『Asia-Pacific forum on Green and Low-Carbon Development Forum』

EV·ESS Battery Reuse, Re-fabrication and Recycle technology in South Korea

20th Oct, 2021

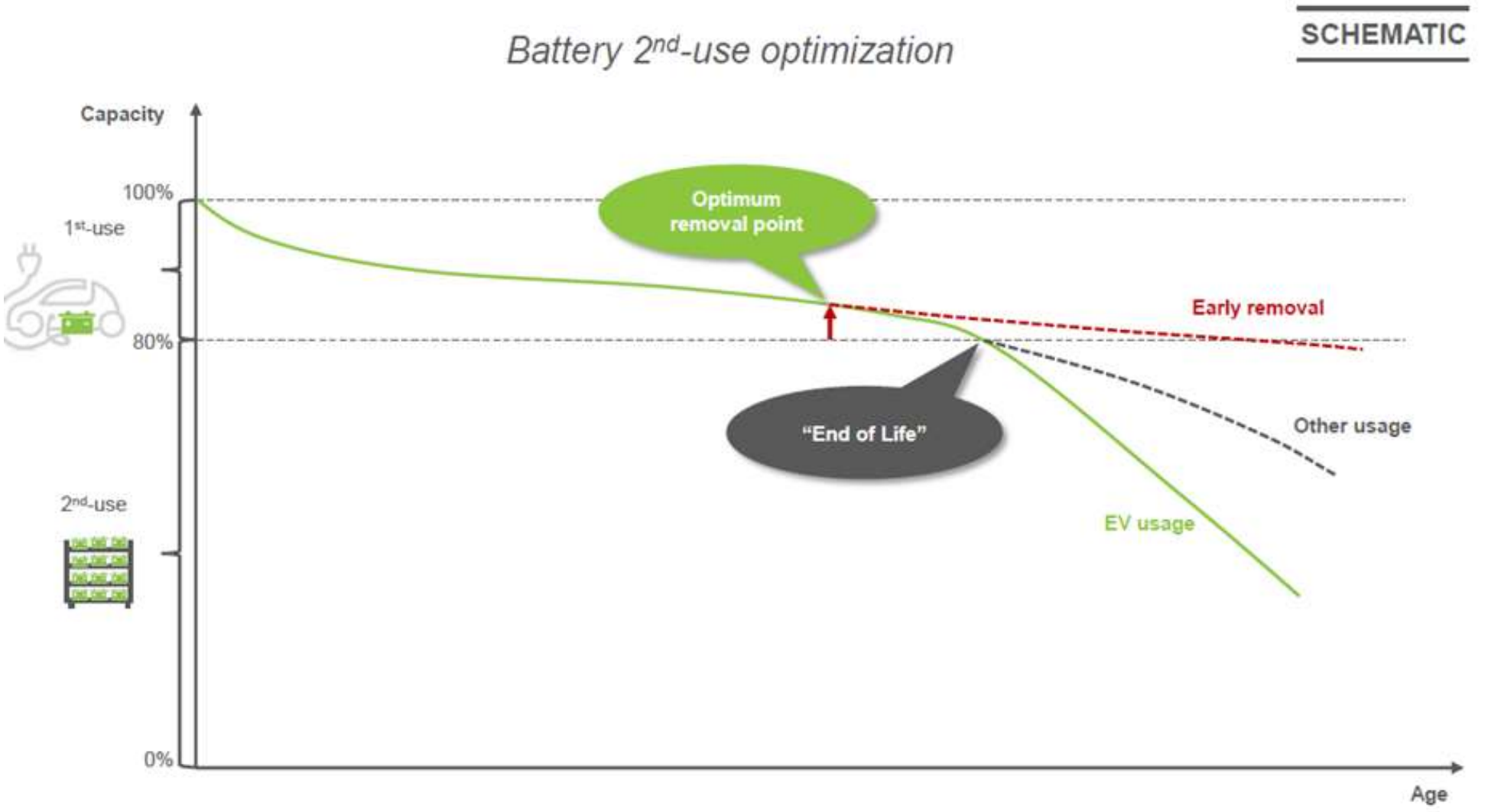
Dr. Yu Tack, Kim (ytkim@battery.or.kr)

KBIA Korea Battery Industry Association

KORBA Battery R&D Association of Korea

CONTENTS

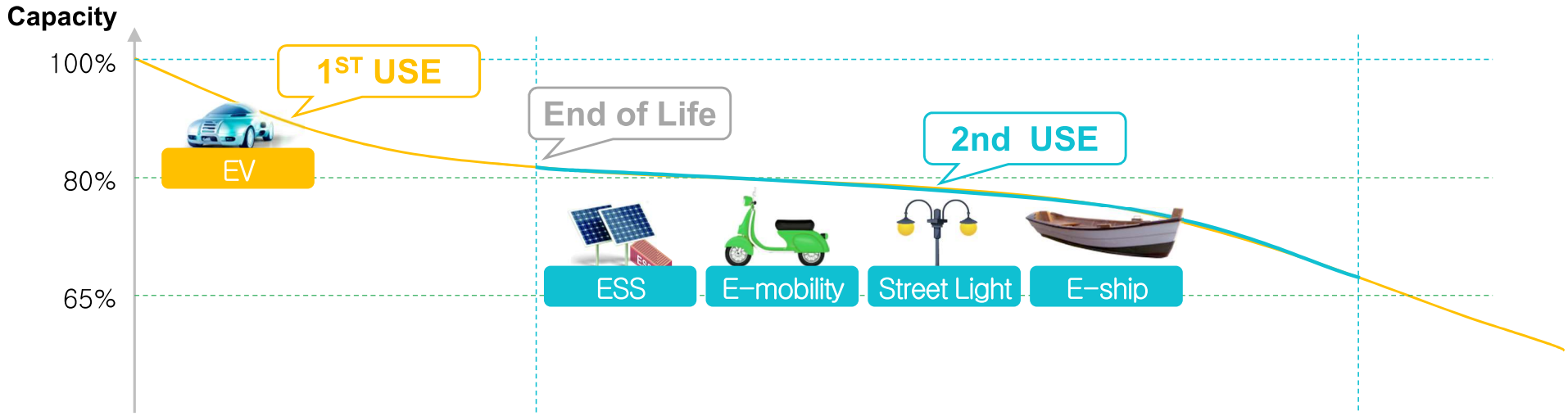
EV Battery capacity degradation



Source: The Mobility House, TUM

1.2 2nd Life of EV Battery

EV Battery 2nd life applications and benefits

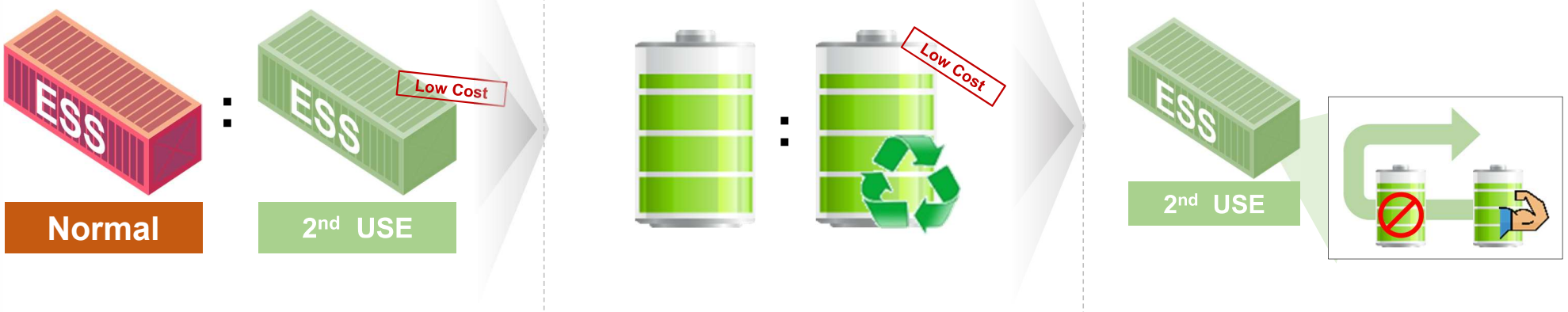


1.2 2nd Life of EV Battery

EV Battery 2nd life applications and benefits

Low Cost ESS applications

Cost 30% and Calendar Life 50% → Save 40%



Initial cost reduction

- Low cost ESS expansion
- Grid support and Various application replace Lead battery

