DC Island

(Demonstration of the LVDC Distribution System in an island)

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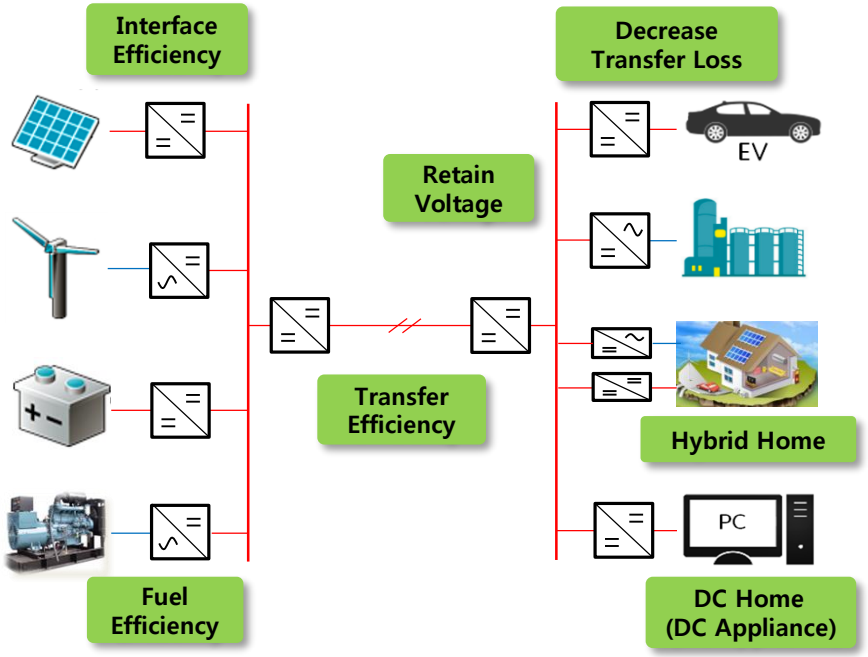
KEPCO

Research Institute

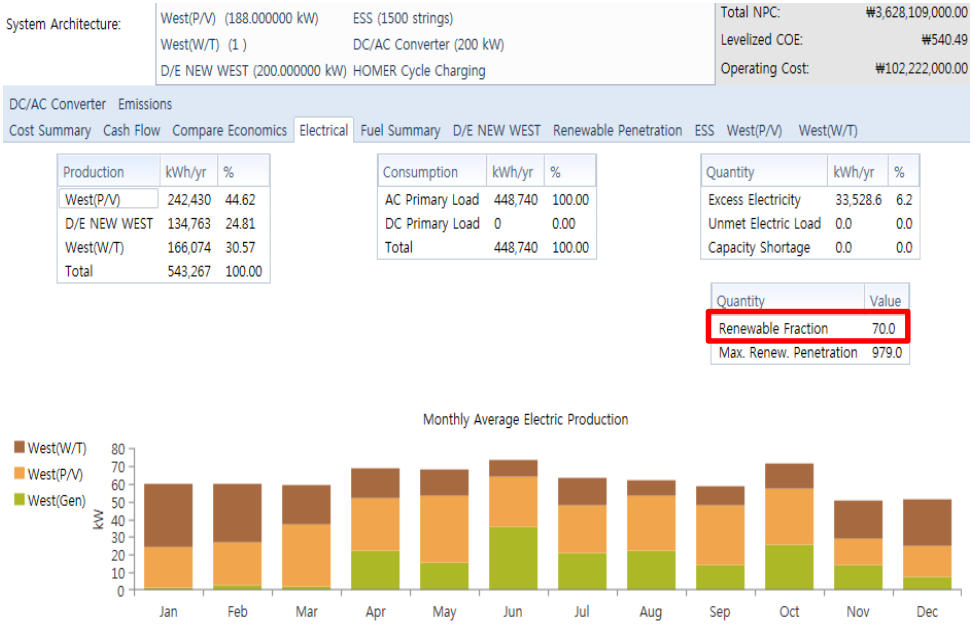
Contents

Demonstration Goal

- Demonstrate DC System **Improved 10% Efficiency** Compared with AC System
- Over 70% Renewable Fraction and Decrease Carbon Emission(490t/yr)



[Goal of each part of DC Island]



[HOMER Simulation Result of Demonstration Site]

