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CreditSights' 2025 "New to Credit" Summer Learning Program

Office Hours Session 3 – East Asia Credits: Themes in the EV Space

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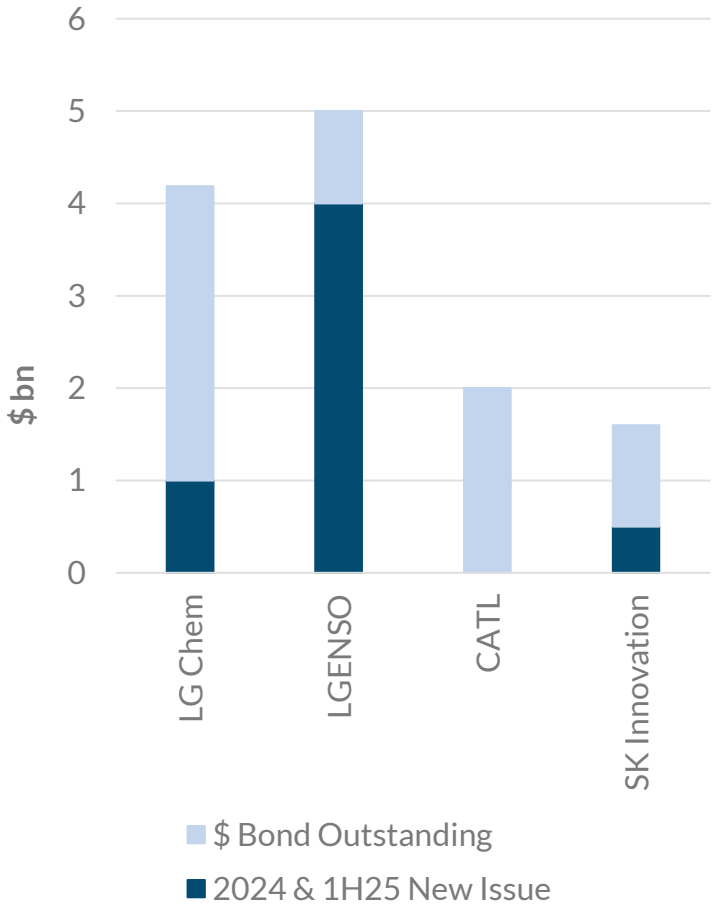
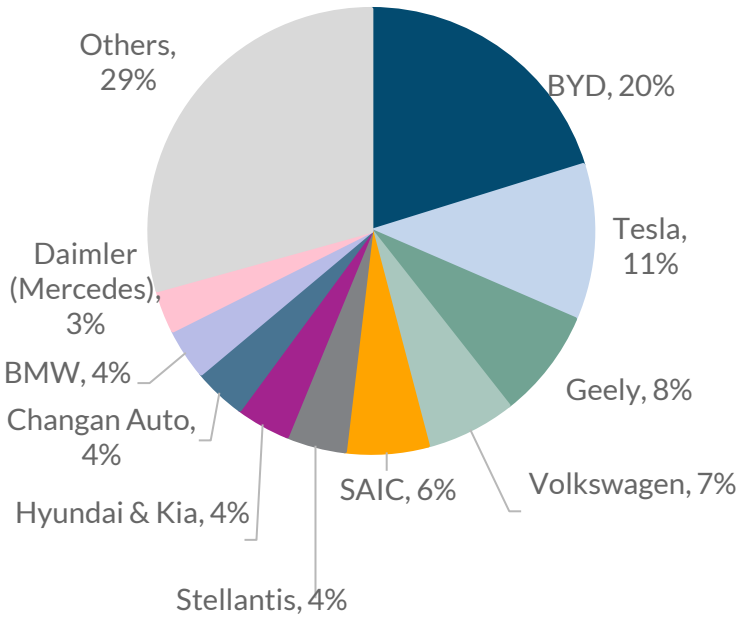
8 July 2025

Why this Sector Matters

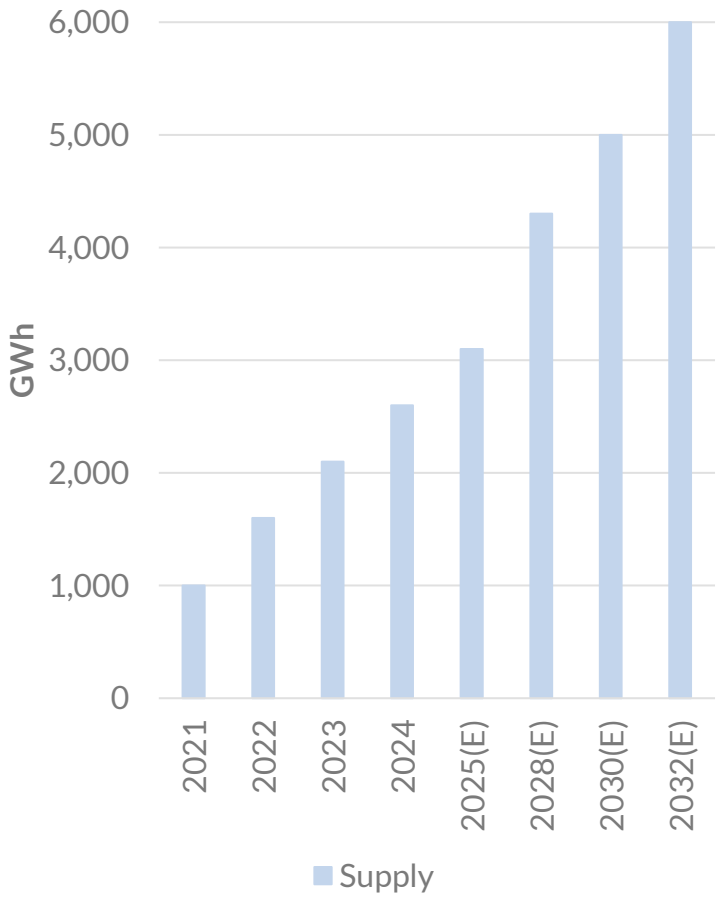
Frequent Issuers in the Asia $ Bond Market