Environment friendly

- Delay 5~7yrs Recycle life
- Save Recycle process cost

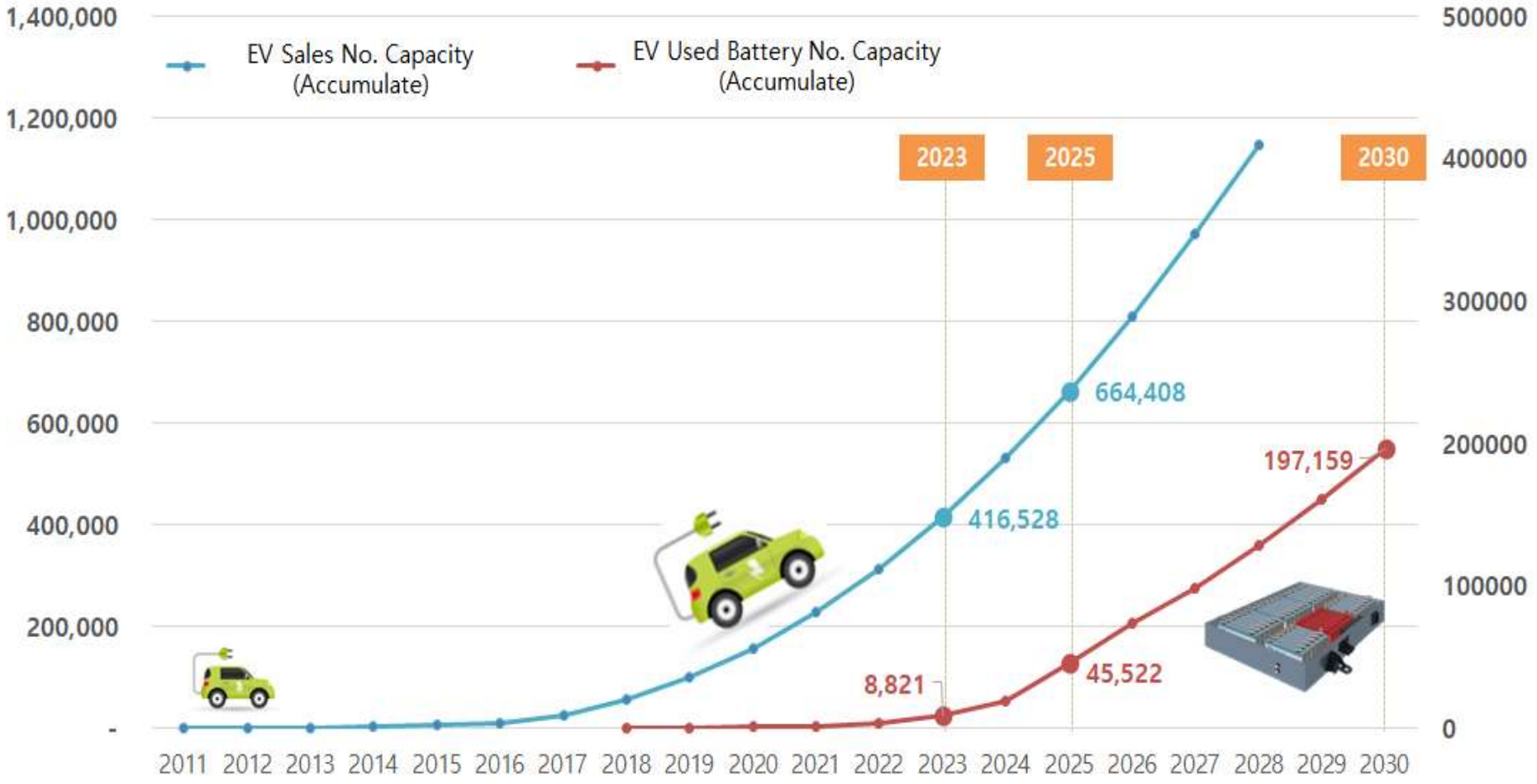
Battery Maintenance

- Approved Battery
- Maintenance cost down

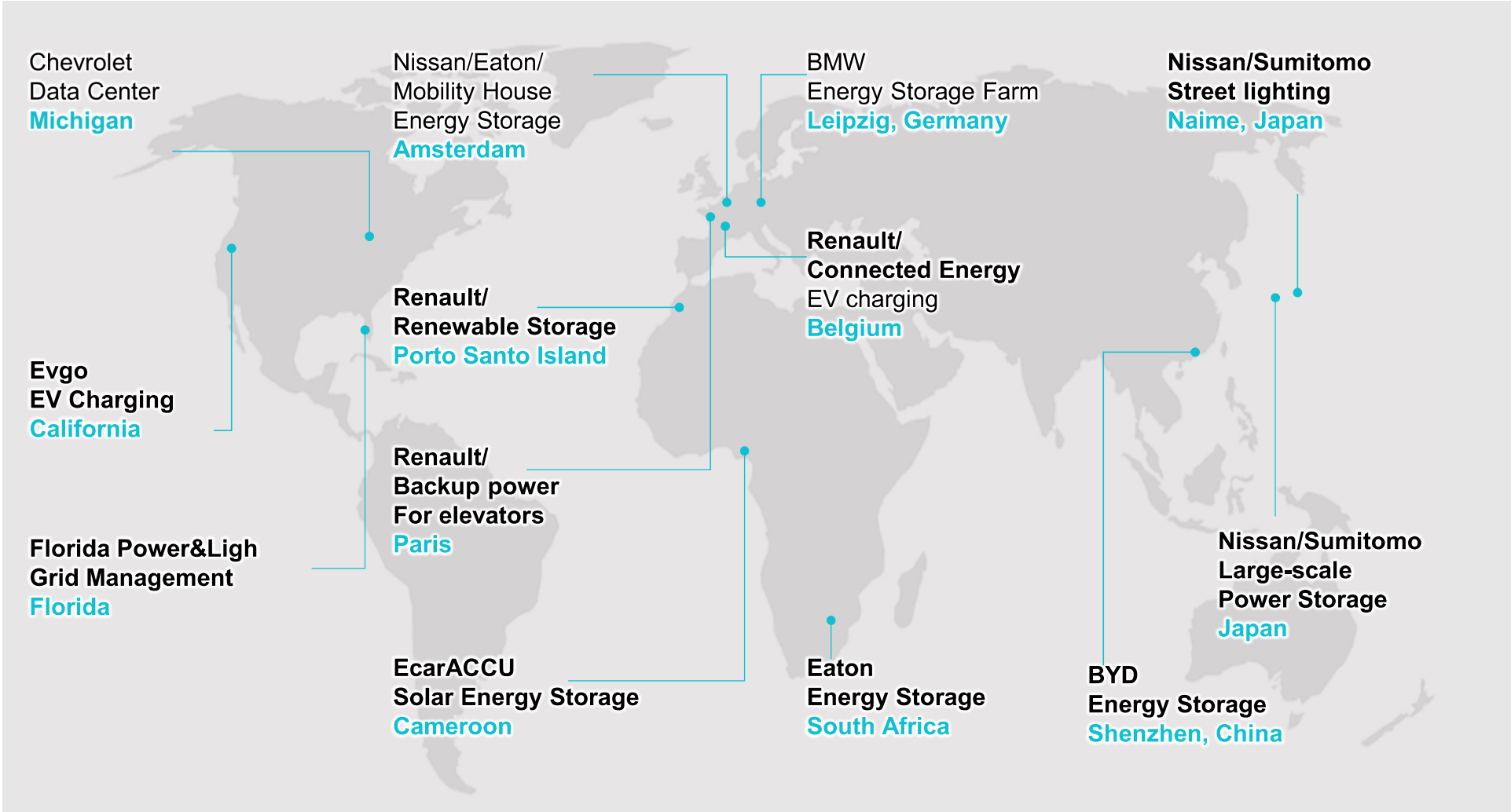
1.3 2nd Life Battery Market

The number of end of Life EV battery in Korea

'25, 750MW ESS(2nd Use) about US$ 112 Millions and 2,250Ton Battery Recycle
'30, 5.9GWh ESS(2nd Use) about US$ 590Millions and 11,820Ton Battery Recycle



Global EV Battery demonstration



280kWh Used Battery ESS operating in Hyundai Steel

BESS sourced by 15 EA, Ionic EV(28kWh) and 12 EA xEV Battery

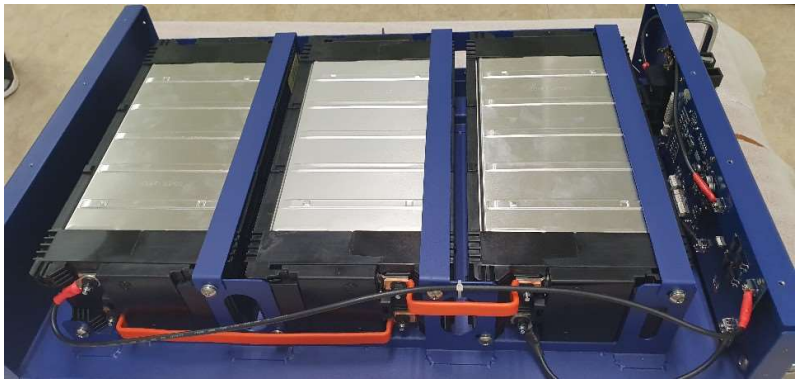
445kWh Hybrid (Used battery + New Battery) ESS

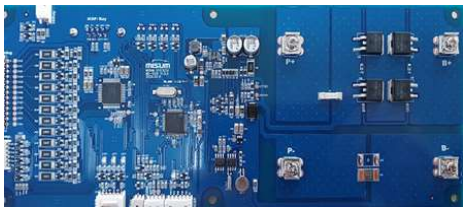
Hybrid ESS(New Battery 344kWh+100kWh Used battery)

EV Charge station (ESS), 250kW/220kWh, e-gopang, Juju

From. EtNews, BMW, ESS for EV charge station mad by BMW i3 used battery. ’19.07.25

Used Battery UPS





2.2 Applications in Korea

Reuse & re-fabrication list

Applications	Date	Capacity	Used Battery Source
Hyundai Steel ESS	`17.10	250kWh	EV Ionic 10 EA
EV Charging Truck ESS	`17.11	50kWh/75kWh	EV Ionic 5 EA
Jeju Substation UPS	`17.12	10kWh 2EA	EV Passenger Car 1EA
Hyundai Steel ESS	`18.11	1MW	EV Ionic 40 EA
Energy Dream Center ESS	`18.12	200kWh	Evic E-Bus 5EA
PV Station ESS	`18.12	100kWh	Evic E-Bus 1EA
Jeju EV Charge Station ESS	`19.08	220kWh	i3 10 EA
Hyundai farm ESS	`19.10	134kWh	i3 10 EA
SK Station EV Charge ESS	`19.10	200kWh	SM3 Z.E. 10 EA

