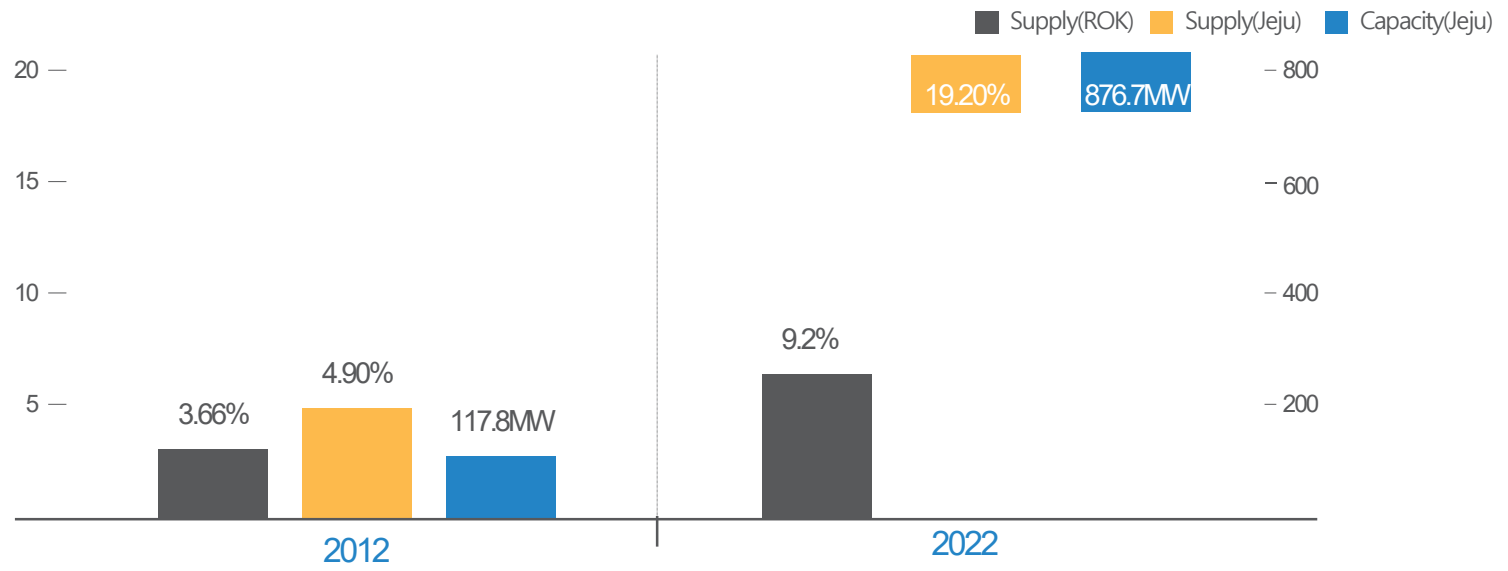
Wind of Change, Decade-long Challenges

Secure energy supply and welfare (GHG reduction by 449,383t CO2eq/yr)

Current Renewable Energy Supply

(unit : %, MW)



- Target delivery rate at over **90%** with 10 years to go

Wind resource development revenue sharing

- Supplying power to 4,000 vulnerable households (300M KRW/yr)
- Solar PV subsidy and after-service in community areas (315 stations / 1,558kw)