Asia OEMs are Dominating the Global EV Space

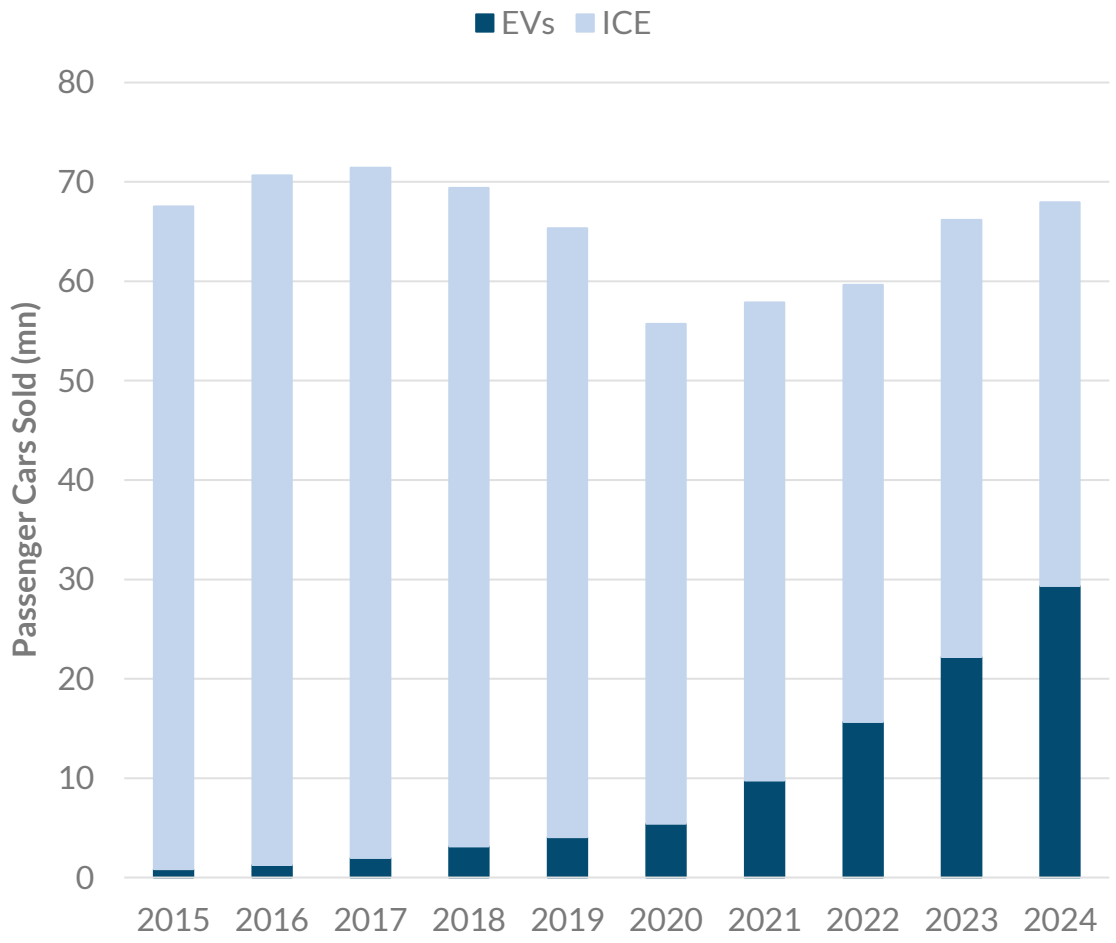


Battery Production Capacity

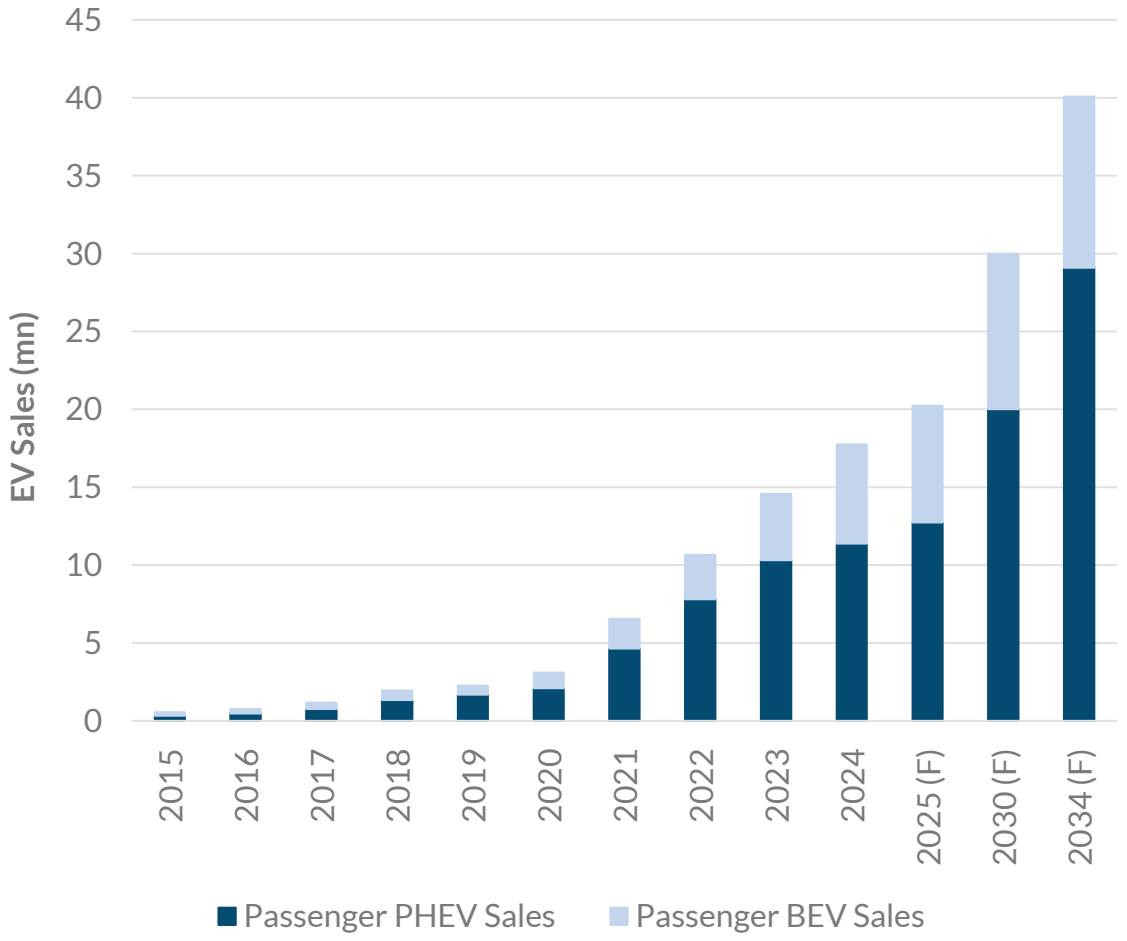


EV Adoption by Numbers

ICE and EV Breakdown



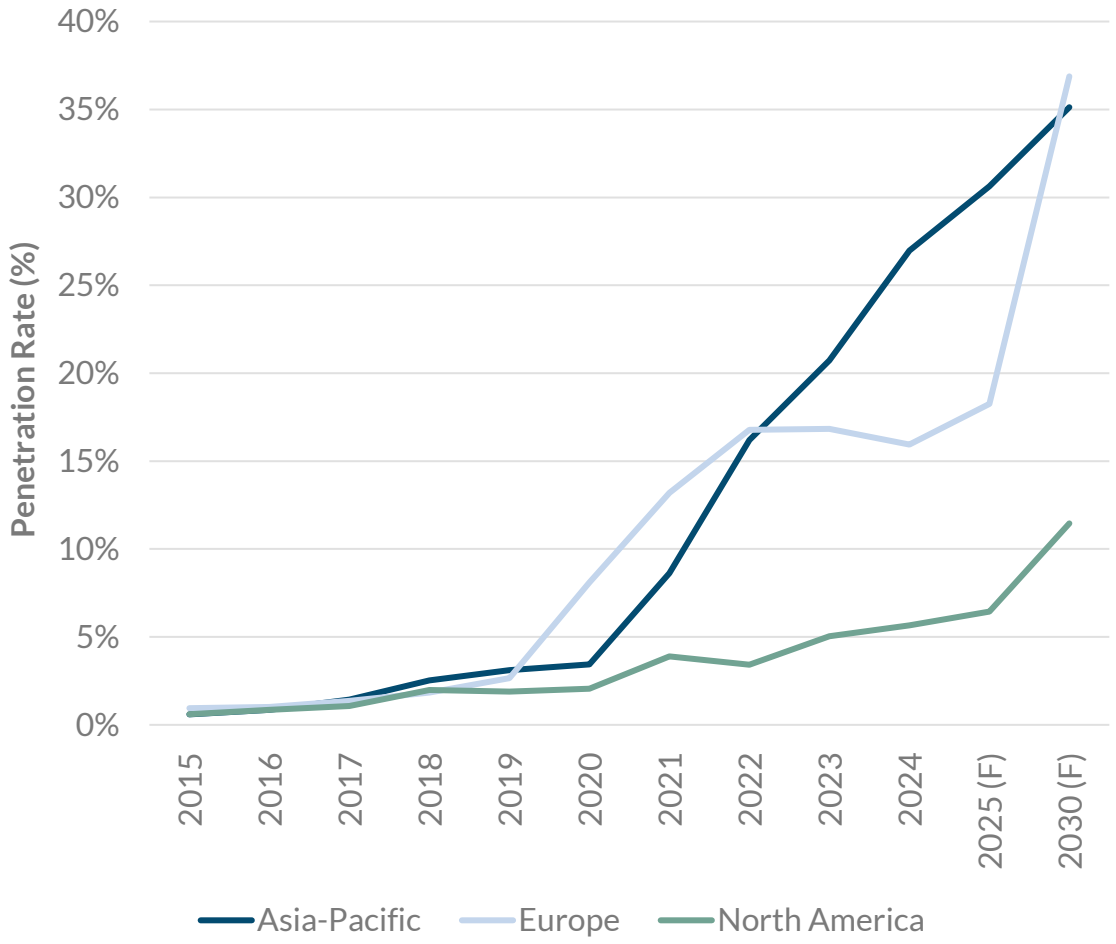
Annual Global EV Sales



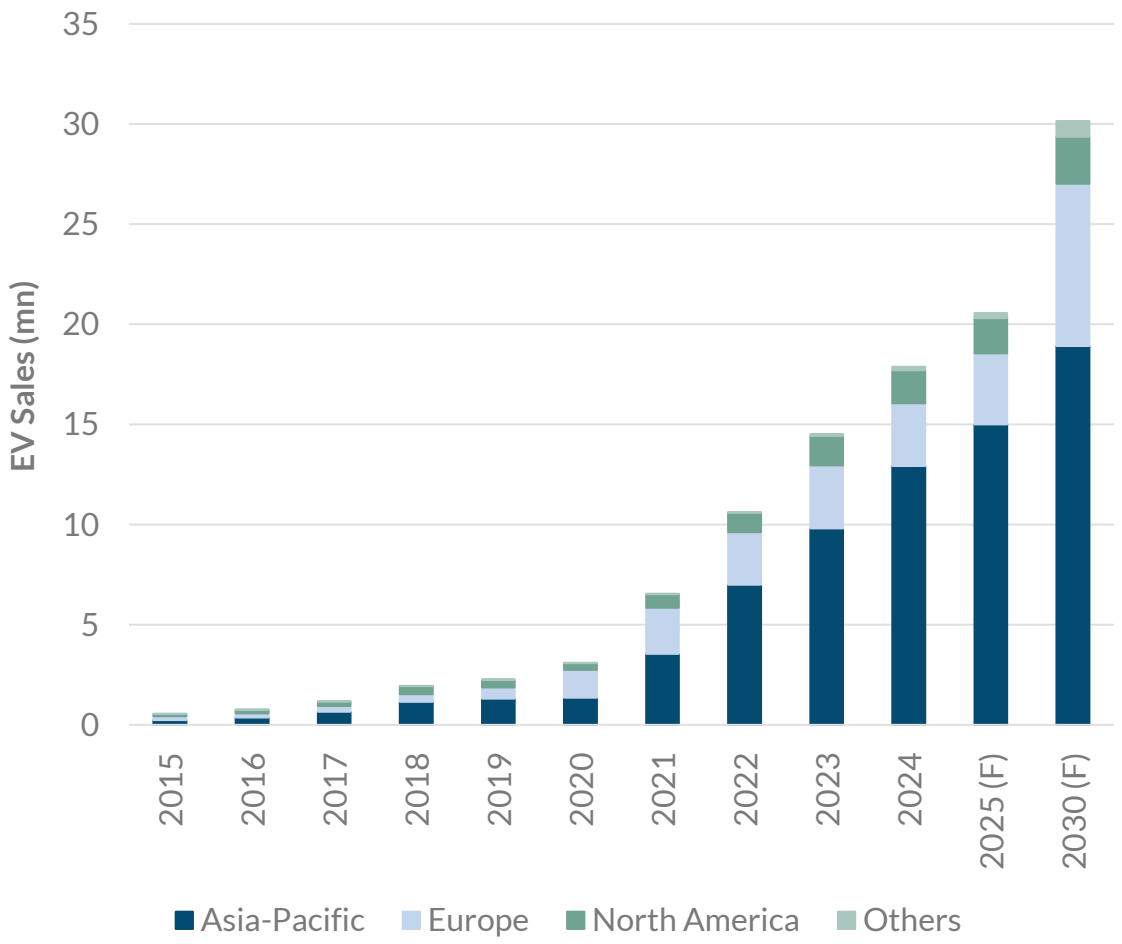
Source: BMI, CreditSights.

EV Adoption by Numbers – Asia leads, US trails, EU plateauing

EV Penetration Rate by Region



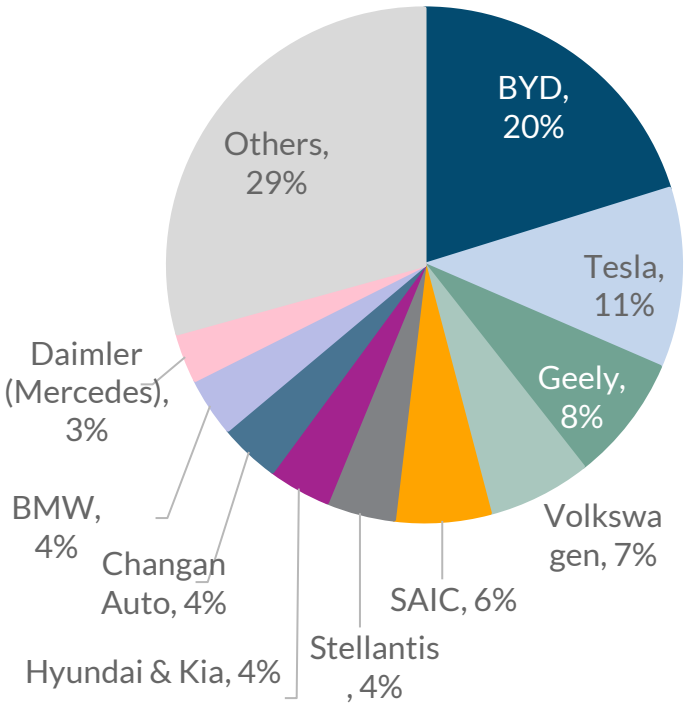
EV Sales by Region



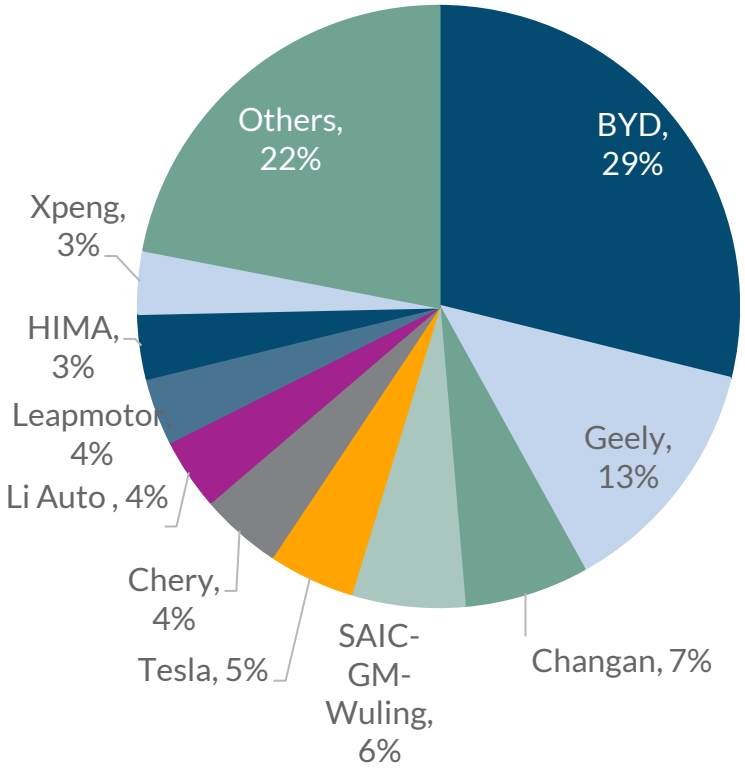
Source: BMI, CreditSights.

EV Market Share Breakdown: Chinese OEM Dominates

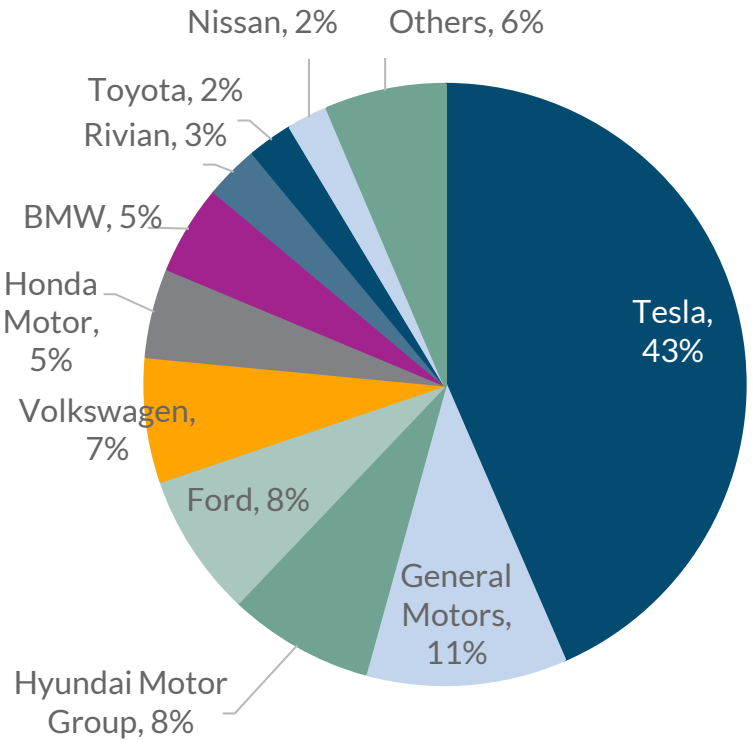
Global



China



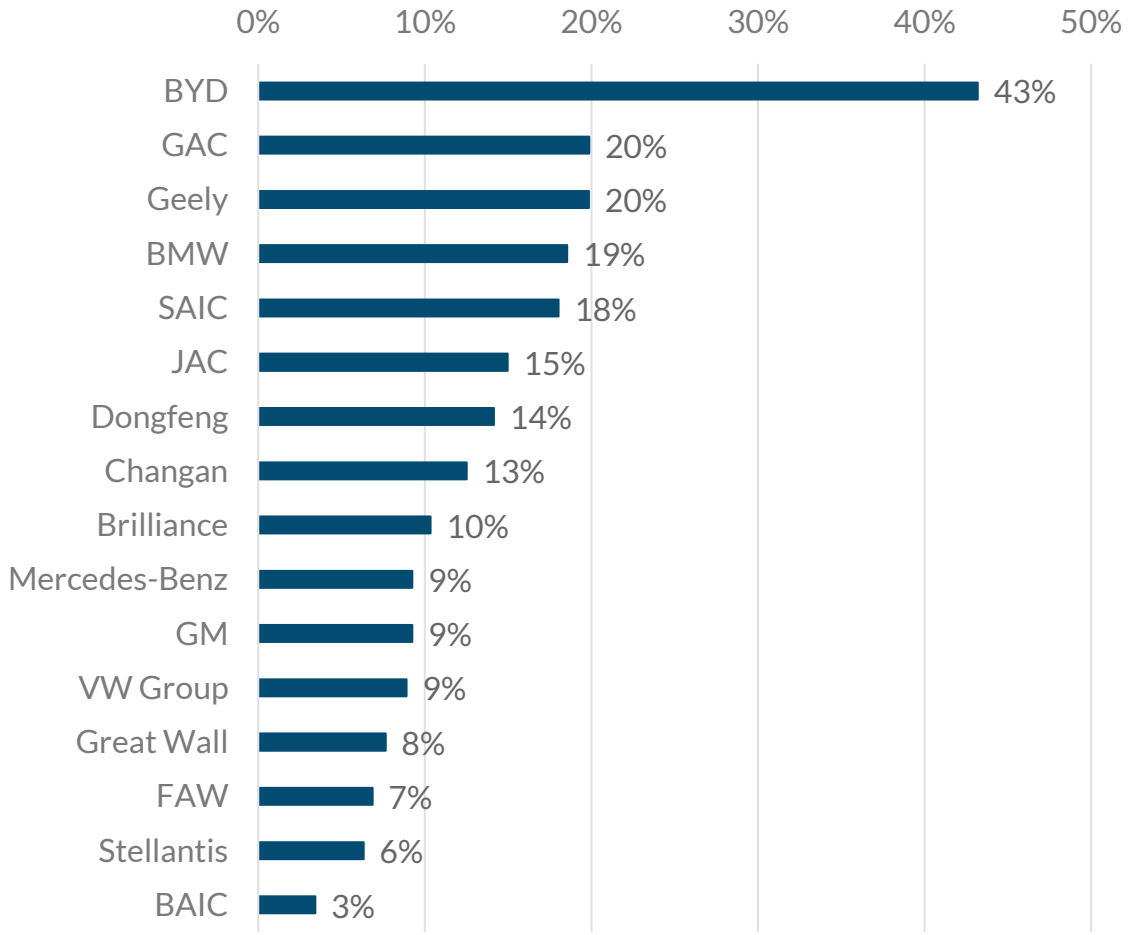
US



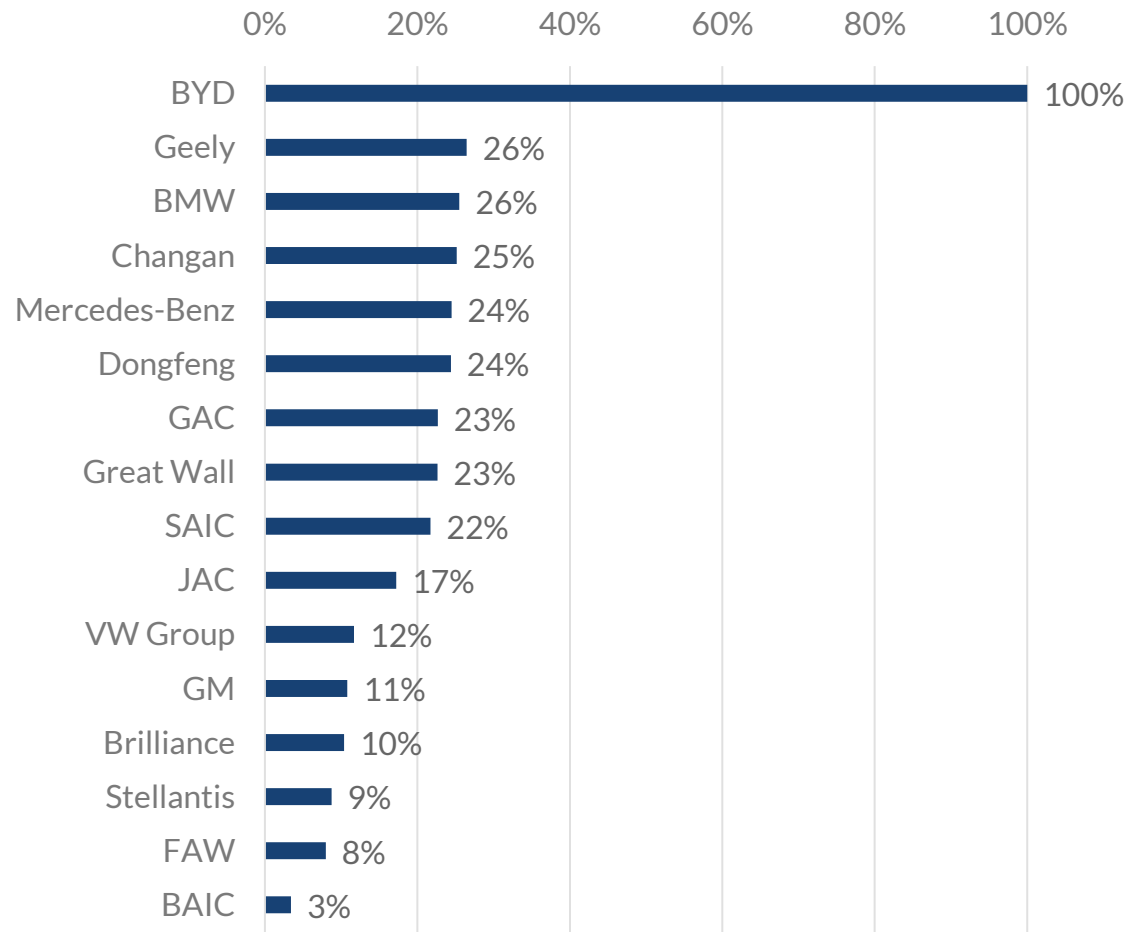
Source: SNE Research, China Passenger Car Association, CreditSights.

