The activities of R&D and Standardization for LIB in Korea

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Ⅱ. R&D Activities for Battery

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Ⅰ. Battery Industry in Korea

1. Battery Development

Rechargeable Battery development by technology

1950	1960	1970	1980	1990	2000	2010

Lead-acid
40Wh/kg

Ni-Cd
60Wh/kg

Ni-Mh
80Wh/kg

Lithium ion Battery

LIB
150Wh/kg

LIPB
150Wh/kg

NaS
120Wh/kg

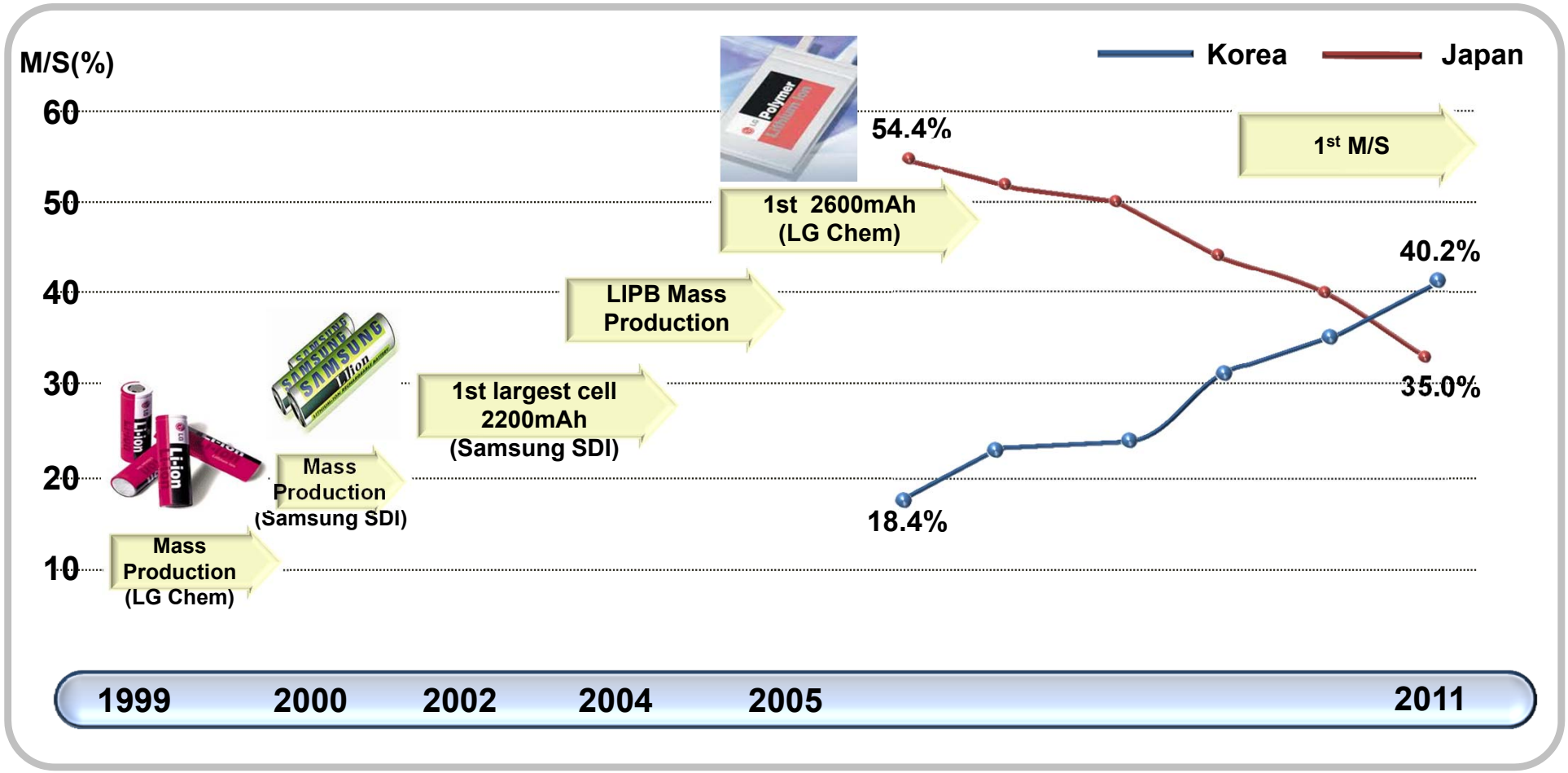
Metal Air
300Wh/kg

Supercapacitor
30Wh/kg

- High voltage, high energy density within light weight
  - → Various Applications as IT, xEV, ESS

2. Battery Industry in Korea

- Korea Lithium ion battery Industry
- Start from 1999, 1st Market Share from 2011



3. KBIA (Korea Battery Industry Association)

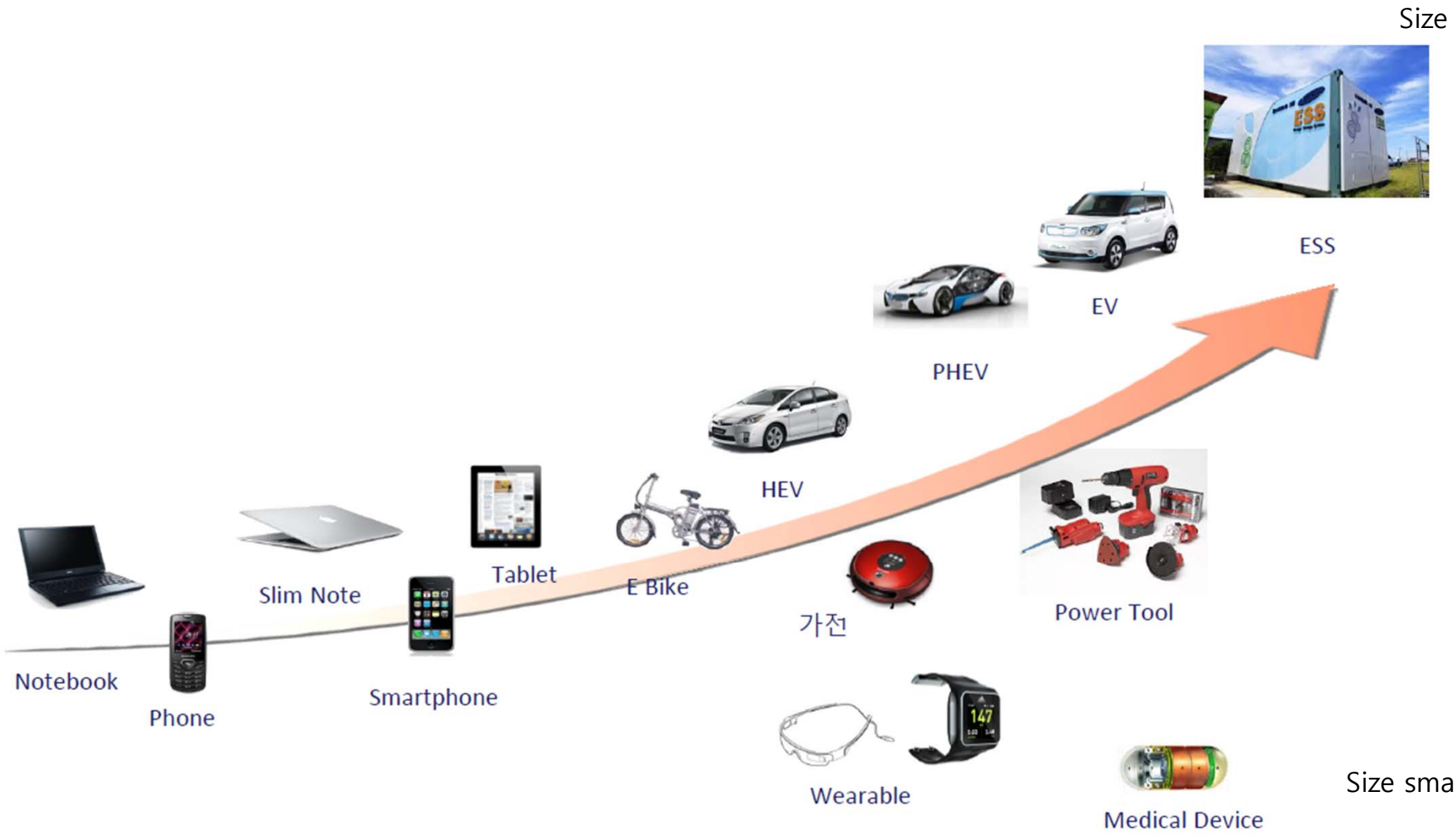
Members of KBIA

Battery manufacturers (12)	SDI, LG Chem, SK Innovation, Kokam, Sebang etc.
Parts & materials companies (31)	GS Energy, POSCO Energy, Ecopro, Panaxetec etc.
Equipment/ system companies (11)	Hyundai MOBIS, PNE Solution, WooJin, Hanwha etc.
Others (3)	KETI, KIER, KERI

