

The Beginning of Commercial Vehicle Innovation

LG Energy Solution's Automotive Batteries
for Commercial Vehicles

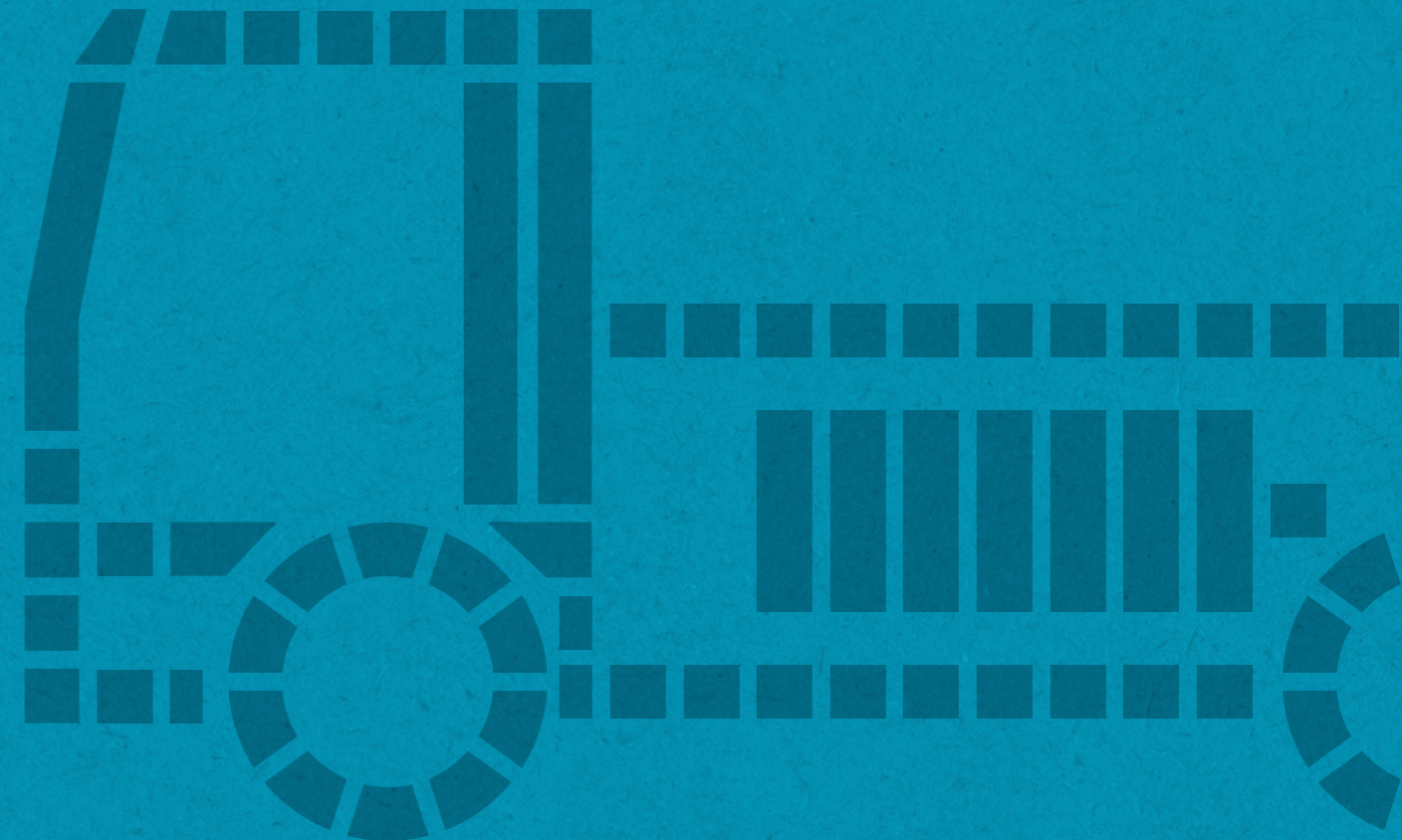
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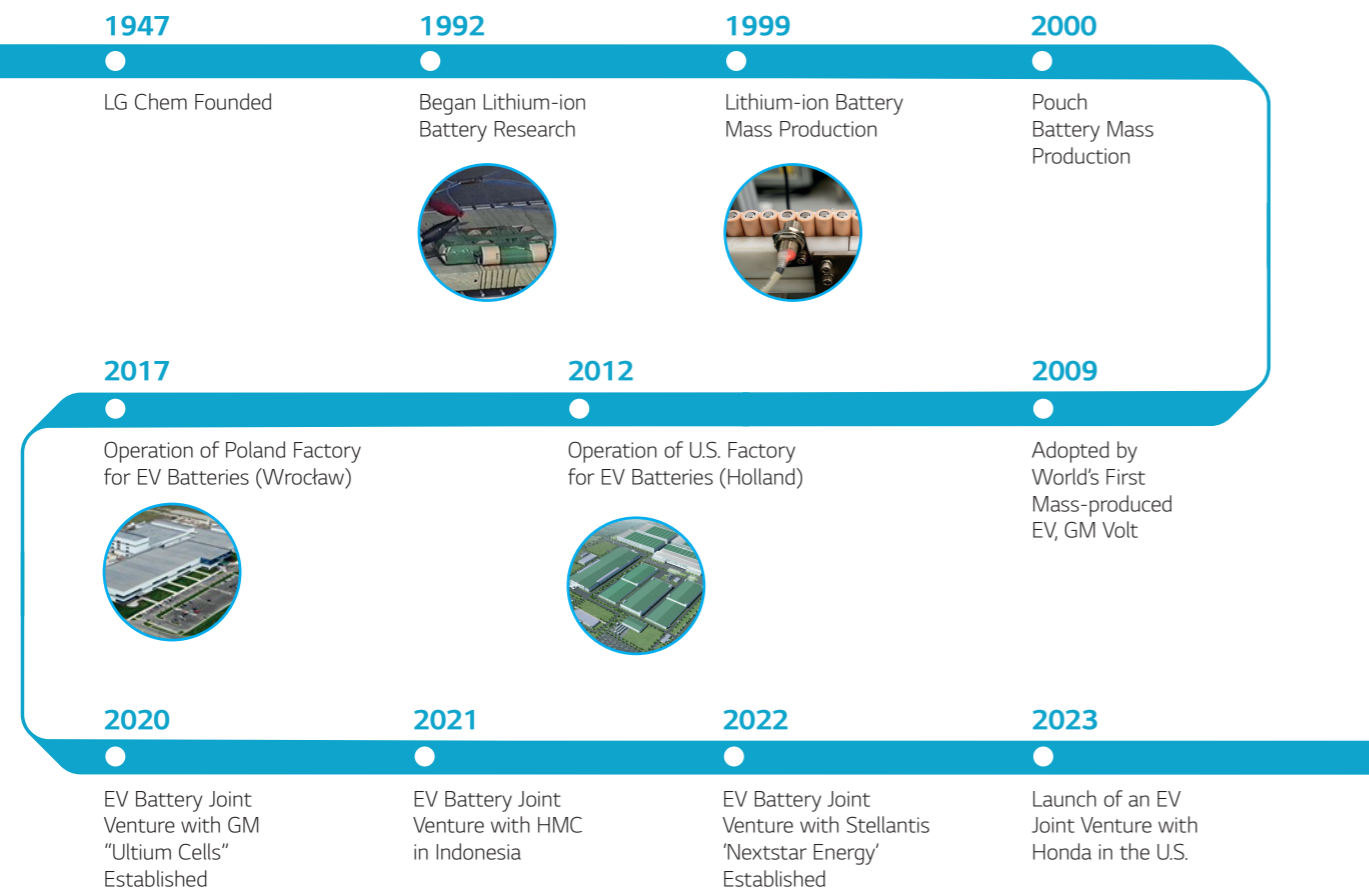


A Firm Global Leader in EV Batteries

Pioneer of EV Battery Industry

LG Energy Solution's challenge to become the best in the world continues with stellar accomplishments in the EV market, such as delivering the world's first automobile battery in 2009 and developing the world's first NCMA high-capacity battery in 2021.