Electrification Across Automakers - Chinese OEMs in the Lead

OEM BEV Sale Share (2024)



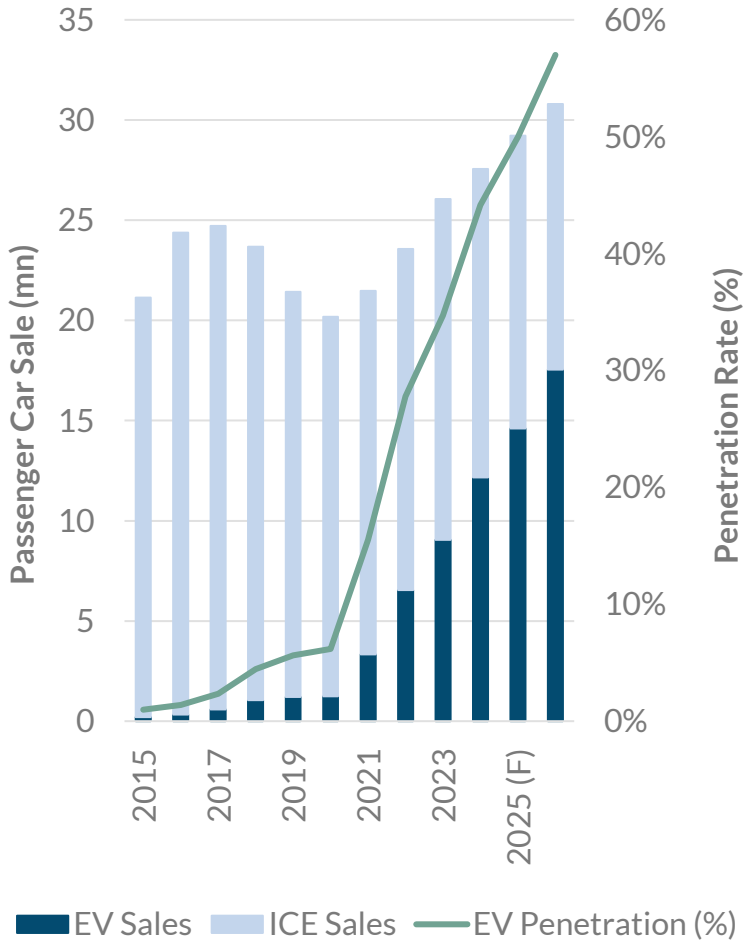
OEM EV Sale Share (2024)



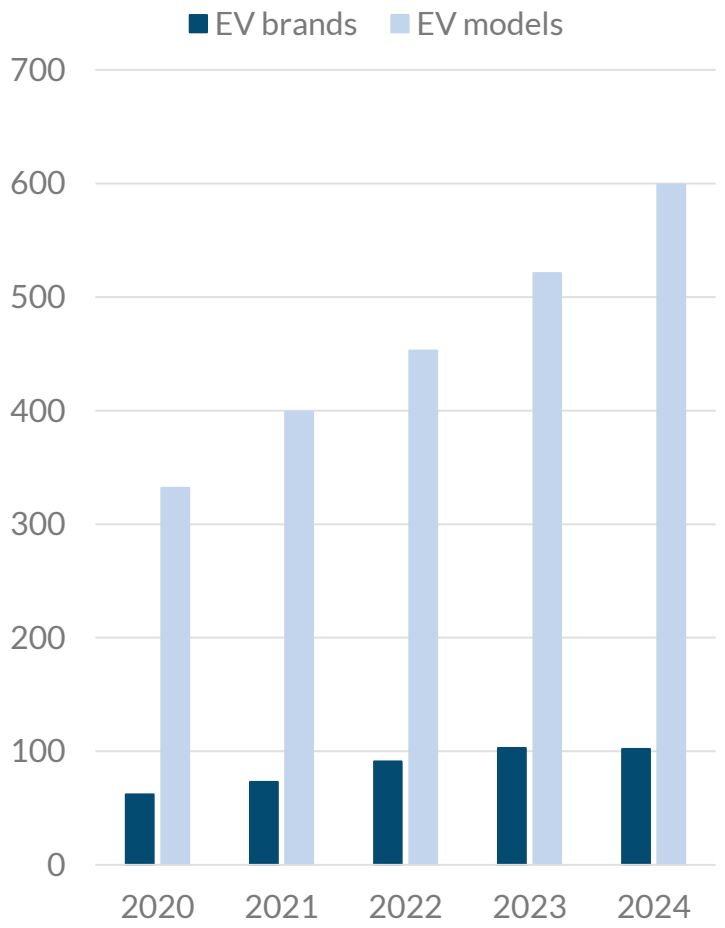
Source: Bloomberg BNEF, CreditSights.

Rapid EV Adoption in China

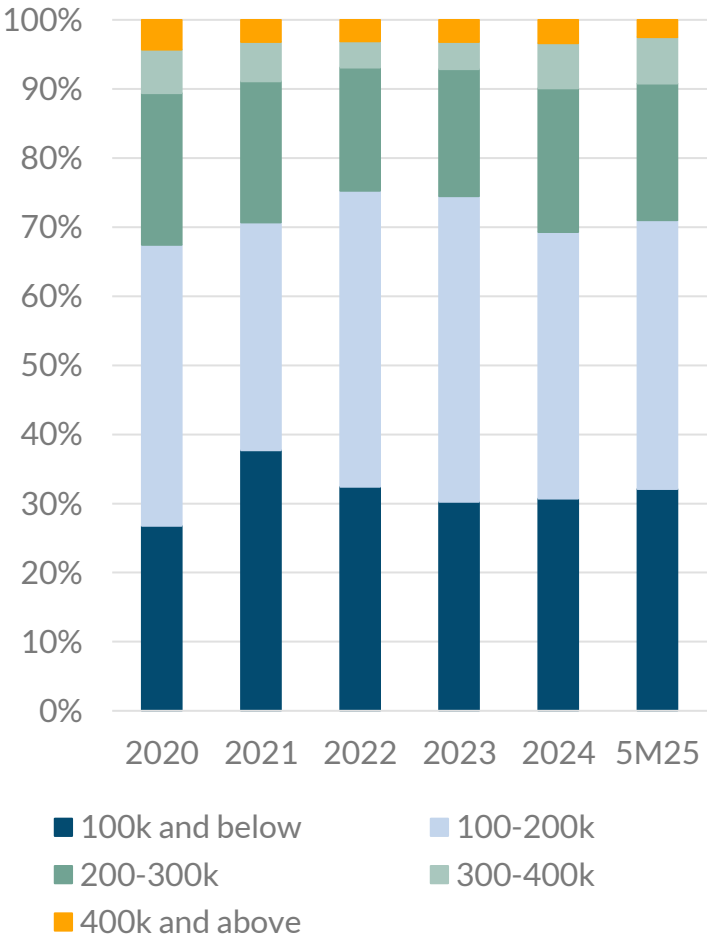
EV Penetration in China



More than 100+ EV models were launched in China last year



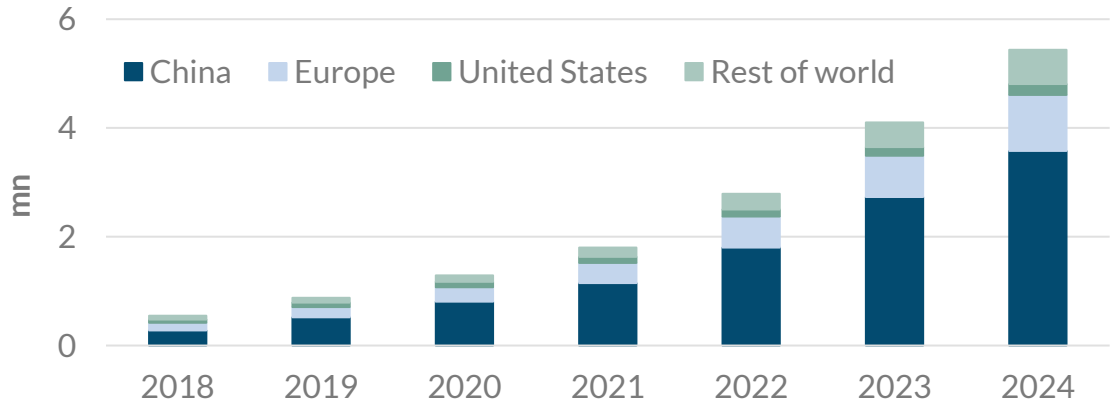
Affordable Pricing



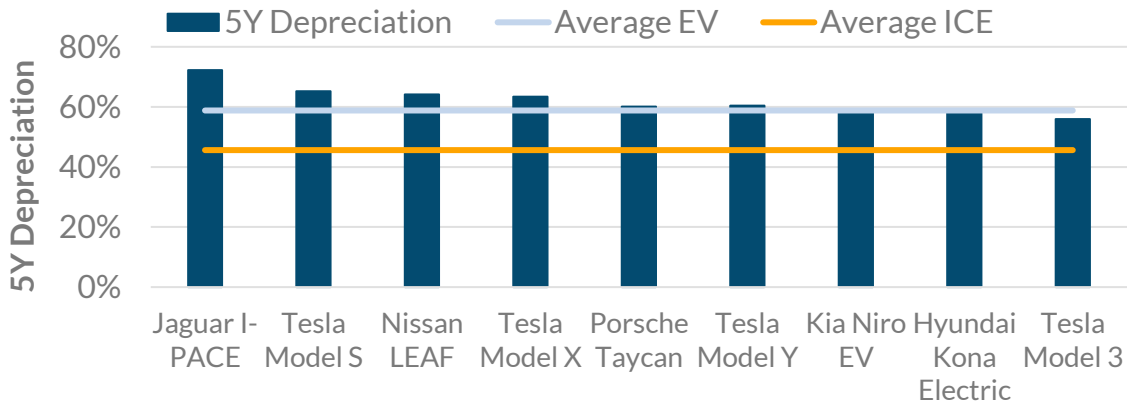
Source: S&P, BMI, China Passenger Car Association, CreditSights

Other Concerns: Infrastructure Gap, Low Residual Value, Price Premium

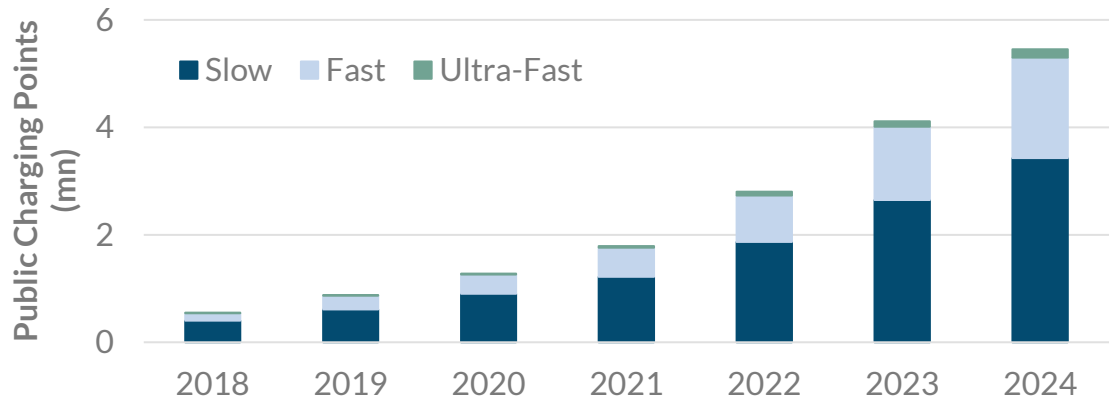
Charging Infrastructure Globally



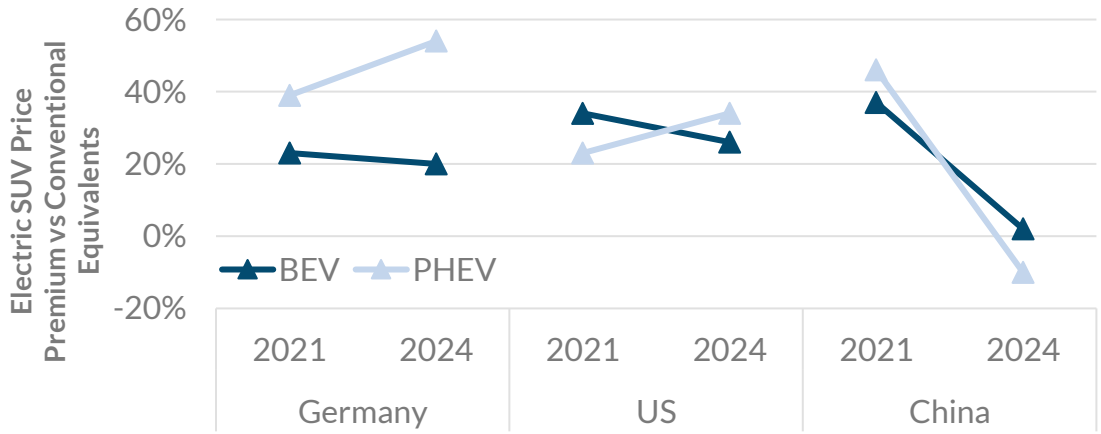
EV Residual Value Under Pressure



Public Charging Points By Speed



EVs are still priced higher against ICE equivalents ex-China



Source: IEA, CreditSights.