4. Battery applications

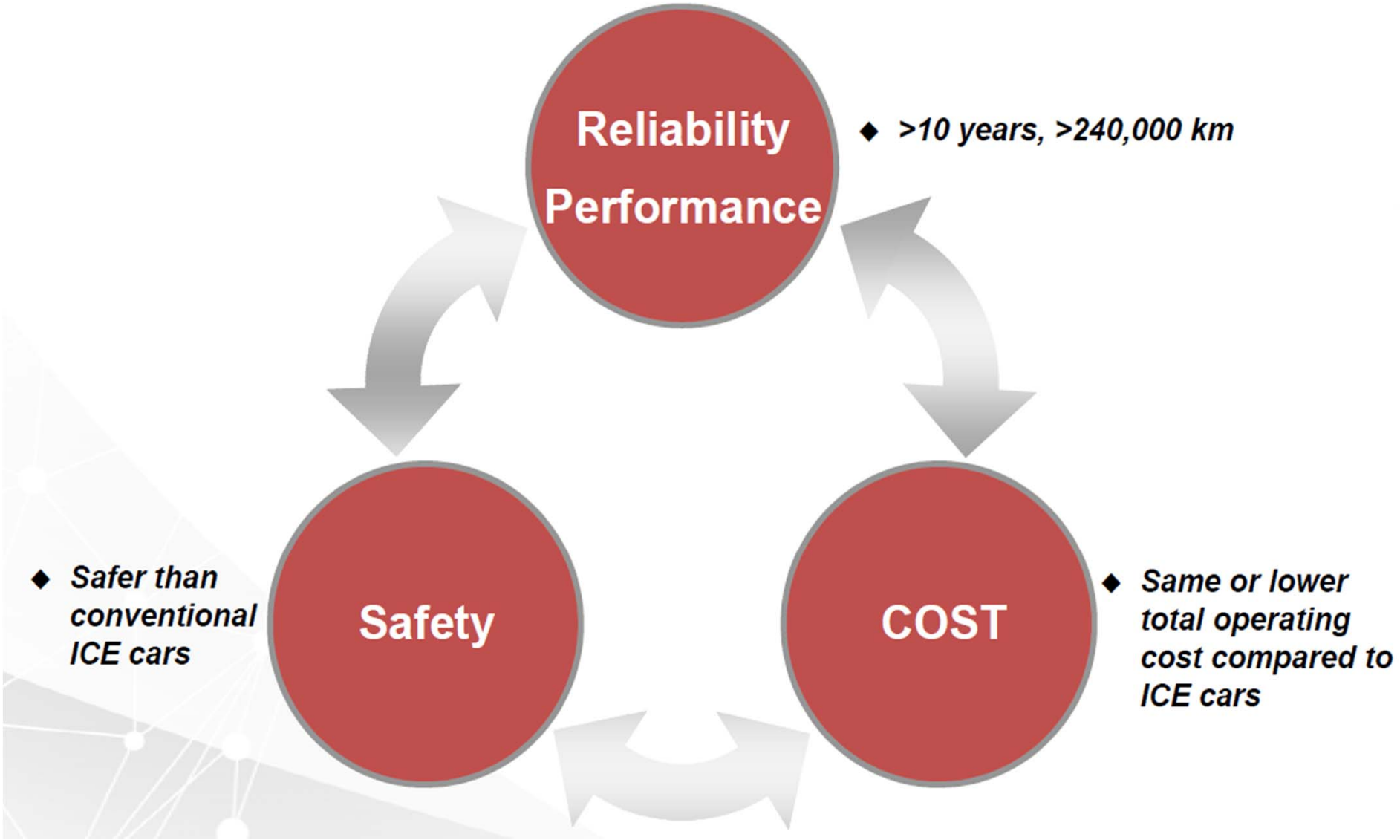
(From. SNE Energy)

