Distributed Energy System using Renewable Energy and Energy Storage System Management

James (Hyeongig) Kim

Senior Researcher / Ph.D

Hyundai Electric & Energy Systems

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EAKPF Republic of Korea

ADB

Hyundai Heavy Industries Group

HYUNDAI HEAVY INDUSTRIES HOLDINGS

As of June, 2021

Ship Building	Construction Equipment	Oil & Energy	Robot	Service
				
Global No. 1	***Global Top 7***	***Top Transformer in U.S.***	***Global Top 6***	***Engine and Ship Maintenance Company***
KSOE (Korea Shipbuilding & Offshore Engineering)	HYUNDAI CONSTRUCTION EQUIPMENT	HYUNDAI ELECTRIC	HYUNDAI ROBOTICS	HYUNDAI GLOBAL SERVICE
HYUNDAI HEAVY INDUSTRIES	HYUNDAI CORE MOTION	HYUNDAI ENERGY SOLUTIONS		
+	+			
DSME	DOOSAN Infracore	Hyundai Oilbank		

: Under M&A Process

Hyundai Families (Pan-Hyundai Group)

HYUNDAI MOTOR GROUP

- World's top 5 automobile company
  - Hyundai Motors, KIA Motors
  - Produces 8 million automobiles in 9 countries
- 60+ affiliates: Hyundai Engineering & Construction (Korea No. 1 construction company) and others

HYUNDAI · KIA · HYUNDAI MOBIS · HYUNDAI STEEL · HYUNDAI ENGINEERING & CONSTRUCTION

KCC

- Korea's No.1 manufacturer of paint and building materials

Other affiliates

HYUNDAI DEPARTMENT STORE · HDC Hyundai Development Company · Hyundai Marine & Fire Insurance

Republic of Korea

Hyundai Electric & Energy Systems

History

+ 1973, HHI Corp.
+ 1977, HHE Corp.
+ 1993, HHI Corp. merged
+ 2017, Hyundai Electric separated
  Revenue :U$1.65 billion /
  Workers : 2,000 as of 2019

ESS Solution

Renewable Energy Solution

▶ Wide range of power energy business areas related to T/D system, and renewable energy
▶ EPC Capability in Energy Solutions such as ESS, FEMS, BEMS and Hybrid Power Plant like Micro Grid

Transmission and Distribution Equipment *FULL LINE-UP for Energy Infra*


GIS


Switchboard


Rotor


Transmission TR


Distribution TR


Switchgear

Energy Solutions


FEMS solution
BEMS solution
SEMS solution


Asset M'gmt
Micro Grid
Smart Farm

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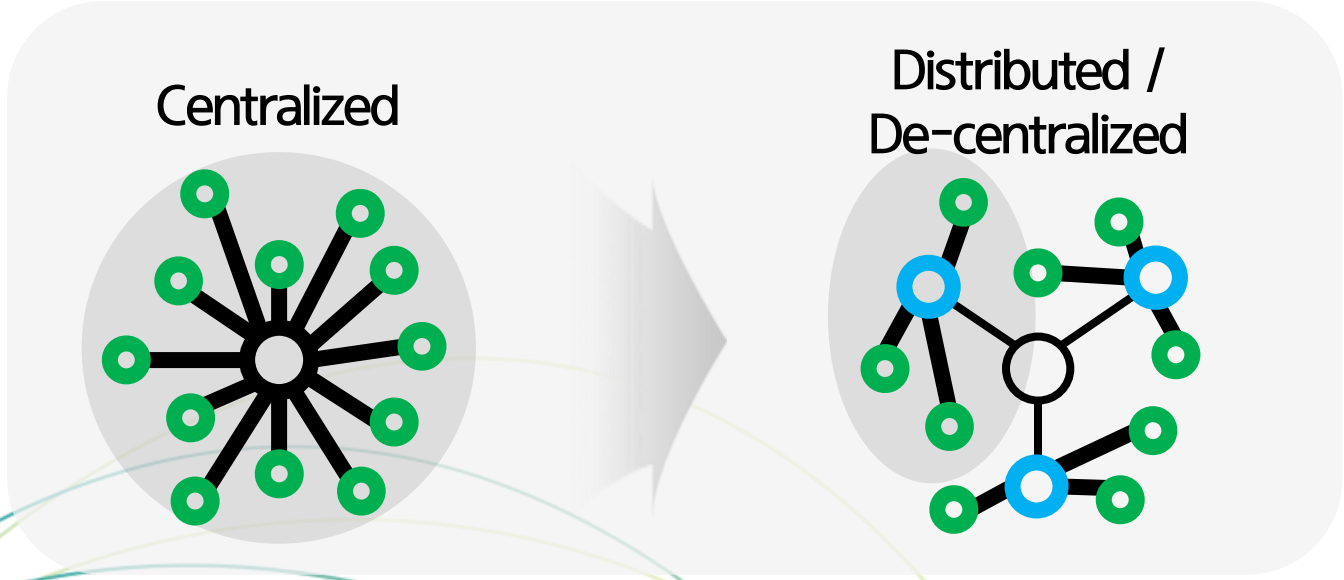
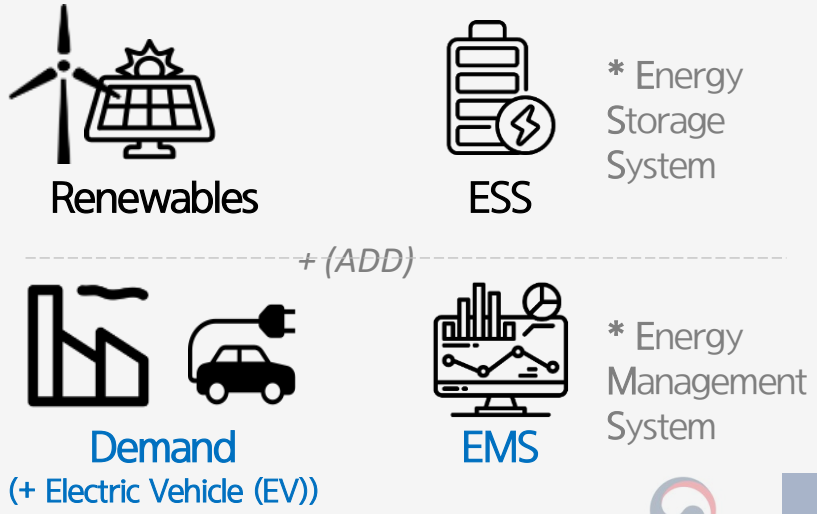
Key words

"[1] Distributed Energy System using [2] Renewable Energy and [3] Energy Storage System Management"

"… apart from the main grid …"

"… with its own operation system"





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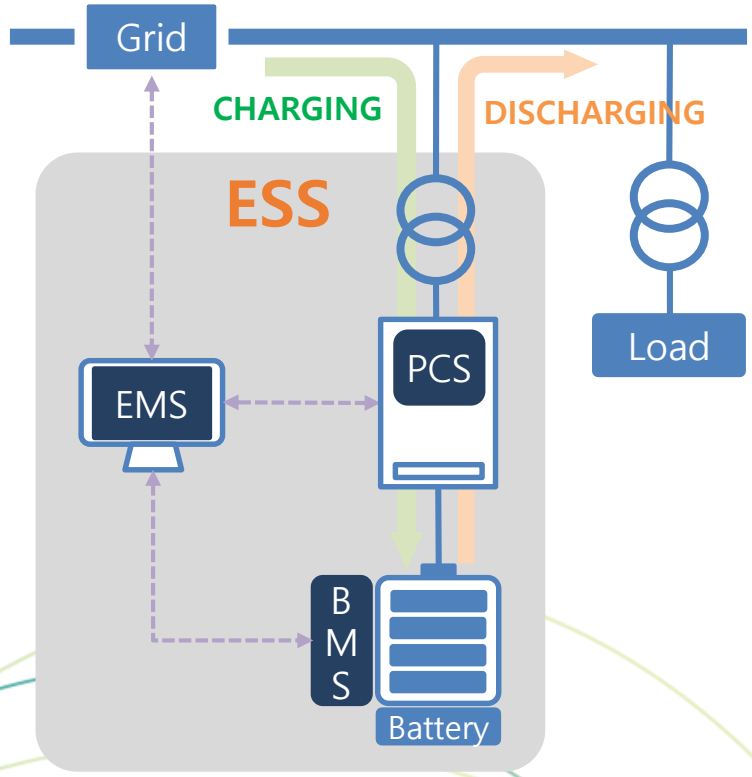
ESS (Energy Storage System)

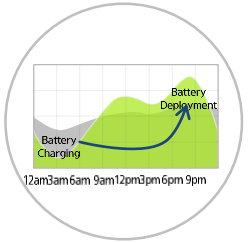
: The system can capture energy produced at one time for use at a later time

Structure

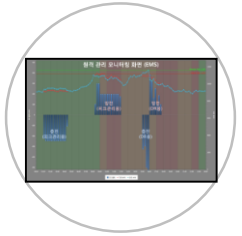


FUNTIONS

PEAK CUT



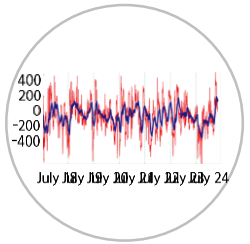
Arbitrage



Emergency Gen.