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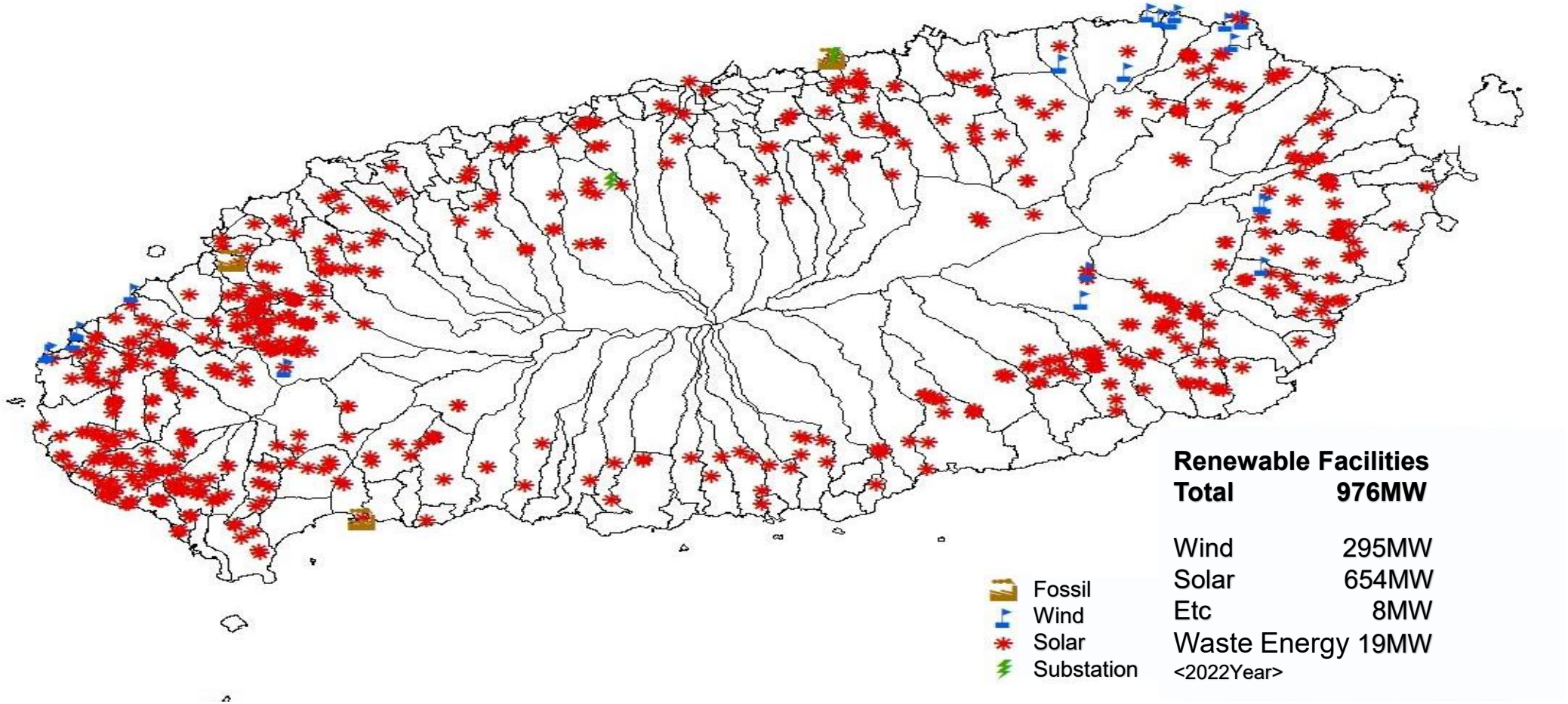
Energy Generation Facilities in Jeju Region

Increase in Renewable Energy Generation Facilities,
Diverse Energy Sources, and Complex Energy Mix