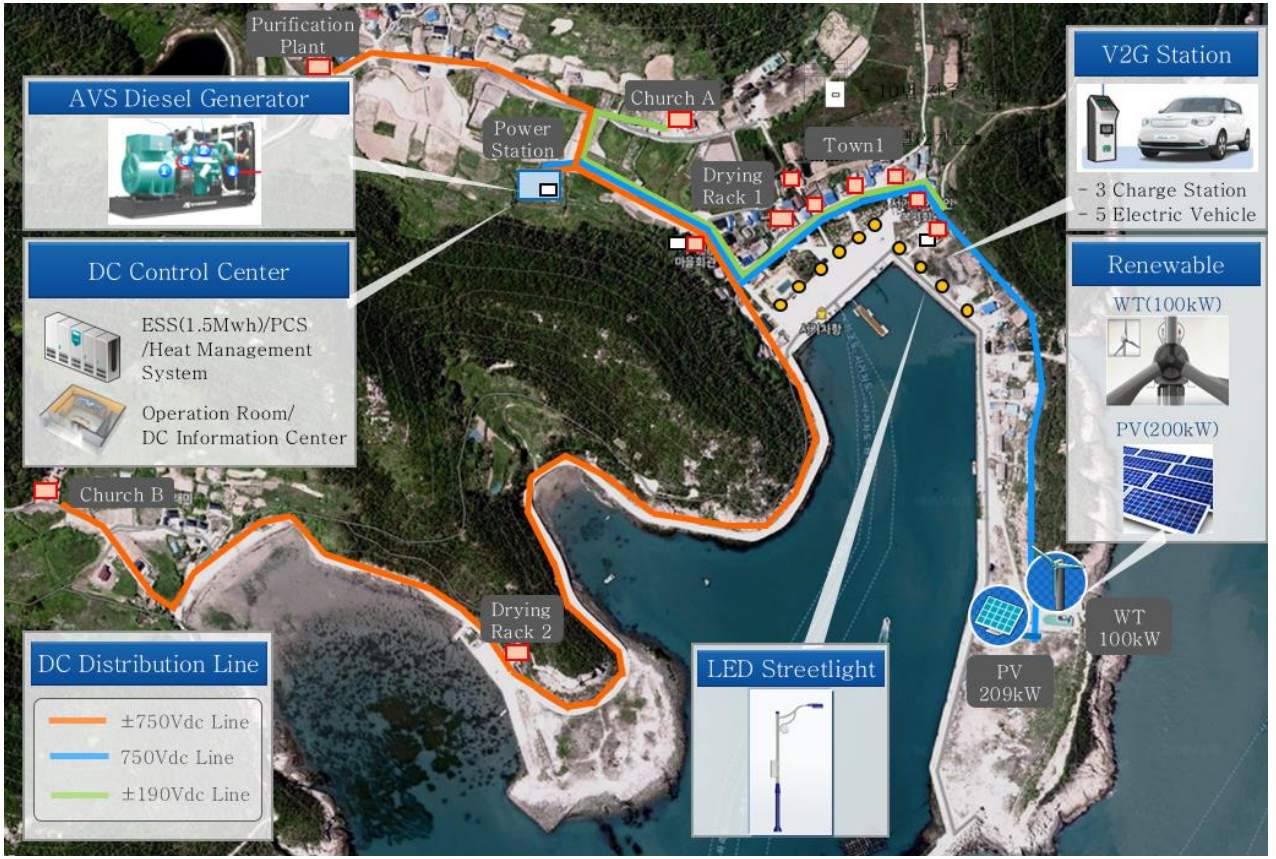
Site Introduction

- **Site : Seogeochado(Island located 24km from main land of South Korea)**
- **One of an Island of Geochado(Consist of Seogeochao and Donggeochao)**

구 분	내 용
Site	· Island located 24km from land · Population : 100 (70 household)
Power	· 150kW x 3 Diesel Generator · 380/6.6kV x 2 Transformer
Consumer	· Home and Public Facilities · Commercial facilities (Purification plant, Drying Rack)
Load	· Average : 124kW (Geochado) · Maximum : 305kW (Geochado)
Cost	· Price : 920 Won/kWh · Cost : 930 million Won/yr

Demonstration Outline

- PV(200kW), WT(100kW), ESS(1.5MWh), AVS* Diesel Generator(200kW)
- 750 Vdc, ±750 Vdc, ±190 Vdc DC Line(4km) and DC Consumer System