Stabilizing of Renewable Energy

Frequency Regulation



Demand Response

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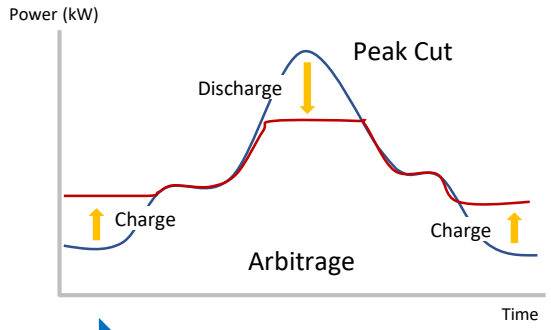
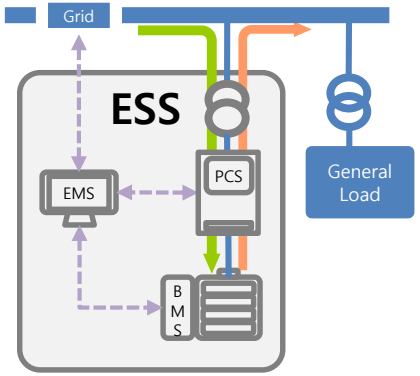
Functions of ESS

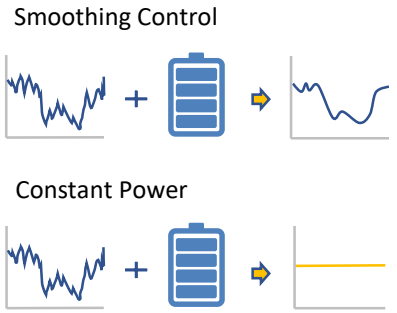
1 Peak Cut / Arbitrage

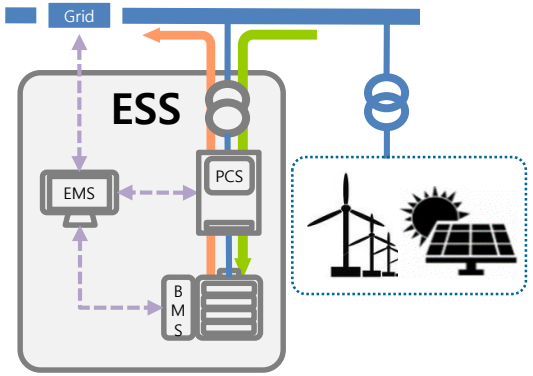




COST SAVING &
INCREASING NATIONAL ELECTRICITY RESERVES

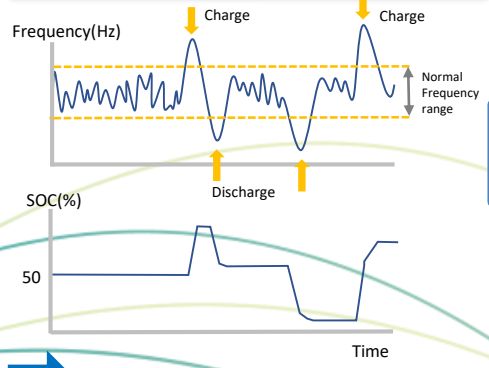
2 Renewable Smoothing

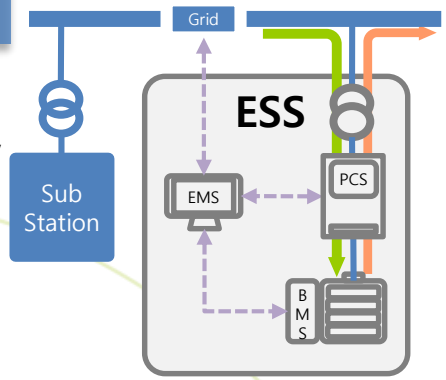




Better Quality & relieving the burden on the GRID

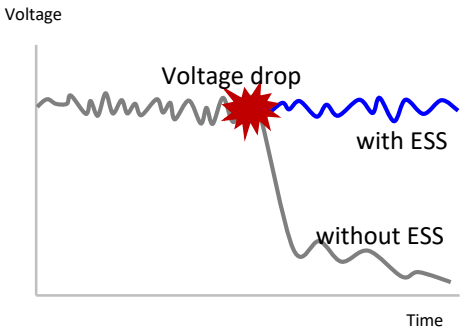
3 Frequency Regulation

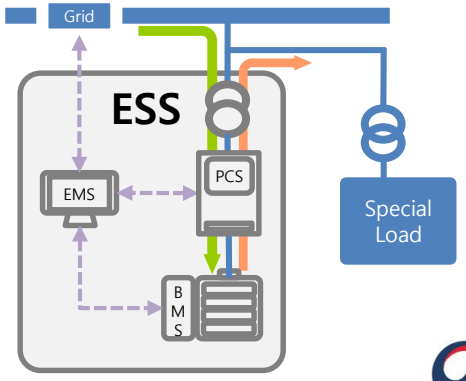




Better Electricity Quality from Power Plants

4 Emergency Backup





SUBSTITUTE FOR E. DIESEL GENERATOR

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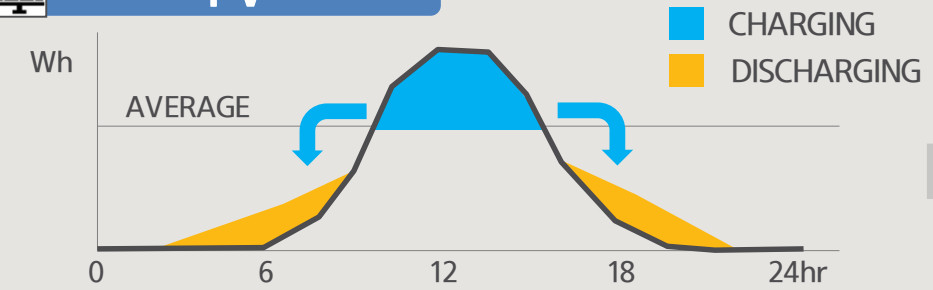
Korean ESS policy

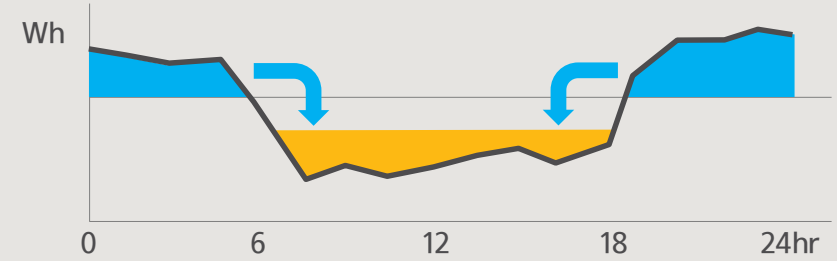
PV



- Charging at day time, Discharging at night time
- 5 RECs/MWh discharge from ESS (1 REC/MWh for PV)

- Discharge at other than 10:00~16:00
- 5 RECs/MWh for ESS lasting for15 Year
- Valid until installation in 2019

WIND



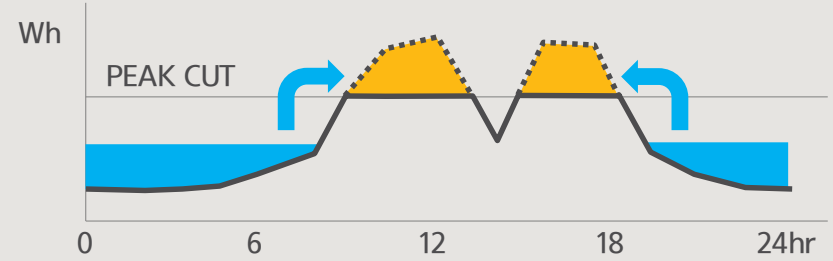
- Charging at night time, Discharging at day time

Discharge at other than

- 09:00~12:00 (3hr) in Spring/Winter
- 13:00~17:00 (4hr) in Summer
- 18:00~21:00 (3hr) in Fall

Different weight of REC incentive every year (start from 5.5 in 2015, 0.5 lower and lower each year)