The Battery Value Chain

Upstream | Mid-stream | Downstream. | End-Users

Raw material Mining & Processing

- Nickel ore
- Cobalt ore
- Lithium ore
- Manganese
- Graphite

Lithium Americas
Rio Tinto
GLENCORE
HUAYOU
Ganfeng Lithium
AngloAmerican

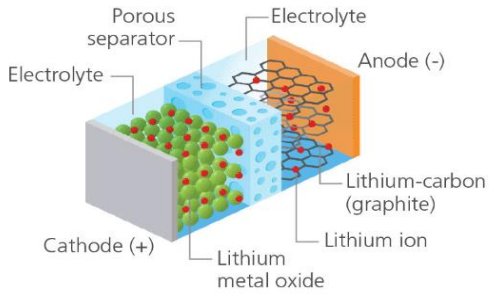
Cell Component Production

- Cathodes
- Electrolytes
- Anodes
- Separators

POSCO FUTURE M
3M
EcoPro BM
L&F Co., Ltd.
LG Chem
umicore

Cell Manufacturing

- Battery cell



CATL
BYD
LG Energy Solution
SK innovation
SAMSUNG SDI
EVE
CALB
Gotion

Cell Assembly

- Battery module and pack

Cell Assembly

- Energy storage
- Electric vehicles
- Battery recycling

TESLA

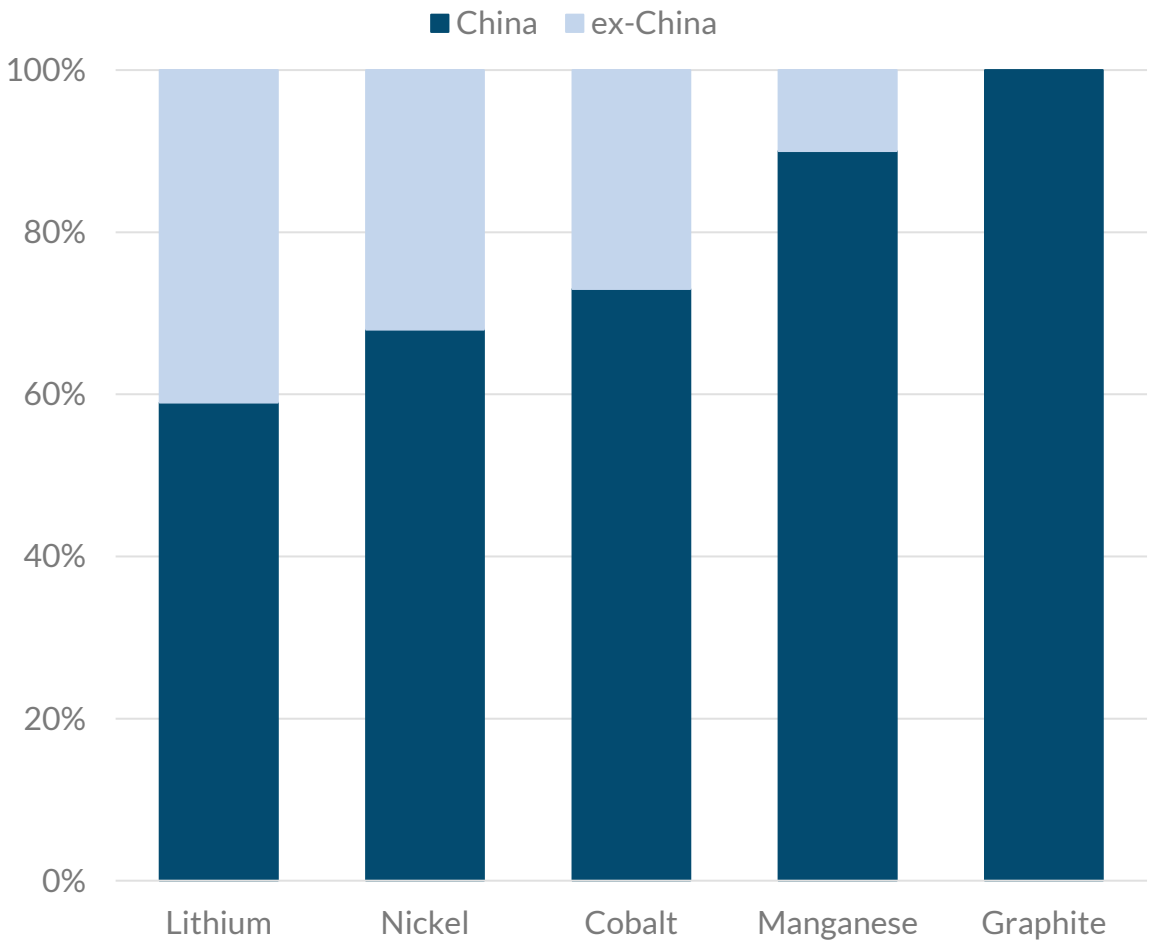
Types of EV Battery

Cathode Material Comparison	NCM	LFP	NCA
Full name	Nickel cobalt manganese	Lithium iron phosphate	Nickel cobalt aluminium oxide
Key material	Lithium, nickel, manganese, cobalt	Lithium, iron, phosphate	Lithium, nickel, cobalt, aluminium
Models	NCM523, NCM 622, NCM 811 *Higher nickel content means higher energy density	n.a.	n.a.
Energy density (Wh/kg)	200-300+	160-210	250-300
Space occupation	Compact	Large	Compact
Safety	Moderate	Good	Moderate
Low-temperature resistance	Good	Moderate	Good
High-temperature resistance	Moderate	Good	Moderate
Charging efficiency	High	Moderate	High
Cycle life	Moderate 800-2,000x or 3-4 years (life span)	Long 3,000x or 7-8 years (life span)	Moderate 800-2,000x or 3-4 years (life span)
Average cost	$100/kWh	$60/kWh	$120/kWh
Other remarks	Good for long-distance travel, but mostly used in high-end EVs due to higher costs	Ideal for city transport, longer life cycle and commonly found in smaller or entry-level EVs	Cell structure very similar to NMC 811, with a high nickel content and a low cobalt and aluminum content
EV usage	Nissan Leaf, Mercedes-Benz EQS, BMW i3	Tesla Model 3 and Model Y, MG ZS, BYD Atto 3, Hyundai Kona EV, Kia Niro EV,	Older models of Tesla

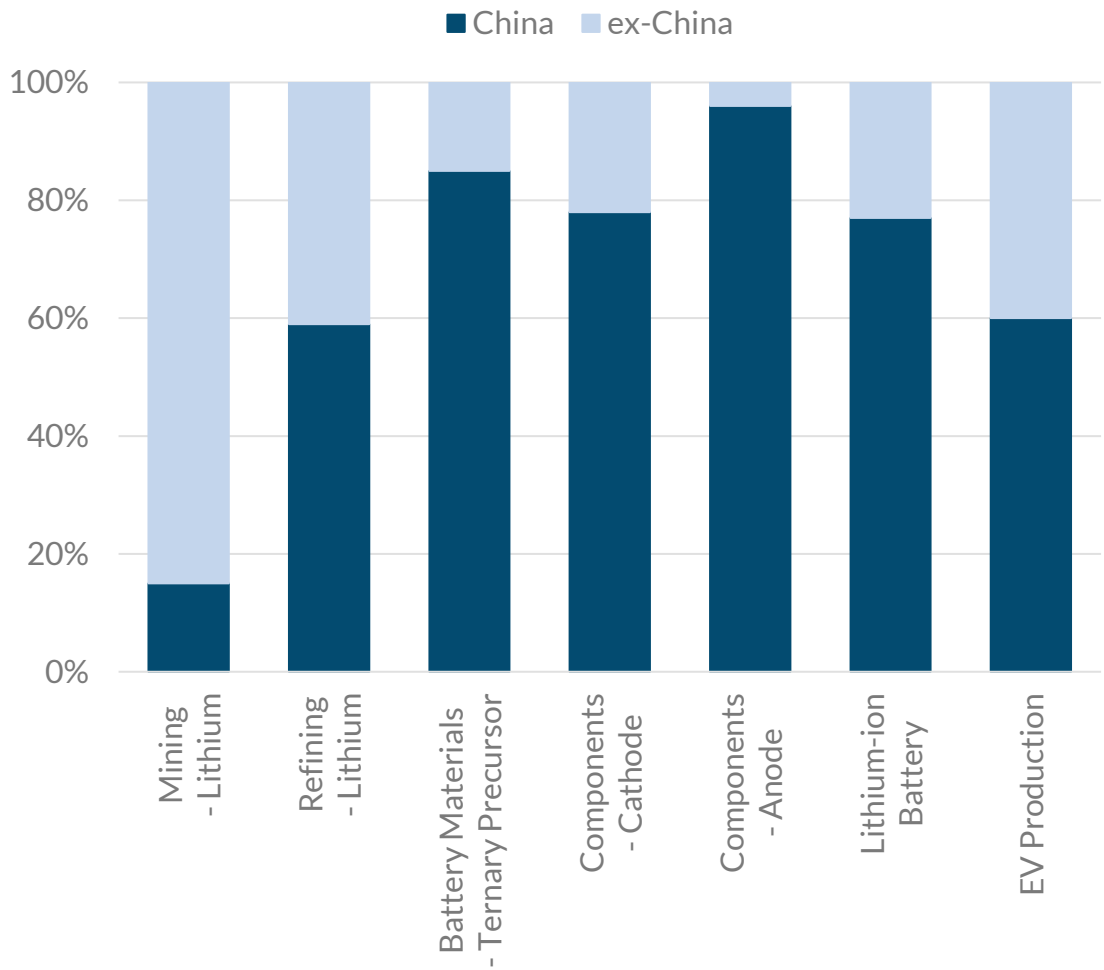
Source: Company official websites, CreditSights

Upstream: China dominates in Refining Battery Metals

Battery Metals Supply: China vs ex-China



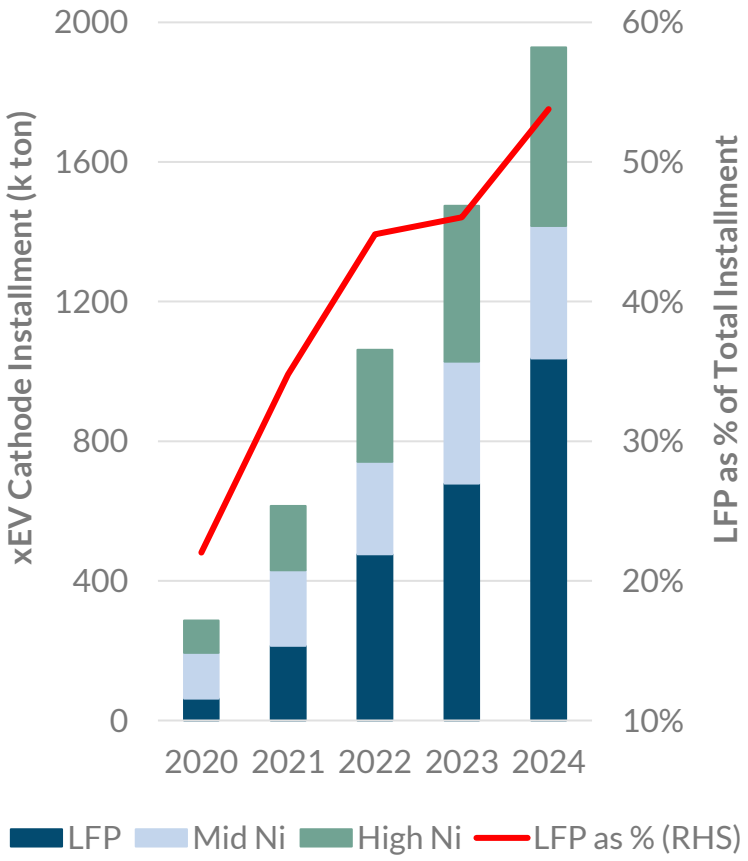
Market Share Across the Value Chain



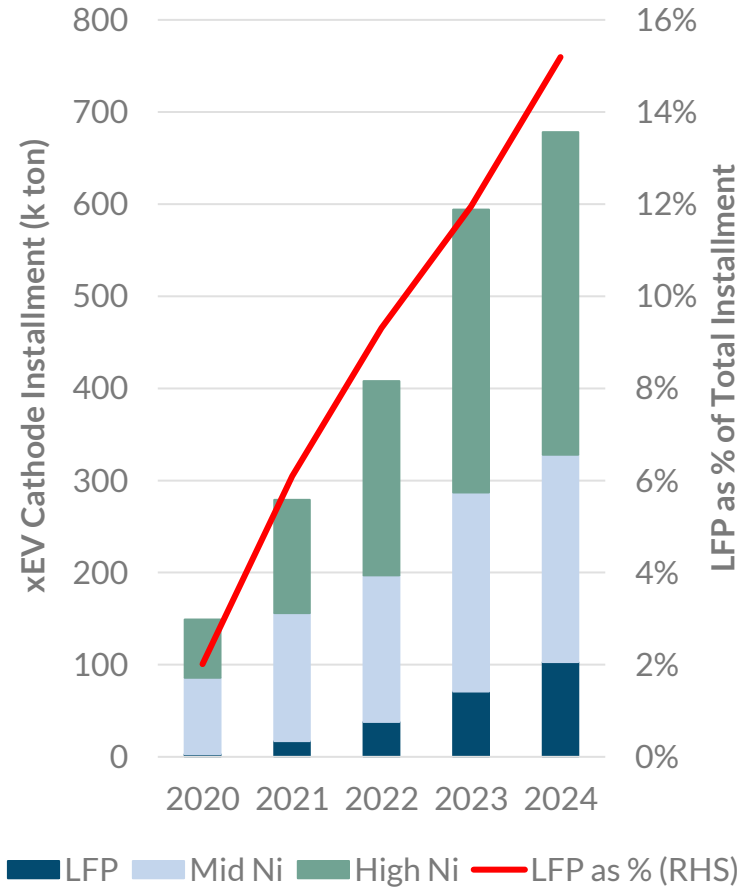
Source: IEA, US Geological Survey, AFCEA, CreditSights

Midstream: Cathode Chemistries and Anodes

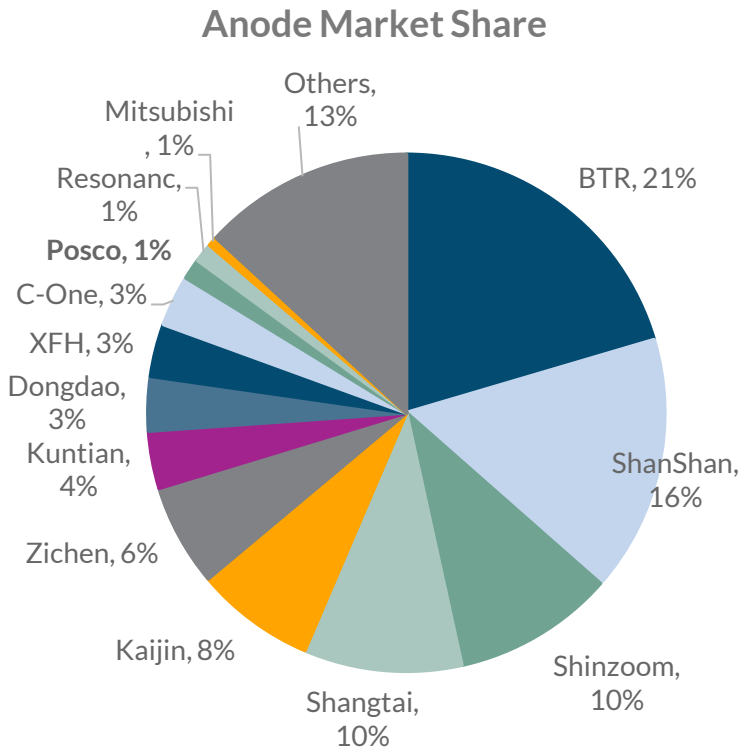
xEV Cathode Instalment by Chemistry



xEV Cathode Instalment by Chemistry (ex-China)



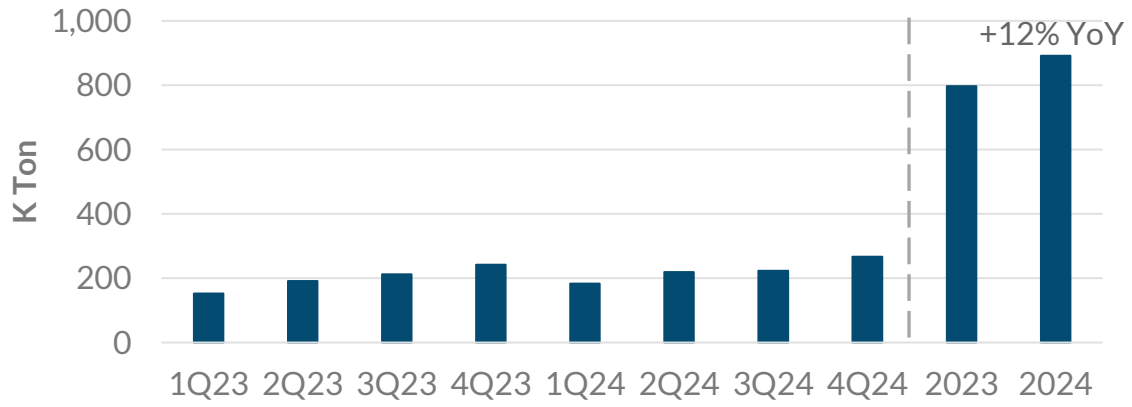
Top 10 Anode Players Are Chinese Manufacturers



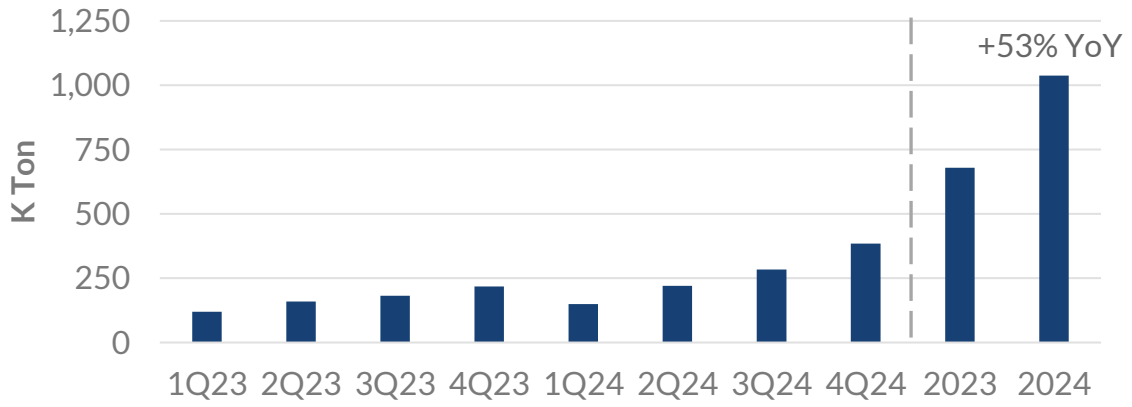
Source: SNE Research, CreditSights.