Lithium ion battery applications development



5. Key issue for EV

- **Current main issue is Safety, Cost and Reliability Performance**

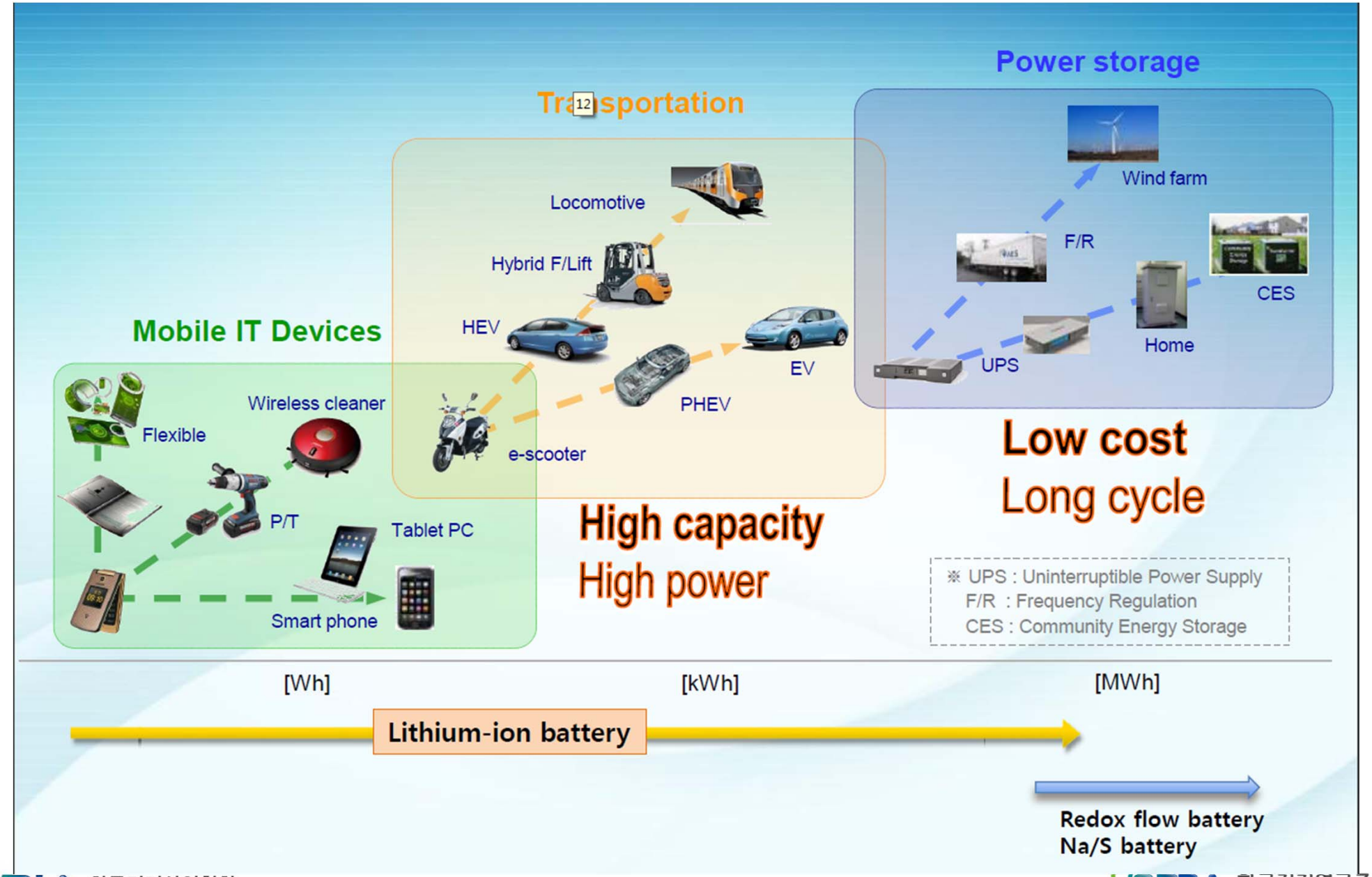


Ⅱ. R&D Activities for Battery

1. LIB applications development

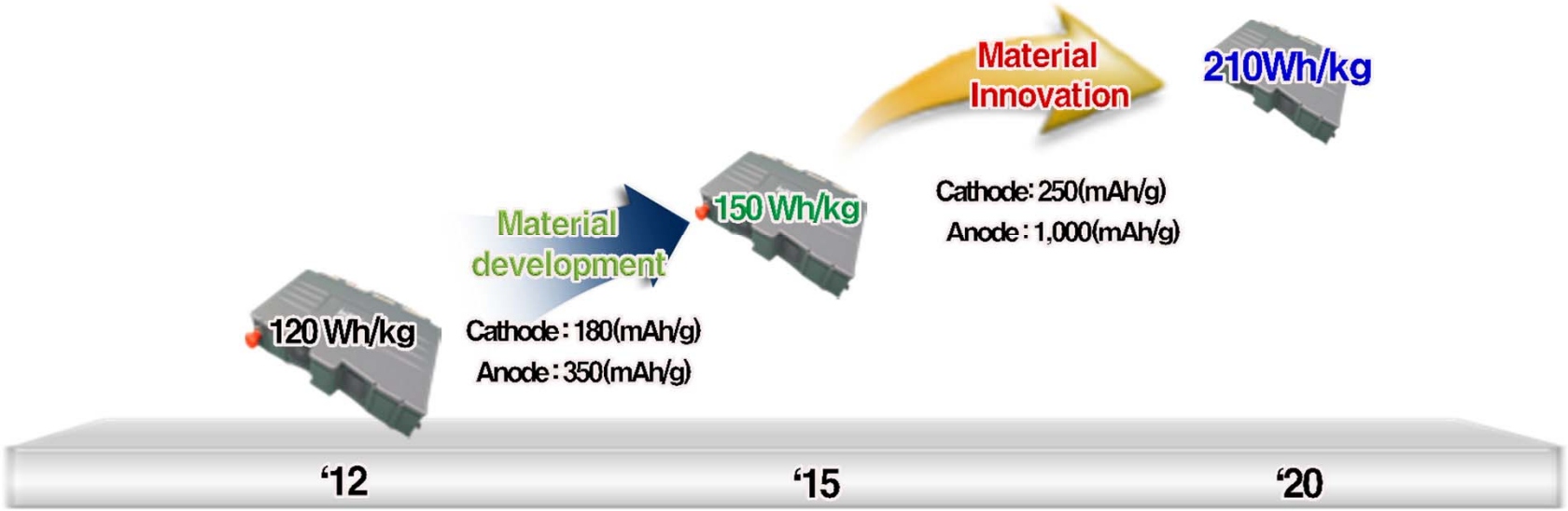
From. KETI

Mobile IT, Transportation and Electrical Energy Storage

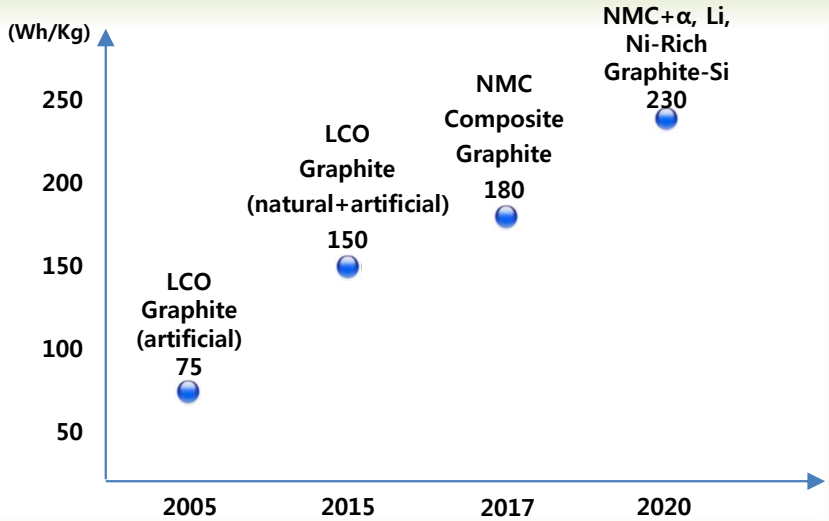


2. Vision of LIB Technology

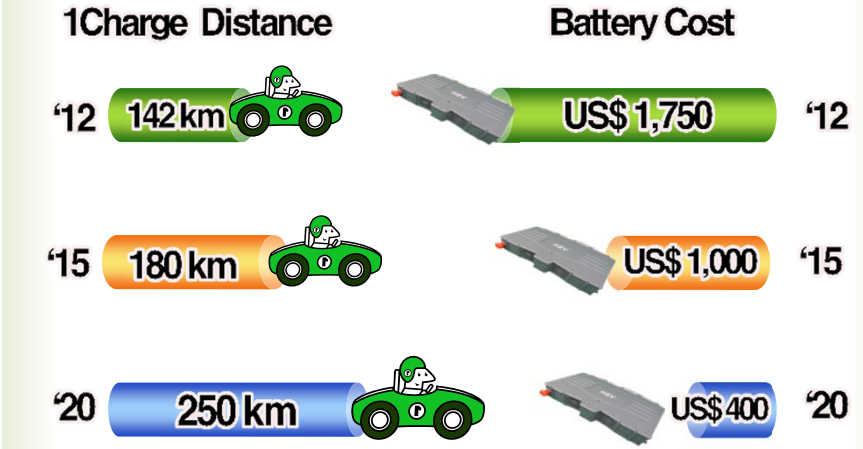
- The capacity is increased by materials and cost is reduced by mass production