INDUSTRIAL

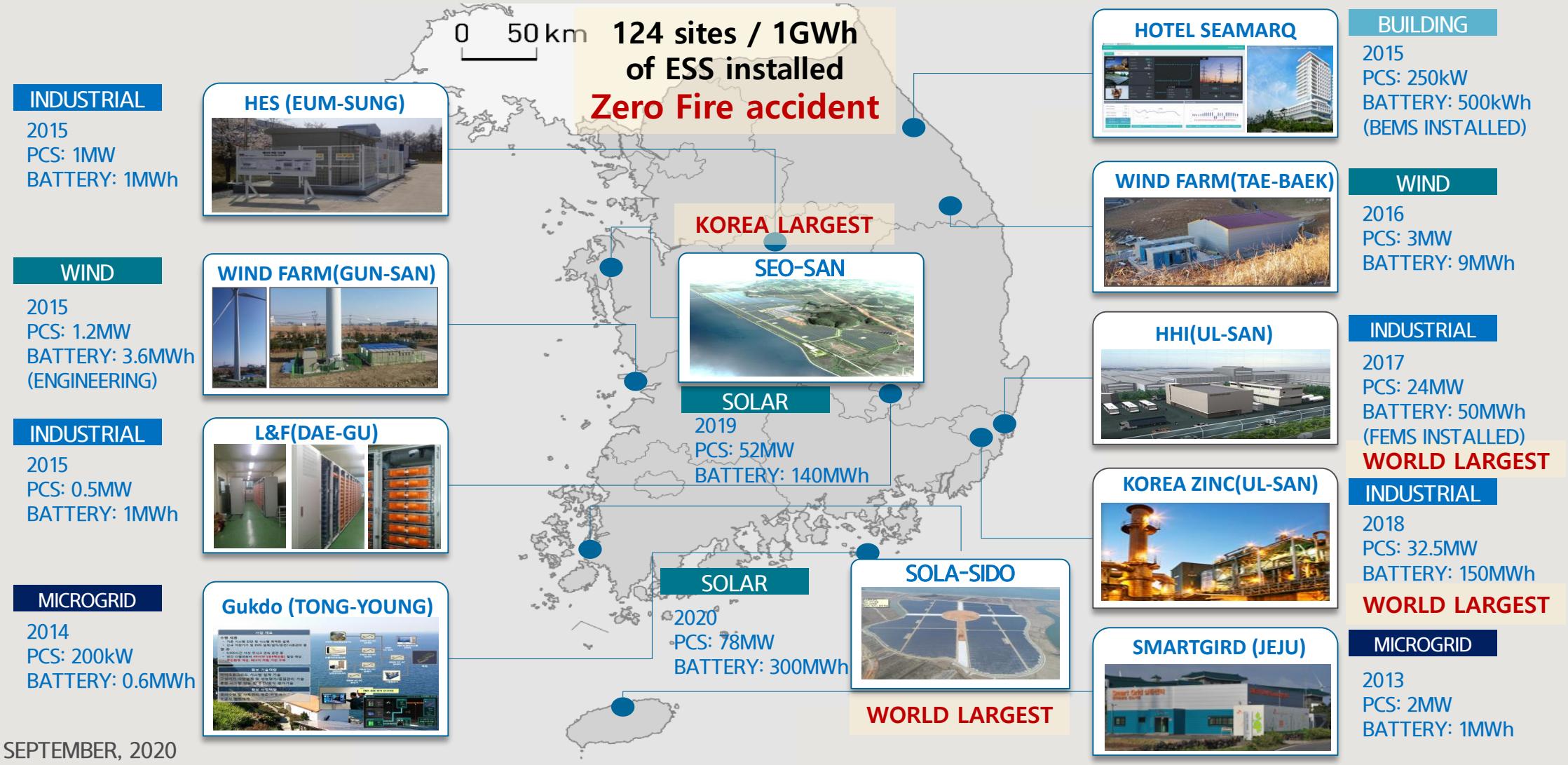


- Reduction of demand charge by peak cut
- Arbitrage according to TOU

Additional Demand charge incentive:
- Average discharge/d during peak time x demand charge

Additional Charge incentive:
- 50% discount of charging charge during off-peak time

HYUNDAI's Energy Solution



* AS OF SEPTEMBER, 2020

Major Achievement: (1) Industrial ESS

FEMS

@ Hyundai Heavy Industry, 2017

COD

Oct. 2017

CAPACITY

PCS: 24 MW
BATTERY: 51.5 MWh
* WORLD LARGEST INDUSTRIAL ESS

LOCATION

HHI(ULSAN) ESS CENTER
* TWO-STORY BUILDING

24MW / 51.5MWh
Hyundai Heavy Industry, Ulsan, Korea

Major Achievement: (1) Factory + ESS

@ Korea Zinc, 2018

ESS Building in the Factory

Oil Transformer

SWGR

PCS

NCM Battery

EMS Dashboard

Republic of Korea

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Major Achievement: (1) Factory + ESS

Functions: operation mode

1) Electricity bill reduction
   - Peak shaving + TOU Arbitrage
2) Demand Response
3) Back-up Generator (Emergency)

Project IRR: 〉20%, Payback Period: 〈 3-4 years

+ Hyundai's solution made more profit (+21%p) than we proposed.

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Major Achievement: (2) Renewables + ESS

@ SOLASEADO, 2020

WORLD LARGEST RENEWABLE ESS

COD

MAR. 2020

LOCATION

Haenam-gun, Jeollanam-do
* 1.6 million m^2

CAPACITY

PCS: 78 MW
BATTERY: 306 MWh

Major Achievement: (3) PV + ESS + EV

@ Jeju island, 2018

First PV+ESS+EV Charger in Korea

COD

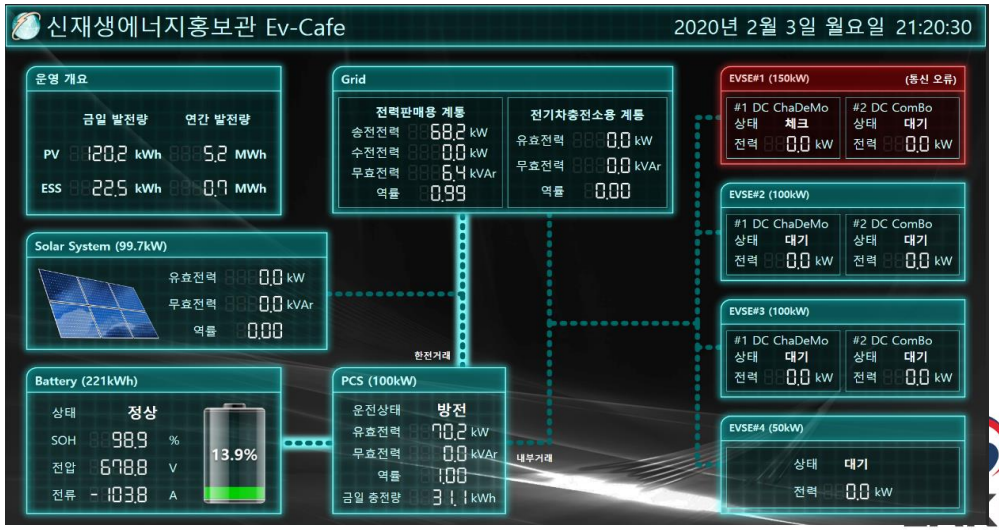
SEP. 2018

LOCATION

Jeju island * two(2) sites

CAPACITY

PV: 600 kW
ESS: 1.2 MWh
EV Charger: 8 EA



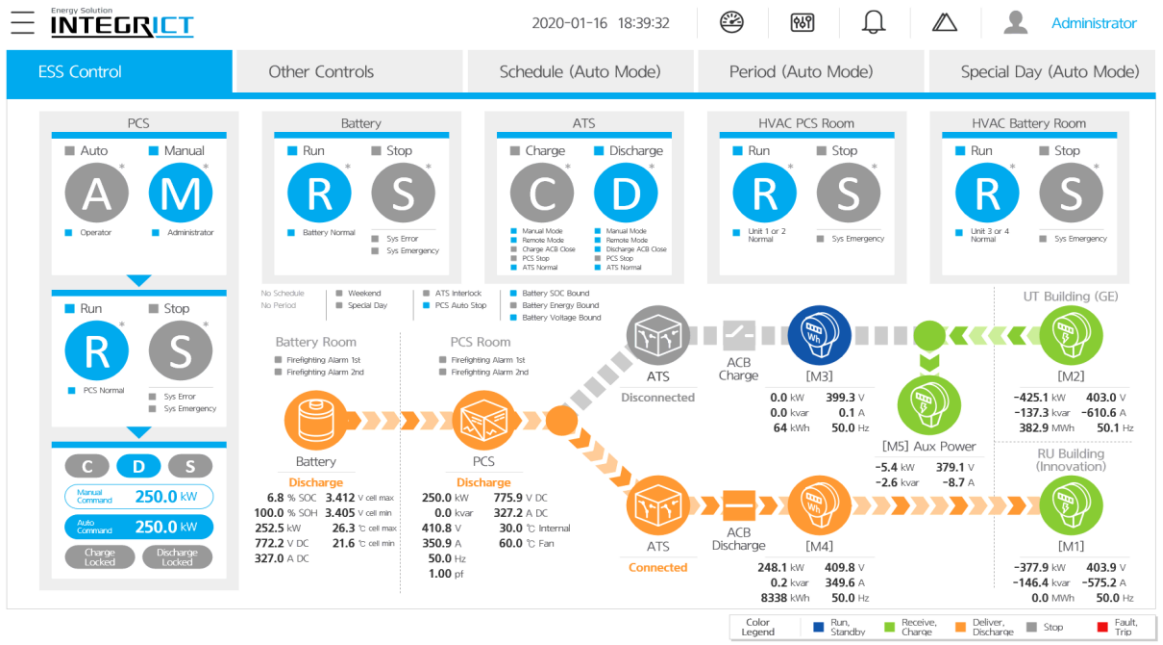
Republic of Korea

Major Achievement: (4) Generator + ESS

Diesel Gen.