2.2 Applications in Korea

Process design of Reuse, Re-fabrication

Research & Development

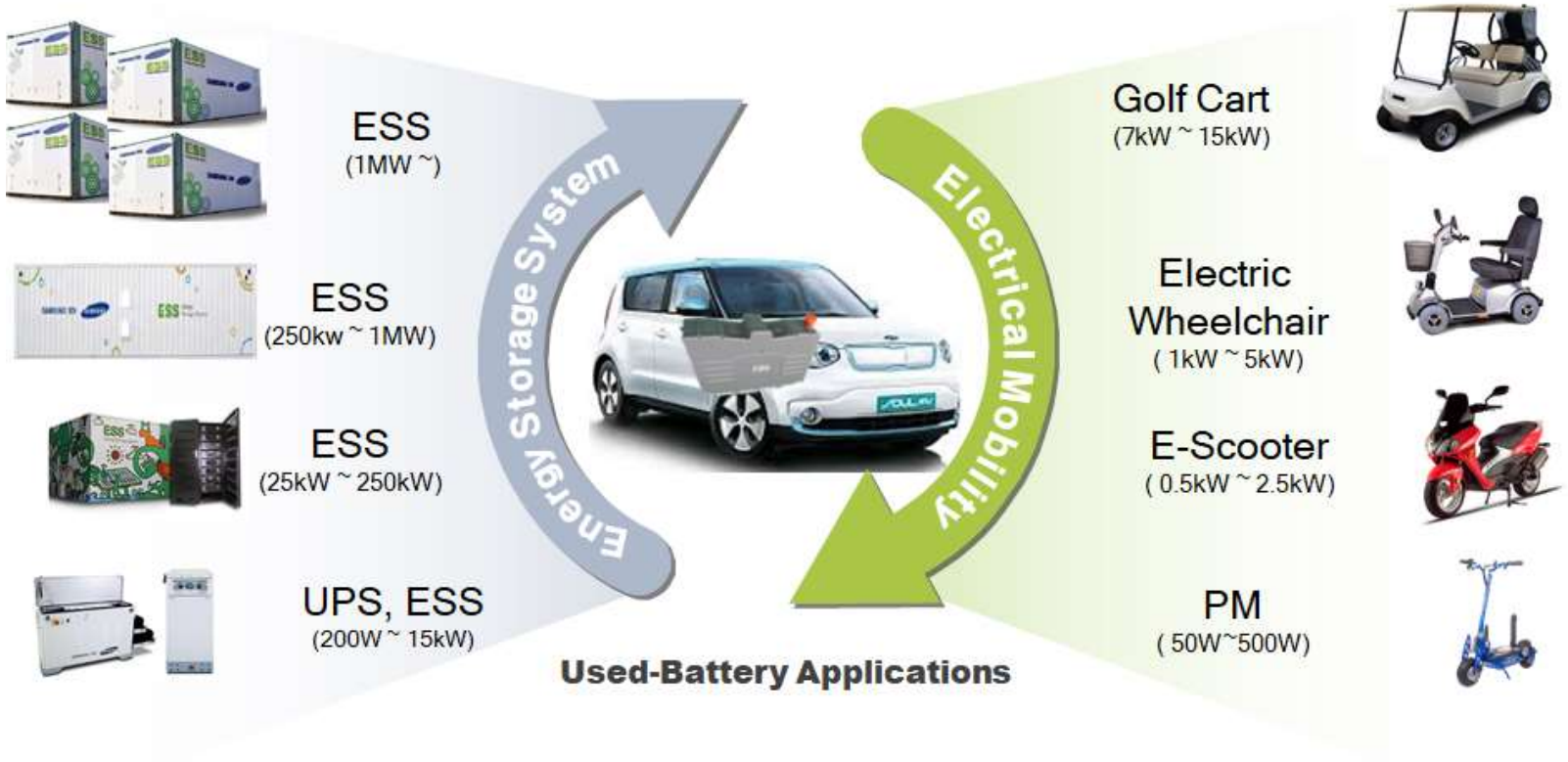
EV Charger

2017	2018	2019	2020

UPS

2.2 Applications

2nd Life Battery Applications



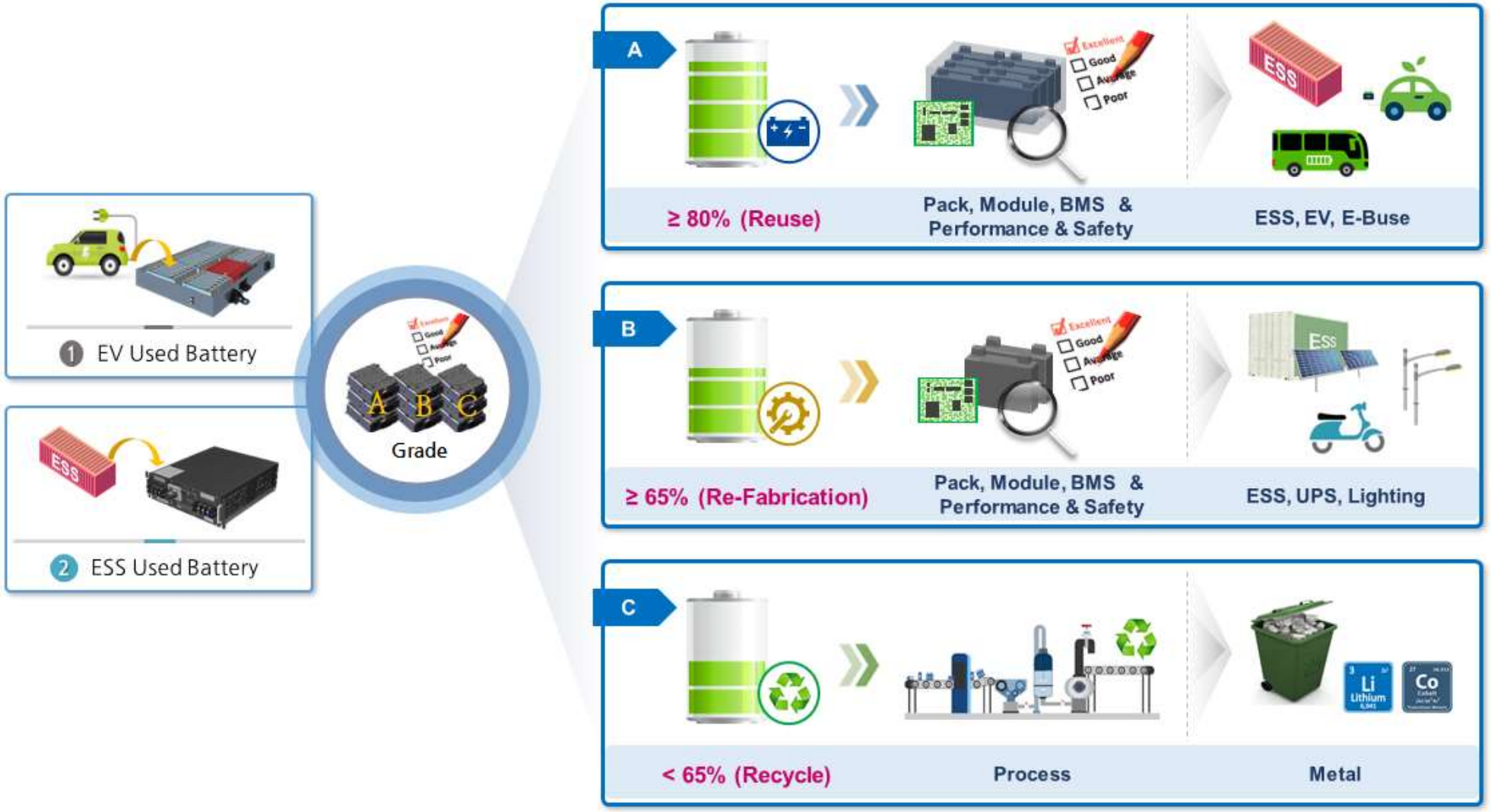
EV, ESS Battery reuse Center by KBIA

Naju, Chen-nam

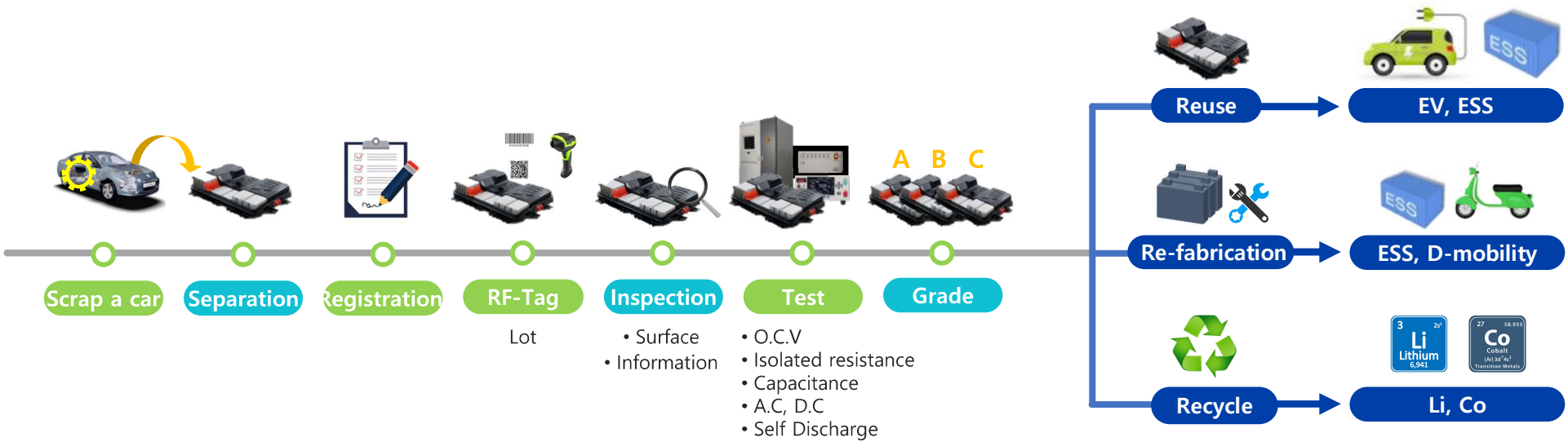
- (Land/ Building) 8,602.40m^2, /2,432.66m^2