LG Energy Solution Milestone



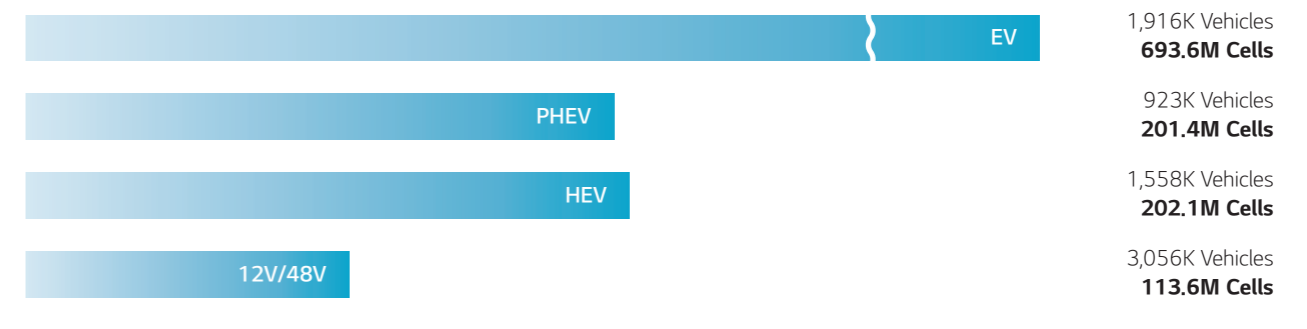
Batteries play a pivotal role in determining EV performance. As a firm global leader in the battery sector, LG Energy Solution will initiate a new era in electric commercial vehicles.

Unparalleled EV Track Records

LG Energy Solution has carried out 79 xEV projects from 31 global automobile manufacturers, expanding its portfolio from cell to pack, and other various solutions.

LG Energy Solution's xEV Battery Adoption ('09-'22)

Since 2009, a total of 1.21B LG Energy Solution cells have been adopted to more than 7,453K xEVs.



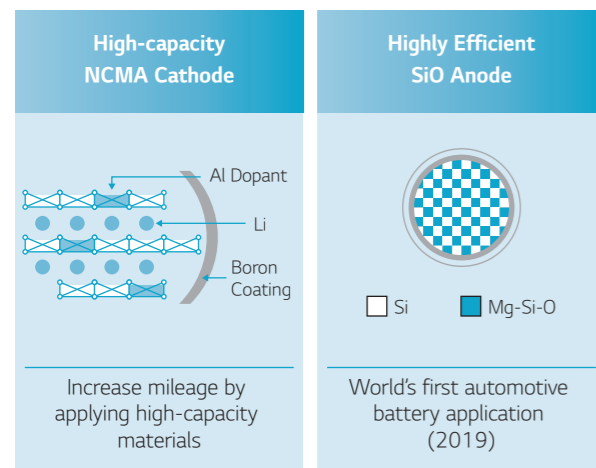
Partnerships with Top Automobile Manufacturers



State-of-the-Art Lithium-ion Batteries

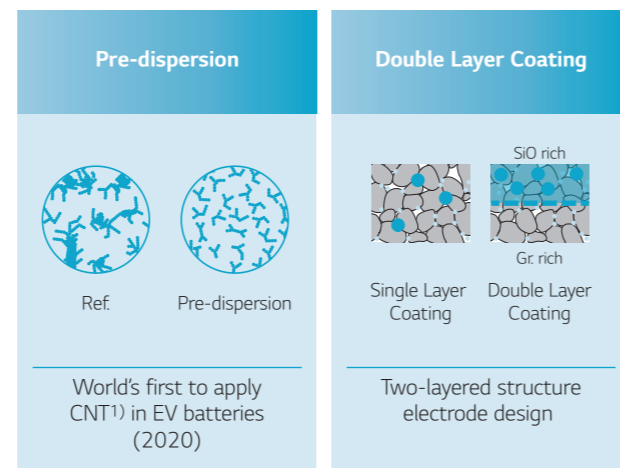
Ultra Power NCMA Cell

High-tech materials like 'NCMA cathode' and 'silicon anode' enable longer driving distances, faster charging, and longer product life.



Innovative Processing Technology

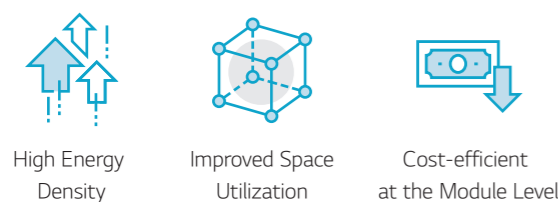
LG Energy Solution's technologies guarantee performance and quality by maximizing battery density, efficiency, and safety.



※ 1) CNT : Carbon Nanotube

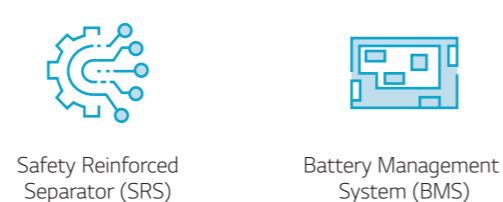
Flexible Pouch Cell Design

Pouch cell design secures high energy density with longer battery life and customizable designs.



Higher Safety

Rigorous safety technologies, such as SRS and BMS, prevent thermal risks or fire hazards and maintain high battery quality.



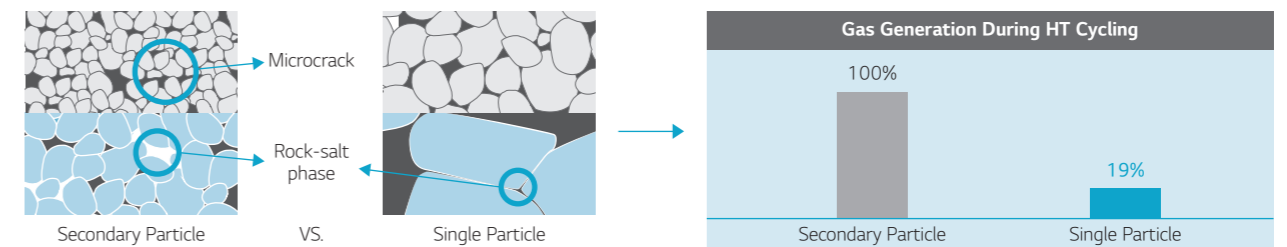
From materials to design, processing, and quality management, LG Energy Solution's accumulated expertise innovates all battery production stages to deliver the most robust batteries.

HV Mid-Ni Chemistry Technology

Our material technology improves durability and reduces gas generation in high-voltage Mid-Ni systems.