[DC Island Component Layout]

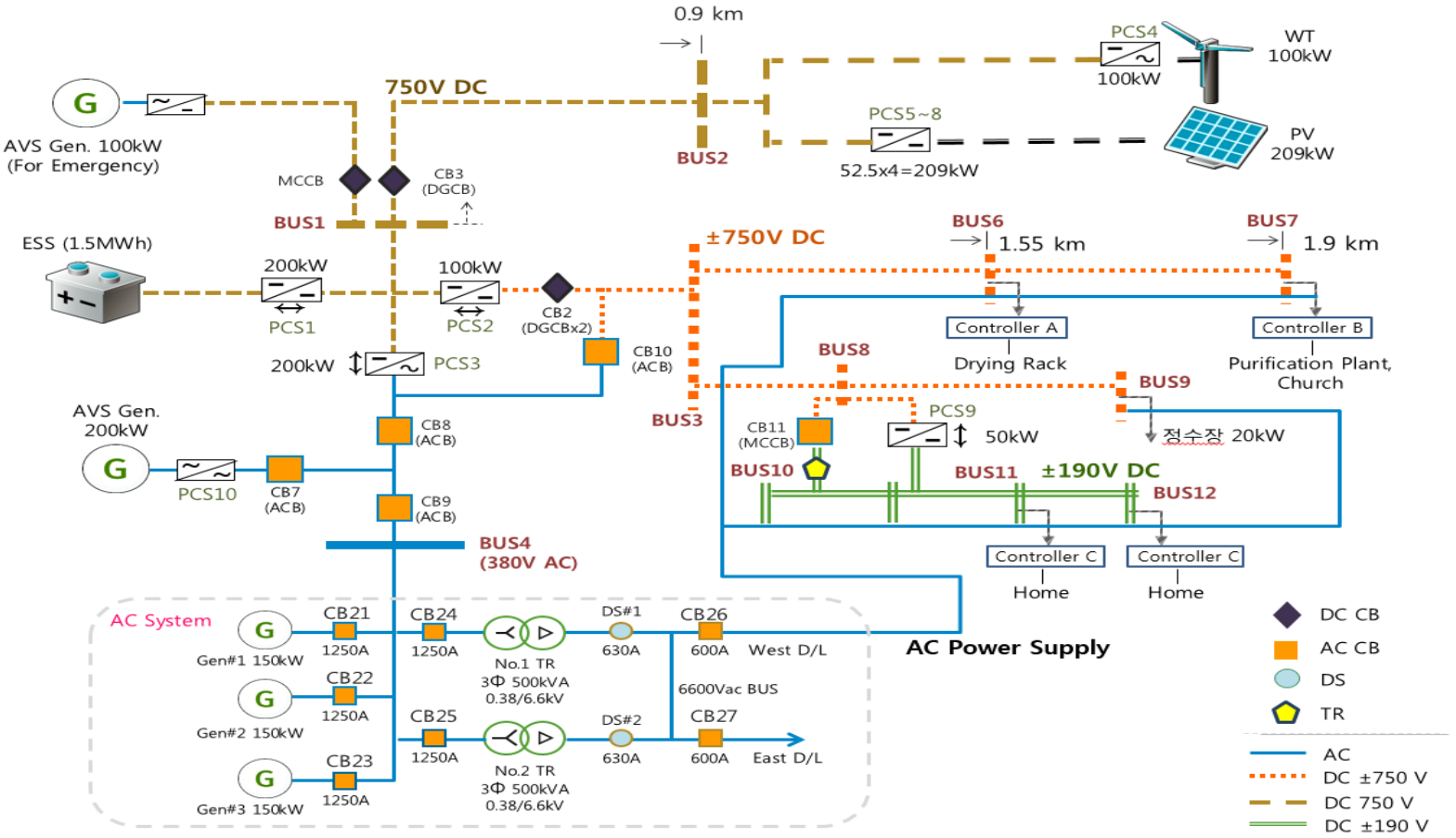
Residential Load
1) Welfare Center (±190Vdc)
2) Health Center (±190Vdc)
3) Police Office (±190Vdc)
4) Church A (±190Vdc)
5) Church B (±750Vdc)
6) Purification Plant (±750Vdc)
7) Home #1 (±190Vdc)
8) Home #2 (±190Vdc)
9) Home #3 (±190Vdc)
10) Home #4 (±190Vdc)
Commercial Load
1) Drying Rack #1 (±750Vdc)
2) Drying Rack #2 (±750Vdc)
DC Load
1) DC Home (DC Appliance)