Mid-Stream: Cathodes Instalment Trend and Market Share

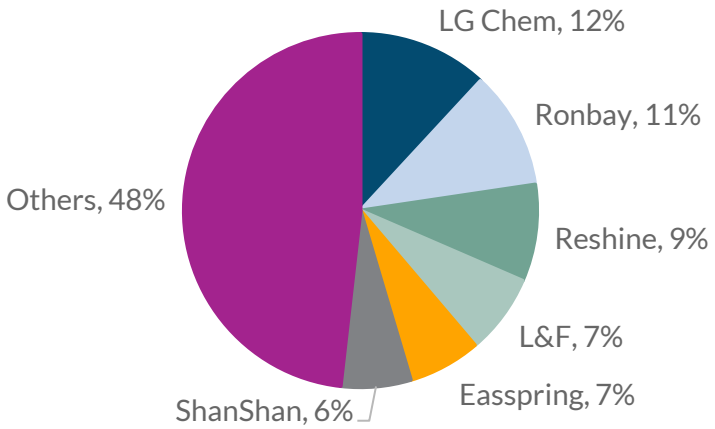
NCx Cathode Instalment Trend



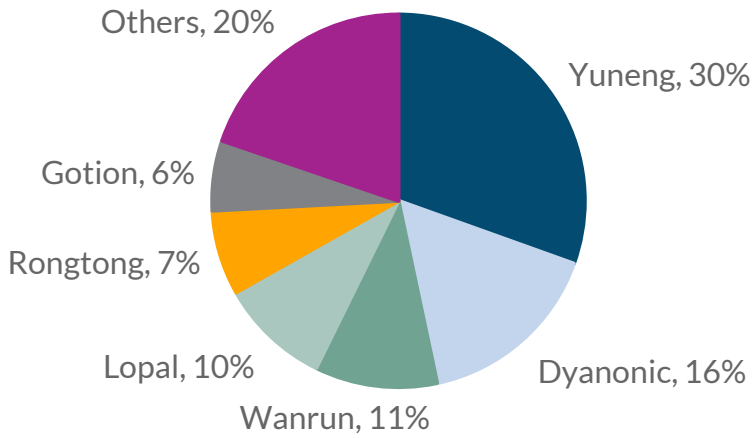
LFP Cathode Instalment Trend



NCx Cathode Market Share



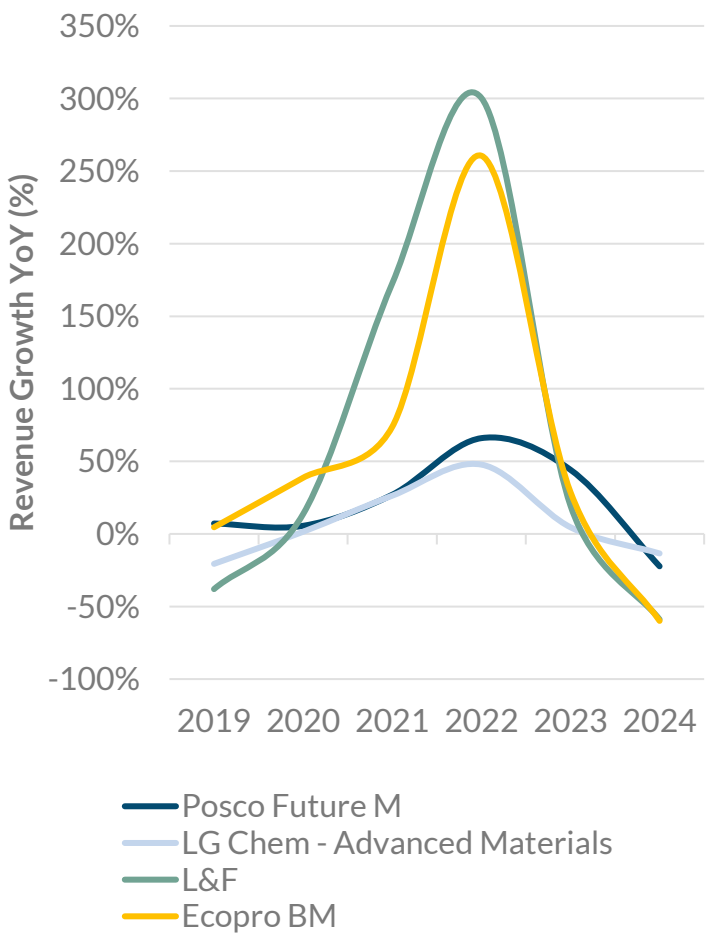
LFP Cathode Market Share



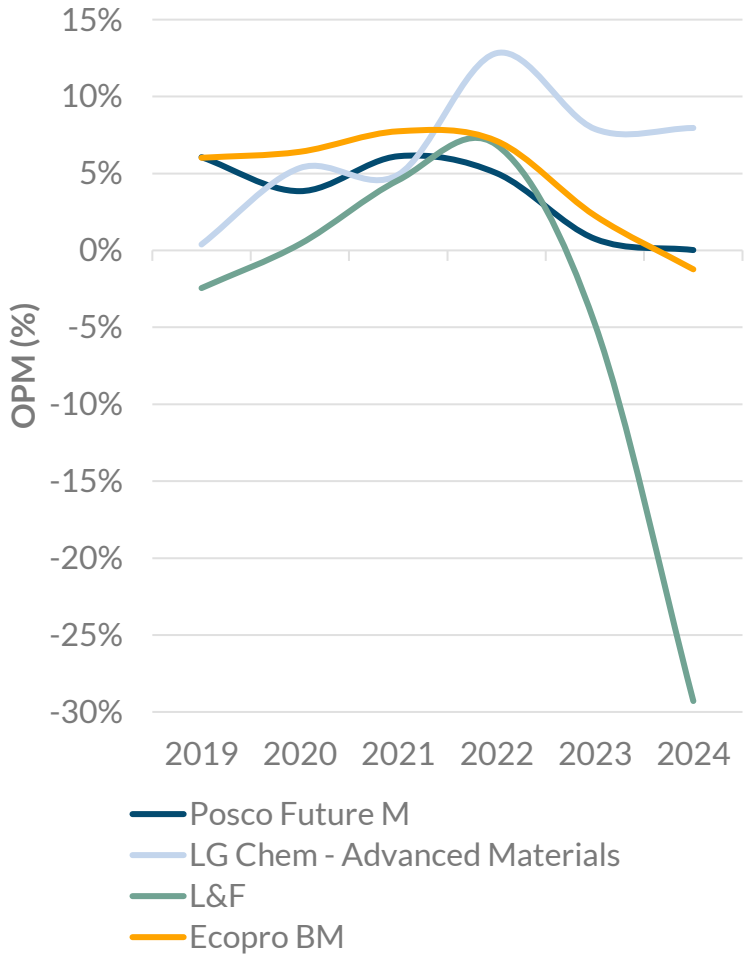
Source: SNE Research, CreditSights.

South Korean Cathode/Anode Manufacturers

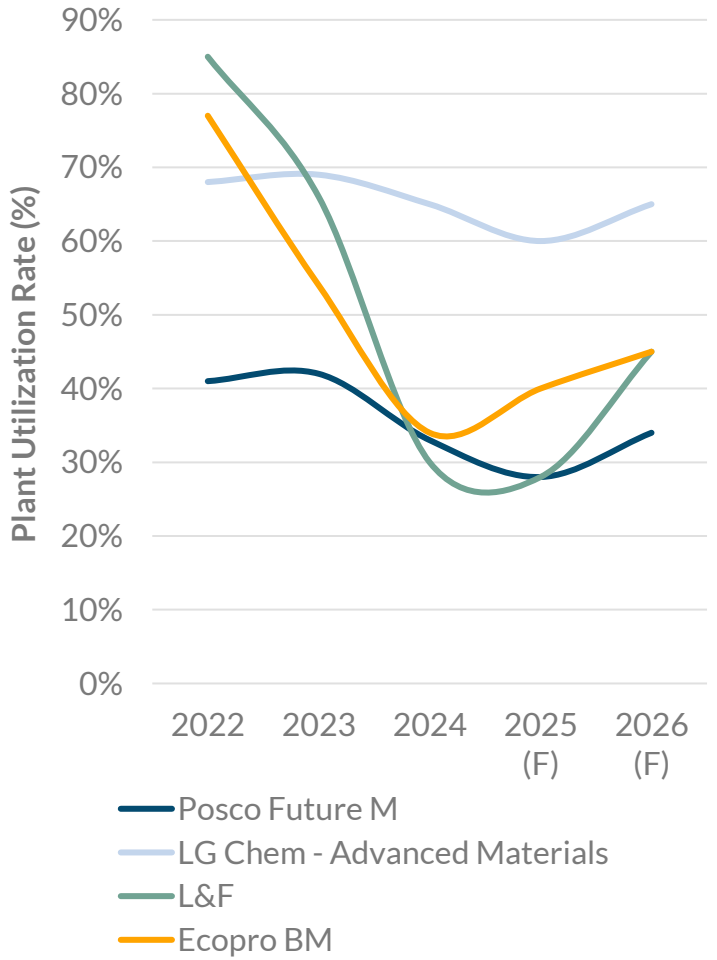
Revenue Growth



Operating Margin



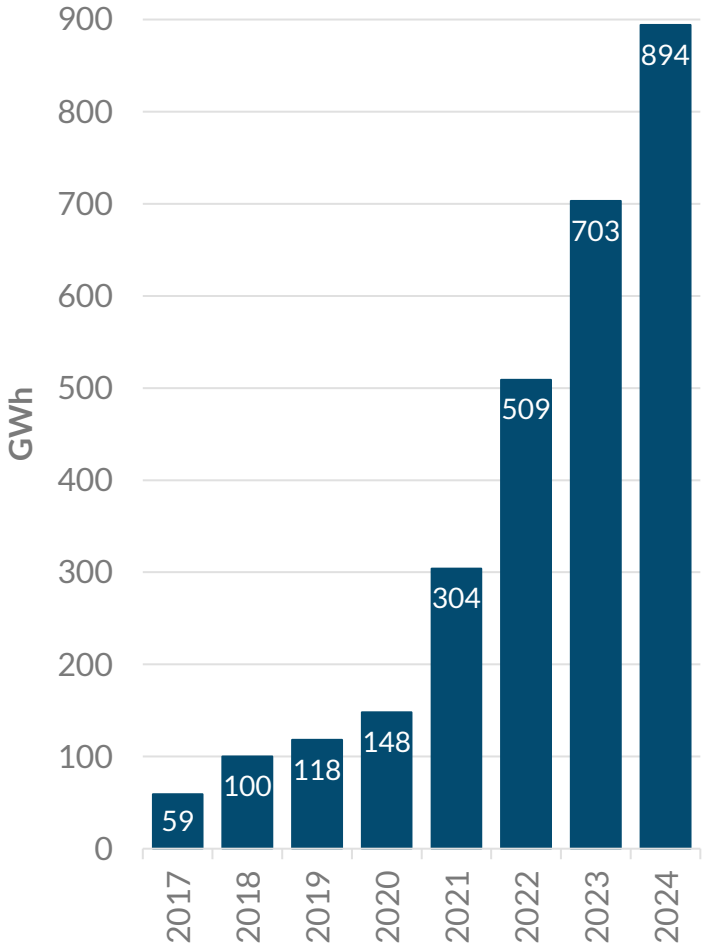
Cathode Utilization Rate



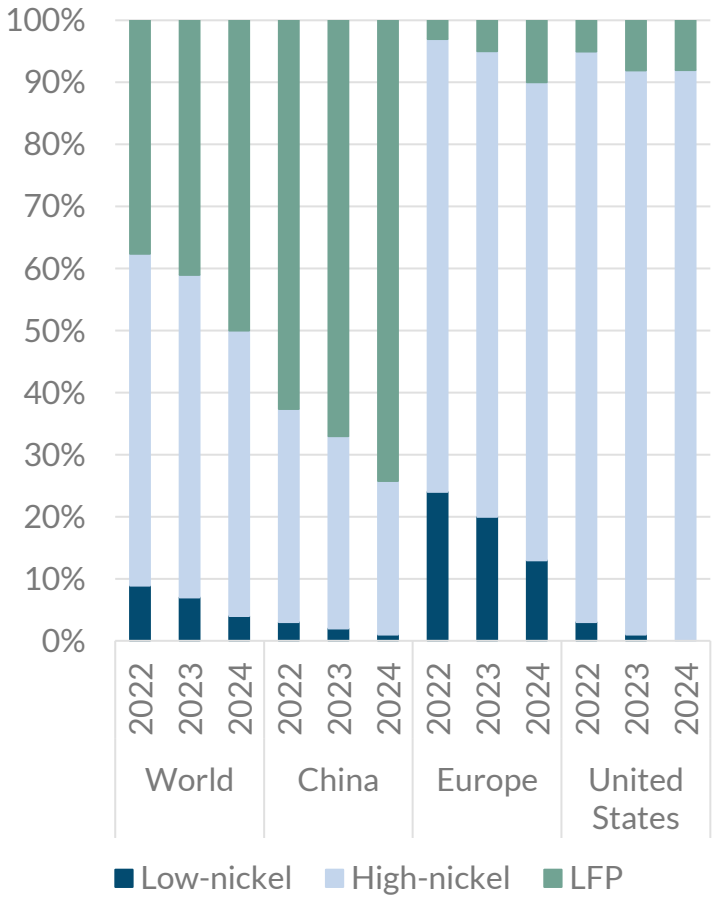
Source: Company filings, CreditSights.

Downstream: Cell to Pack

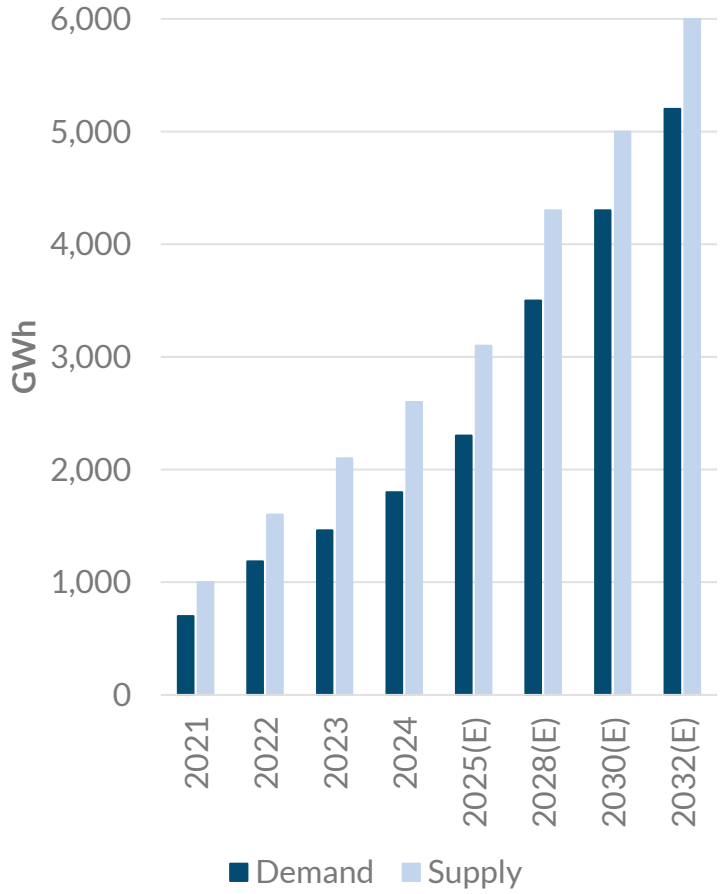
Global xEV Battery Instalment



Electric Vehicle Battery Sales Share By Chemistry



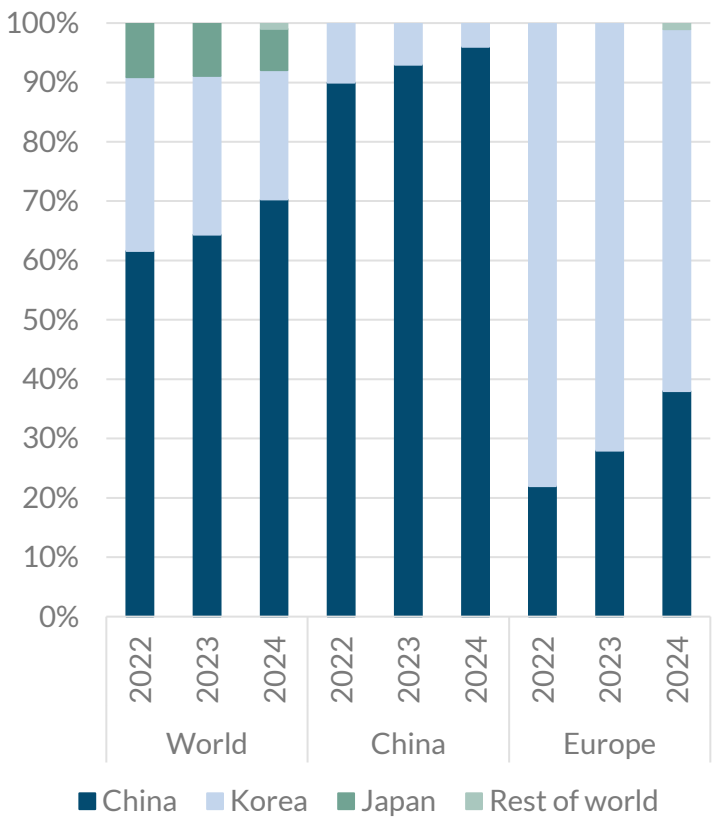
Global Lithium-Ion Battery Production Capacity Growth