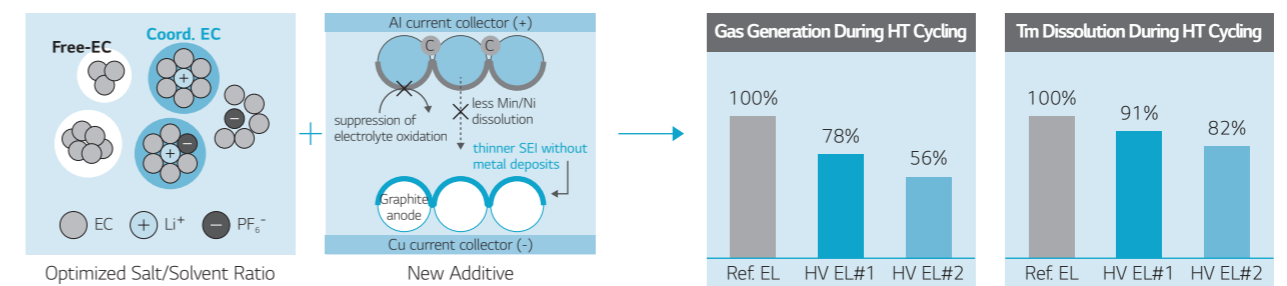
Single Particle Cathode Materials

Low effective surface area and high structural stability reduce gas generation and extend cycle life at high voltage.



New Electrolyte for High Voltage System

Lowering electrolyte oxidation and metal dissolution extends high voltage cycle life while reducing gas.

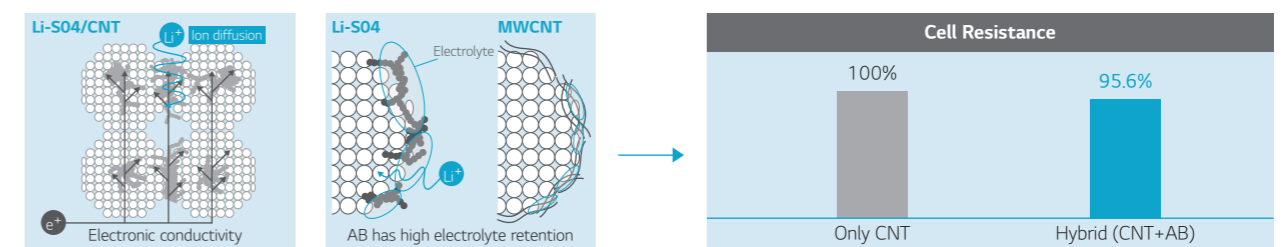


Hybrid Conducting Agent System

0-Dimensional Conducting Agent: Higher electrolyte absorption for ionic path.

1-Dimensional Conducting Agent: High-conductivity electrical path.

→ Optimal ratio of 0D / 1D conducting agent reduces cell resistance and improves producibility.



Highly Optimized Solutions for Commercial Vehicles

Standard Pack Solutions

Standard pack is a highly versatile solution that encompasses various vehicle types, ranging from buses to trucks.



High Energy Density

Mid-Ni chemistry allows high energy density, and is ideal for heavy-duty trucks that need extended driving time.



Longer Life Performance

LG Energy Solution standard pack provides 4,000 cycle life and is able to achieve long life performance required for heavy duty trucks.

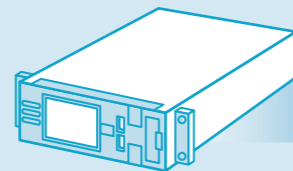


Light Weight Scalability

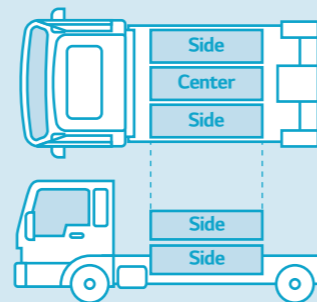
Thanks to its innovative and flexible pouch technology, LG Energy Solution standard pack is lightweight, which in turn enhances driving efficiency and payload.

Easy to Apply

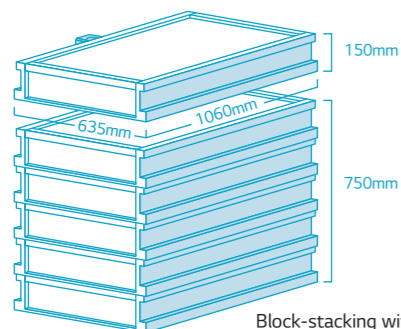
A single, optimized standard pack can be effortlessly mounted on various heavy-duty trucks.



Standard Pack



LG Energy Solution's Standard Pack Product Details



Block-stacking without extra space

| | | | |
|---------------------------|--------|-----------------|------------------------------|
| Chemistry | Mid-Ni | Size [mm] | 1060 x 635 x 150 (W x D x H) |
| Form Factor | Pouch | Cycle | 4000 |
| Energy [kWh] | 31.6 | Cooling Type | Liquid |
| VED ¹⁾ [Wh/L] | 318 | Production Site | EU(ESWA) / NA(ESMI) |
| GED ²⁾ [Wh/Kg] | 230 | Target SOP | 2026.4Q |

1) Volumetric Energy Density | 2) Gravimetric Energy Density * Some detail specifications could be changed

The most ideal battery solutions for commercial vehicles are provided by LG Energy Solution based on its world-renowned technology and varieties of knowhow.

Standard BMS Solutions

LG Energy Solution's Standard BMS is the smartest approach to boost battery performance, leveraging expertise and advanced technology.



Extensive Expertise

Delivers excellent quality assurance confirmed by partnerships with various global OEMs.



Cost-Effective Solutions

Reduces engineering resources and verification costs through lowering EDnD costs and LG Energy Solution's internal quality protocols.



Advanced Safety Management

Applies specified diagnosis strategy* and supports system-level diagnosis.**

(*MAVD, SVD, OV, OC, OT, etc / **IR monitoring, Crash, HVIL, etc)



Optimized Performance and Lifetime

Realizes exceptional battery longevity and output with an advanced battery cell SOX algorithm.

Standard BMS Compatible with Various Applications

LG Energy Solution's Standard BMS is engineered to seamlessly integrate into diverse applications.



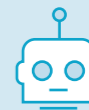
EV/PHEV
E-Truck/E-Bus



E-Bike
E-Scooters



Lawn Mower
Golf Carts



Robot AGV*
*AGV: Automatic Guided Vehicle

Saving Time and Costs

- Pre-development for OTS (Off-the-Shelf) products dramatically reduces both time and costs.
- LG Energy Solution's advanced safety diagnosis SW enhances vehicle safety.
- Safety check sheet validation process ensures the reliability of customer design.

Pre-development

VS.

New Development

2-3 months
Validation

Reduce Time and Costs

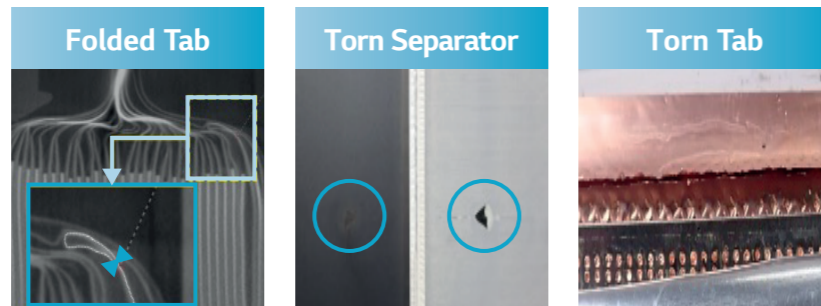
Total Time Required : 2-3 years

Rigorous Safety Management with Competitive Safety Diagnosis SW

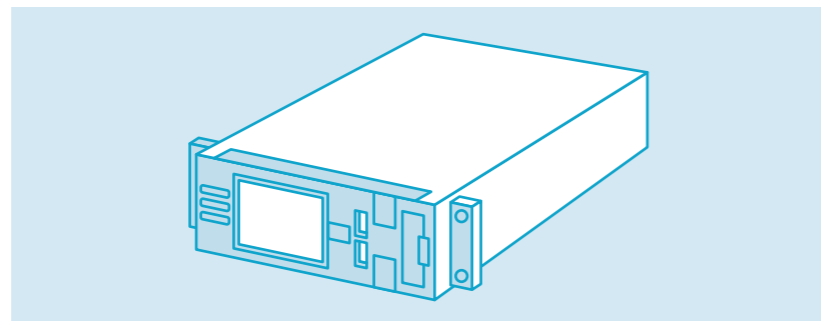
Ensuring Safety and Reliability

Our diagnosis software has been verified through extensive cell, pack, and vehicle testing, and is continuously improved through field data analysis after mass production.