[Site Target Load]

※ AVS : Adjustable Varying Speed

System Configuration

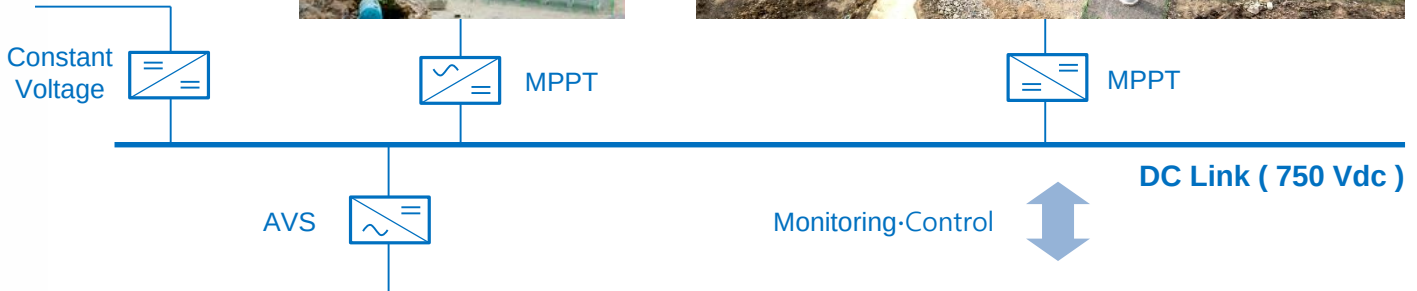
- Interface Existing AC System and New DC System using AC/DC Converter
- Supply Power by Existing AC System when New DC System shutdown



[Power System Configuration of DC Island]

Distributed Energy Resource

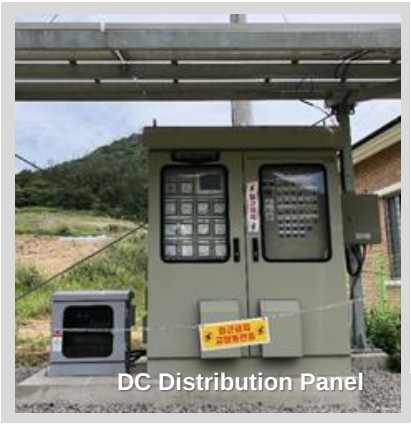
- Interface PV(200kW), WT(100kW), ESS(1.5MWh) with DC Link(750Vdc)
- Interface AVS Diesel Generator System(100kW) with DC Link(750Vdc)