Material Technology



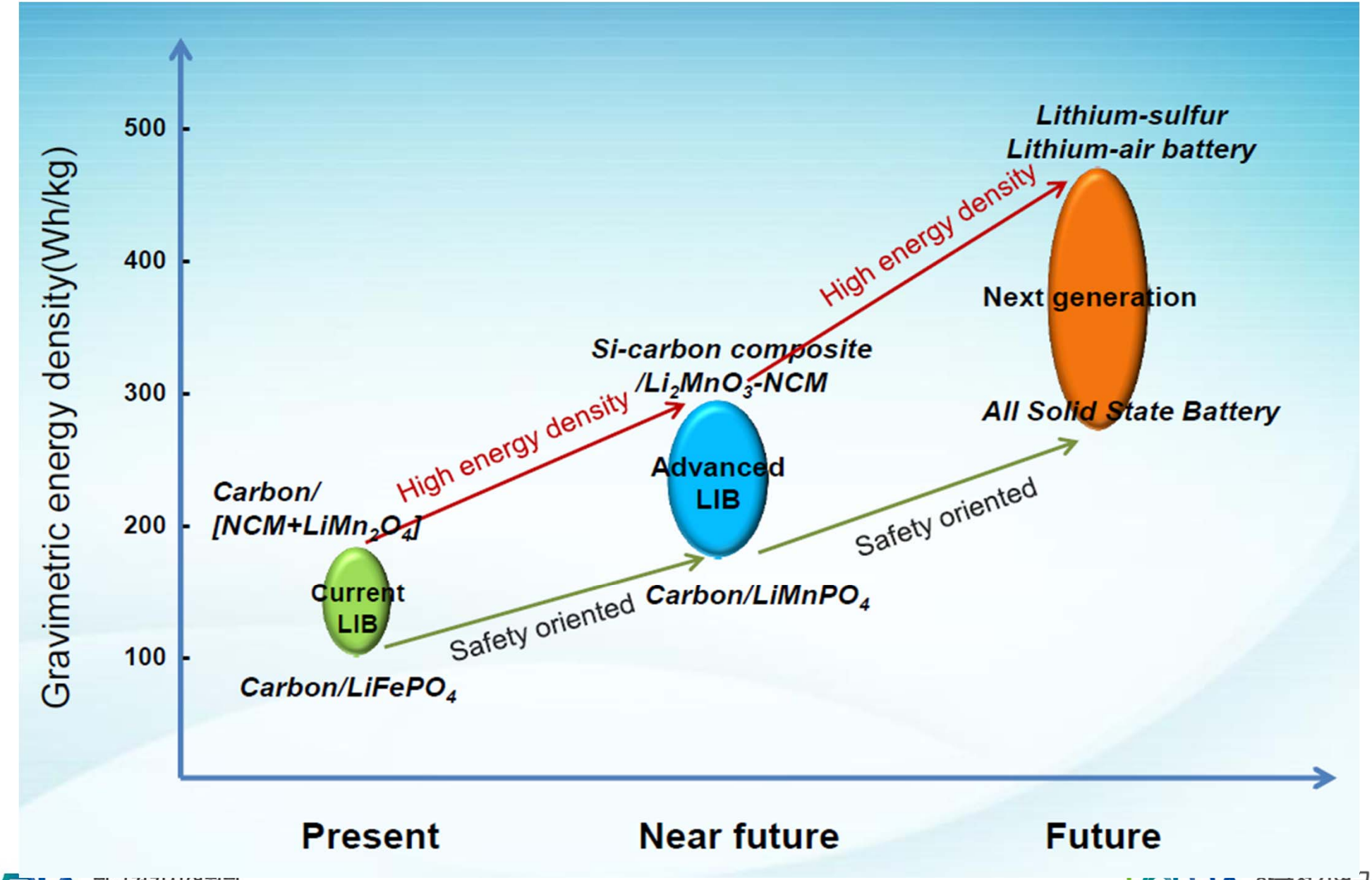
xEV



2. Vision of LIB Technology

From. KETI

- Post LIB Technology(LiS, Li-Air, All solid state battery)



2. Vision of LIB Technology

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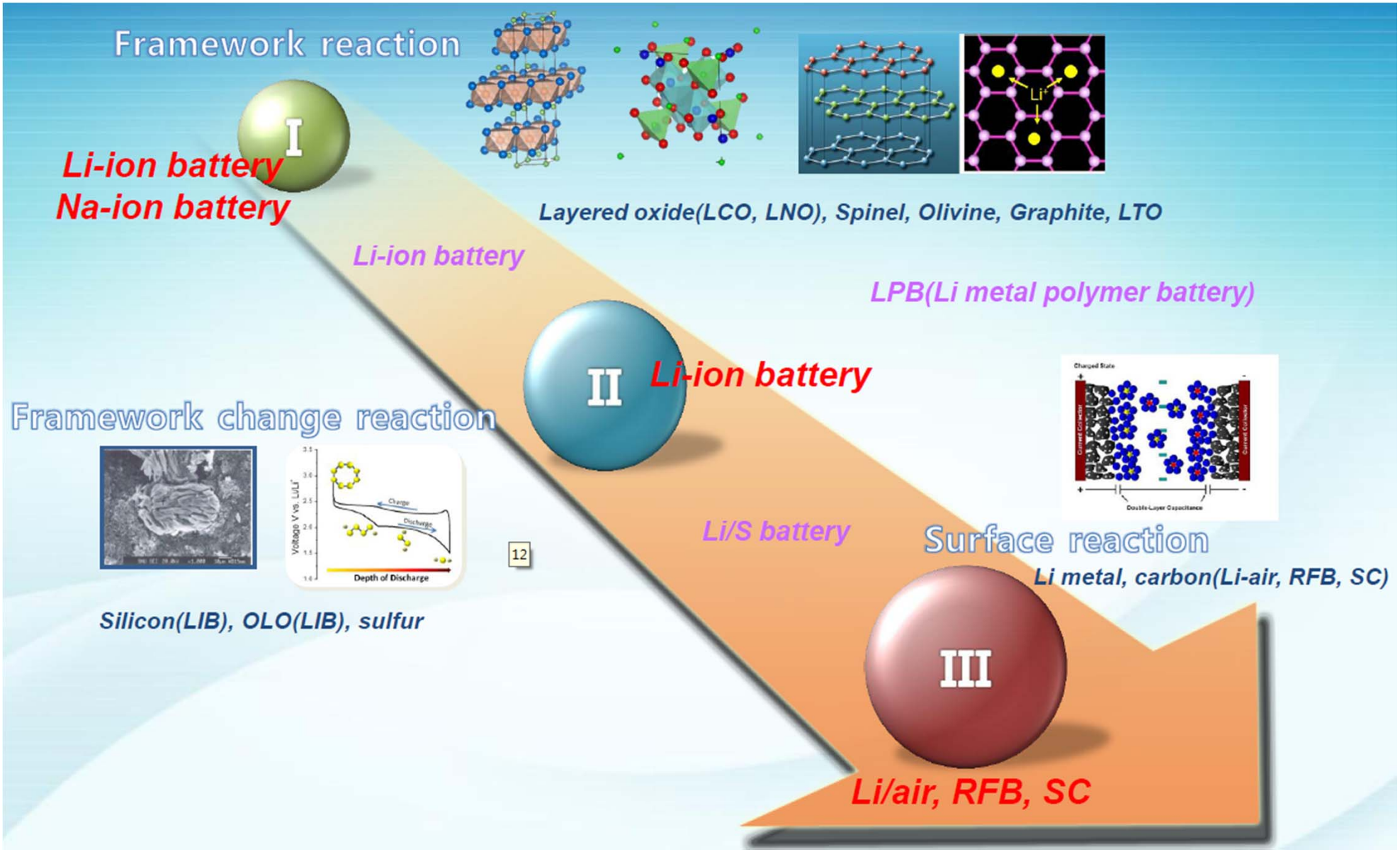
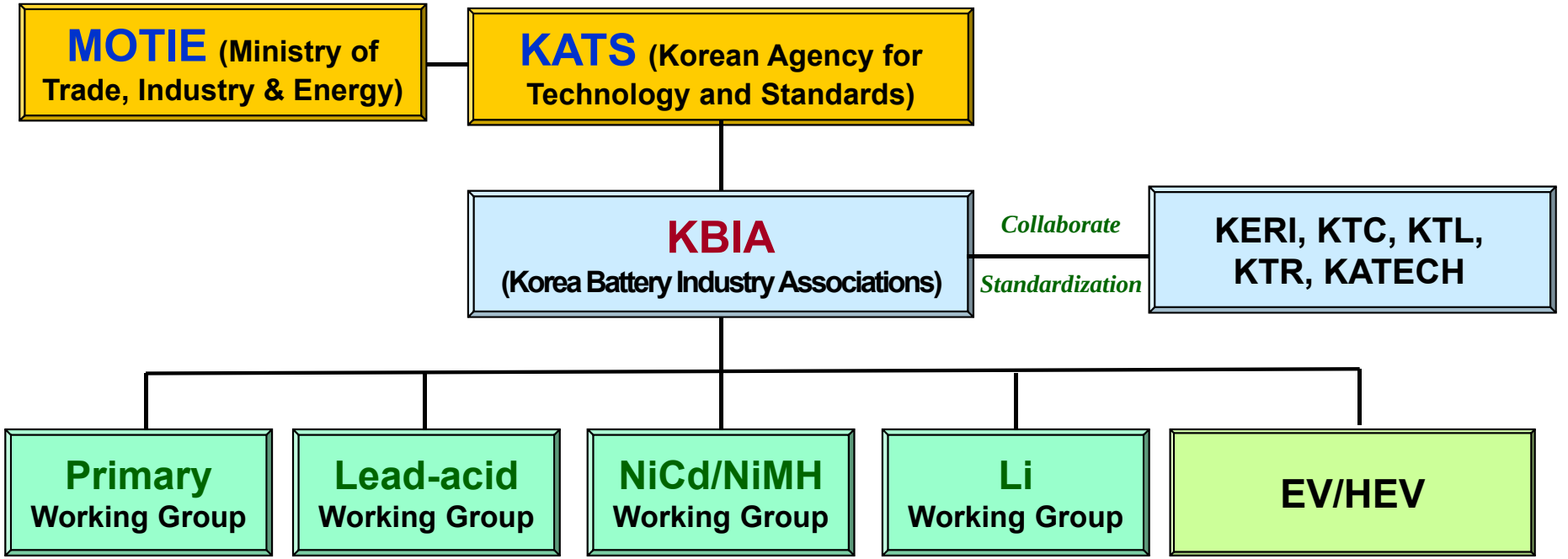
Post LIB Technology(LiS, Li-Air, All solid state battery)