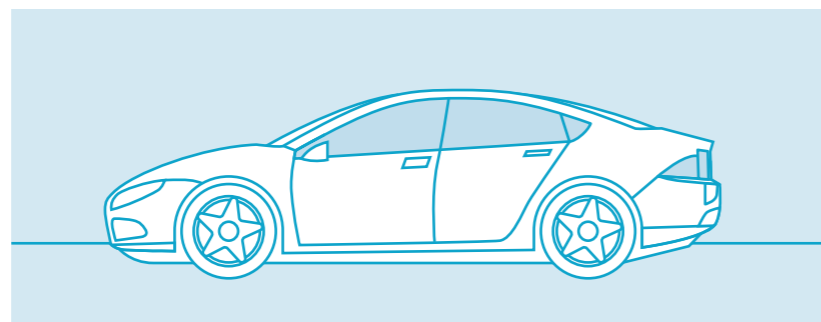
Retrofit Cells Test
>10,000



Pack Test
>1,000



Vehicle Data
>100,000



Since 2018, LG Energy Solution has been a leader in developing battery safety diagnosis software that detects cell defects, proven effective in mass production. Our research now advances in battery data analysis and diagnosis, thanks to our domain experts' knowledge.

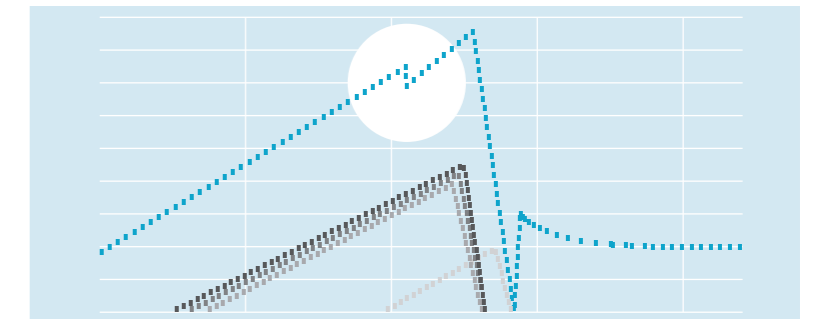
Advanced Safety Diagnosis

Through a comprehensive analysis and thorough detection of cell defects, we ensure the safety and stability of battery performance.

MAVD

Moving Average Voltage Deviation

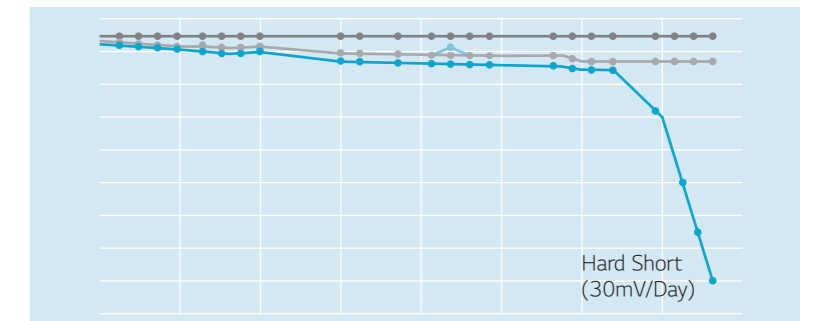
Detects a fine voltage that drops momentarily due to the cell tab failure.



RdV

Relaxation delta Voltage

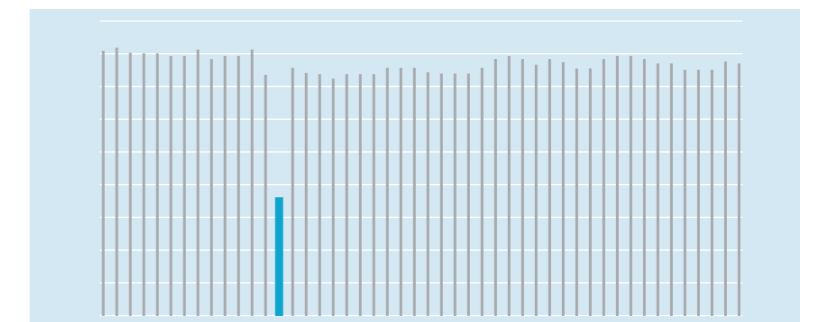
Detects continuous voltage drop due to the micro internal short circuit in cell.



dSOH

delta State Of Health

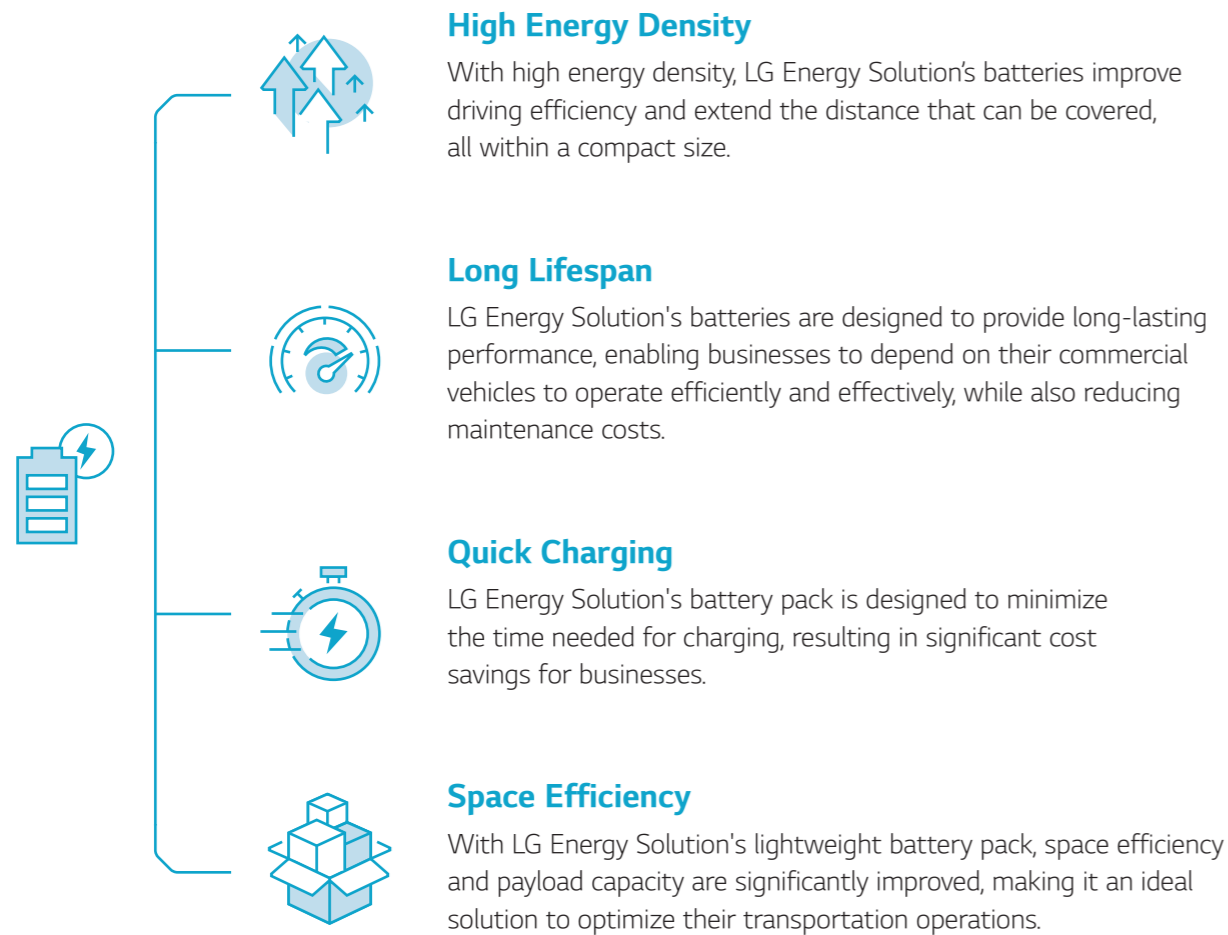
Detects capacity anomalies due to Lithium deposition or pouch damage.