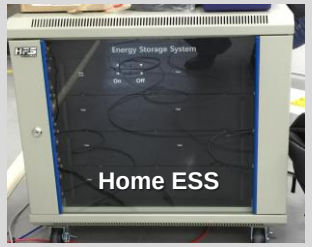


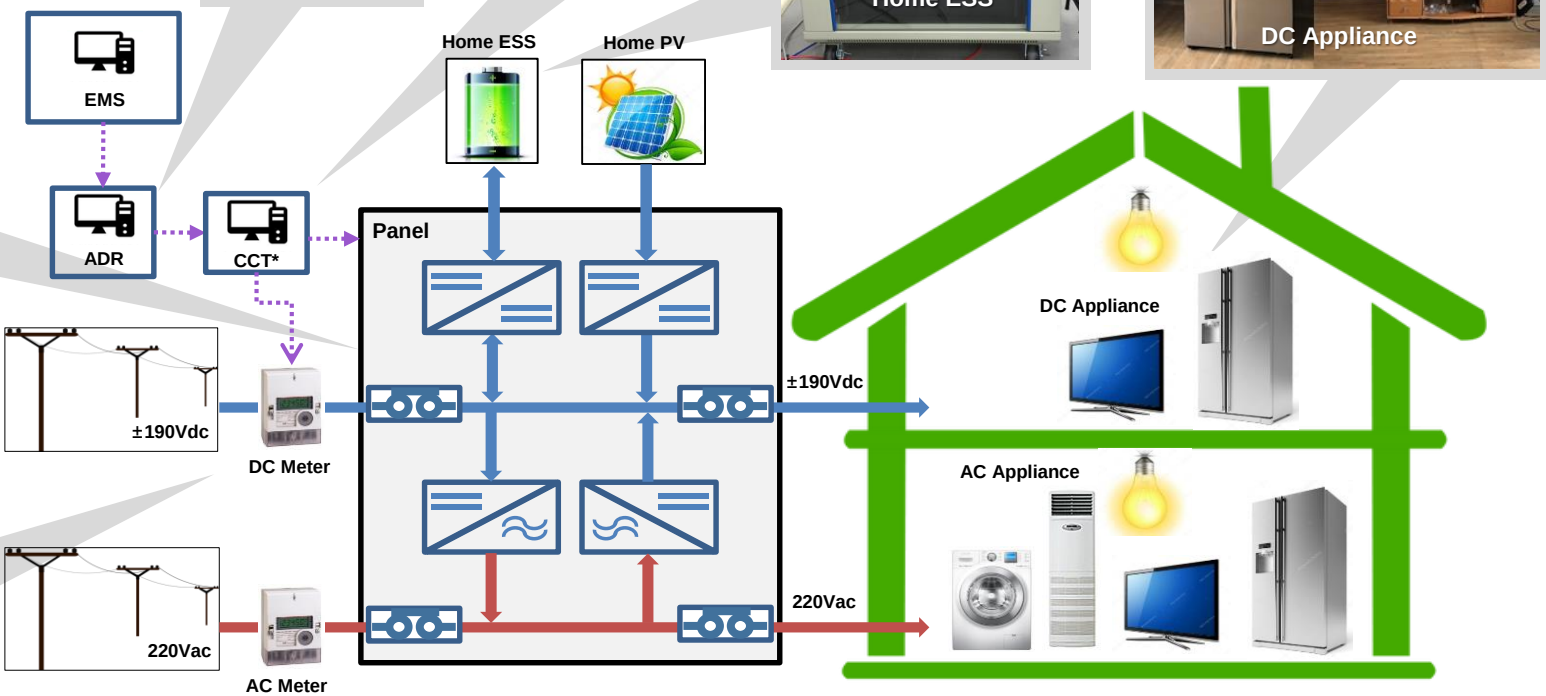
※ AVS : Adjustable Varying Speed

DC Home Consumer

- Home available both AC/DC power by DC Panel ant Control Terminal
- Home ESS·PV· DC Meter and ADR System installed for DC Home







※ CCT : Cabinet Control Terminal

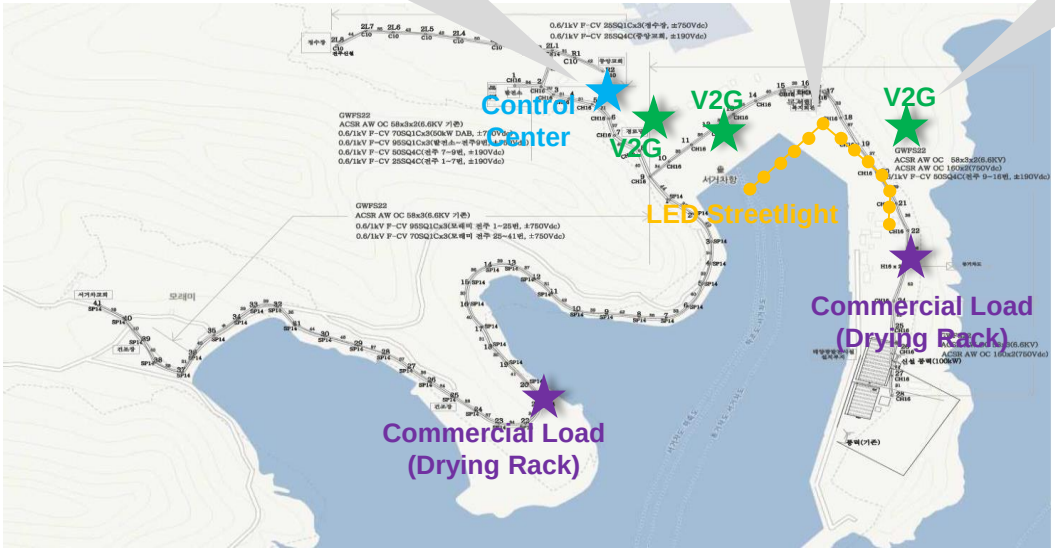
DC Public Consumer

2. Construction

- 5 Electric Vehicle pluged with DC Distribution System by 3 V2G Station
- Solar Wall(Rooftop), Heat Storage(1st Floor) and Heat Management System