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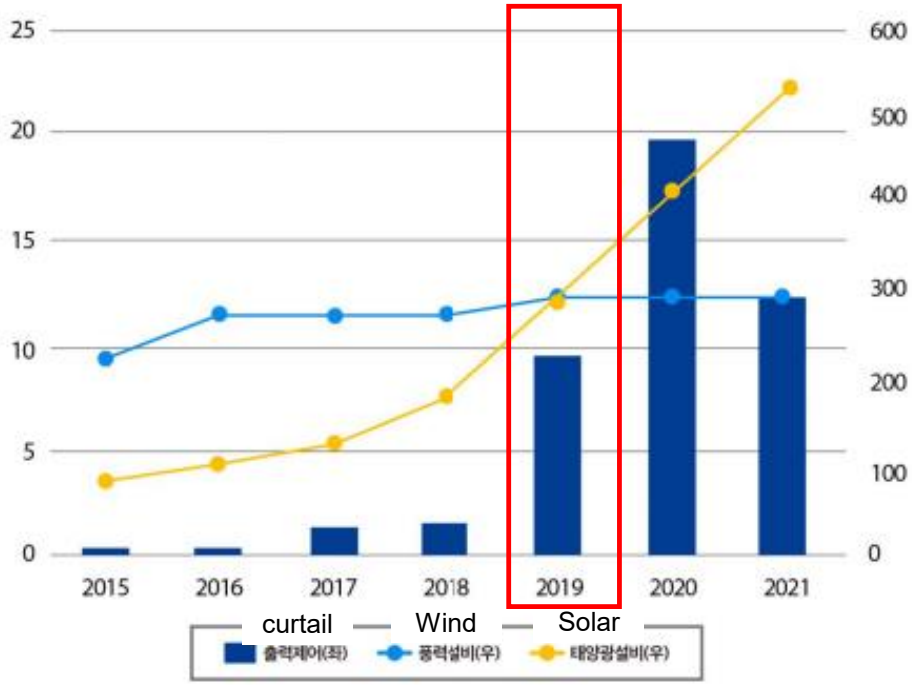
Curtailment of JEJU

- First occurrence of excess generation in 2015, rapid increase since 2019.
- In 2022, 104 of wind power curtailment (25.6 GWh) and 28 of solar power curtailment (3.2 GWh) equivalent to two days' power usage for Jeju residents.

Year	Number of Curtailment	Amount of Curtailment (MWh)	Total Generation (MWh)	Propogation (%)
2015	3	152	352,031	0.04
2016	6	252	470,324	0.05
2017	14	1,300	541,225	0.24
2018	15	1,633	534,879	0.31
2019	46	9,223	548,385	1.68
2020	77	19,449	576,396	3.37
2021	64(1)	12,016	527,766	2.28
2022	104(28)	25,634	572,340	4.48
2023	117(64)	26,197	515,063	5.09



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IEA – Key transition Challenges in different phases of integration of renewalbes

- The integration of variable renewable energy sources (VRE) into electricity systems can be categorised into six distinct phases, which can help to identify.
- relevant challenges and integration measures (IEA, 2017)

Source: Adapted from IEA (2018a), *World Energy Outlook 2018*.

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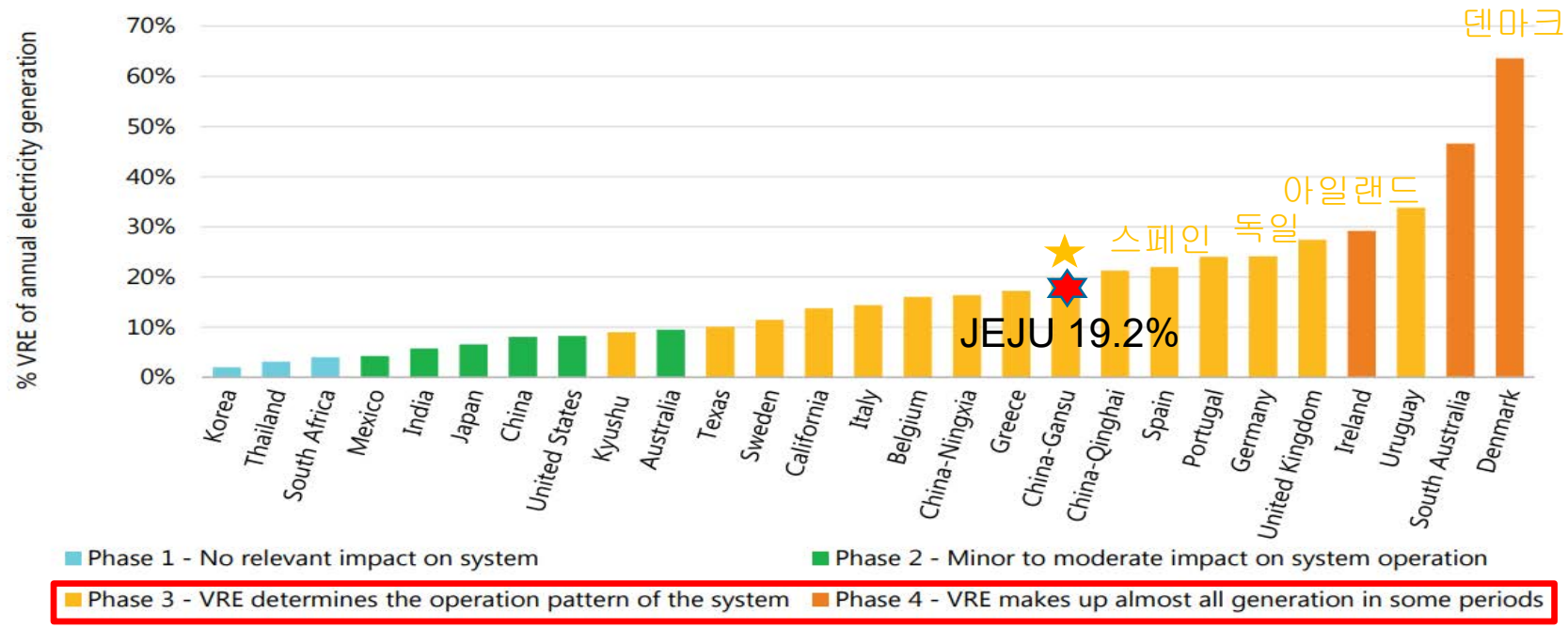
IEA – different phases of integration of renewables