Core Competencies of LG Energy Solution's Battery for Commercial Vehicles

Most Competent Battery for Commercial Vehicles

Electrification of commercial vehicles has become a reality. LG Energy Solution's advanced battery technology opens the door to the next generation of electric commercial vehicles, making sustainable driving possible.



With high performance and enhanced efficiency, LG Energy Solution's batteries are an ideal solution to a wide range of electric commercial vehicles, boosting productivity and increasing profit.

Various Commercial Vehicle Applications

LG Energy Solution provides best solutions for various commercial vehicles with our safe, reliable and innovative battery product lineups.



Bus

Our fast-charging batteries minimize charging time and reduce passenger transportation costs.



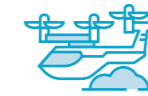
Light & Heavy-duty Truck

High-capacity battery for electric trucks is space-efficient, maximizing cargo space.



Vessel

We promote a sustainable marine ecosystem with longer driving duration from one-time charging.



Urban Air Mobility

Robust yet lightweight battery enhances reliability and energy efficiency in the UAM industry.



Utility Vehicle

Light and slim battery pack design improves design freedom for multi-purpose vehicles.



Off Highway Vehicle

We offer stable and long-lasting power for electric tractors or mining vehicles.

Partnerships with Global Commercial Vehicle Manufacturers



Cell Solutions for Powerful EV Performance

LG Energy Solution's high-energy-density and high-power cell lineups maximize EV performance, while battery design freedom caters to a range of customer EV concepts.

Cells

| Category | | | Power Cell | | Energy Cell | | |
|----------------------------|---|---|------------------|------------------------|---|---|-------------------|
| Model | | | P41 | JP3 | E101A | N2.2 | E72B |
| Chemistry | | | NCM/Graphite | NCM/Graphite | NCM/Graphite | NCM/Graphite | NCMA/Graphite+SiO |
| Performance | Capacity (Min, 25°C, 0.3C) | Ah | 40.8 | 62.4 (Min, 25°C, 0.5C) | 101.8 | 64.8 | 72.2 |
| | Nominal Voltage | Vdc | 3.63 | 4 | 3.67 | 3.634 | 3.67 |
| | Energy | Wh | 148 | 229.6 Wh (Min.) | 374 | 235 | 264 |
| | Energy | Wh/L | 486 | 389 Wh/L (Min.) | 637 | 556 | 625 |
| | Density (Min) | Wh/kg | 226 | 184 Wh/kg (Min.) | 287 | 266 | 287 |
| | Pulse Charge Max Current(A)* (10sec, SoC 50%, 25°C, BOL) | | 380 | 192 | 395 | 146 | 316 |
| | Pulse Discharge Max Current(A)* (10sec, SoC 50%, 25°C, BOL) | | 380 | 192 | 590 | 146 | 550 |
| | Continuous Discharge Performance* (SoC 100%→0%) | | 5C, 12min, 25°C | - | - | - | 3C, 10.1min, 25°C |
| | Max Discharge Power (W) | 10sec, SoC 50%, 25°C | 1241 | 706.5 | 1174 | 531 | 1540 |
| | Internal Resistance (mΩ) | 10sec, SoC 50%, 25°C | 1.28 | 0.88 ± 0.25 mΩ | 1.05-1.45 (10sec, SoC 28% (Shipping), 23°C) | 1.2-1.9 (10sec, SoC 28% (Shipping), 23°C) | 1.09 |
| Power to Energy Ratio | W(Power 10sec, SoC 50%, 25°C) /Energy | 8.3 | - | 3.1 | 2.3 | 5.8 | |
| Quick Charge | | 8-80% @30-40min | | | | | |
| Warranty | | 80% Capacity retention @8years, passenger car condition | | | | | |
| Dimension | L*W*T(mm) | 266.5*139*8.22 | 353.5*101.7*16.4 | 580*112.4*9 | 301.5*100.7*14.0 | 354*101.65*11.44 | |
| Weight | g | 654.5 | 1245 | 1303 | 885 | 906 | |
| Operating Temperature (°C) | | -30 ~ 55 | | | -30 ~ 55 | | |
| Storage Temperature (°C) | | -30 ~ 60 | | | -30 ~ 60 | | |
| Mass Production | | Poland('21-) | China('18-) | China/Poland('23-) | Korea/USA('23-) | Poland('23-) | |

* As just reference data of cell level test, the detailed values can be modified upon system specification such as derating logic, cooling performance, etc. Concrete values can be specified based on customer's definition of its value.

| Energy Cell | | | | | Low Voltage Cell | HEV Cell |
|---|--------------------|-------------------|--|------------------|--------------------|--|
| E65D | E66C | E78 | E79 | E56A | LV 9.8 | H5.5 |
| NCM/Graphite | NCM/Graphite | NCM/Graphite | NCMA/Graphite | NCM/Graphite | NCM/Graphite + LTO | NCM/Graphite |
| 64.5 | 65.4 | 78 | 78 | 56 | 9.8 | 5.5 |
| 3.66 | 3.68 | 3.67 | 3.69 | 3.66 | 3.67 | 3.68 |
| 236 | 240 | 286 | 287 | 205 | 36 | 20.24 |
| 444 | 575 | 602 | 591 | 512.5 | 195.6 | 232.3 |
| 234 | 266 | 265 | 267 | 238.9 | 113.3 | 135.8 |
| 300 | 110 | 184 | 202 | 200 | 275 | 750w Pulse Charge Max Power(w)* (10sec, SoC50%, 25°C, BOL) |
| 400 | 330 | 496 | 546 | 400 | 400 | 750w Pulse Discharge Max Power(w)* (10sec, SoC 50%, 25°C, BOL) |
| 2C, 21min, 25°C | 3C, 20min, 25°C | 3C, 11.3min, 45°C | 3C, 17.3min, 45°C 3C, 12.4min, 25°C | - | - | - |
| 1260 | 1068 | 1463 | 1365 | 1000 | 1000 | - |
| 1.2 | 1.42 | 1.48 | 1.27 | 1.57 | 1.7 | - |
| 5.3 | 4.45 | 5 | 4.7 | 4.9 | 27.8 | - |
| 8-80% @30-40min | | | | | - | - |
| 80% Capacity retention @8years, passenger car condition | | | | | | |
| 290.5*159*11.5 | 354*101.05*11.66 | 548*100*8.65 | 548*100.1*8.55 | 354*101.05*11.18 | 112.0*246.5*6.66 | 180*105*4.61 |
| 1017 | 900 | 1083 | 1075 | 863 | 317.5 | 149 |
| -30 ~ 55 | | | -30 ~ 60 | | | |
| -30 ~ 60 | | | -40 ~ 70 | | | |
| Korea('21-) | Poland/China('20-) | Poland('19-) | Poland('23-) | China('21-) | China('17-) | China('17-)/Poland('24-) |

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Module Solutions for Maximizing EV Space Efficiency

LG Energy Solution's module lineups with compact battery volume enable flexible height and width variations, resulting in diverse module combinations that support more innovative EV designs.