Heating

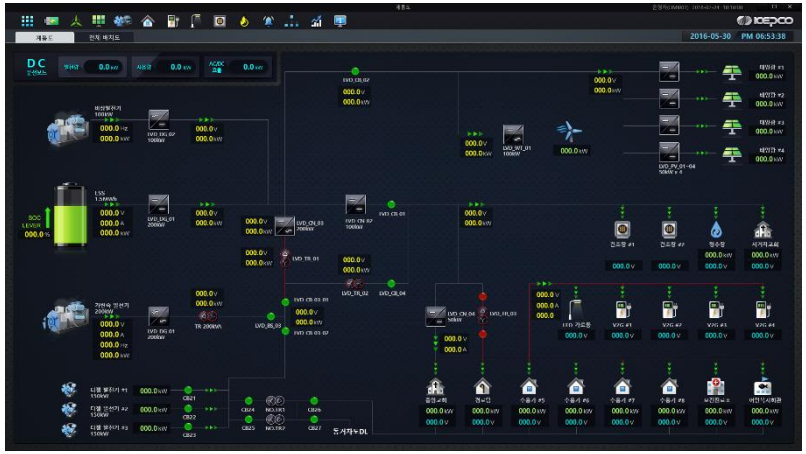
Solar Heat



Discharge

Charge

- Communication Interface with Fiber Optic Cable and Monitoring by DC EMS
- SCADA, HMI and Real-time Applications for DC System installed in EMS



[HMI – System Diagram]

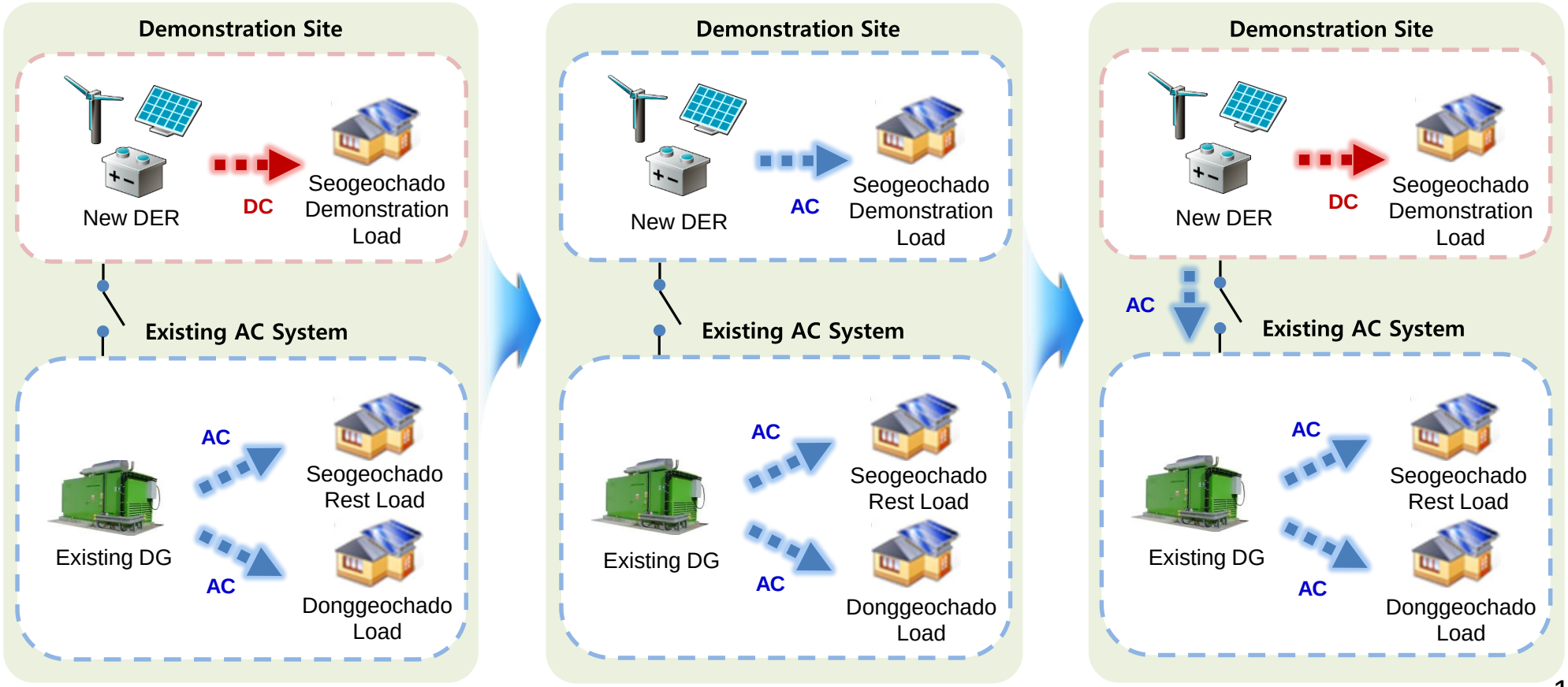
[HMI – Main Window]