- in the Jeju region, the proportion of variable renewable energy in the total power generation was 19.2% in 2022, corresponding system integration phase 3 according to the International Energy Agency (IEA) standards.
- **"Renewable energy is at a stage where it is driving changes in grid operation patterns. Measures are needed to address variability and excess generation.**

Figure 2. Annual VRE share and corresponding system integration phase in selected countries/regions, 2018



Note: China = the People's Republic of China.

Source: IEA (forthcoming), *Renewables 2019: Analysis and Forecasts to 2024.*

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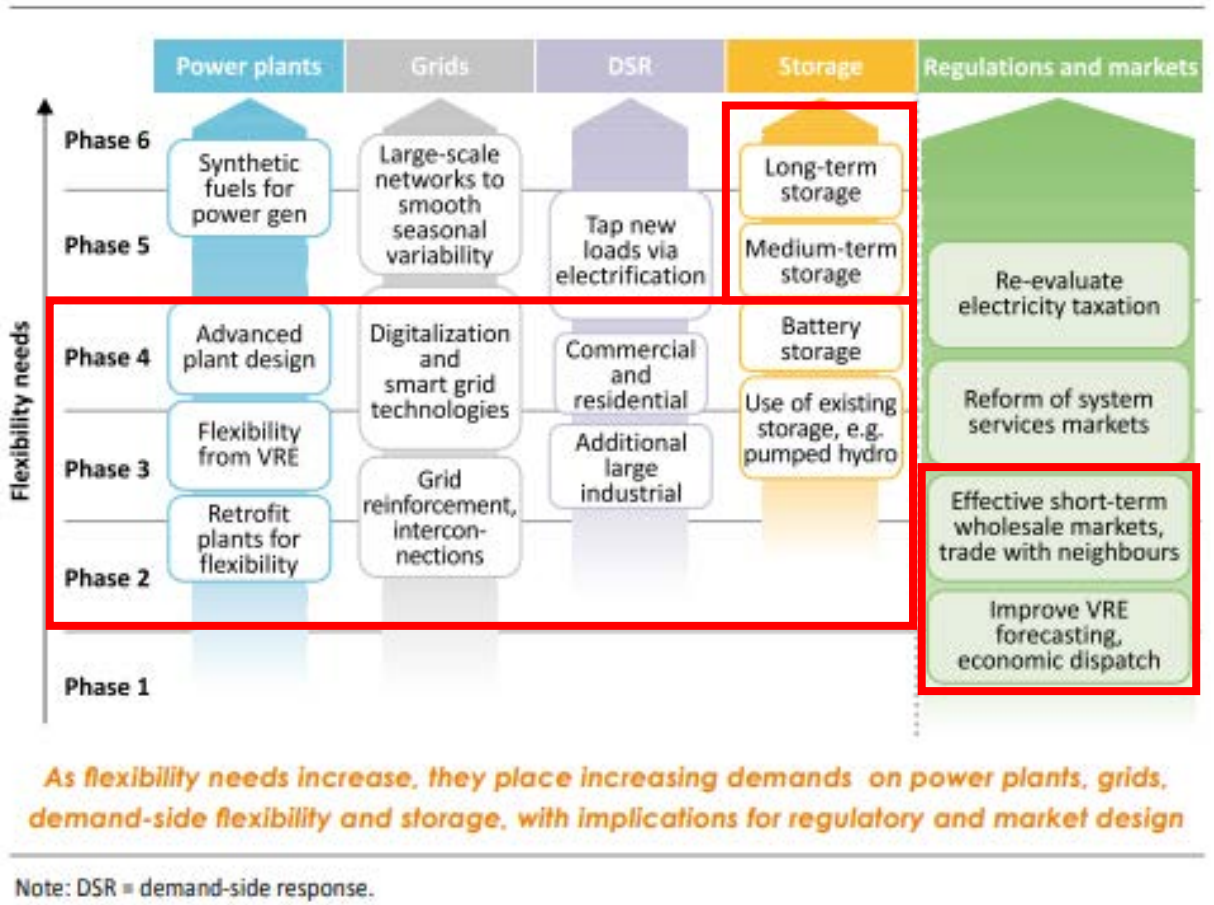
IEA- ways to source flexibility to balance power systems:

There are four main ways to source flexibility to balance power systems:

- make the power generation fleet more flexible;
- make demand more flexible;
- deploy energy storage
- upgrade and improve electricity grids and their operation

All of these require appropriate regulatory frameworks and market design if they are to function correctly.



Note: DSR = demand-side response.

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Solutions to Overcome Limitations in Jeju

Energy Storage

에너지 저장

미활용 전력 전기에너지 저장

1. BESS
2. V2G(전기차)

Sector Coupling

에너지 전환

저장된 미활용 전력 전기에너지
타 에너지로 전환

3. P2G(그린수소)
4. P2H(히트펌프)
5. Electrifying

Energy Demand

에너지 관리

신재생에너지 통합 운영으로
최적화된 에너지 관리

6. DR(수요관리)
7. VPP(가상발전소)

Energy Market

에너지 시장

전력시장제도 개선을 통한
발전출력제약 최소화 방안 수립

11. Market and Operation

Energy Interconnectio

에너지 전송

전압형 HVDC를 통한
제주와 육지 간의 전력 전송

10. HVDC

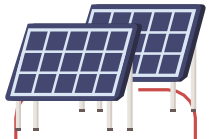
Energy Control

에너지 제어

기존 발전기 제어능력 기술 응용
신재생에너지 발전기 제어기술 적용

8. AGC(자동제어)
9. Forecasting

Accelerating RE & EV to achieve carbon neutrality



Carbon Neutrality

Expansion

Reducing curtailment: Distributed Energy Action Plan

- Expanding large-scale ESS and sector-coupling (P2X)

Just transition for base load sectors

- Thermal plants → Hydrogen & clean energy

Balance between RE and low-carbon base load

- Designating special districts for distributed energy

Local action plan based on the Carbon Neutral Green Growth Act

- GHG reduction across all sectors (power, industry, mobility, etc)

Climate budget for climate change response

- Strengthening social security against climate crisis

Advancing Jeju's hydrogen economy

- P2H in mobility and agriculture sectors

Voluntary RE100 participation for Carbon-intensive industries

- Increase RE usage through the RE100 initiative

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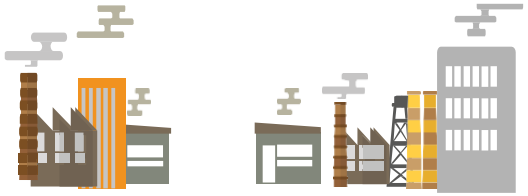
Efforts to achieve carbon neutrality