Modules

| Category | | Short Module | | Long Module | | |
|----------------------------|--------------------------|---|-----------------------------|--|-----------------------------|---------|
| Model | | E66C 3P4S | E72B 2P6S | E78 2P12S | E78 3P8S | |
| Configuration | | 3P 4S | 2P 6S | 2P 12S | 3P 8S | |
| Chemistry | | NCM / Graphite | NCM / Graphite+SiO | NCM / Graphite | | |
| Performance | Capacity | Ah | 196.2 | 144.4 | 156 | 234 |
| | Nominal Voltage | Vdc | 14.68 | 22.02 | 44.04 | 29.36 |
| | Operating Voltage Range | Vdc | 12 - 17 | 16.8 - 25.2 | 36 - 51 | 24 - 34 |
| | Energy (Min) | kWh | 2.88 | 3.17 | 6.87 | 6.87 |
| | Energy | Wh/L | 453 | 501 | 486 | 486 |
| | Density(Min) | Wh/kg | 213 | 240 | 221 | 221 |
| | Max Charge Power (kW) | 10sec, SoC 50%, 25°C, BOL | 5.1 | 13.8 | 16.3 | 16.3 |
| | Max Discharge Power (kW) | 10sec, SoC 50%, 25°C, BOL | 12.8 | 20.8 | 34.7 | 34.7 |
| | Quick Charge | | SOC 6% - 78%, 37min @35degC | SOC6% - 79.6%, 21min @25degC | SOC 8% - 80%, 40min @25degC | |
| Dimension | L*W*T(mm) | 390*151.6*107.5 | 390.3*151*107.5 | 590*225*108 (589*222.6*107.5, Nominal) | | |
| Weight | kg | 13.5 | 13.2 | 31 | | |
| Operating Temperature (°C) | | -30 - 60 | | | | |
| Storage Temperature (°C) | | -30 - 60 | | | | |
| Warranty | | 80% Capacity retention @8years, passenger car condition | | | | |
| Production Site | | Poland/China ('20-) | Poland ('23-) | Poland ('21-) | | |

* As just reference data of Module level test, the detailed values can be modified upon system specification such as derating logic, cooling performance, etc. Concrete values can be specified.

| Long Module | | Low Height Module | | Pack |
|--|-----------|---|----------|-------------------|
| E79 2P12S | E79 3P8S | E60 2P12S | E60 3P8S | E65D Pack |
| 2P 12S | 3P 8S | 2P 12S | 3P 8S | 1P 16S |
| NCMA / Graphite | | NCM / Graphite | | NCM / Graphite |
| 156 | 234 | 118.6 | 177.9 | Min 64.5 |
| 44.28 | 29.52 | 44.04 | 29.36 | 58.6 |
| 36 - 50.4 | 24 - 33.6 | 30 - 51 | 20 - 34 | 40 - 67.2 |
| 6.91 | 6.91 | 5.22 | 5.22 | 3.78 |
| 479 | 479 | 460 | 460 | 54.7 |
| 223 | 223 | 226 | 226 | 75.6 |
| 18.1 | 18.1 | 19 | 19 | - |
| 40.1 | 40.1 | 25 | 25 | - |
| SOC 8% - 80%, 30min @25degC | | SOC 15% - 80%, 34min @35degC | | - |
| 589*225.76*108.58 (W/O Foam Rope, Nominal) | | 580*233*84 | | 908.8*368.9*270.1 |
| 31 | | 23 | | 49 ±2 |
| | | -30 - 60 | | -30 - 60 |
| | | -30 - 60 | | -40 - 60 |
| | | 80% Capacity retention @8years, passenger car condition | | 8years |
| Poland ('23-) | | Poland ('21-) | | Korea ('24-) |

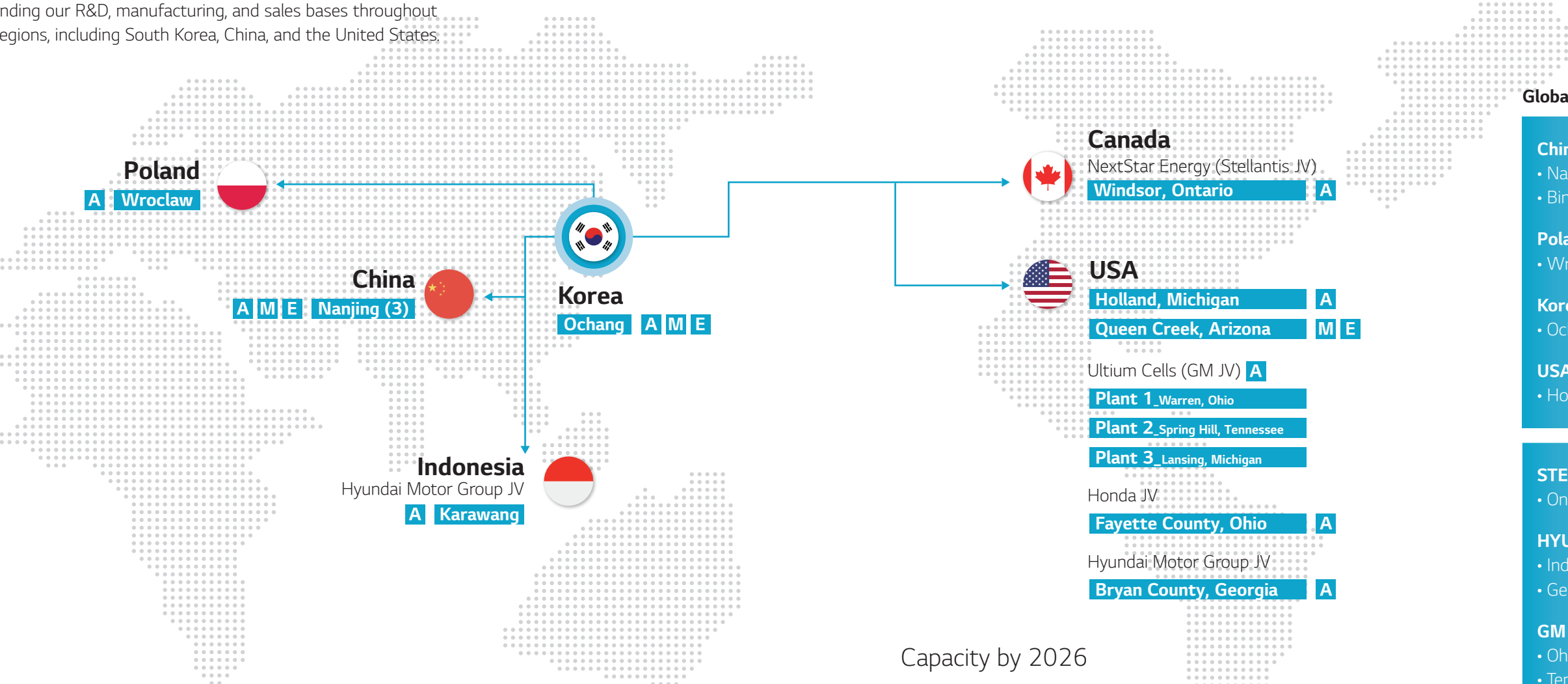
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Unmatched Global Production Capacity

LG Energy Solution boasts the highest global production capacity with multiple facilities on major continents. This global system streamlines local production and quality control to secure a reliable battery supply.

Global Network

Expanding our R&D, manufacturing, and sales bases throughout key regions, including South Korea, China, and the United States.