Ⅲ. Standardization Activities for Battery

1. National Committee

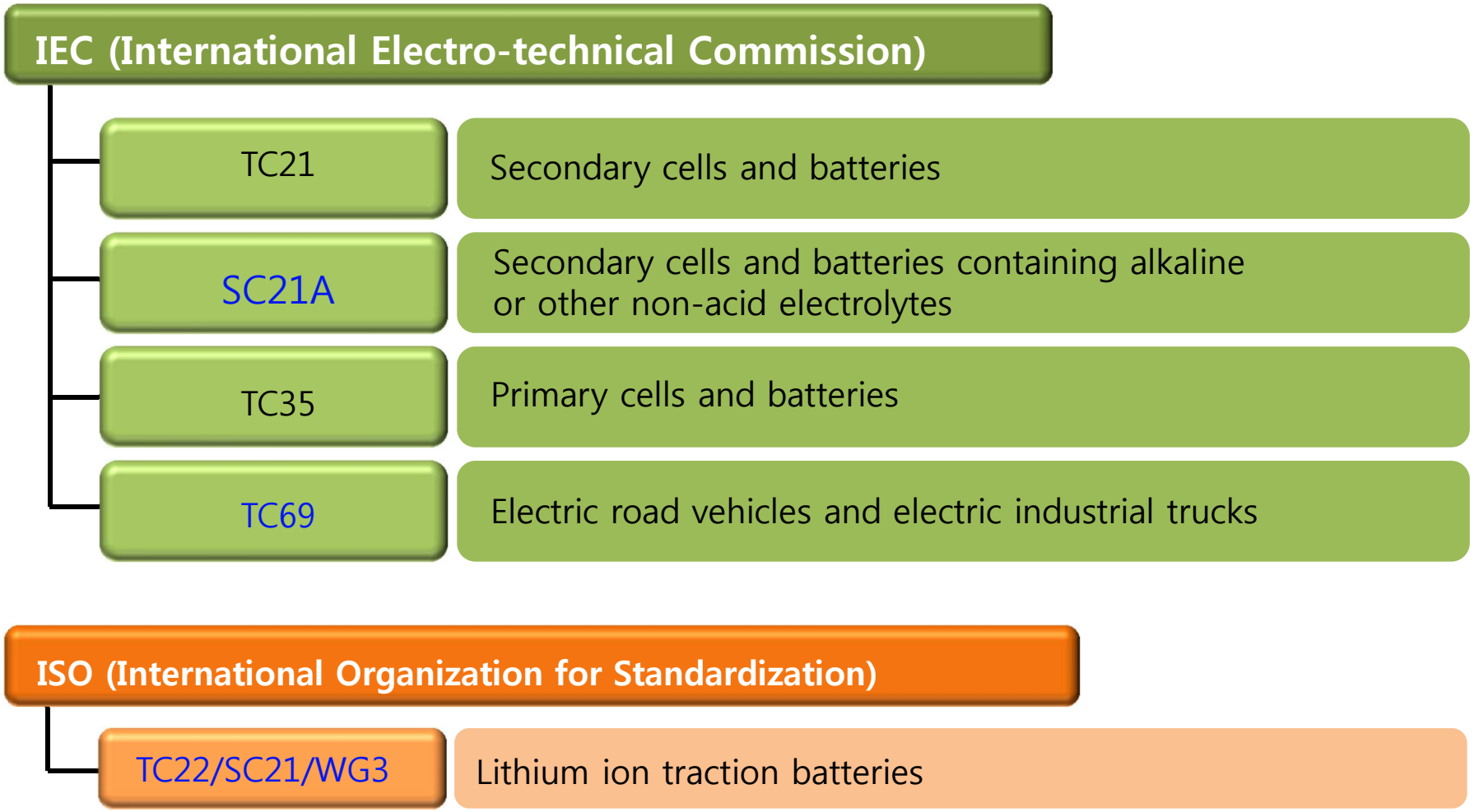
Korea Standardization Structure of Battery



Primary Working Group	Lead-acid Working Group	NiCd/NiMH Working Group	Li Working Group	EV/HEV
▪ Bexel ▪ Rocket	▪ Global battery ▪ Delko ▪ Seongwoo Automotive ▪ AtlasBX	▪ Global battery ▪ Seongwoo Automotive ▪ IBT ▪ Energreen	▪ Samsung SDI ▪ LG Chem. ▪ SKI ▪ Kokam ▪ Ener 1 Korea ▪ EIG ▪ Enerland	▪ Samsung SDI ▪ LG Chem ▪ SKI ▪ Kokam ▪ Enertech International ▪ EIG ▪ KATECH
[IEC TC35]	[IEC TC21]	[IEC SC21A WG 1&2]	[IEC SC21A WG 3~5]	[IEC TC21/JWG69 Li] [ISO TC22/SC21 WG3]

2. Organization

TC(Technical Committee) & SC(Sub-Committee)