Scientific/technological effect

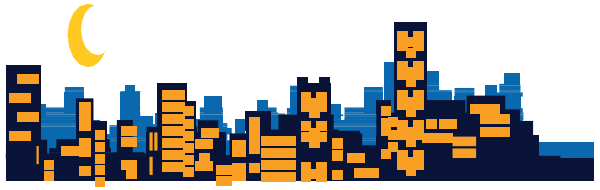
Securing optimal operating technology



- Securing technology and establishing a domestic production system
- Securing power system flexibility
- Establishment of green hydrogen production management system using new technology

Economic/industrial effect

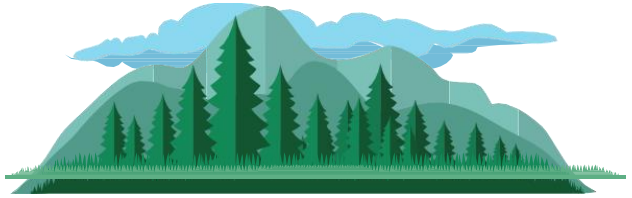
Activation of the industrial ecosystem



- Activation of domestic industry for green hydrogen production
- Securing economic feasibility by using surplus electricity
- Overseas export of green hydrogen production technology

Socio-environmental effects

Early achievement of 2050 carbon neutrality



- Eliminate power system instability
- Green hydrogen production safety standards through legal improvement
- Contribute to carbon reduction by using renewable energy and diversifying demand for green hydrogen

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CFI Results & impact realized

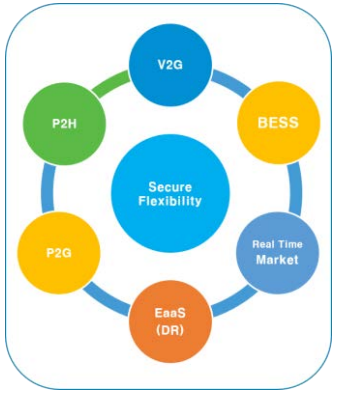
New & Renewable energy generation & Electric Vehicles

Highest New & Renewable energy generation rate in Korea (19.2% /2022)

First offshore wind power in Korea (2017)

EV Battery Recycling Center (2019)

First in Korea to reach 30K Evs (2023)



Using echnological Innovation and Efficiency (2020 -)

Smart City Projects for 'CFI 2030 Jeju'

Smart Green City Project (Ministry of Environment)

Smart City Challenge Project (Ministry of Land, Infrastructure and Transport)

Korea's first 'Special Distributed Energy Zone' (Ministry of Trade, Industry and Energy)

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Global efforts to realize CFI 2030

CFI JEJU 2030 Initiative was introduced at Paris UN Climate Change Conference in COP21 (2015)

PARIS2015 UN CLIMATE CHANGE CONFERENCE COP21·CMP11

Knowledge sharing, and Policy and RE development for PICs (Pacific Island Countries) linked to the World Bank(2021)

THE WORLD BANK

Promoting international cooperation for the development of energy projects in Africa (2020)

JEJU ENERGY CORPORATION

JRI Jeju Research Institute

Winning the 2021 P4G Energy Sector State-of-the - Art Best Partnership, CFI partnerships are striving f international cooperation to carbon-neutral.(2021)

P4G
Partnering for Green·Growth and the Global Goals 2030

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Jeju and the Republic of Korea will lead the way to global achievements.

Real-time Renewable Energy Supply and Demand in Jeju

(제주지역 실시간 신재생에너지 수급현황)

https://www.jeju.go.kr/cfi/presenteng.htm

Real-time Power Supply and Demand in Jeju

(제주지역 실시간 전력수급현황)

https://www.jeju.go.kr/cfi/livegrapheng.htm