@Global Power Synergy, Thailand

"... a 1.5MWh smart Energy Storage System (ESS), which is the largest Li-ION ESS in Thailand to date. ...not only to reduce the cost of electricity, but also to increase the reliability of power system... "



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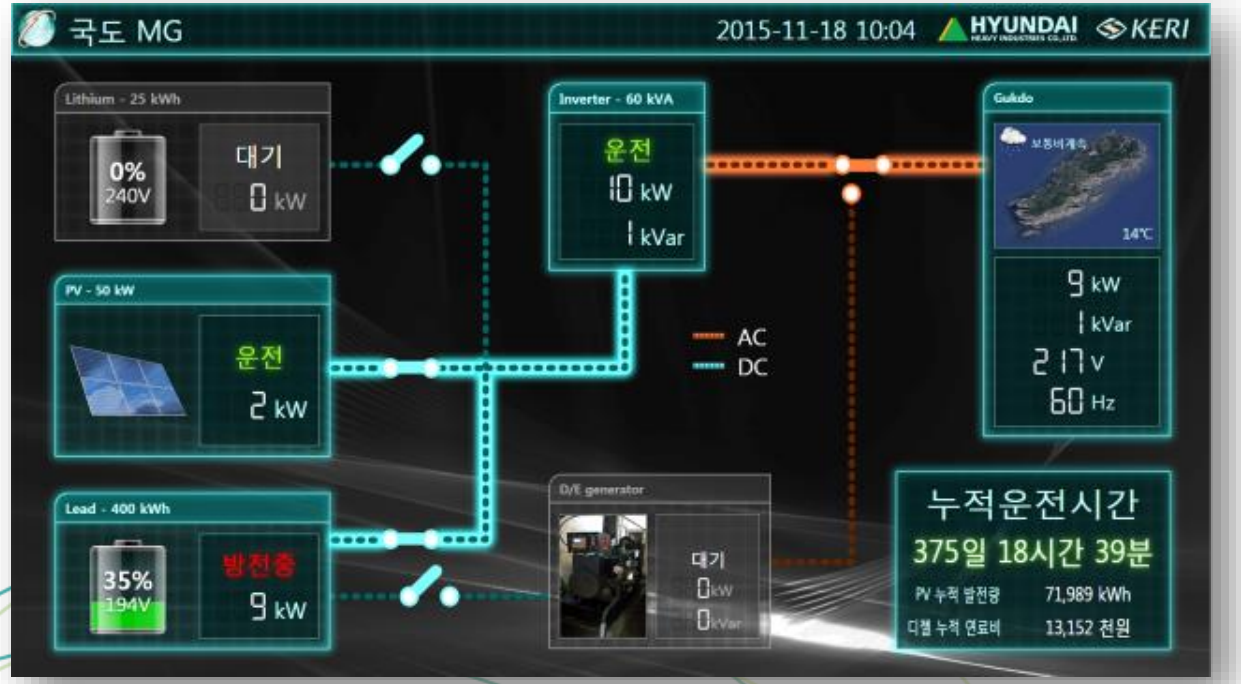
Major Achievement: (5) Microgrid

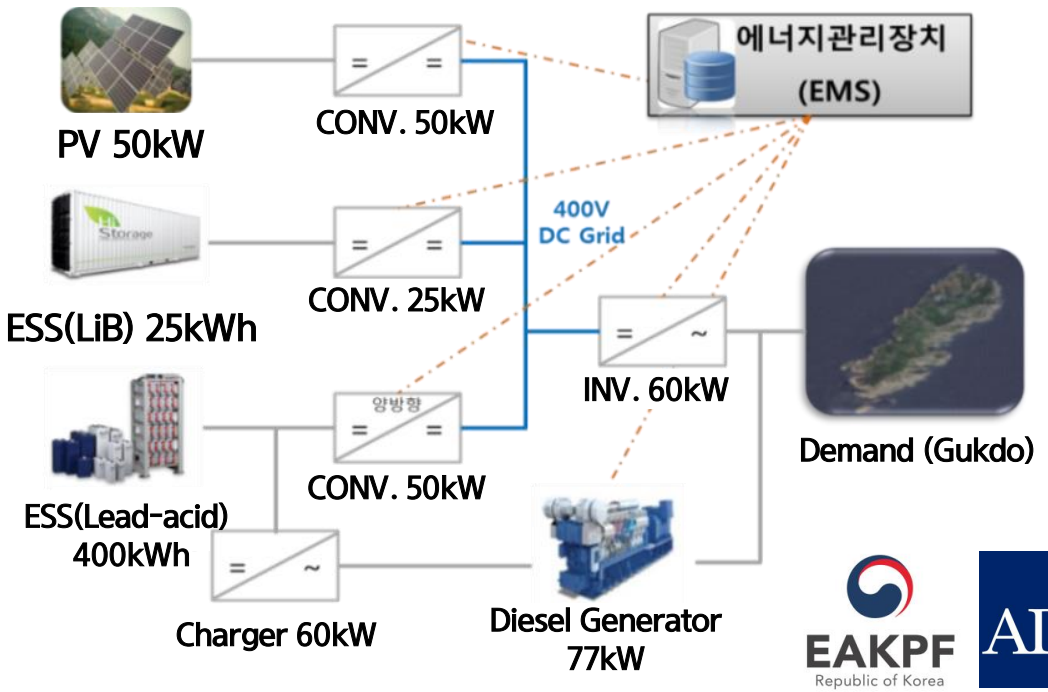
@ Guk island, 2014

Microgrid for private island, Kukdo – design, EPC, EMS (O&M)

Isolated Microgrid with PV, ESS(LiB, Lead-acid), and Diesel Generator

Fuel cost reduction: -60% **DG runtime reduction: 1,358hr/year** **Clean, noise-free island**





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ADB

Major Achievement: (5) Microgrid

@ Yukon, Canada, 2017

Front Engineering & Consulting

Microgrid design with PV, ESS, and Diesel Generator to minimize Yukon's energy cost(LCOE) for the Utility company(ATCO).

- Optimal Capacity
- Optimal operation strategy
- Power system analysis

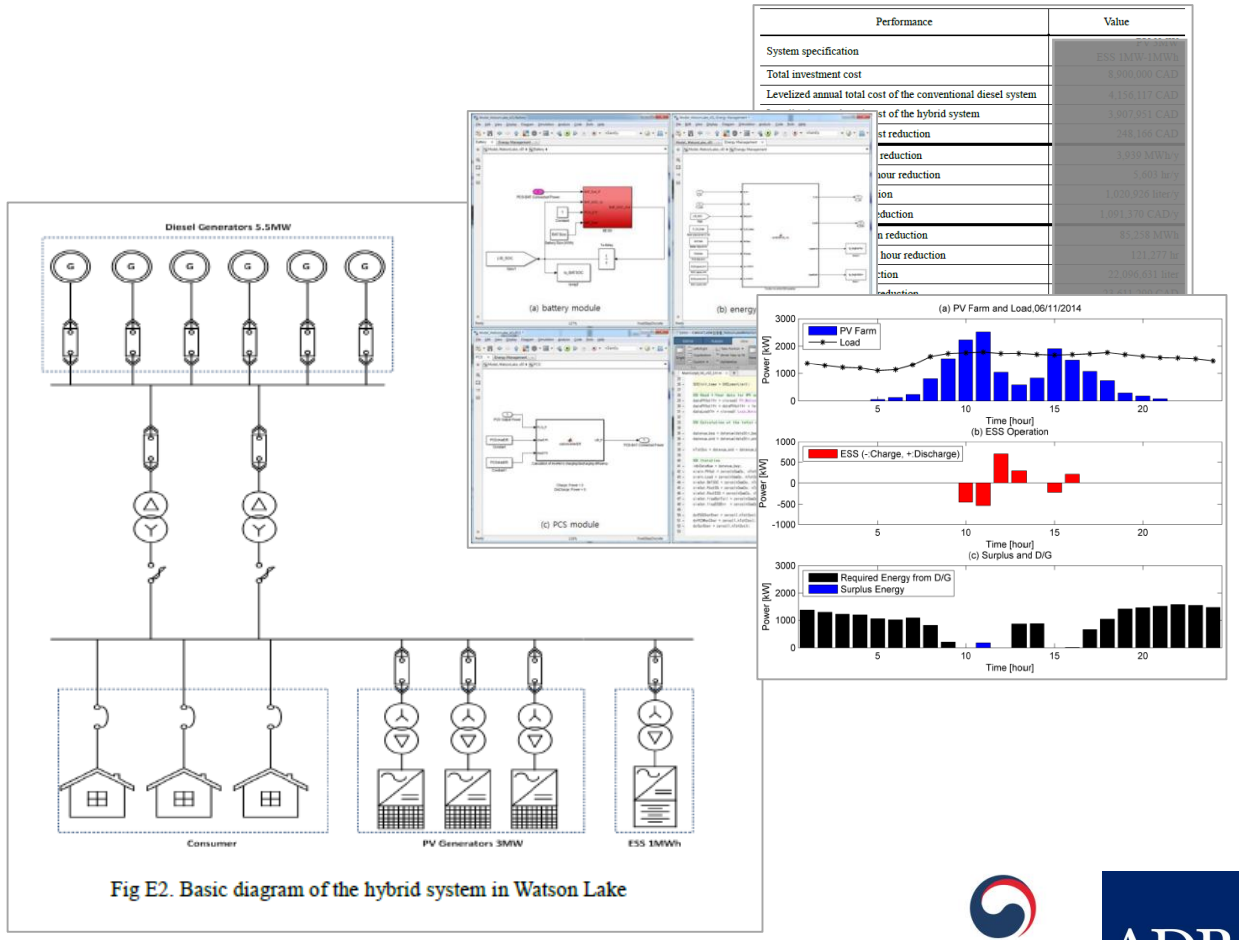

Fig E2. Basic diagram of the hybrid system in Watson Lake

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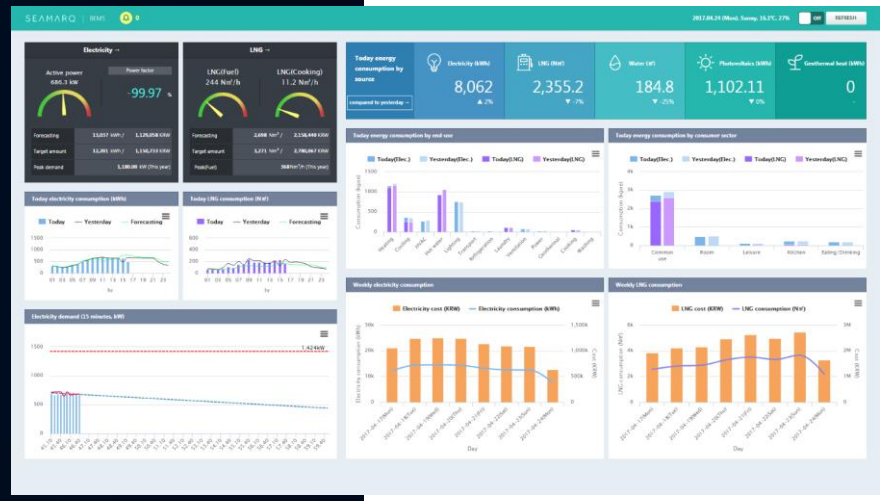
ADB