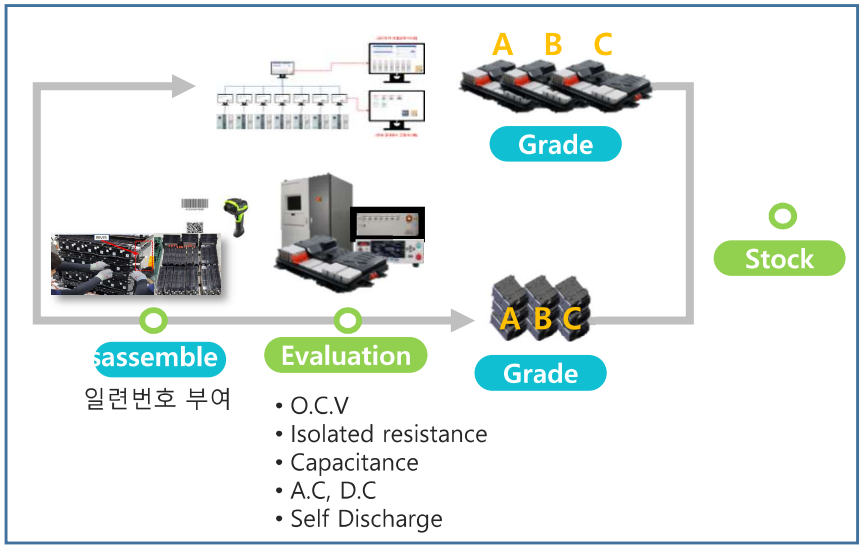
■ 배치도

EV·ESS 2nd Life Process

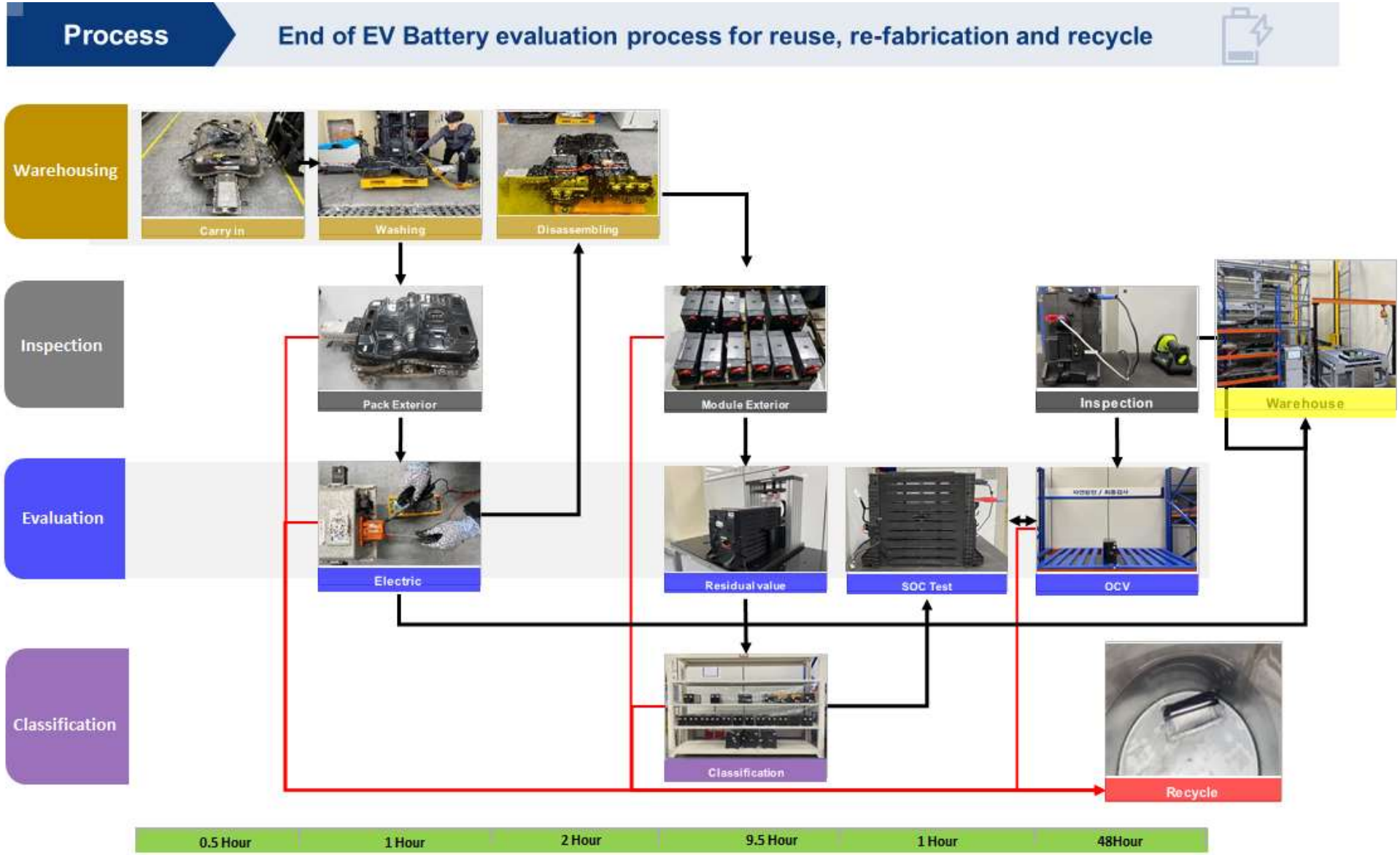


Process design of Reuse, Re-fabrication





Process design of Reuse, Re-fabrication



Process design of Reuse, Re-fabrication

Detail Process

Warehousing

① Carry in

② Washing

Pack Exterior Inspection

③ Exterior Inspection

ex) Failure

Pack Electric Inspection

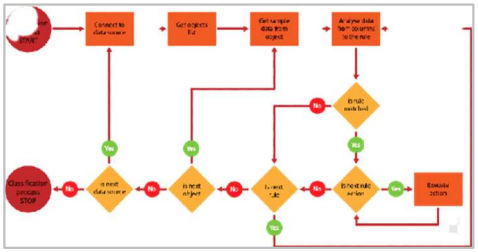
④ Voltage & Internal Resistance

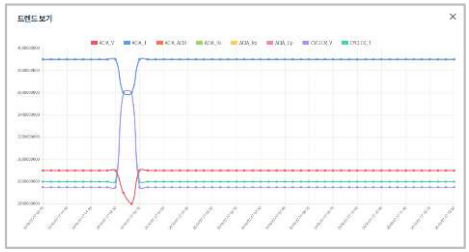
(a. Voltage)

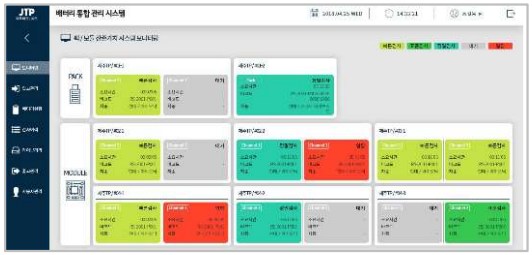
(b. Resistance)

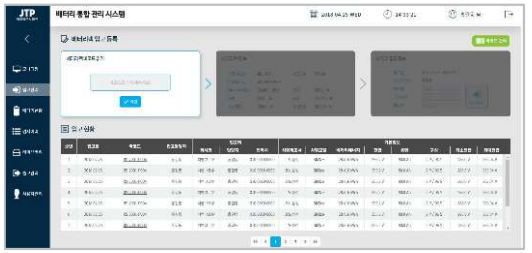
Process design of Reuse, Re-fabrication

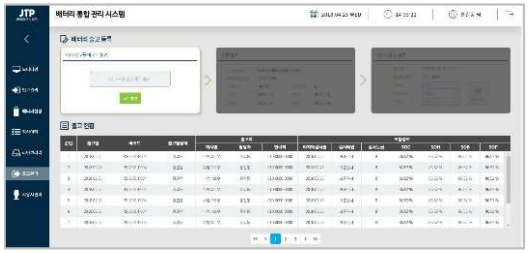
EV Battery Pack & Module Evaluation Test System