[HMI – PV Window]

[HMI – WT Window]

Demonstration Scenario

- [1st Step] Isolated DC Operation : DC System Test and Demonstration
- [2nd Step] Isolated AC Operation : Mode Conversion for Efficiency Comparison
- [3rd Step] Interface Operation : Stability Test and Use Rest Renewable Energy



[1st Step : Isolated DC Operation] [2nd Step : Isolated AC Operation] [3rd Step : Interface Operation]

Operation Strategy

- [Conventional Mode] DC System DER Operation based SOC of ESS
- [Advanced Mode] DC System DER Operation by DC Applications

SOC(%) State	ESS	WT/PV	AVS Diesel Generator
SOC<30	Constant Voltage	PV: Output Limit WT: Output Limit	Start
30≤SOC<80	Constant Voltage	PV: MPPT WT: MPPT	Stop
80≤SOC<85	Constant Voltage	PV: Output Limit WT: MPPT	Stop
85≤SOC<90	Constant Voltage	PV: Stop WT: MPPT	Stop
90≤SOC	Constant Voltage	PV: Stop WT: Stop	Stop

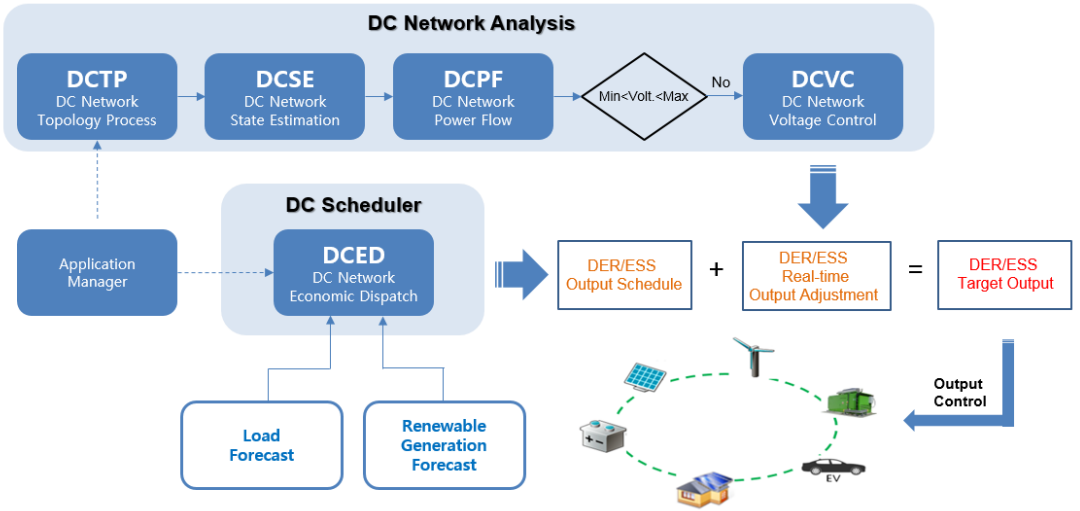
[Conventional Mode based SOC]

▣ **DC Scheduler Program**

☞ Optimal DER Scheduling base Forecasting

▣ **DC Network Analysis Programs**

☞ DER Output Adjustment to solve Voltage Violation



[Advanced Mode by DC Applications]

※ DER : Distributed Energy Resource

Q & A