Major Achievement: (6) xEMS (BEMS, FEMS, CEMS, …)

@ SEAMARQ Hotel, 2015

BEMS in SEAMARQ, a 6-star hotel near Pyeongchang, where the 2018 Winter Olympics will be held
Hyundai Electric is leading the BEMS market by promoting energy savings
in energy-intensive buildings such as hotels, hospitals, and data centers.

- Lighting Power
- Heating & Cooling Power
- Gas
- Hot Water
- Renewal Facility
- Geothermal Heating



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ADB

Major Achievement: (6) xEMS (BEMS, FEMS, CEMS, …)

@ SEAMARQ Hotel, 2015

GRID

BEMS

TOC

E. D/G

U/G

- Back-up power
  : More than 30min.
- Demand Response

LOADS

ENERGY CONTROL

ESS

- Cost Saving
- Demand Response
- UPS

EV CHARGER

PARKING LOT

DC

UPS

HVAC

LIGHTS

LOAD CONTROL

DR

DR Aggregator

PV

R/T

- Sub. Generation
- Clean Energy

CUSTOMER VALUE

1. COST SAVING
2. VALUE ADD.
   (New business opportunity)
3. STABLE POWER
4. Brand Image Promotion

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ADB

Major Achievement: (6) xEMS (BEMS, FEMS, CEMS, …)

@ Hyundai Heavy Industry, 2017

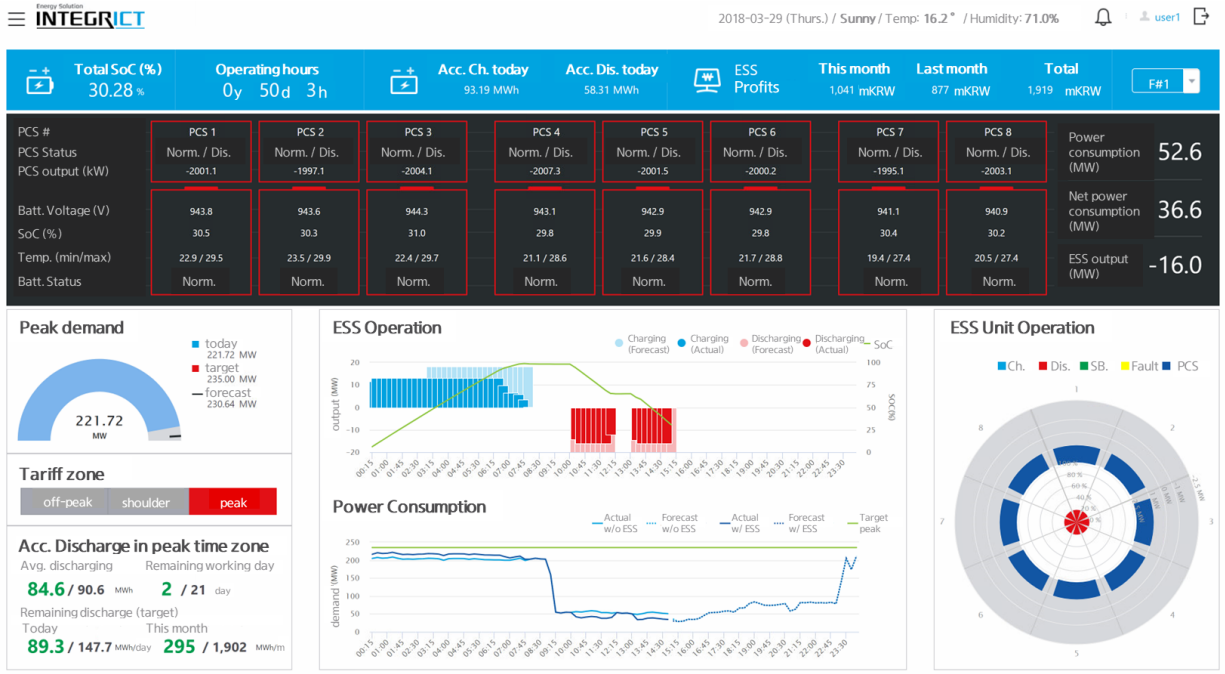
Total Energy Monitoring and Control system: Electricity + LNG + Heat

Measurement point: 〉+40,000

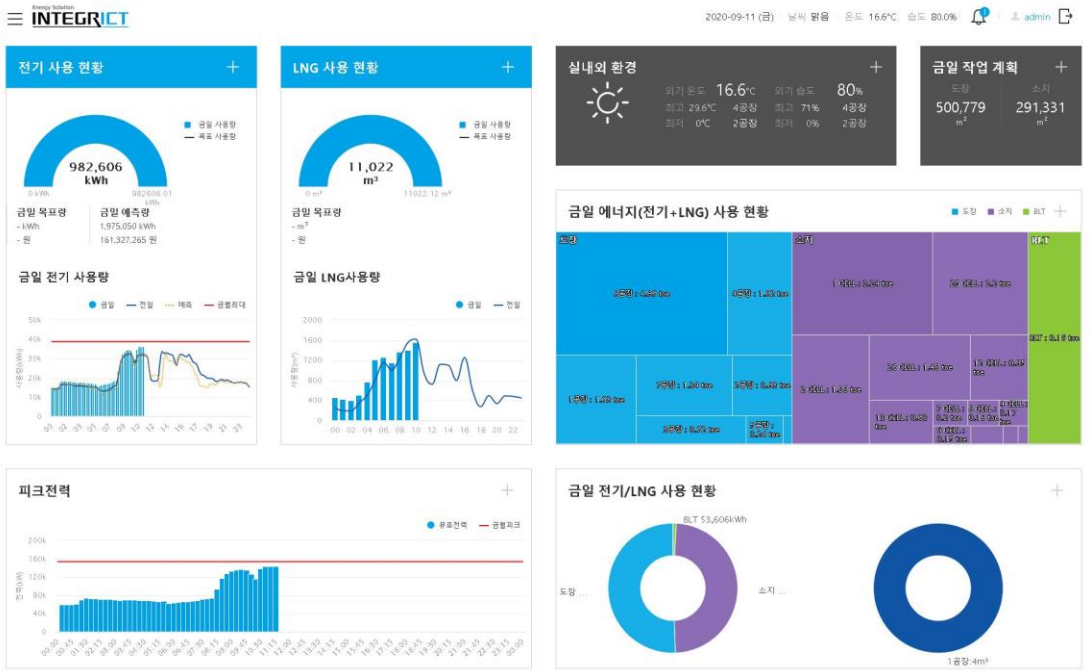
Monitor→ Forecast → Analysis → Control

**** Energy cost reduction: 〉+10%***

**** 1st grade FEMS** certificated by government*



** example page (optional)*



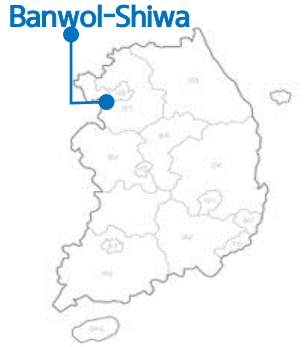
Major Achievement: (6) xEMS (BEMS, FEMS, CEMS, …)