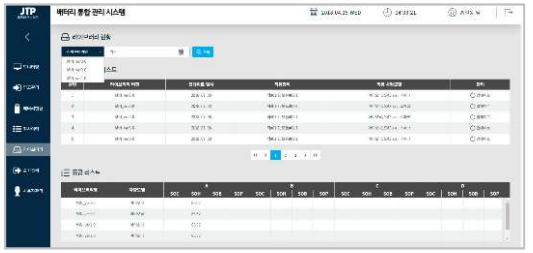


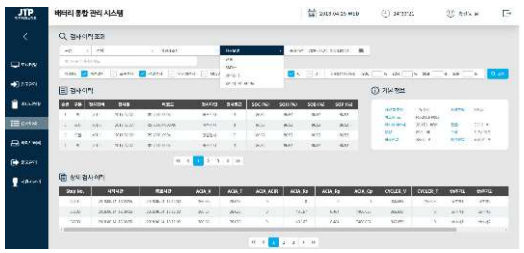


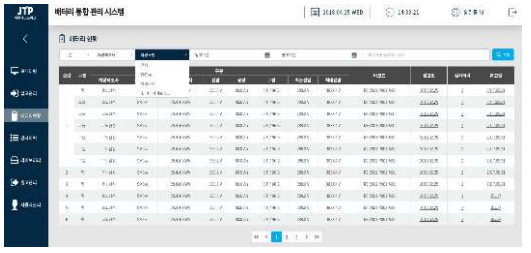


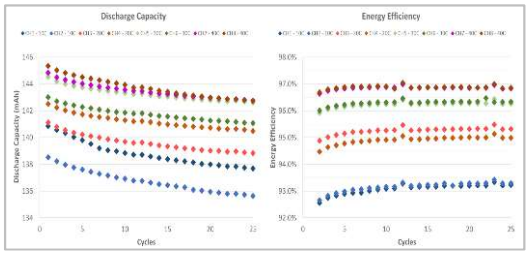


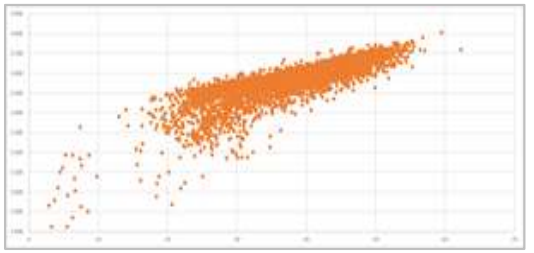












2.4 Economic Analysis

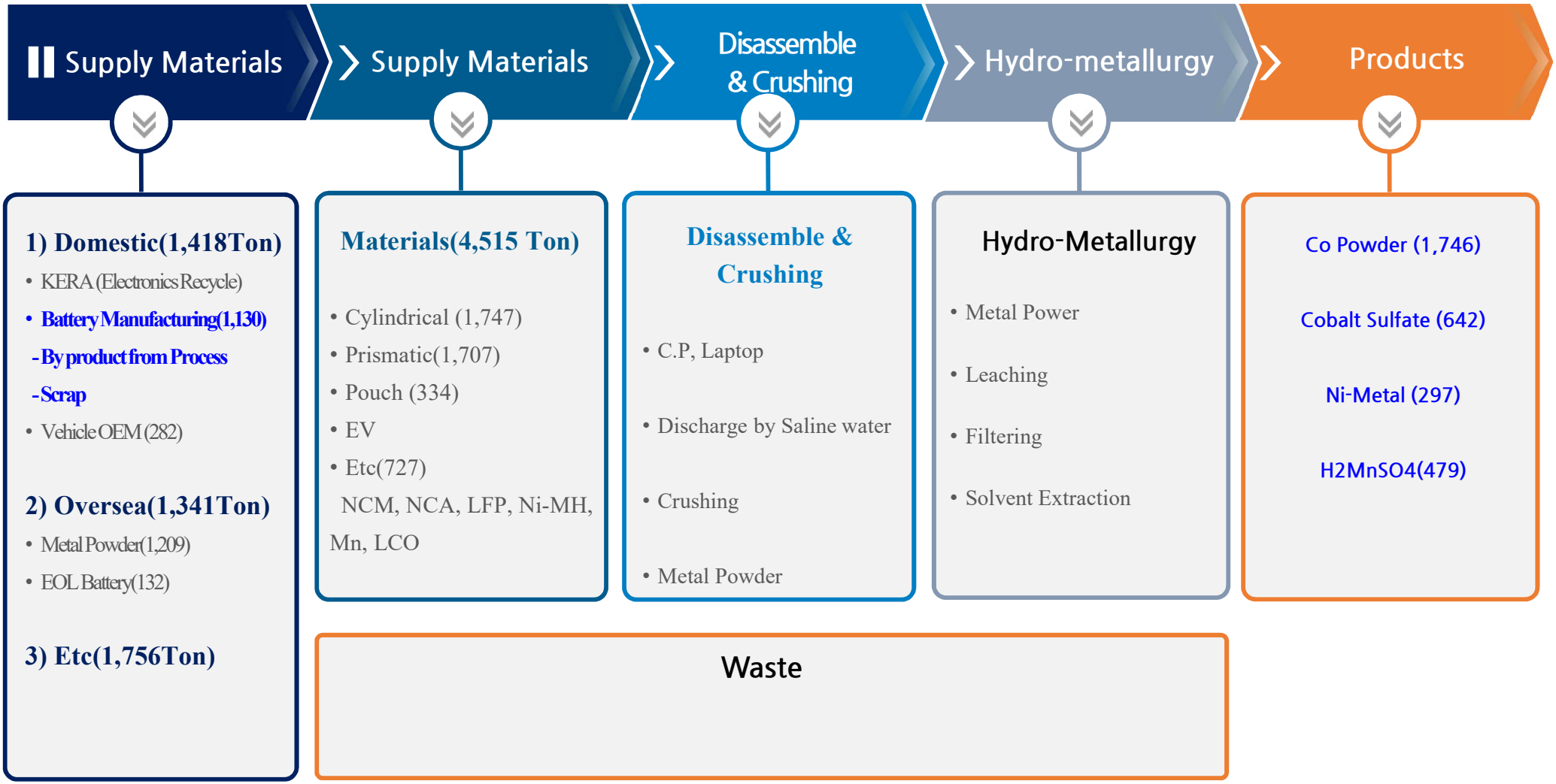
Reuse vs Recycle

- EV Used Battery : 12ea ('17) → 1,464ea ('20) → 9,155ea('22)
- HEV Used Battery : 3,657ea('17) → 19,167ea('20) → 74,988('22)

4.1 Recycle in Korea

Clean Recycle Technology

The Flow Chart of Lithium Battery in recycling center (Ton/2015)