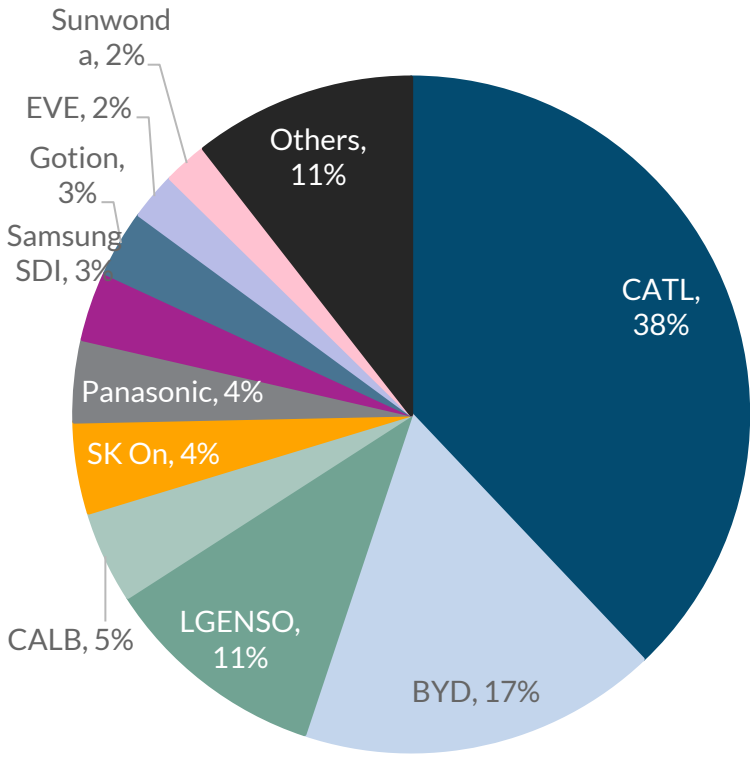
Source: SNE Research, Wood Mackenzie, CreditSights.

Downstream: Cell to Pack

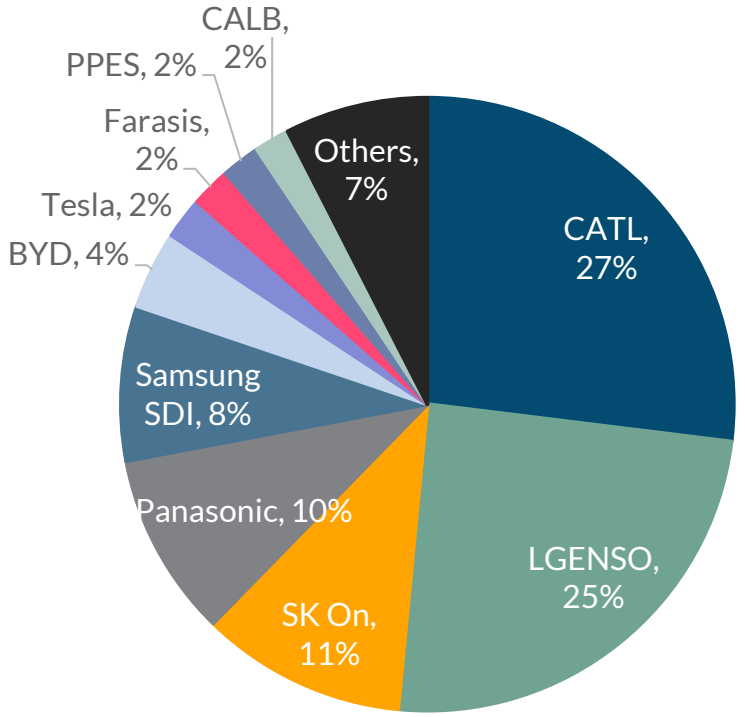
Share of electric car battery sales by battery manufacturer's headquarters



Global Battery Market Share



Battery Market Share (ex-China)



Source: IEA, SNE Research, CreditSights.

Major Cell Makers

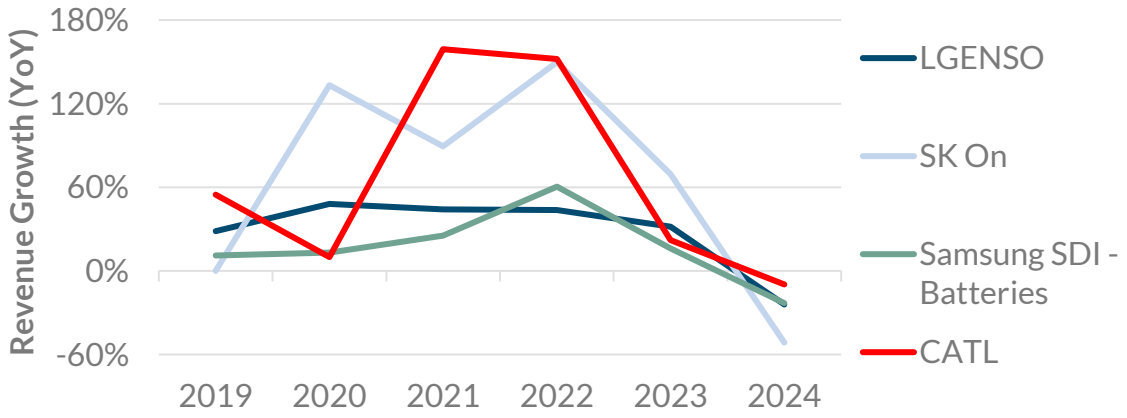
	CATL	LG Energy Solution (LGENSO)	SK On (Under SK Innovation)
Product	- LFP battery - High nickel NCM battery - The only one capable of producing pouch, prismatic and cylindrical batteries - M3P battery, a modified version of lithium iron manganese phosphate (LMFP, which is similar to LFP battery but with 15% increase in energy density), similar to NCMA 2170 but not 95% Nickel 4680	- High-nickel NCM pouch battery - NCMA 2170 - Start producing LFP ESS battery at the Arizona plant in 2025 - Evaluating entry into LFP EV battery	- High-nickel NCM pouch battery - In the final developing stage for prismatic battery
R&D focus	- Sodium ion battery with energy density of up to 160Wh/kg - 200Wh/kg, with charging time in 15 minutes to 80% - Cell to chassis: integrate the battery cell with the vehicle body, chassis, electric drive, thermal management extending driving range to over 1,000 km	- Cylindrical battery with a 4680 cell form factor - Commercializing LFP battery for low range EV - Commercializing polymer and sulfide solid state battery by 2026 and 2030, with energy density of more than 900Wh/liter - Adopting silicon anode with >10% silicon mix by 2025 (current: 2-5%)	- LFP battery in collaboration with BASF - Cylindrical battery with a 4680 cell form factor - NCM9 cell with a nickel content of nearly 90% to be supplied to Polestar from 2025
Capacity (YE24)	676 GWh	310 GWh	111 GWh
OEM partnerships	Stellantis, Mercedes, BMW, Volvo Cars, Tesla, Ford Motor	Volkswagen, Stellantis, Renault, Volvo Cars, Tesla	Volkswagen, Ford, Polestar

Note: Cylindrical cells can discharge their energy faster than prismatic cells, making them ideal for high-performance applications, whereas prismatic cells are ideal to optimize energy efficiency. Pouch cells are lighter and more flexible.

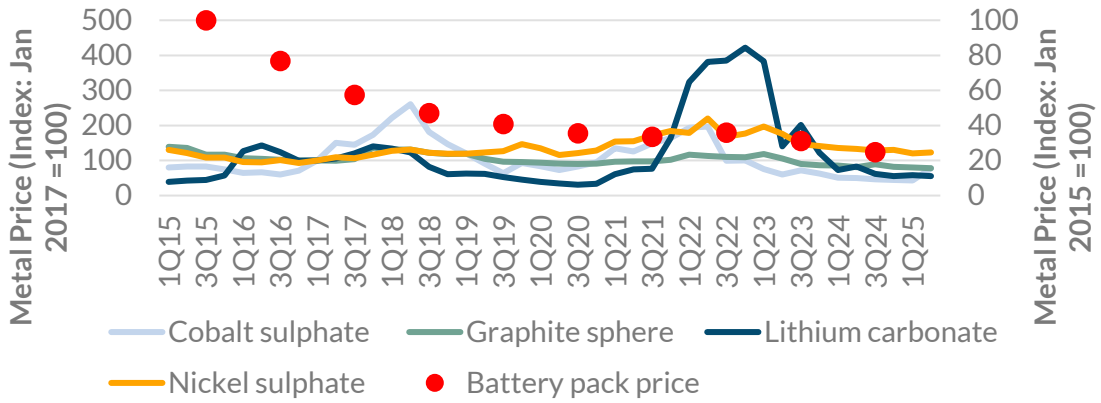
Source: Company websites, CreditSights

EV Battery Issuers: Cyclical Downcycle Since 2024

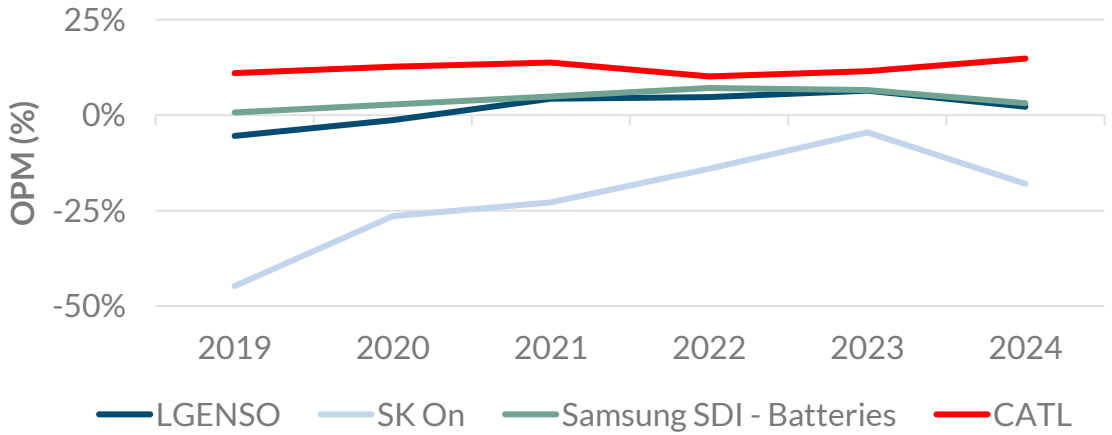
Revenue Growth



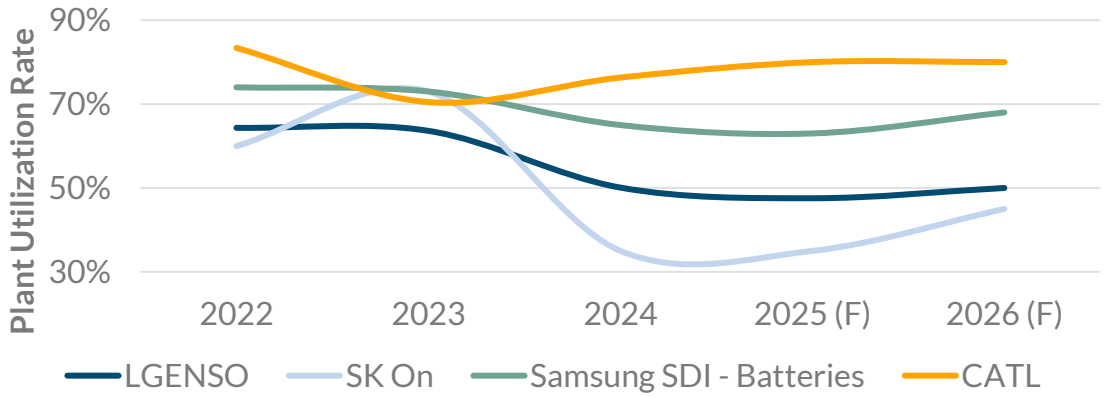
Average Selling Price of Batteries



Operating Margin



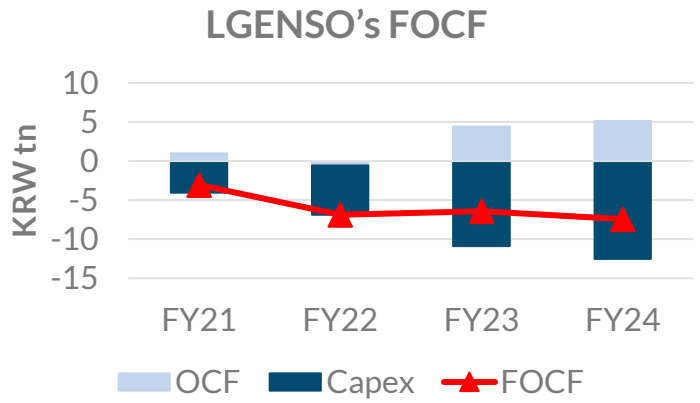
Utilization Rate

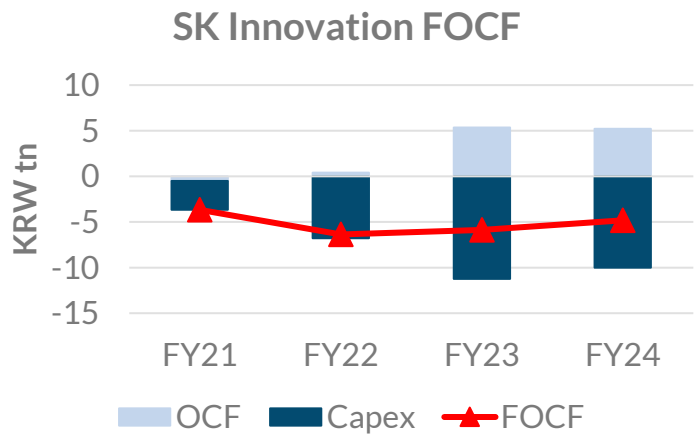


Source: Company filings, CreditSights.