@ Banwol-Shiwa National Industrial Park, 2020

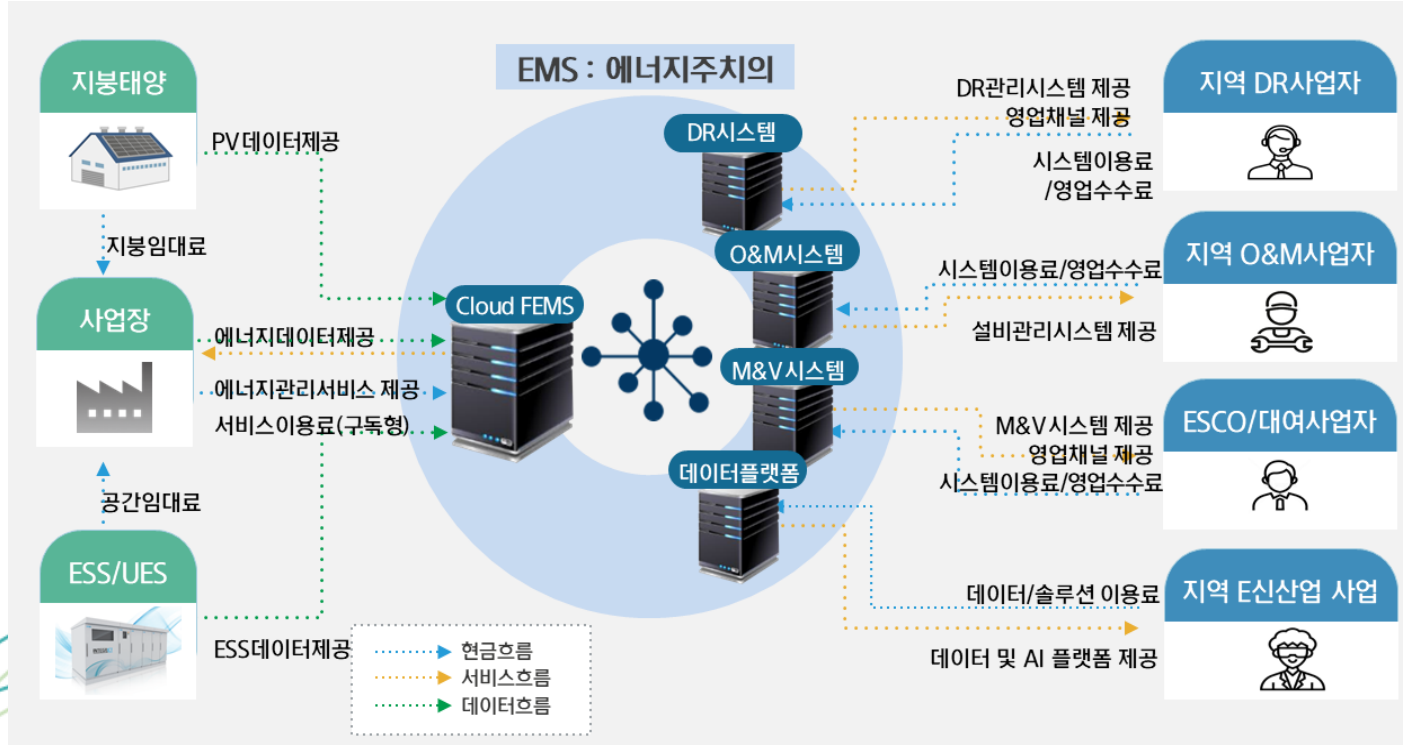
AICBM*-based subscribable FEMS solution

for small and medium-sized companies without large investment for local system

+100 company, +10% Energy Efficiency, + 100 Demand Response, + 20 PV/Fuel Cell, +100 ESS

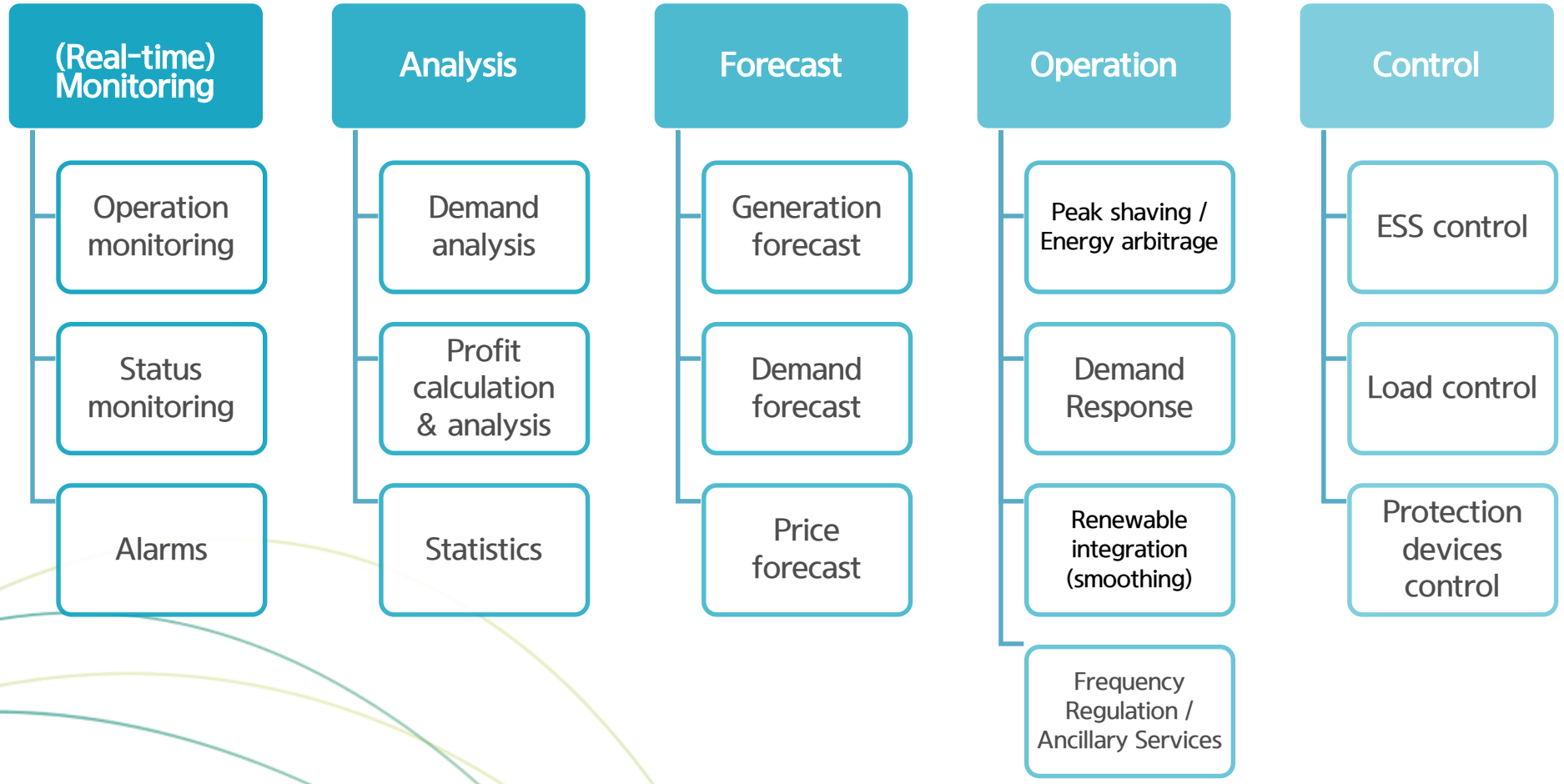


** AICBM: Artificial Intelligence(AI), Internet of Things(IoT), Cloud, Big Data, Mobile*



Hyundai's Competitiveness: (A) Data + Connectivity

"Hyundai's Energy Solution provides state of the art (modular) services …
*…including **monitoring, data analysis, optimization, and control**"*



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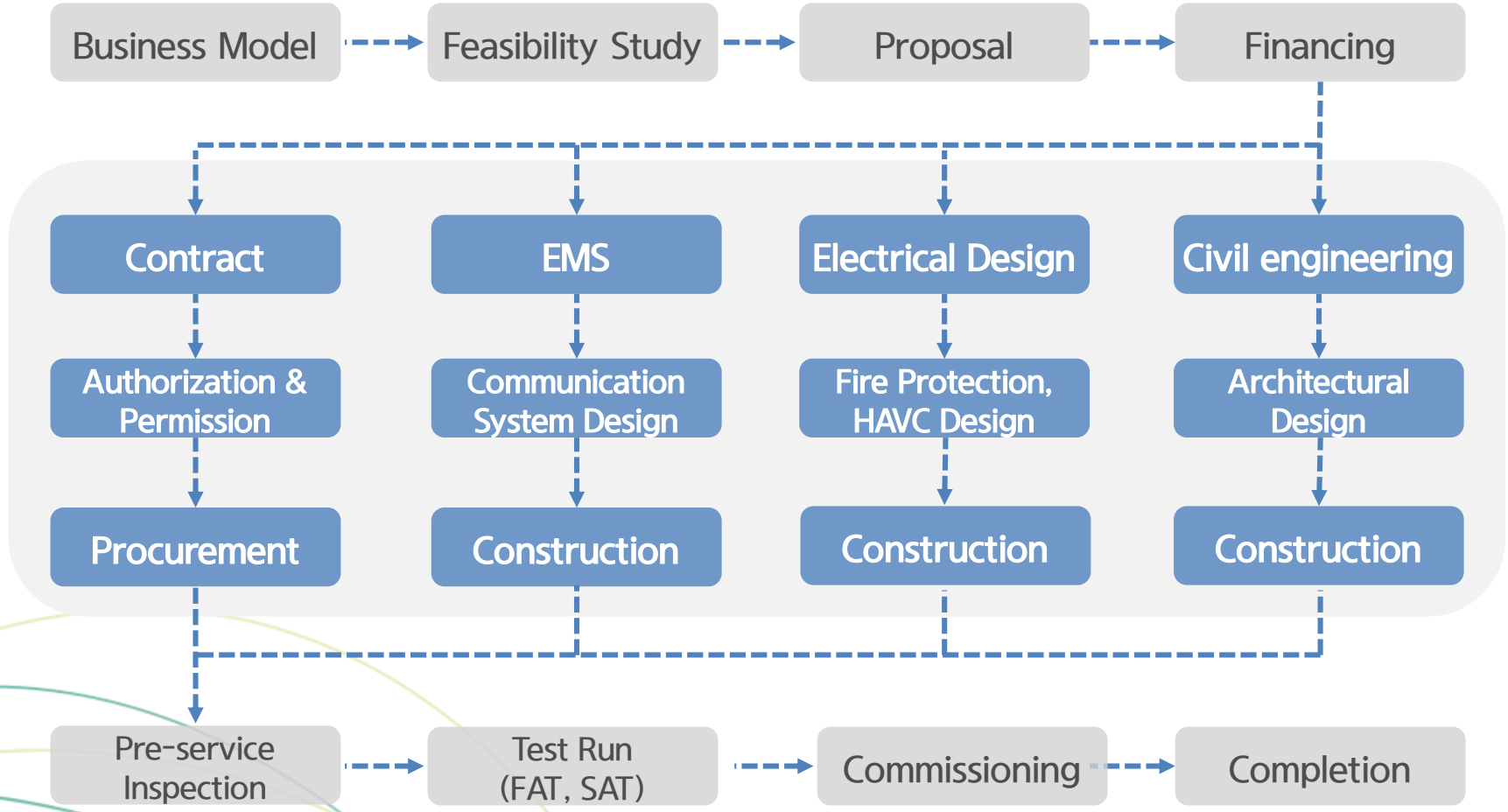
Hyundai's Competitiveness: (B) Total Solution Provider