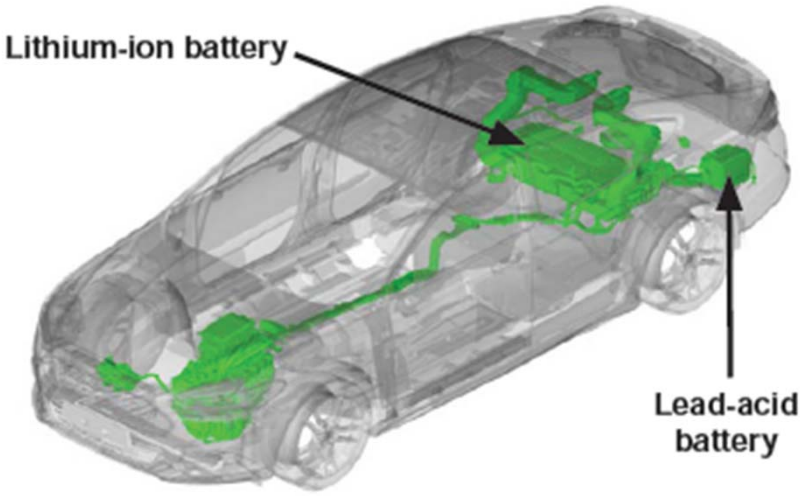


※ TC : Technical Committee, SC : Sub-Committee

3. Another approach

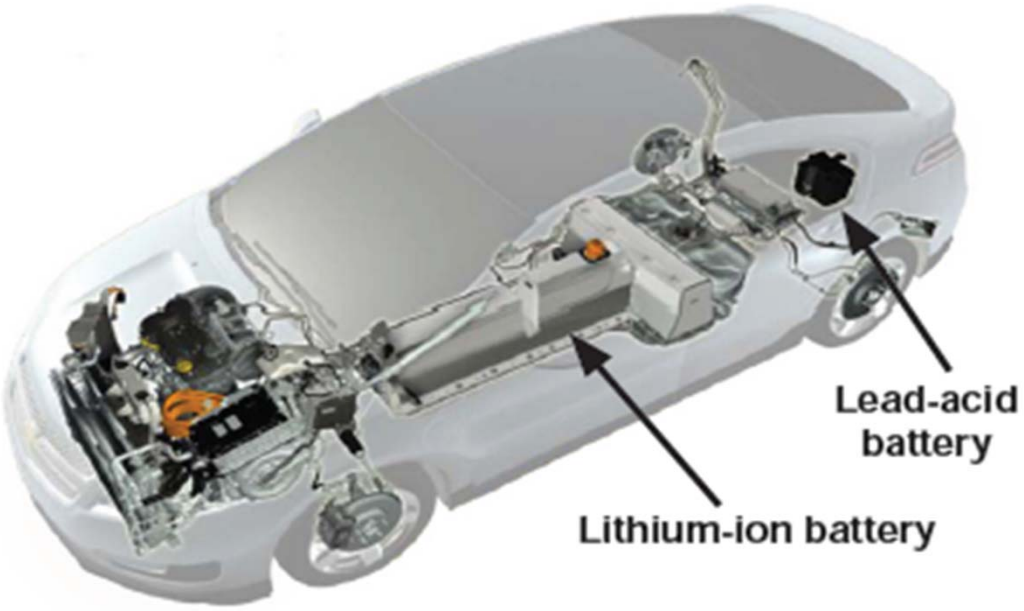
From. Advanced Lead Acid Battery Association

Dual Battery System



<Ford Fusion Hybrid Battery System>

<Chevrolet Volt Battery system>

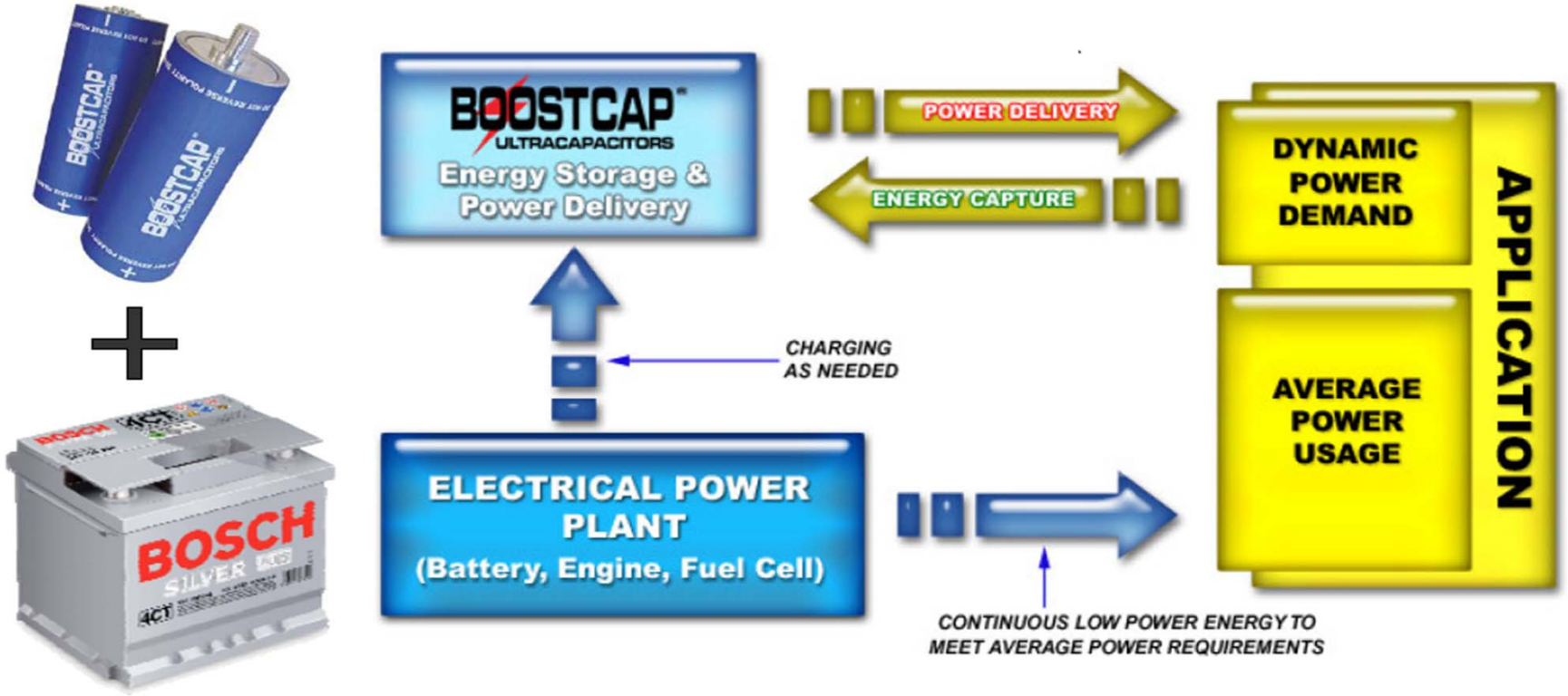


3. Another approach

From. Maxwell Technology

Dual Battery System

- The new combination!
  - The strengths of both.
    - High power density component plus
    - High energy density component