4.1 Recycle in Korea

Current Process

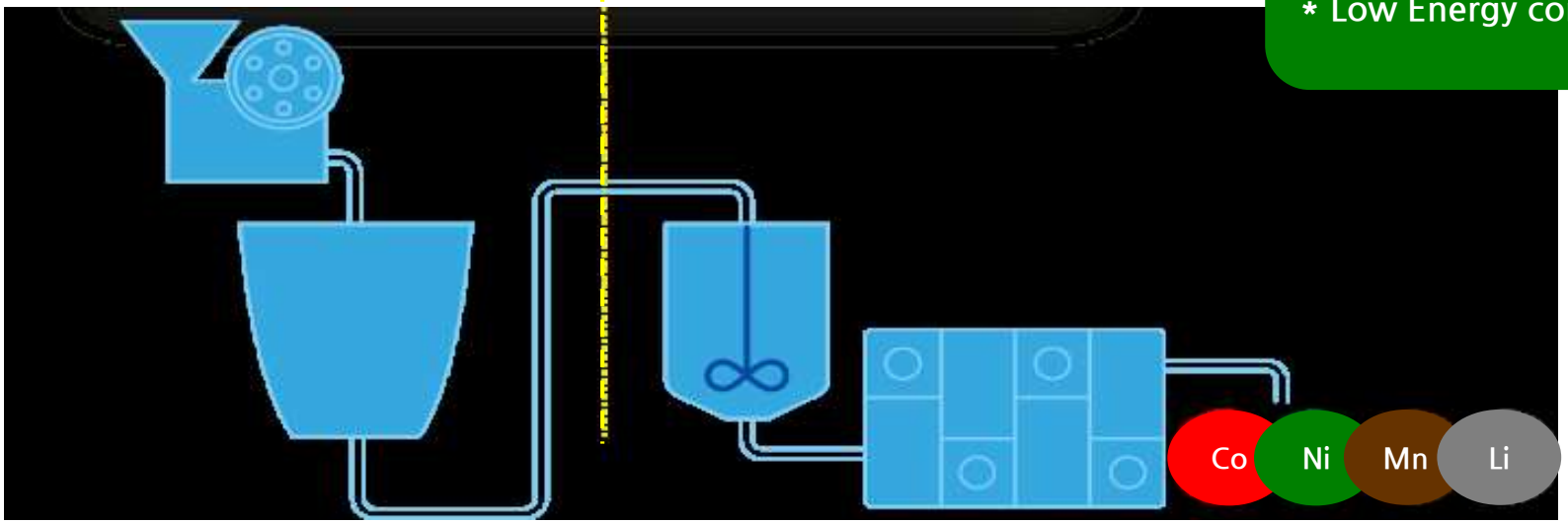
- Processing Method : Include purification and separation, through hydrometallurgy process after physical pretreatment

Sourcing raw materials on domestic overseas

Purification and Separation by solvent extraction

Collect → Physical Treatment → Chemical Separation & Purification → Materialization

Hydro metallurgical Treatment



Hydrometallurgy process

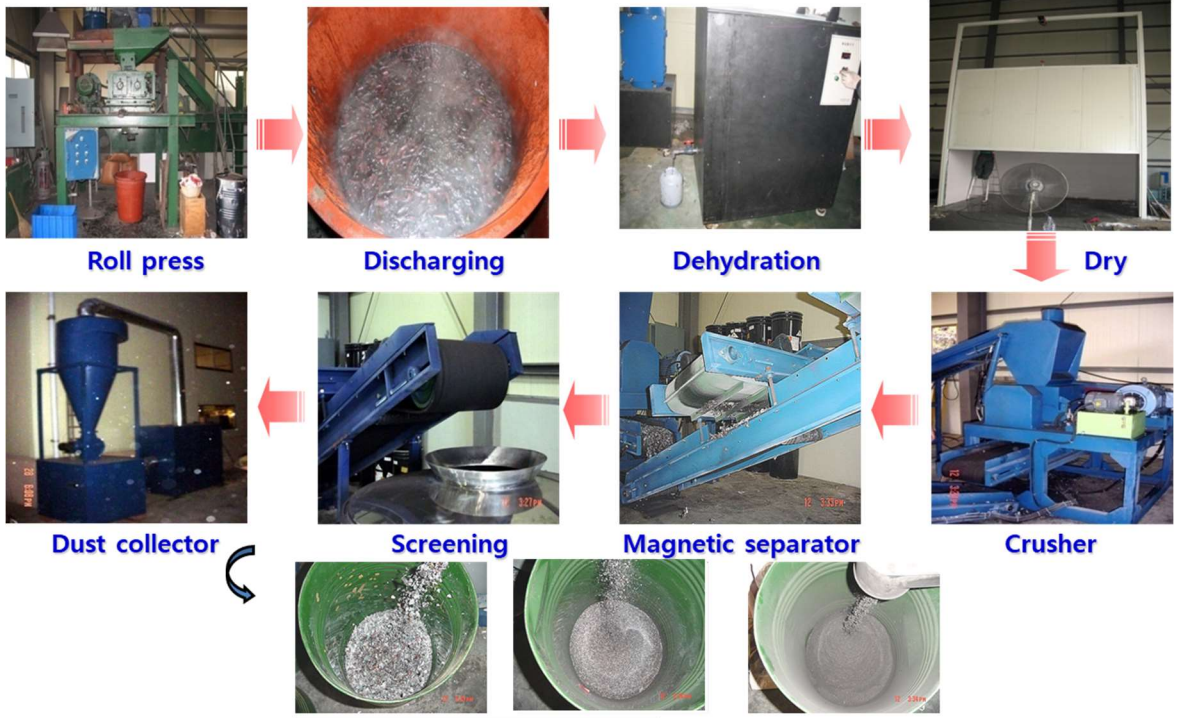
* Easy variation of material change
* High recovery rate
* Recover Co, Ni, Mn, Li
* Low equipment cost
* Low Energy consumption

4.1 Recycle in Korea

Current Process

(Waste mobile battery, Lithium polymer battery..etc.)