"Total Energy Solution Provider"



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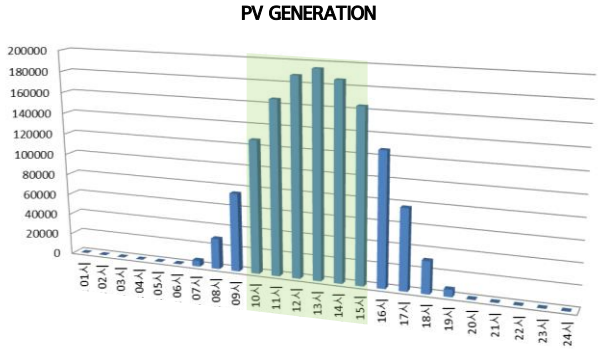
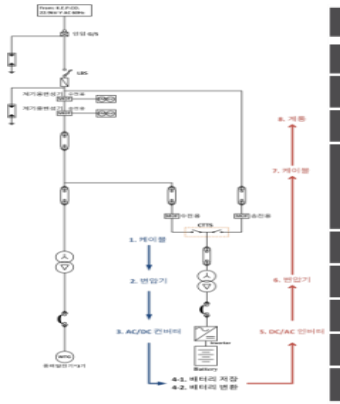
Hyundai's Competitiveness: (C) Front Engineering (Analysis)

A Analysis: Gen profile



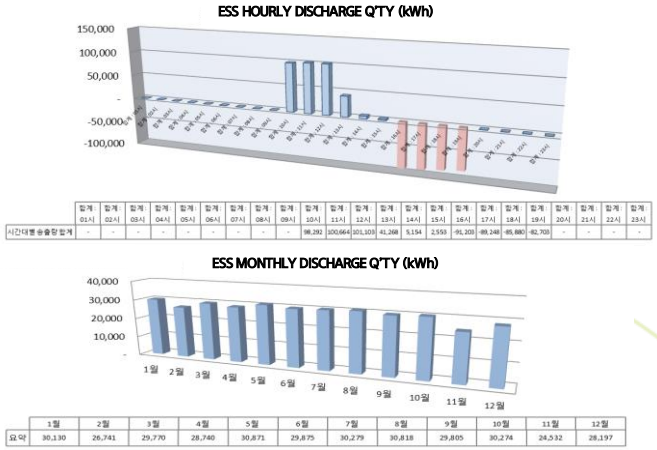
B Design: Operation Algorithm

C System Efficiency Design



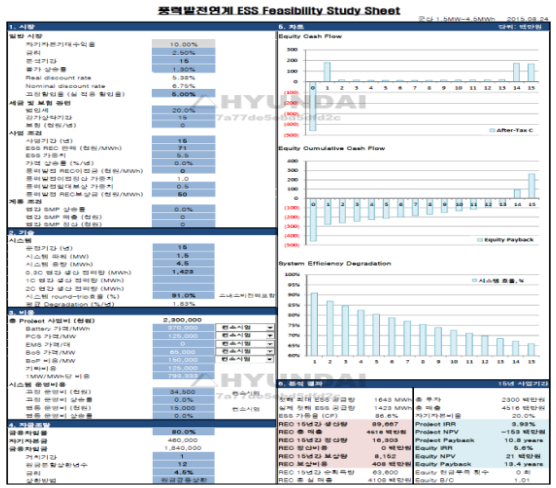
NO.	EQUIP.	EFFI.
1	CABLE	99.50%
2	TR_ESS	99.00%
3	AC/DC CONVERTER	98.80%
4	BATTERY (STRORAGE)	99.75%
	BATTERY (CONVERSION)	97.00%
5	DC/AC INVERTER	98.80%
6	TR_ESS용	99.00%
7	CABLE	99.50%
8	GRID	100.00%
SYSTEM EFFICIENCY		91.65%

D Simulation: Considering ESS/PV/Diesel

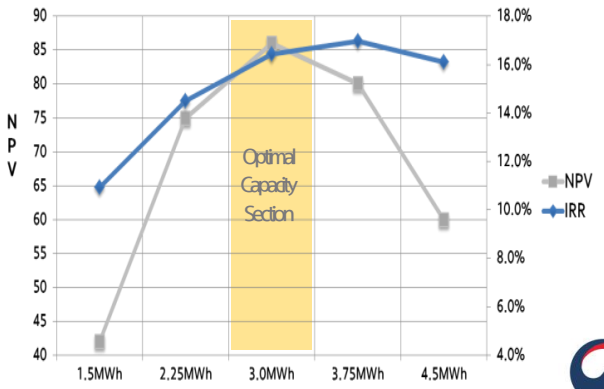


	1월	2월	3월	4월	5월	6월	7월	8월	9월	10월	11월	12월
요약	30,130	26,741	29,770	28,740	30,871	29,875	30,279	30,818	29,805	30,274	24,532	28,197

E Pre-Feasibility Study



F Optimization Design



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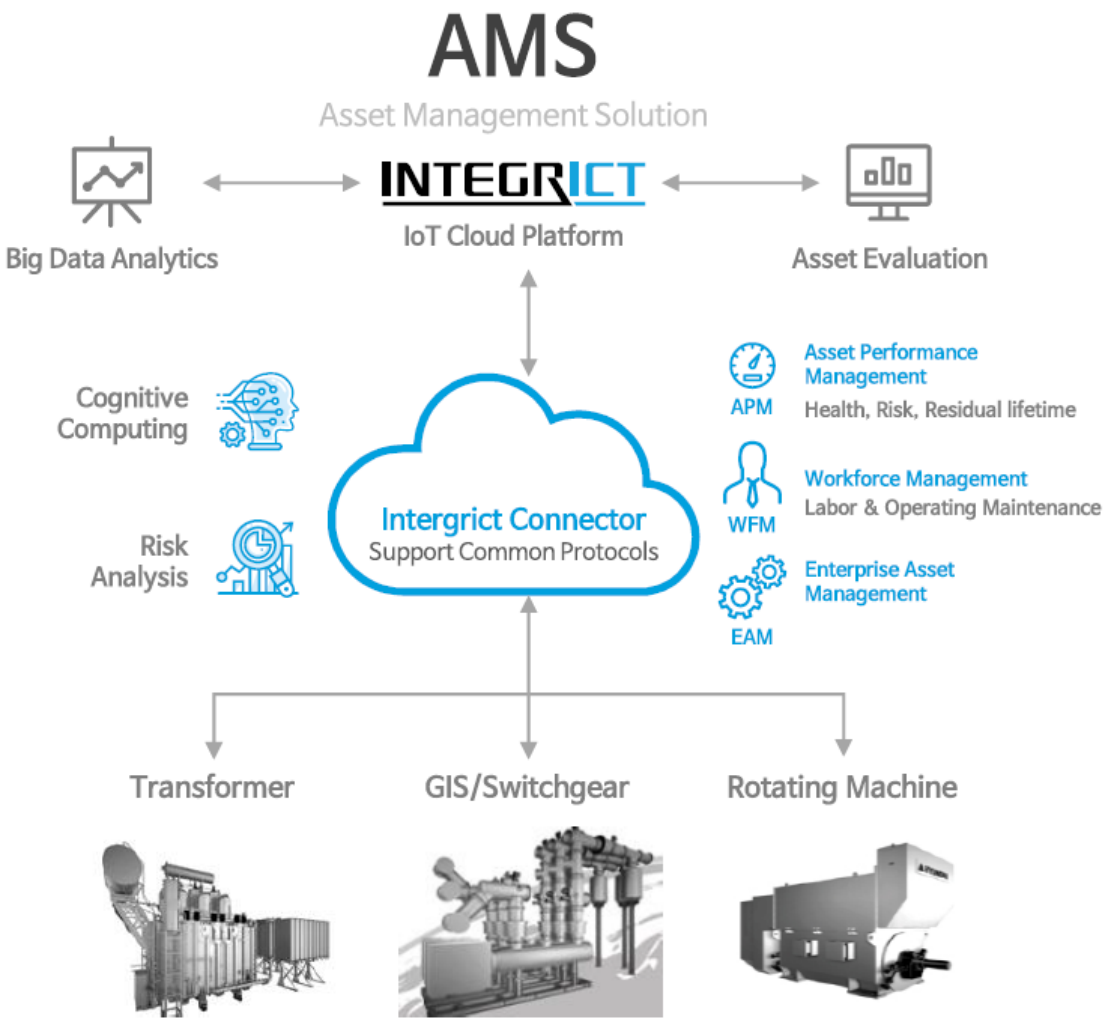
Hyundai's Competitiveness: (D) Asset management