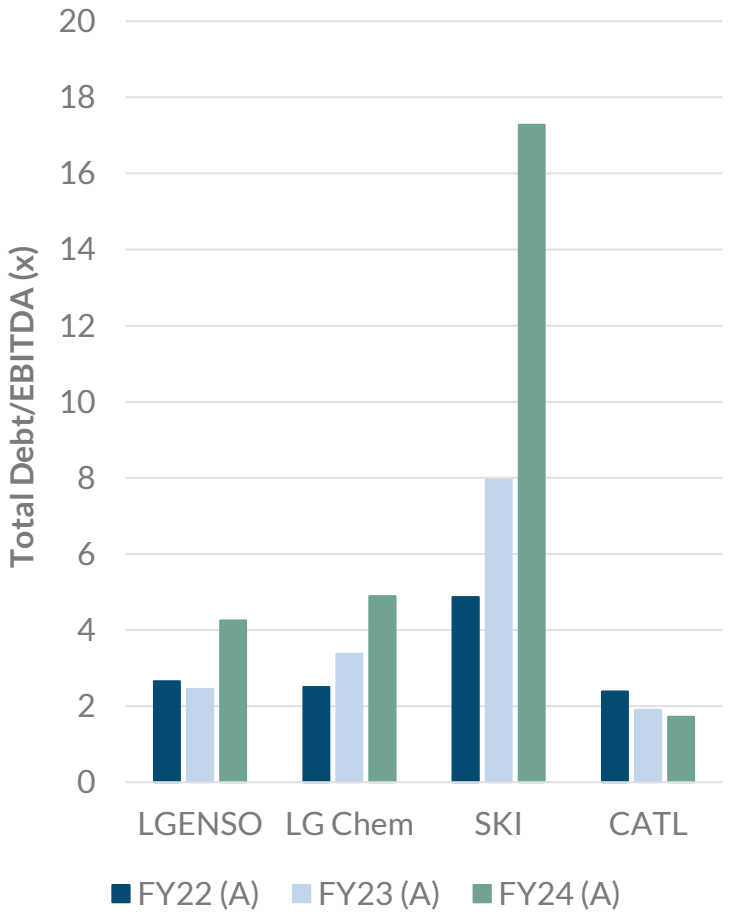
EV Battery: Ratings Downgrade on High Capex and Weak Debt Metrics

Negative FOCF with Rising Capex





Debt Metrics



Rating Downgrades

LGENSO and LGCHM

Moody's: Downgraded LGCHM from A3 to Baa1 in Dec-24, with a Negative outlook. LGENSO's outlook was shifted to Negative from Stable as well. *We expect further rating downgrade to Baa2.*

S&P: Downgraded from BBB+ to BBB in Mar-25; outlook stable

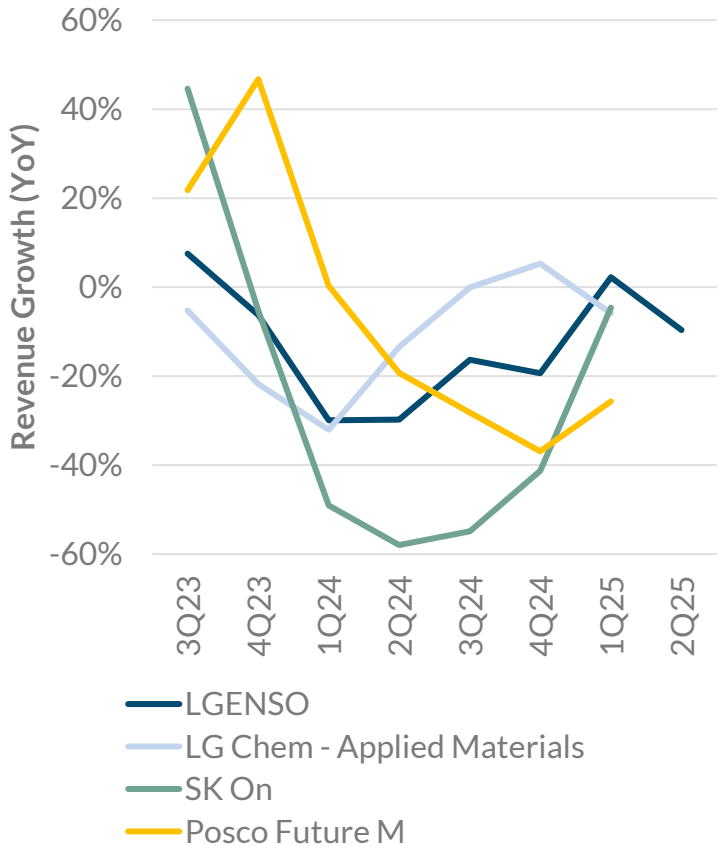
SK Innovation

Moody's: Downgraded SK Innovation to Ba1 from BBB- in Mar-25, with a Negative outlook.

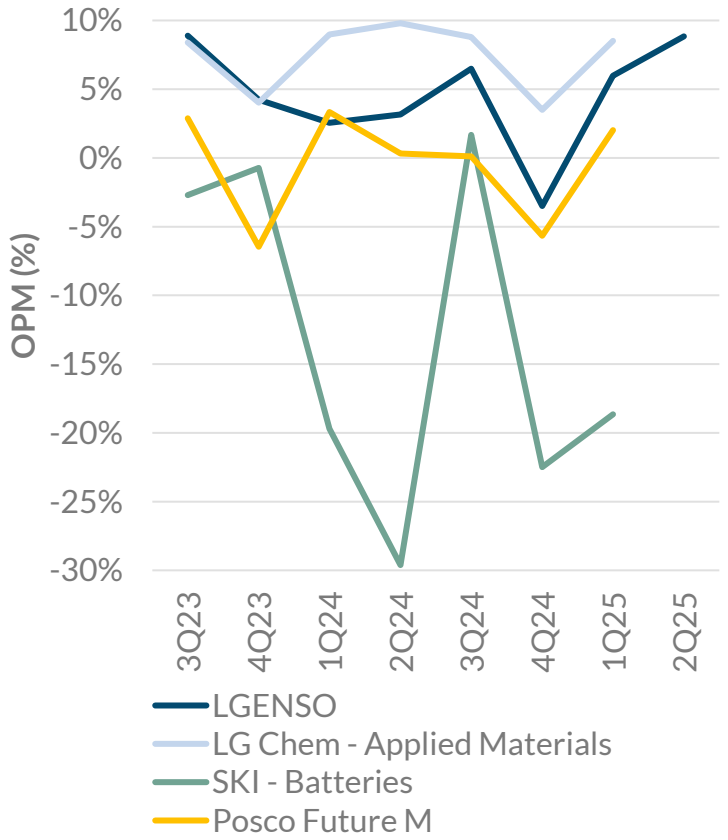
S&P: Downgraded SK Innovation to BB+ from BBB- in Mar-24, before upgrading it to BBB- in Mar-25 with a Negative outlook

Korean EV Batteries and Cathode: Current Situation (1Q25 Earnings Recap)

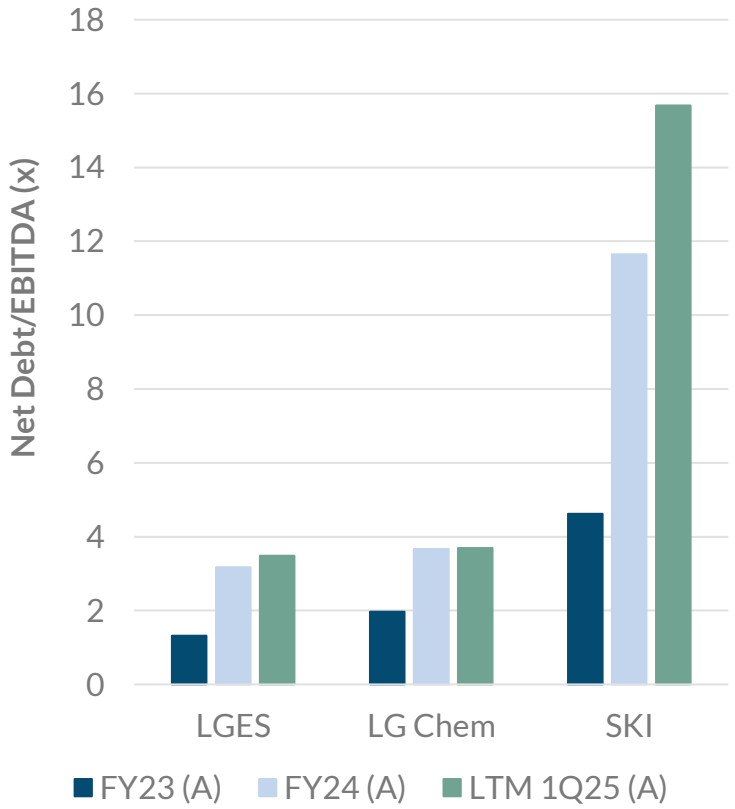
Slight Improvement in Topline Growth in 1Q25, but 2Q likely weaker



OPM largely improved in 1Q25 on better product mix and higher AMPC tax recognition



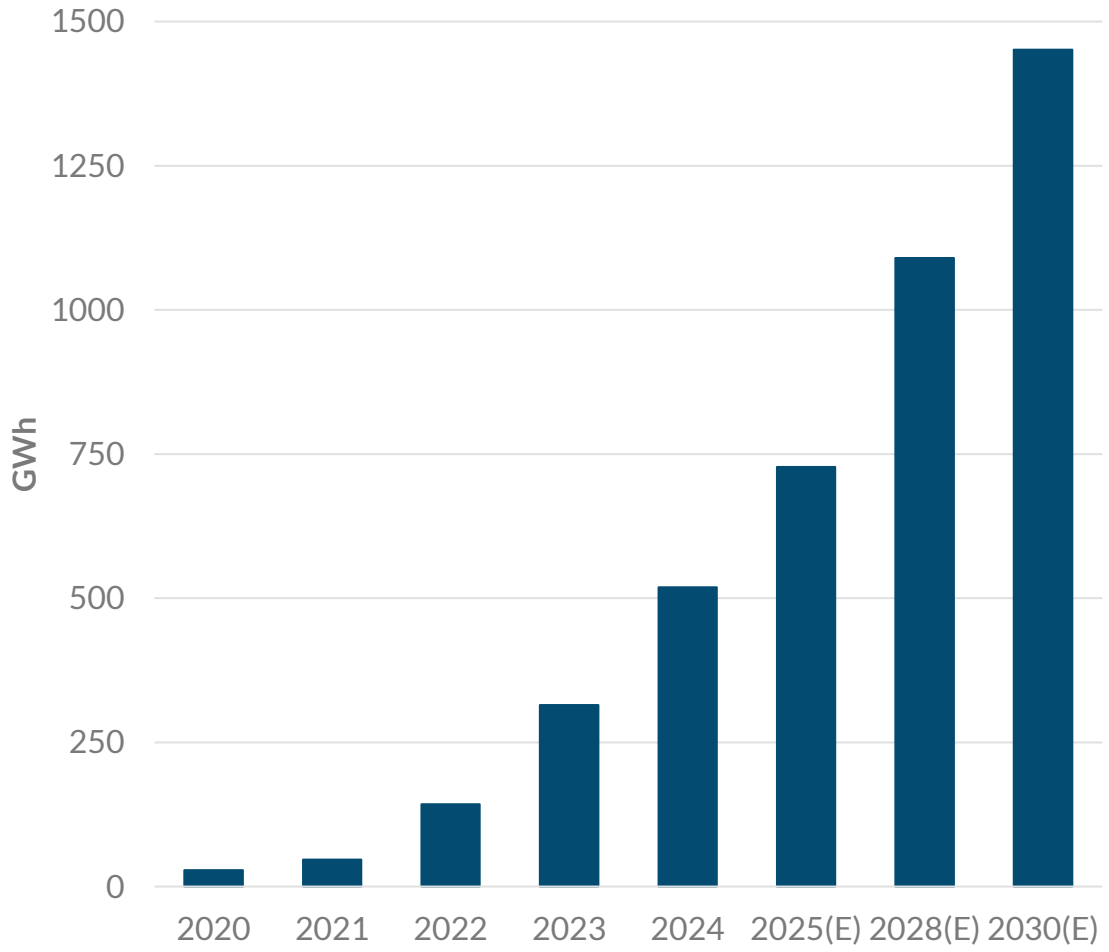
Though, debt metrics further weakened on negative FOCF



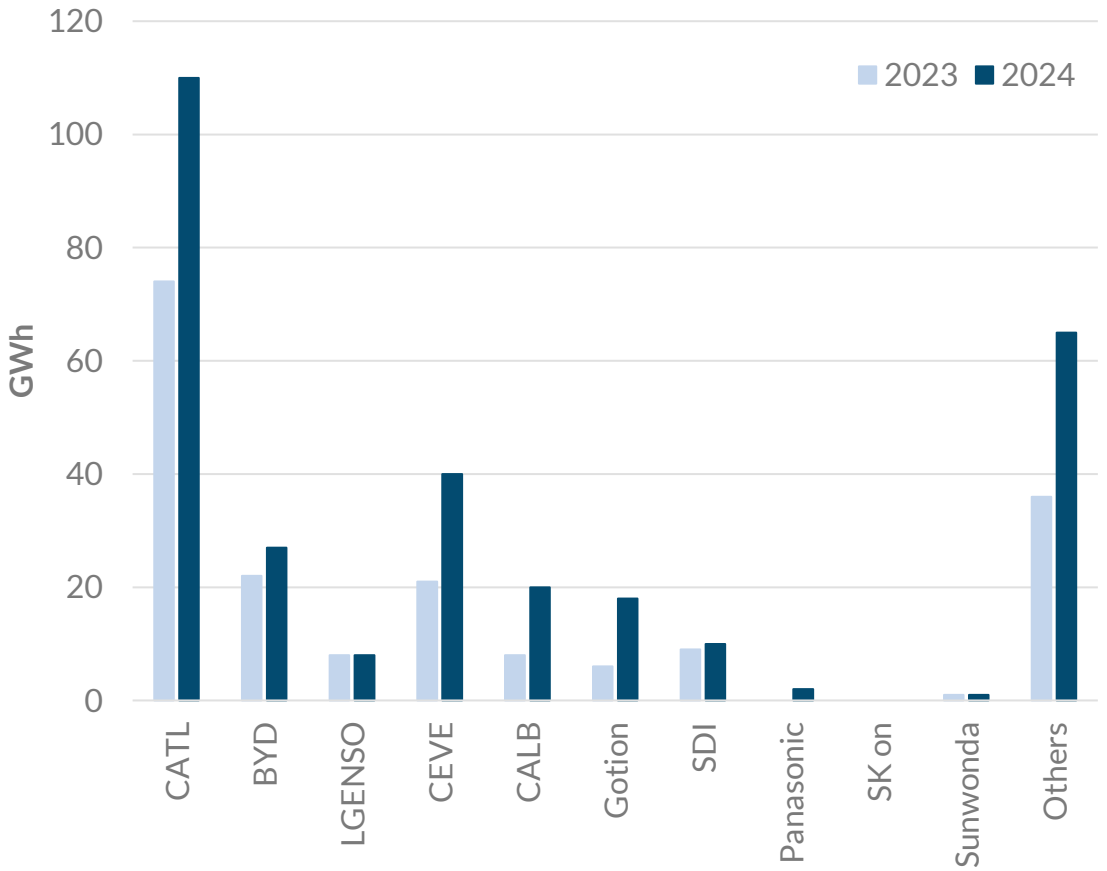
Source: Company filings, CreditSights.