Global xEV Battery Plants

- China**
 - Nanjing Plant
 - Binjiang Plant
- Poland**
 - Wroclaw Plant
- Korea**
 - Ochang Plant
- USA**
 - Holland Plant

- STELLANTIS JV**
 - Ontario, CA
- HYUNDAI JV**
 - Indonesia
 - Georgia, US
- GM JV**
 - Ohio, US
 - Tennessee, US
 - Michigan, US
- Honda JV**
 - Ohio, US

Capacity by 2026
550 GWh+ /Year

Extensive Global Supply Chain Network

With worldwide raw material and component partners, LG Energy Solution maintains a stable supply chain for high-performance battery production.

Long-term Partnerships for Stable Raw Material Procurement

We ensure stable raw material procurement and cost innovation through long-term partnerships with global partners.

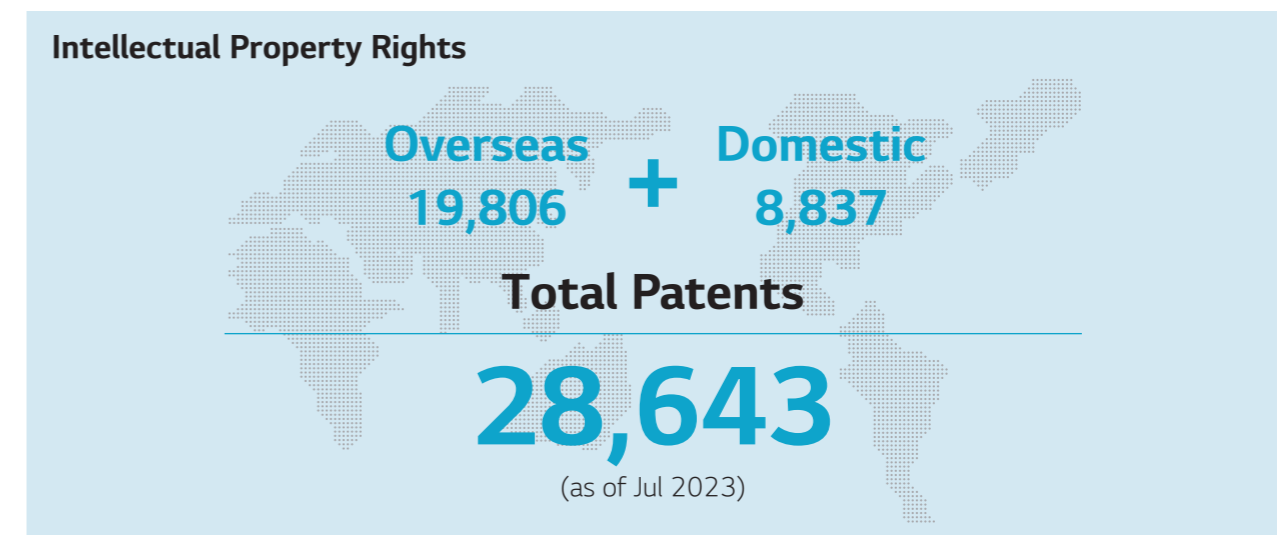
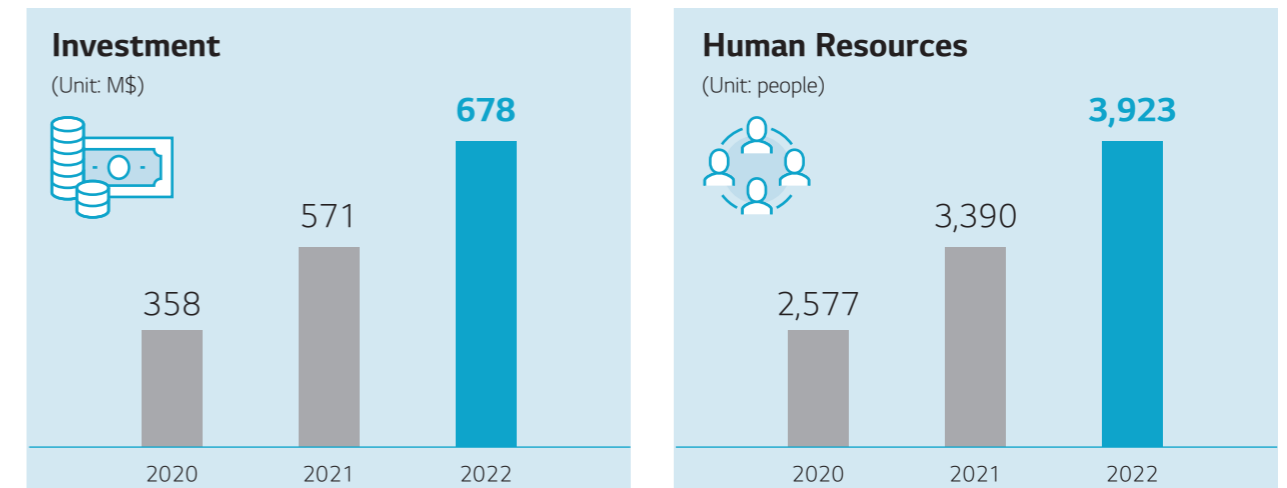
| Year | Month | Entity | Details |
|------|-------|--|--|
| 2020 | OCT | QPM | 10-year supply agreement for 7,000 tons of nickel and 0.7 tons of cobalt |
| | DEC | Indonesia Government | MOU to secure local nickel deposits for the Indonesia's local JV |
| 2021 | JAN | SQM | 8-year supply agreement for 55,000 tons of lithium |
| | | Solus Advanced Materials | \$380 million contract for Hungary copper foil factory |
| | | Shenzhen Capchem Technology | 15% acquisition of shares in Polish electrolyte JV with Capchem |
| | APR | QPM | 20,000 tons of nickel secured for 6 years from 2023 |
| | JUN | EcoPro | Partnership agreement for high steel recycling in battery manufacturing plants |
| QPM | | 7,000 tons of nickel and 700 tons of cobalt secured annually for 10 years from 2025 | |
| 2022 | JAN | Liontown | 700,00 tons of lithium ore (Spodumene) secured annually for 5 years from 2024 |
| | | Vulcan energy | 45,000 tons of lithium hydroxide secured annually for 5 years from 2026 |
| | JUN | Compass Minerals | 40% supply of carbonate and lithium hydroxide produced by Compass Minerals for 7 years from 2025 |
| OCT | Syrah | Start of supply of 2,000 tons of natural graphite from 2025, with continuous cooperation for expanding mass production | |
| 2023 | MAY | Green Technology Metals | 25% supply of lithium ore produced for 5 years from 2026 |
| | JUL | SQM | 100,000 tons of carbonate and lithium hydroxide secured annually for 7 years from 2023 |

Expertise in World-class Technology

LG Energy Solution leads the battery sector with the world's largest number of patents, and our commitment to widening this lead continues through continuous investment in R&D and specialized manpower training.

Empowering the Future through Research & Development

We provide our customers with both safety and assurance for future business while simultaneously ensuring the freedom for technological expansion through our commitment to R&D investments.



Next Generation Technological Roadmap

Future Technology Development Path

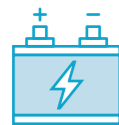
LG Energy Solution take the lead in developing future technology in all areas of the battery industry.