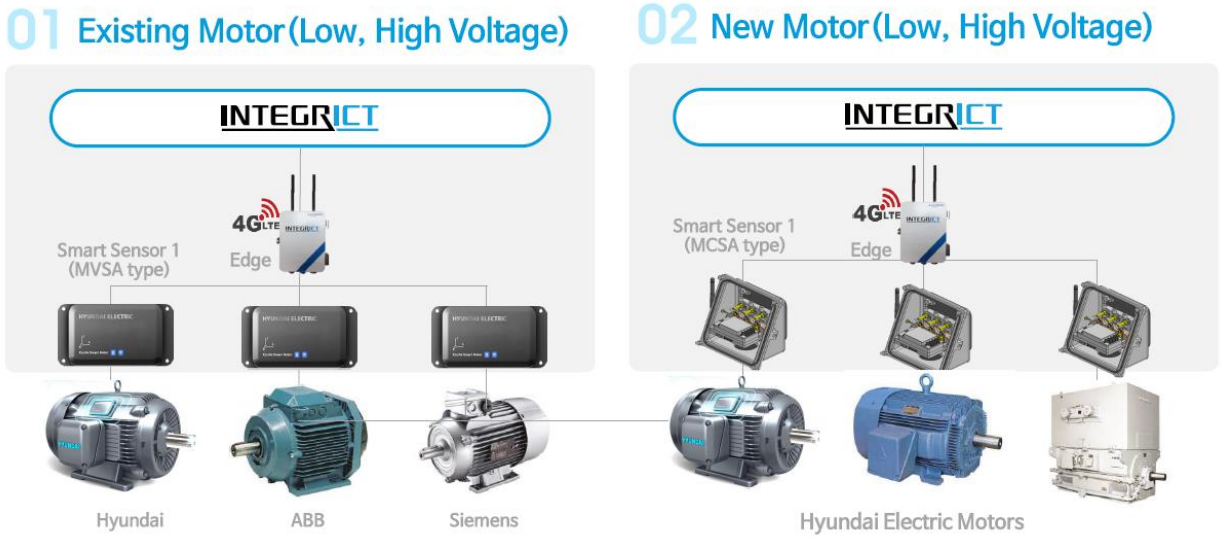


Asset Management System (AMS)...

reduces unplanned downtime and field service visits,

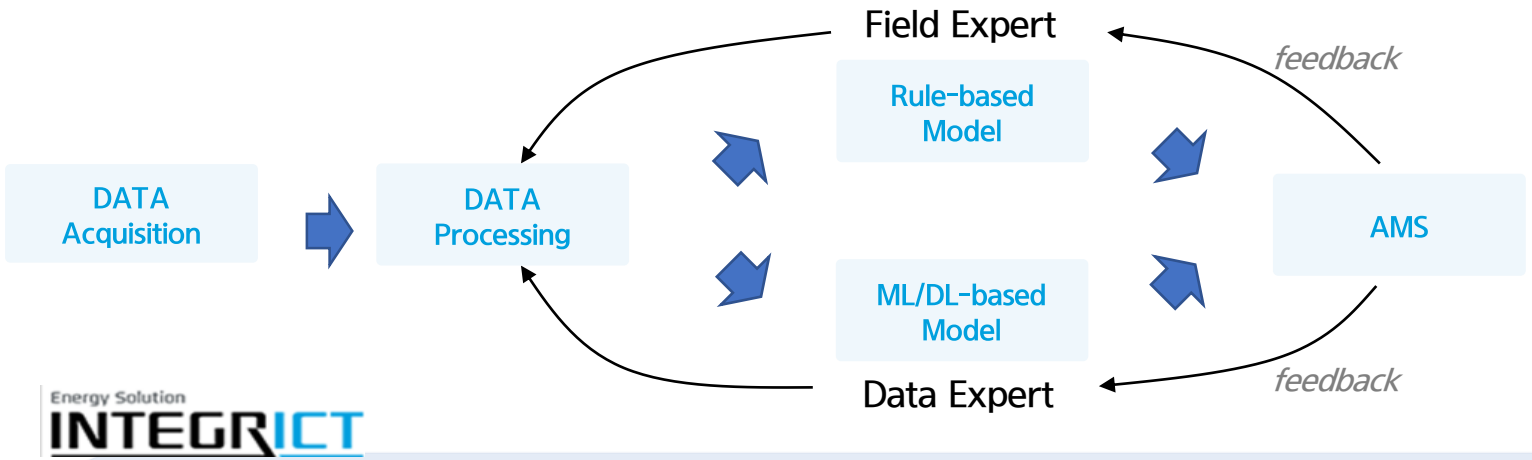
enables electrical devices to be operated with peak performance

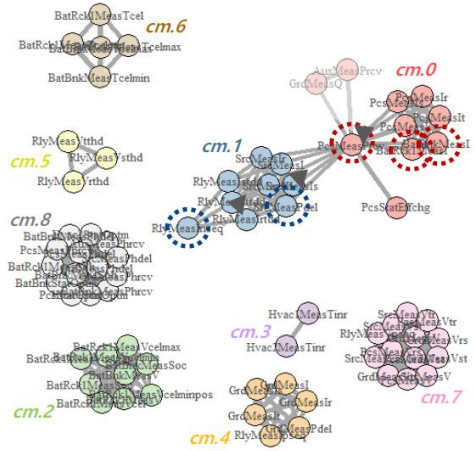
by the proactive and preventive maintenance.



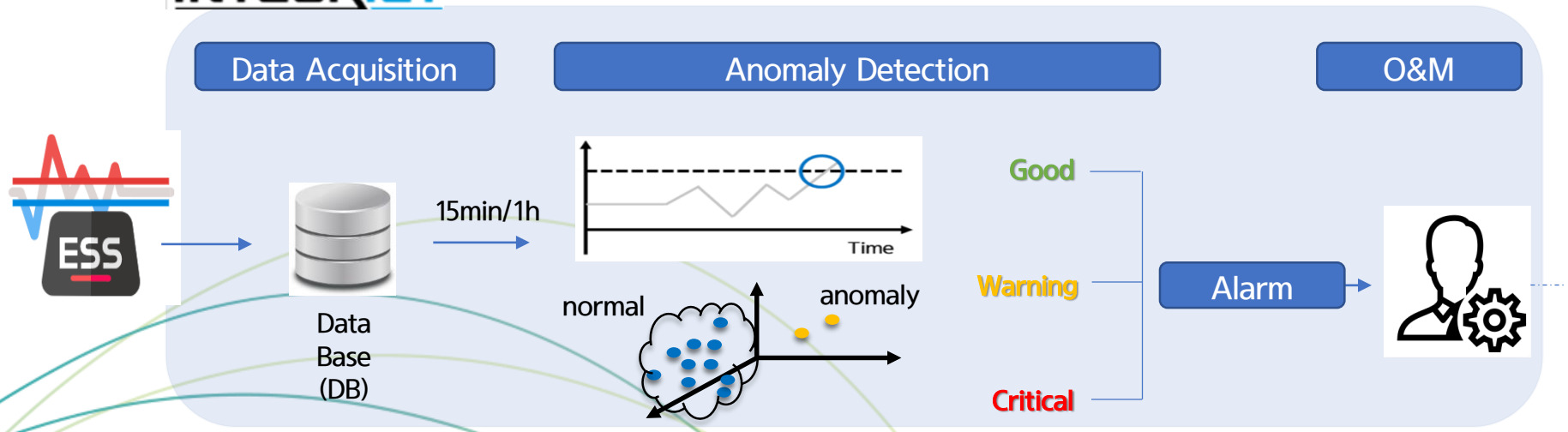
Hyundai's Competitiveness: (D) Asset management

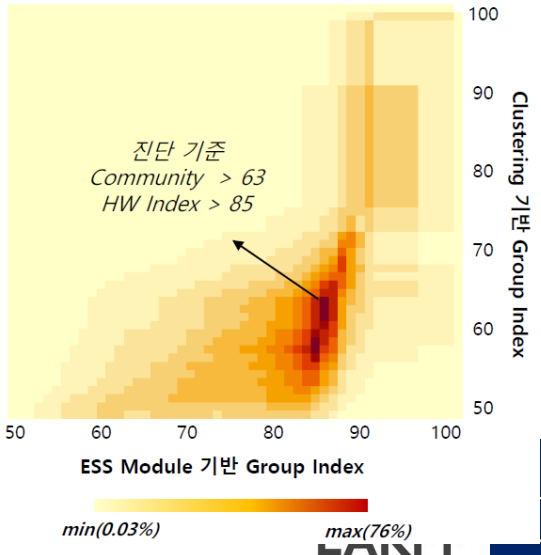
*ML/DL-based **ESS Asset Management System**: Anomaly detection (in 2019)*





Energy Solution INTEGRICT





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