4. Cost reduction

From. SB Limotive

Standardization of Li-Ion Cell Dimensions

Cost of Battery Cells

Standardization is Key Requirement for Cost Reduction

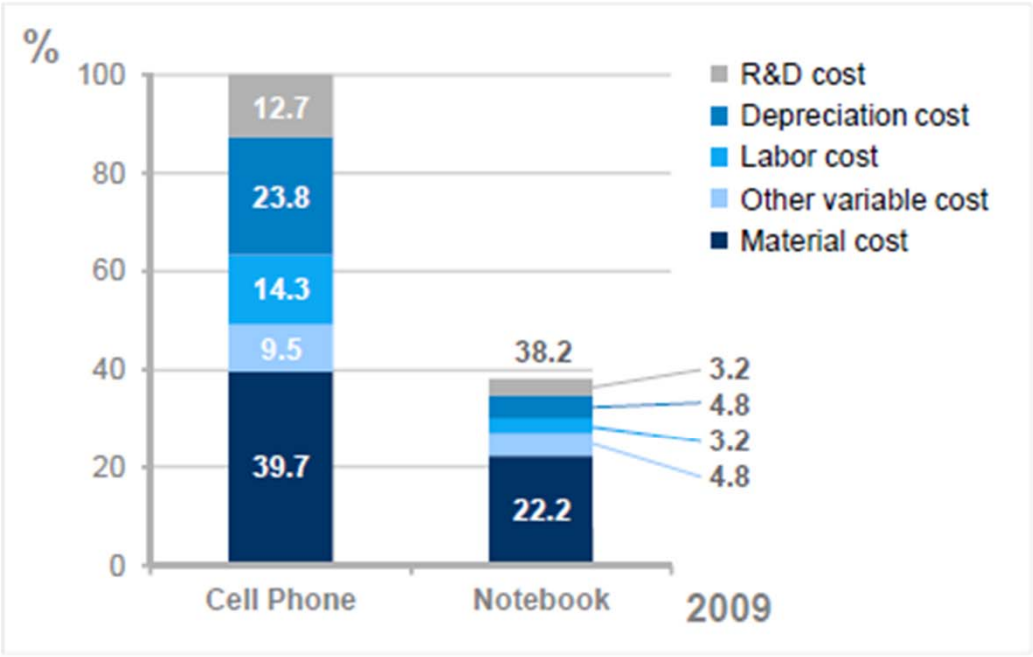
Cell Phone

Notebook

* Typical annual production volume

0.1-10 Million	100-300 Million

→ Relative Cost of Li-Ion Cells per Wh

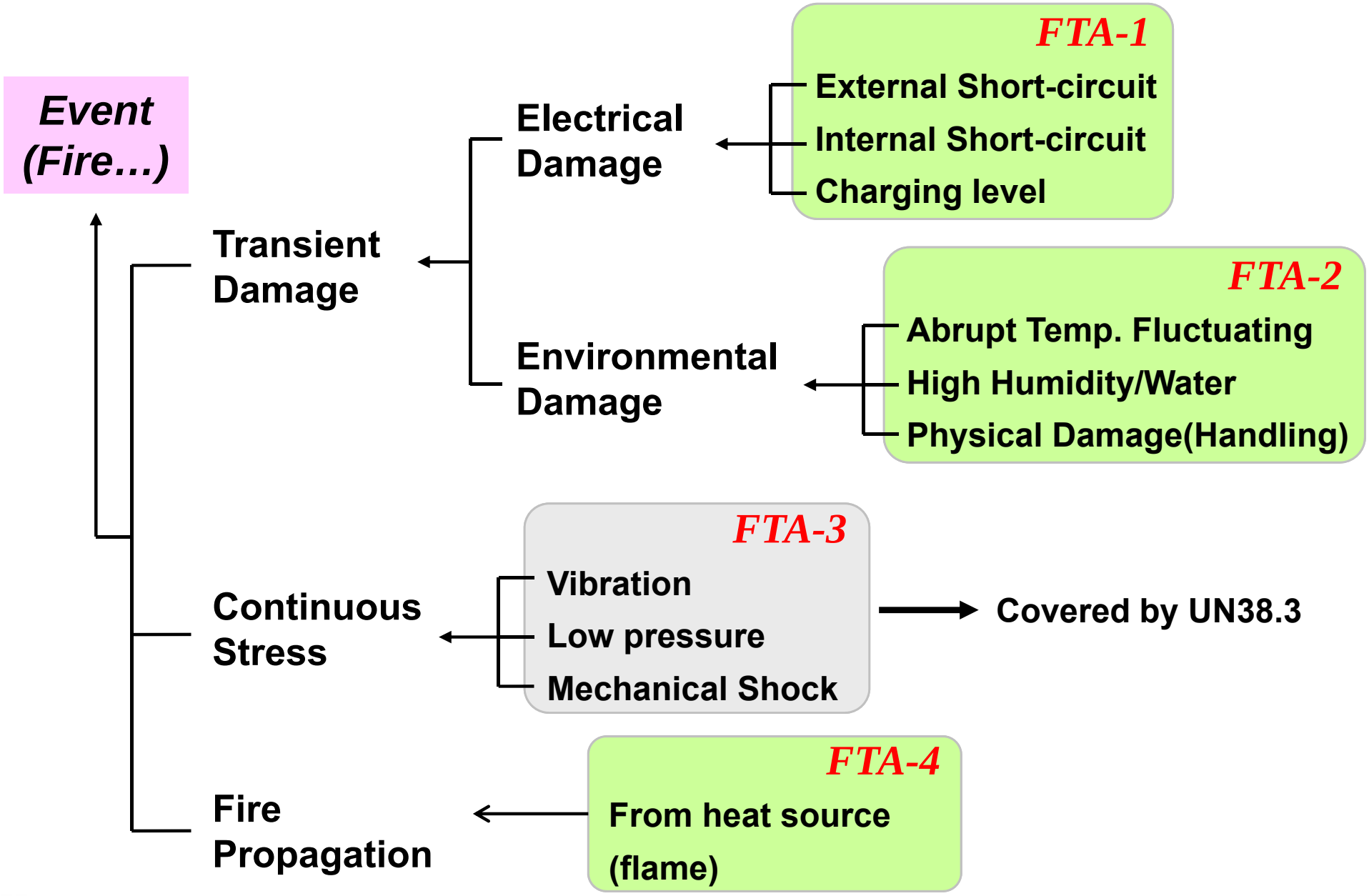


* Source: Li-ion Battery Market & Industry Trend - Goldman Sachs Japan Analyst Report – September 2009

SB LiMotive

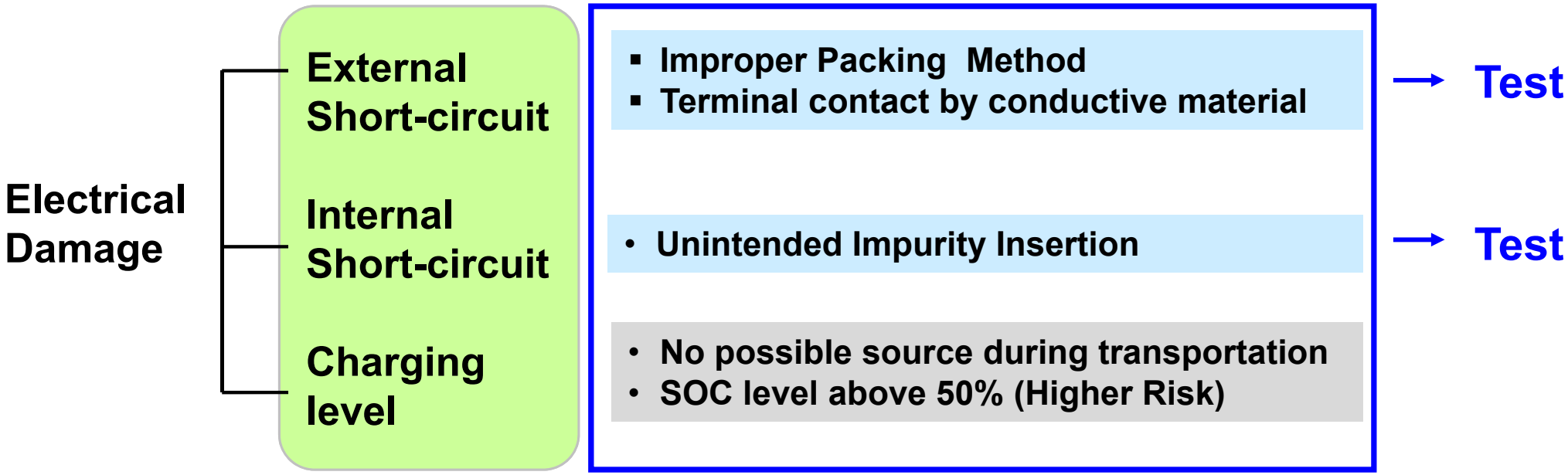
5. Safety Test Report in ICAO

- FTA(Fault Tree Analysis) for LIB



7. Safety Test Report in ICAO

FTA(Fault Tree Analysis) for LIB



FTA-1 Test	Condition	Result	
External Short Circuit	Direct terminal short-circuit using Wire and Bolt	No Fire	
Internal Short Circuit	Nail penetration	No Fire	

7. Safety Test Report in ICAO

- FTA(Fault Tree Analysis) for LIB

Fire Propagation ← • Aircraft fire (initiated from surrounded material) → Test

FTA-4 Test	Condition	Result	
Fire Propagation Test	From fire source(Charcoal) Temperature of heat source: 800~900℃	No issue	