Material & Cell

Basic Materials and Cell Technologies Innovation for Improved Performance

- High-capacity NCMA
- High-efficiency silicon
- Low expansion graphite



Module & Pack

Integrated Design Cell + Module + Pack + System

- Cooling and cell fixing structure
- Fire extinguishing/Heat barrier design
- Integrated structure development based on vehicle platform



Simulation

Thermal, Electrical, and Mechanical Optimal Feedback

- Battery system performance forecast
- Stability prediction
- Process mechanism analysis and interpretation



Digital Transformation

New Business Models in Battery Certification and Reused Battery Analysis

- Battery/Material analysis based on AI and big data
- Battery life prediction
- Safety diagnostic technology

LG Energy Solution is paving the way for the future of batteries with continuous process innovations and technological advancements in battery materials and cell technology. We are moving the industry closer to the next generation of high-performance, low-cost batteries that are safer and more efficient.

Next-generation Batteries

LG Energy Solution is developing a revolutionary next-generation battery portfolio employing state-of-the-art technology.

| Solid-state Battery | Lithium-sulfur Battery |
|--|---|
| <p>Solid-state batteries are rechargeable batteries with a solid-state electrolyte between a cathode and an anode, enabling high energy density and high capacity with a low risk of combustion.</p> | <p>Lithium-sulfur batteries are made from lightweight materials, such as sulfur-carbon composite in the cathode and lithium-metal in the anode, giving them an energy density 2 times higher than conventional lithium-ion batteries.</p> |
| <p>Lithium-ion Battery (Liquid electrolyte)</p> | <p>Solid-state Battery (Solid-state electrolyte)</p> |
| | |
| <p>E-Mobility Wearable Aircraft</p> | <p>Drone UAM</p> |

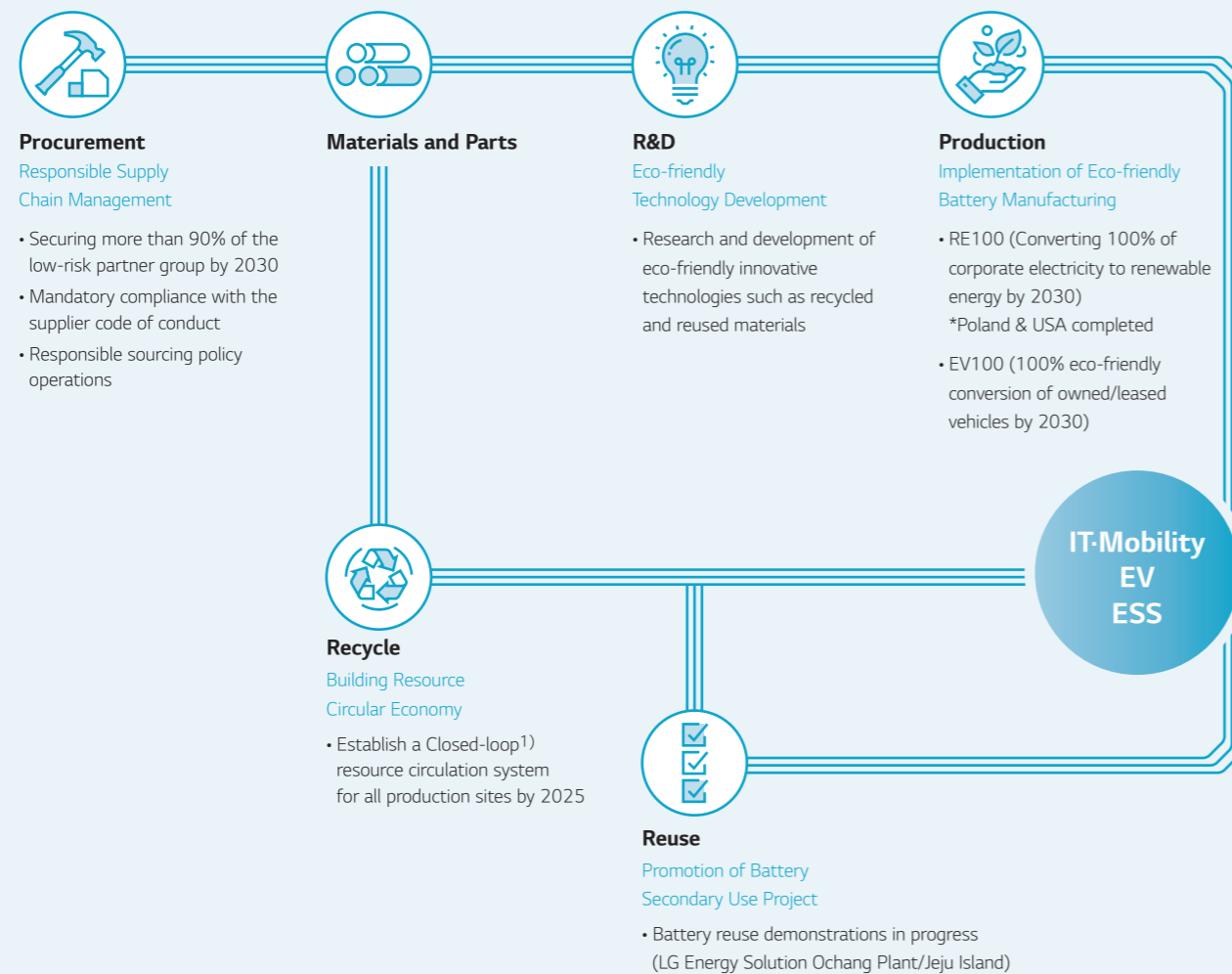
Next-generation Battery Portfolio

| | 2026 | 2027 | 2028 | 2030 |
|--------------------------------|--|--------------------------|-----------------------------------|-----------------------------------|
| Energy Density | 680Wh/L (300Wh/kg) | 550Wh/L (500Wh/kg) | 820Wh/L (350Wh/kg) | 900Wh/L (400Wh/kg) |
| Next-generation Battery | Polymer-based Semi-solid-state battery | Lithium-sulfur battery | Polymer-based solid-state battery | Sulfide-based solid-state battery |
| Material | | | | |
| Cathode | High Ni | S/CNT Composite Material | High Ni | High Ni |
| Anode | Graphite / SiO | Li metal | Li metal | Si |
| Electrolyte | Solid Electrolyte | | Solid Electrolyte | Sulfide SSE |

Commitment to Sustainability

Battery Circular Ecosystem of LG Energy Solution is Offering

From raw material procurement to recycling, we protect the environment and innovate businesses with a sustainable battery circular ecosystem.



Notes : 1) Closed-loop : Raw materials such as lithium, nickel, and cobalt are extracted from waste batteries or scraps generated during the production process and recycled in the cathode material production stage

LG Energy Solution is fulfilling its corporate social responsibility by taking a lead in climate action by practicing sustainable business innovation in partnership with customers throughout the industry value chain.

Climate Action for the Future

LG Energy Solution has simultaneously committed to RE100 and EV100 and is actively participating in an international campaign to convert all electricity used on business sites to 100% renewable energy, and all company vehicles to 100% eco-friendly models by 2030.

RE 100

LG Energy Solution will convert 100% of the electricity to renewable energy by 2025 for our global production plants, and the non-manufacturing business sites such as R&D centers are preparing to have 100% conversion by 2030.

Global Business Site RE100 Progress

| | | | |
|---|-------------------|---|------------------------|
|  COMPLETE | Poland Plant 2019 |  COMPLETE | U.S. Plant 2020 |
|  | China Plant 2025 |  | South Korea Plant 2025 |

EV 100

LG Energy Solution aims to make EV100 a reality which requires that 100% of all company-owned automobiles be converted to eco-friendly vehicles by 2030.

 **50%**
Target by 2026

 Continuous expansion of **EV Charging Stations** on business sites

• RE100 is an international campaign with the goal of providing 100% of electricity consumed by companies and users with renewable energy such as wind/solar power by 2050.
• EV100 is an international campaign with the goal of converting corporate-owned/operated vehicles to 100% electric by 2030 to reduce CO2 in the transport sector.