EV Batteries



Current Process

Leaching

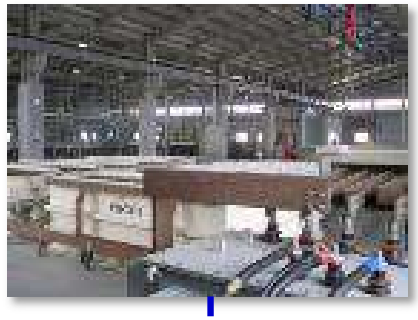
Filtration

Storage Tank

Solvent Extraction

Crystallization

Electro-Winning



$NiSO_4 \cdot 6H_2O$

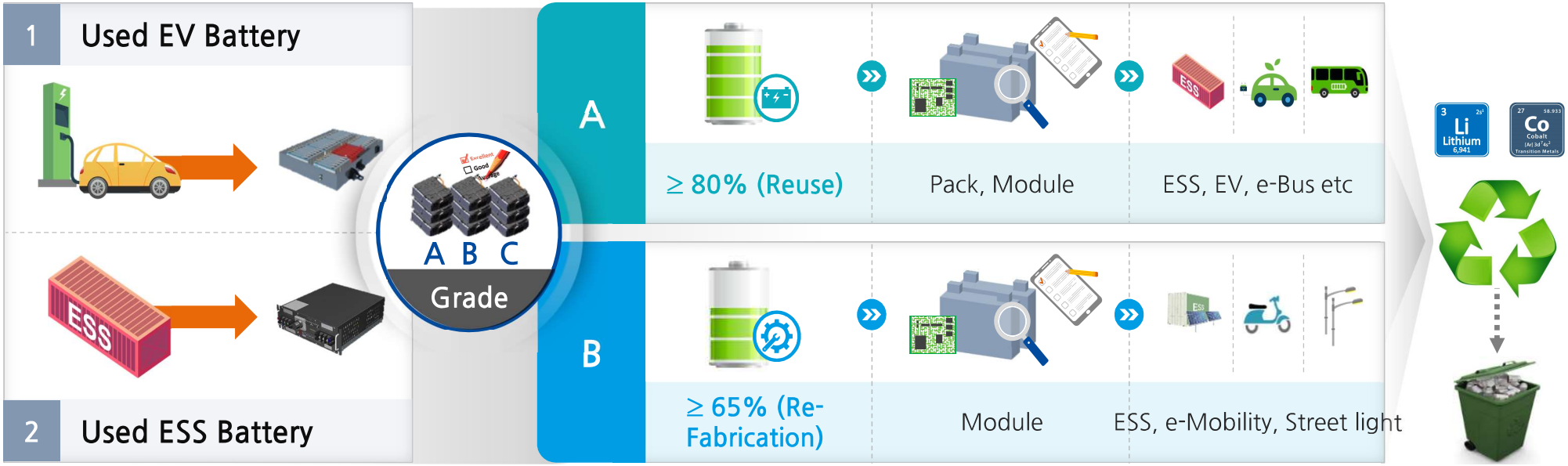
$CoSO_4 \cdot 7H_2O$

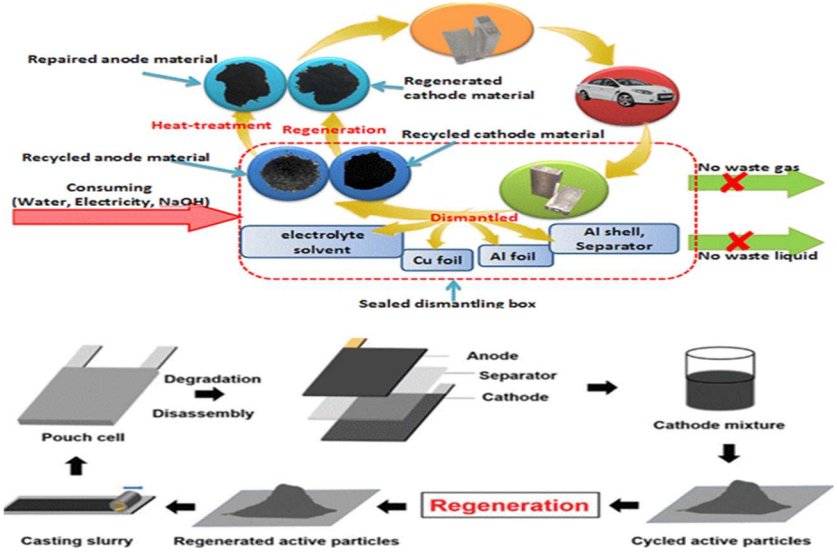
$MnSO_4 \cdot H_2O$

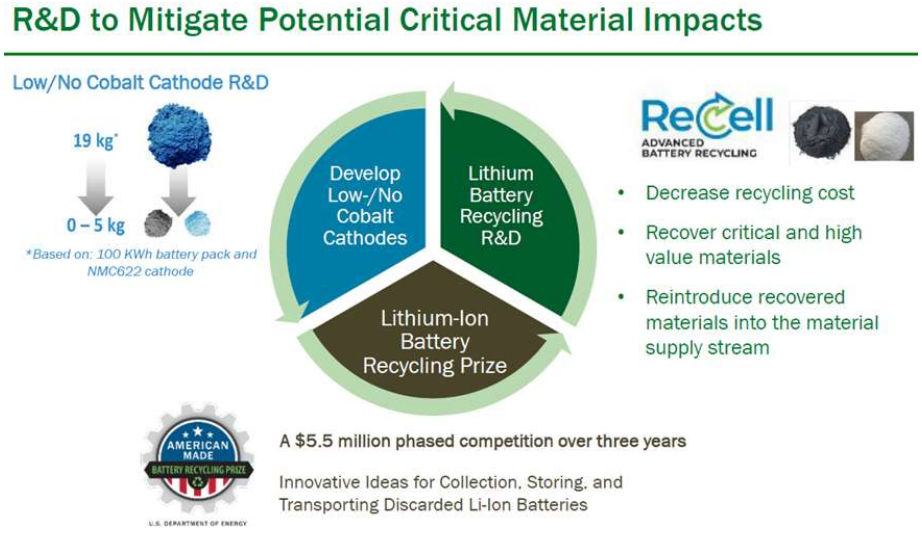
Ni-Metal

4.2 Clean Recycle Plan

Electrochemical recycle process

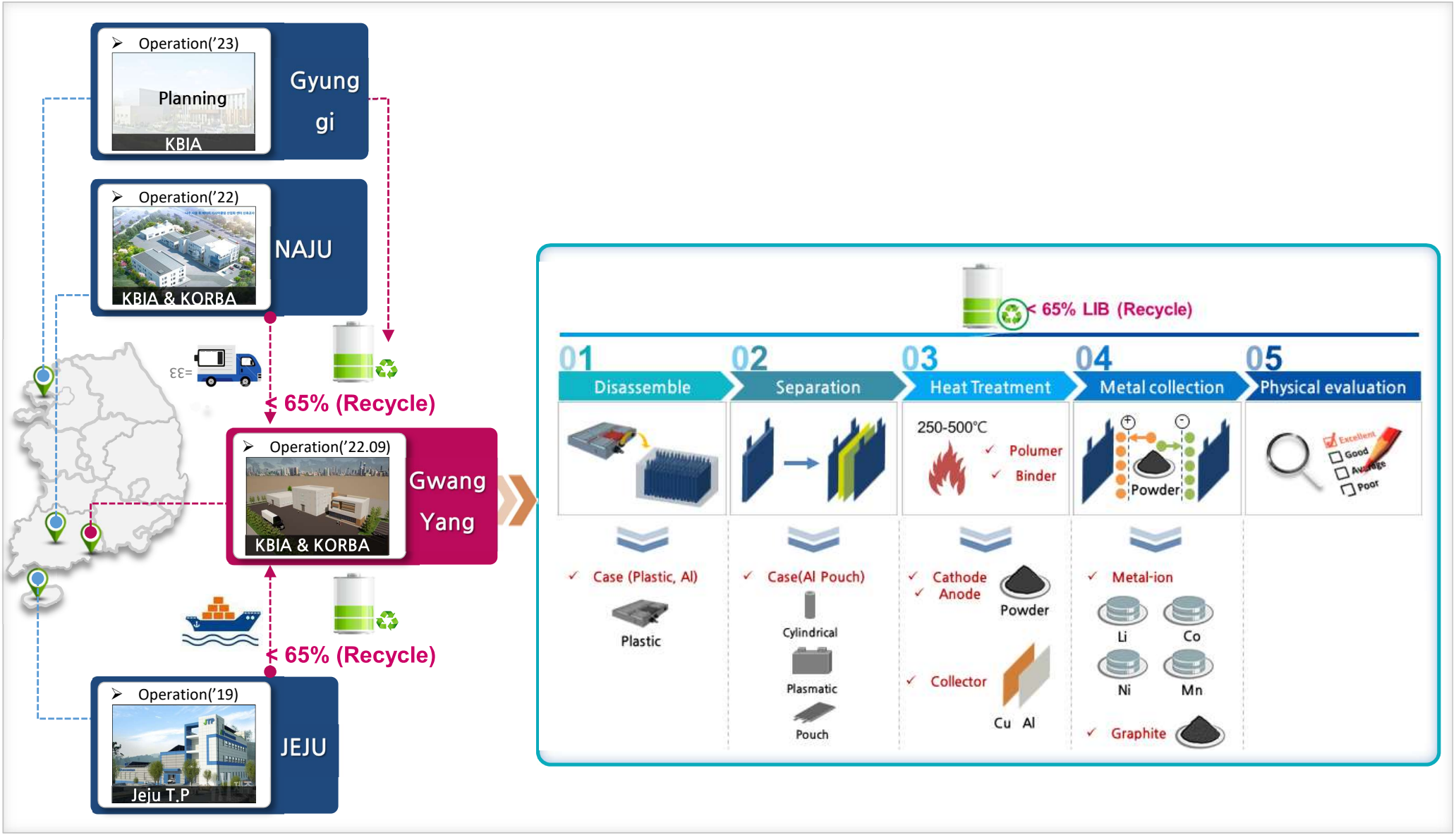






4.2 Clean Recycle Plan

Electrochemical recycle process



KBIA Korea Battery Industry Association

KORBA Battery R&D Association of Korea