7. Safety Test Report in ICAO

FTA(Fault Tree Analysis) for LIB

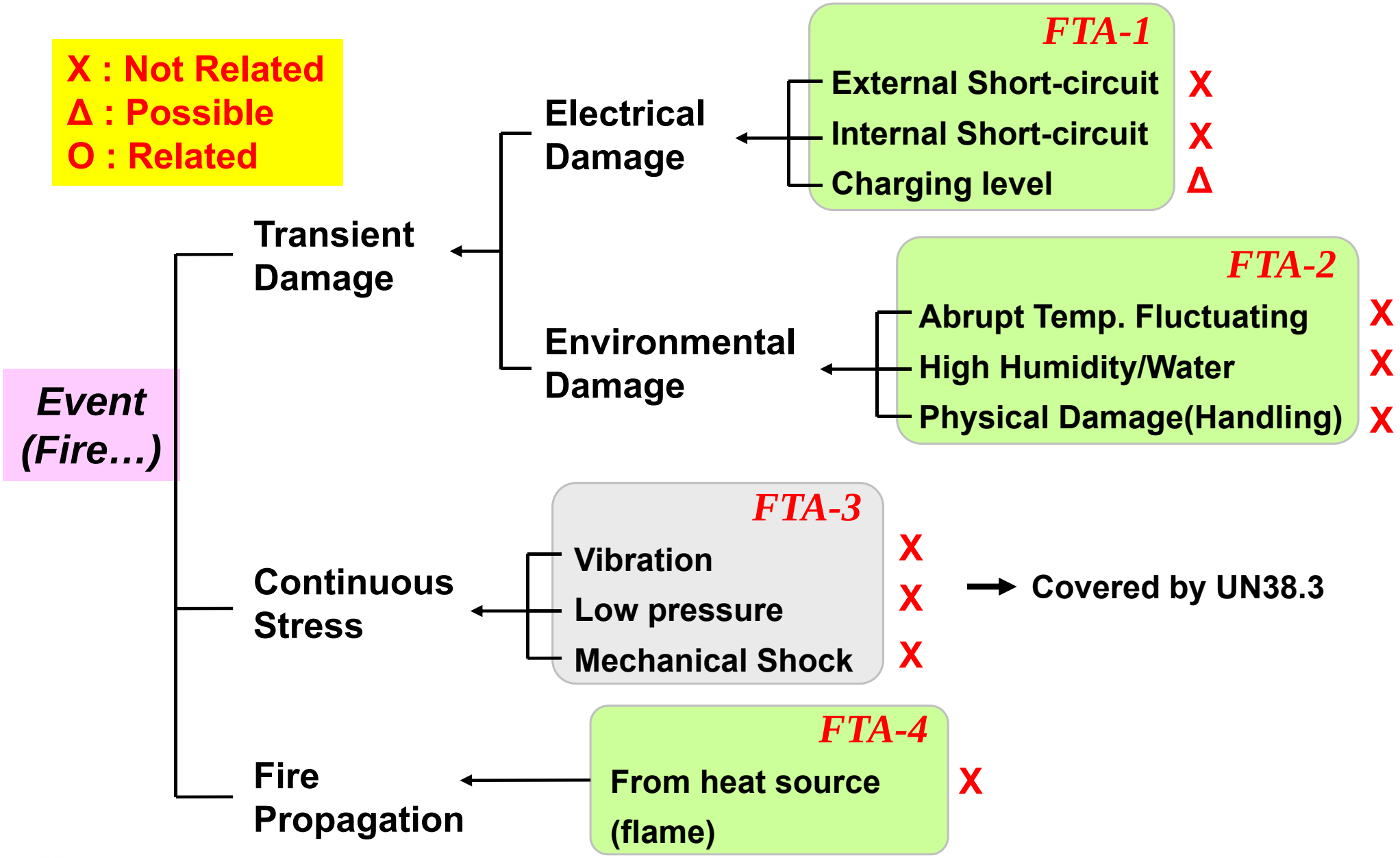
Environmental Damage

- **Abrupt Temp. Fluctuating**
  - • Transportation route → Covered by UN38.8
- **High Humidity/Water**
  - • Dewing / Water exposure → Test
- **Physical Damage (Handling)**
  - • Violation Handling Guideline
  - • Drop / Crush → Test

FTA-2 Test	Condition	Result	
Immersion Test	Pure water, 1 min	No Fire	
Package drop	Height : 3.7 M, Drop to Concrete	No Fire	
Package Crush	Pressure 150 KN	No Fire	
Impact	Using impact tester to expose the internal materials of the cell	No Fire	

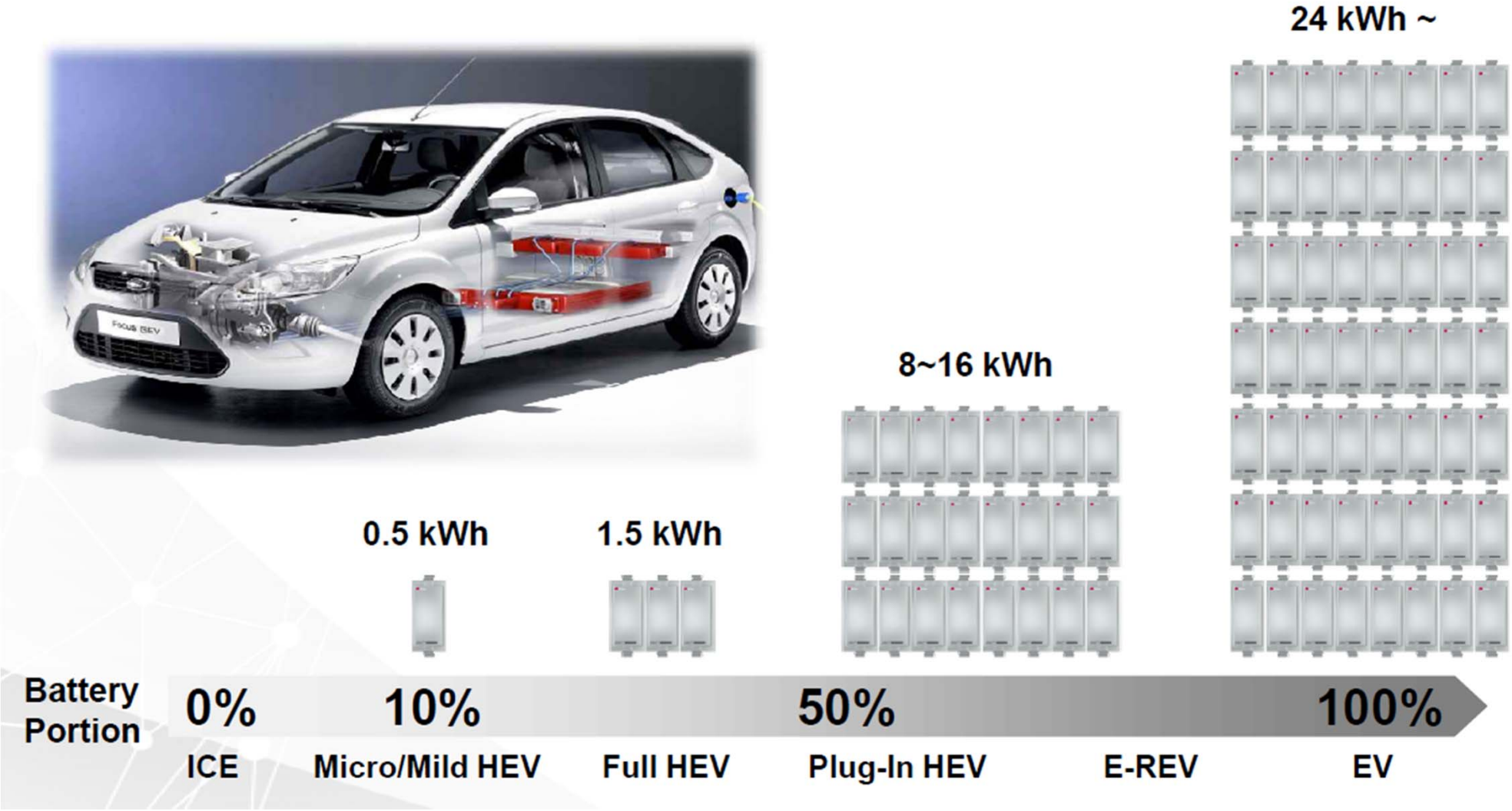
7. Safety Test Report in ICAO

- FTA(Fault Tree Analysis) for LIB



Ⅳ. Summary

Summary


24 kWh ~
8~16 kWh
0.5 kWh
1.5 kWh
Battery Portion
0%
10%
50%
100%
ICE
Micro/Mild HEV
Full HEV
Plug-In HEV
E-REV
EV

감사합니다.