Expansion into ESS Batteries

ESS Shipment Growth



ESS Shipments by Company



Source: CIC, SNE Research, CreditSights

Future of EV Battery Chemistries

New Battery Chemistries

Feature	Solid State	Sodium Ion	LFP	NCM
Energy Density (Wh/kg)	400-500 (future target)	100-160	160-210	220-300+
Cost	High (early stages)	Very low (Na is cheap)	Low	Medium-High
Cycle Life	Excellent (1000-2000+)	Good (1000+)	V. High (2000-3000+)	Moderate (800-1500)
Safety	Very High	High	Very High	Moderate
Charge Speed	Fast (in theory)	Moderate	Good	Fast
Temp Tolerance	Excellent	Excellent (Cold-friendly)	Good	Excellent
Raw Material Cost	High (solid electrolyte, Li Metal)	Very Low	Low	High (Ni and Co)
Current Use	Prototype/Demo Stage	Early commercial usage in China	Mass market EVs	Mass market EVs
Best For	High performance EVs, Aviation	Low cost EVs, 2W/2E, Grid storage	Mass market EVs, buses, commercial	Long range premium EVs
Maturity	Experimental (2025-2030)	Early adoption (2024~)	Mature and widely used	Mature and widely used
Companies	LGENSO, Samsung SDI, SK On	CATL		

US Inflation Reduction Act: Advanced Manufacturing Production Credits

	Battery Component	Critical Minerals
Maximum credit	$7,500 per vehicle	
Credit components	$3,750 for any vehicle meeting the battery component requirement	$3,750 for any vehicle meeting the critical mineral requirement
Components	Electrodes, separator, electrolyte, battery cells	Mines and refined metals like lithium, cobalt, nickel, also includes anode and cathode materials
Foreign entity of concern (FEOC)	Beginning in 2024, an eligible clean vehicle may not contain any battery components that are manufactured by a FEOC	Beginning in 2025, an eligible clean vehicle may not contain any critical minerals that were extracted, processed, or recycled by a FEOC
Time of determination	FEOC compliance will be determined at the time of manufacture or assembly	FEOC compliance will be determined by reviewing all phases of applicable critical mineral extraction, processing and recycling
Thresholds	To be eligible for the $3,750 credit, the % of the battery's components manufactured or assembled in North America have to meet threshold amounts: - 60% for 2024 and 2025 - 70% for 2026 - 80% for 2027 - 90% for 2028 - 100% after 2028	To be eligible for the $3,750 credit, the battery must contain a threshold % of critical minerals that were extracted or processed in the US or a country with which the US has a free trade agreement or be recycled in North America: - 50% for 2024 - 60% for 2025 - 70% for 2026 - 80% after 2026
Other criteria	- Clean vehicles include 1) plug-in EVs with a battery capacity of at least 7 kwh; 2) fuel cell vehicles - Vehicles final assembly occurred in North America Retail price capped at $80k for vans, SUVs or pickup trucks, and $55k for other vehicles - taxpayers can only claim the credit for one vehicle per year	

Source: Federal Register, IRS, CreditSights

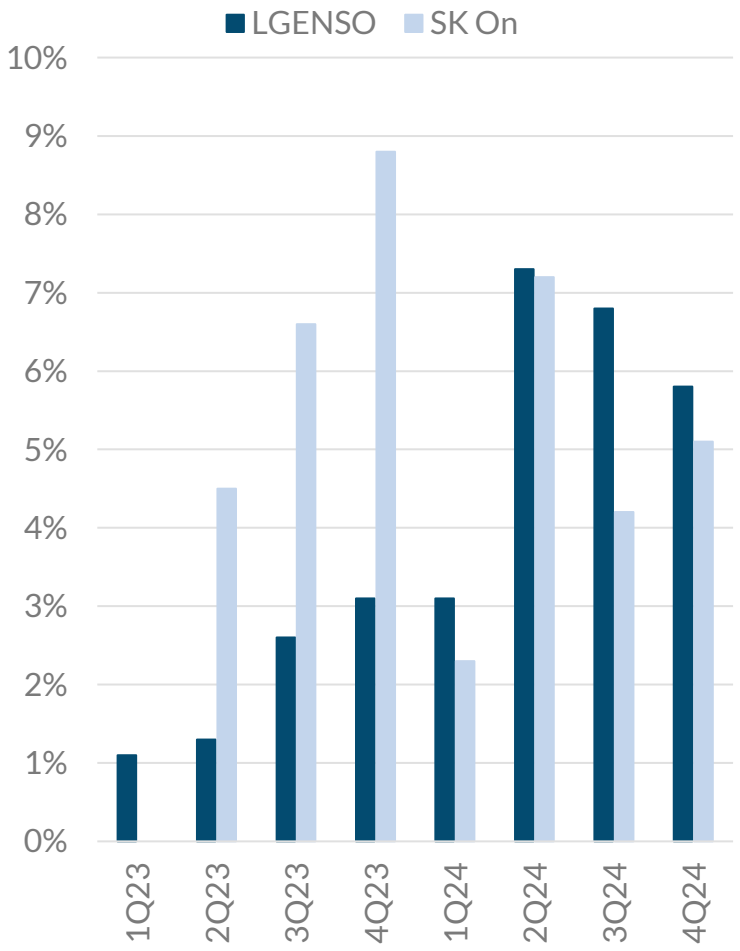
One Big Beautiful Bill – Key Changes to the US IRA

Tax Credits	Clause	Previous	New	Impact
Clean Vehicle Credit (30D)	Eligibility Period	$7,500 tax credit for households that buy or lease a new EV till 31 Dec 2032	Elimination of $7,500 tax credits after **30 Sep 2025**	Reduce pace of reaching cost parity of ICE vs Evs in the US; Lowers expected US EV and battery demand
AMPC (45X)	Phaseout for eligible components (no change)	2030: 70% of base credit 2031: 50% of base credit 2032: 25% of base credit 2033: 0% of base credit	2030: 70% of base credit 2031: 50% of base credit 2032: 25% of base credit 2033: 0% of base credit	Largely preserves the previous IRA timeline; supports market share expansion for Korean battery makers
		Terminated after 2032	Terminated after 2032	
	New Foreign Entity of Concern (FEOC) Clause	n.a.	From 1 Jan 2026, it excludes components that receives "material assistance" from any FEOC entity	

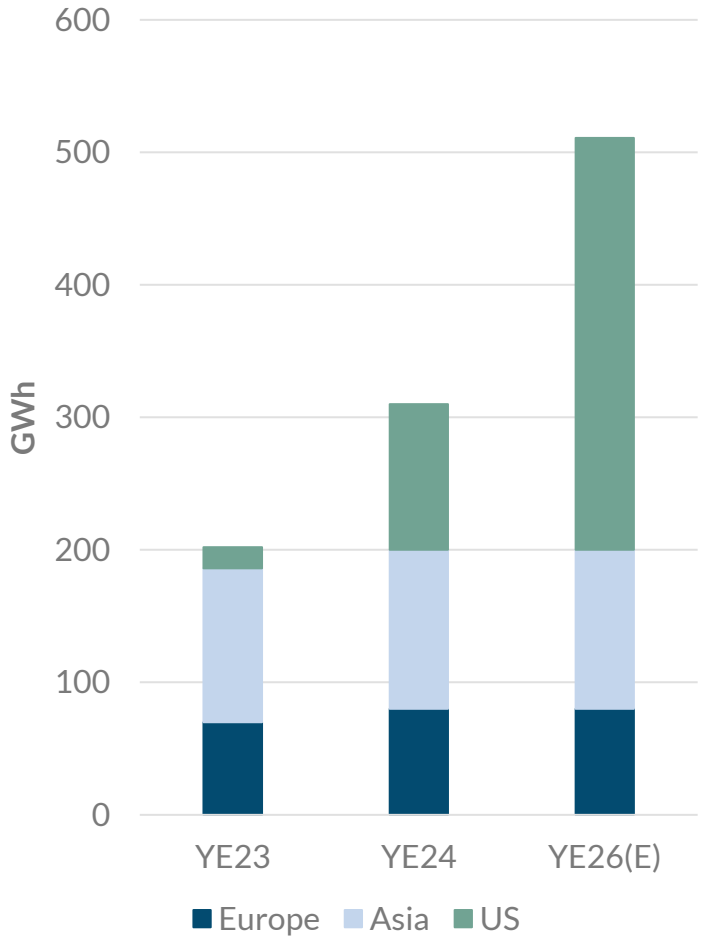
Source: Federal Register, IRS, CreditSights

Who does the US IRA AMPC Tax Credits Benefit?

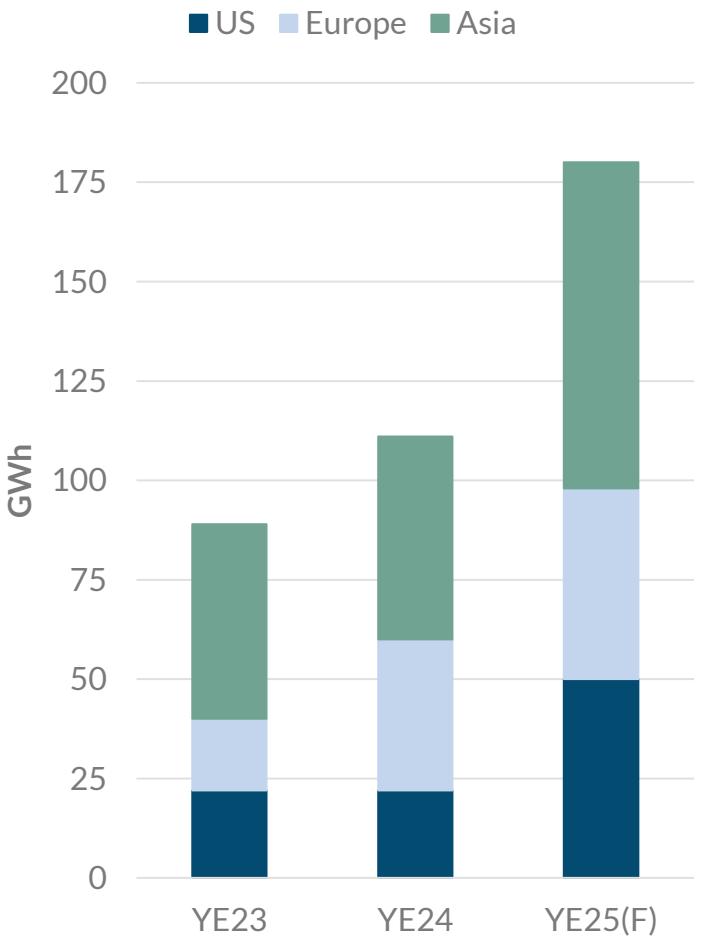
AMPC as % of Revenues



LGES Planned Capacity



SK On's Planned Capacity



Source: Company filings, CreditSights

Global Trade Barriers on EV OEMs and EV Batteries

Trade Tariffs Imposed

United States

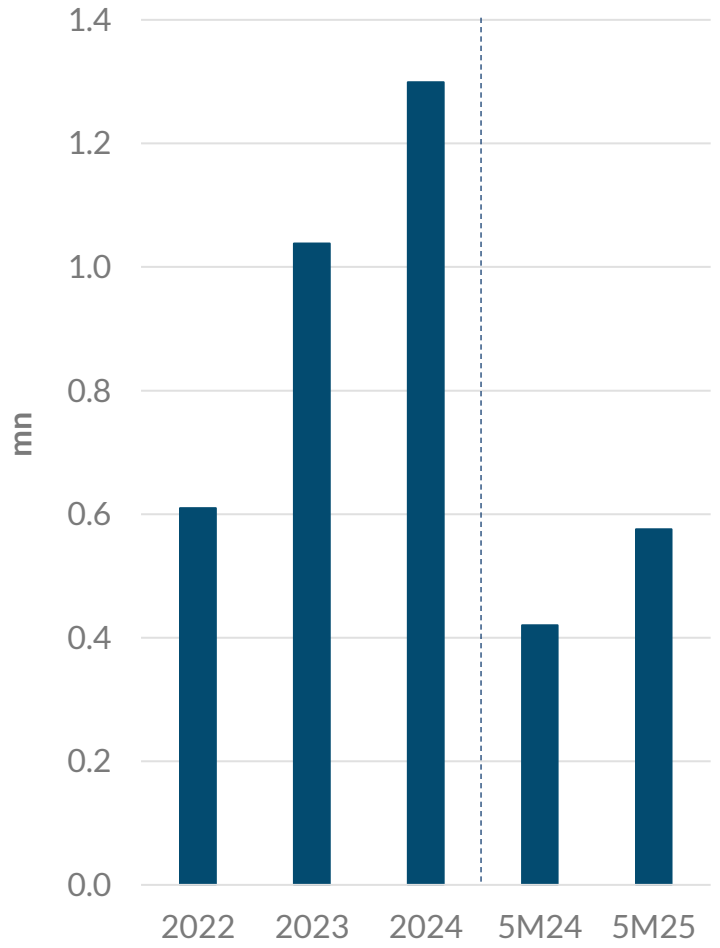
Imposed 25% on global automobiles and auto parts

Imposed 25%-100% of tariffs on Chinese EVs, batteries, and battery parts

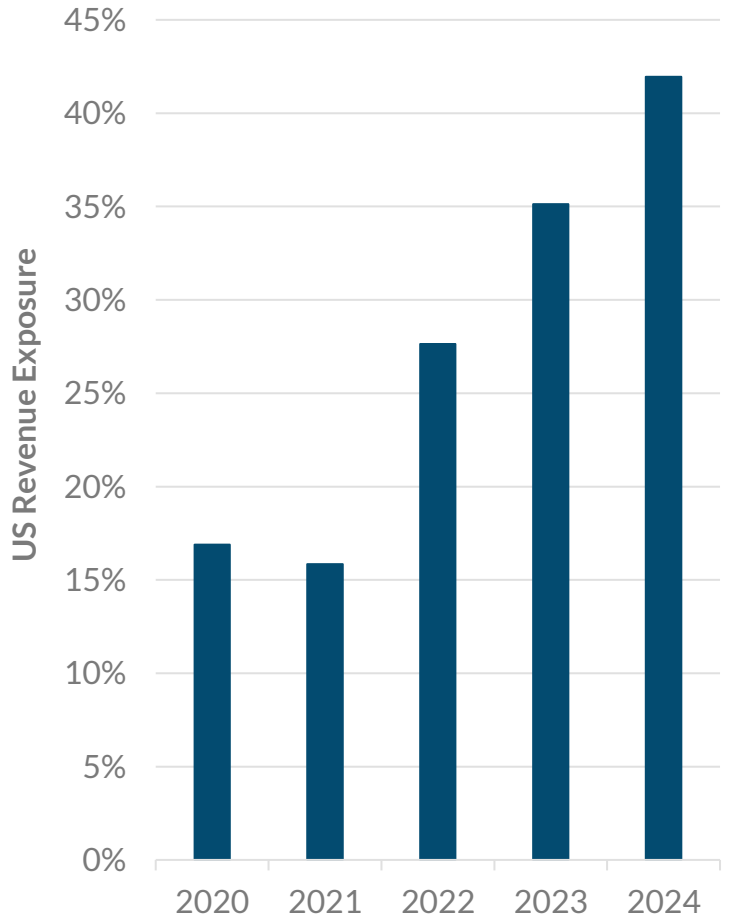
Europe

Imposed tariffs of up to 45.3% on Chinese EVs. This includes 17% for BYD, 18.8% on Geely, 35.3% on SAIC, on top of the EU's standard car import duty of 10%.

China OEM Exports



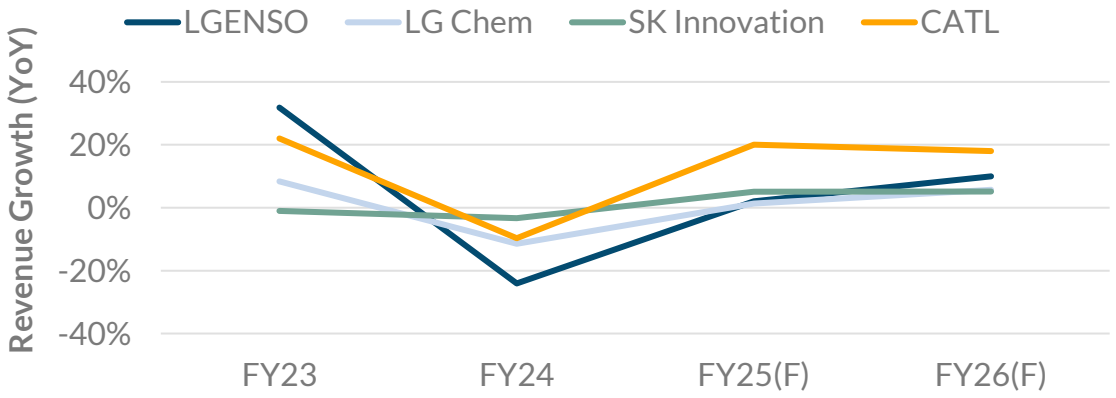
US Revenue Exposure – LG Energy Solution



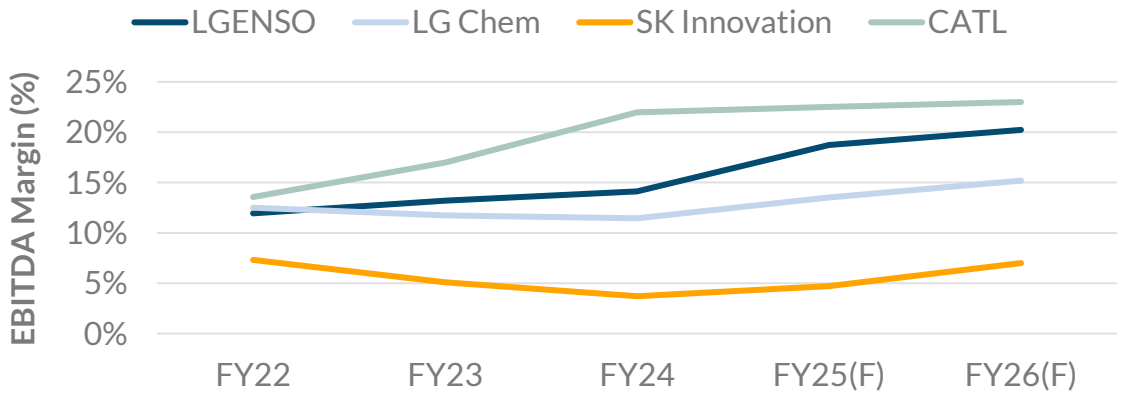
Source: Company filings, China Passenger Car Association, CreditSights.

Outlook: Better Days Ahead

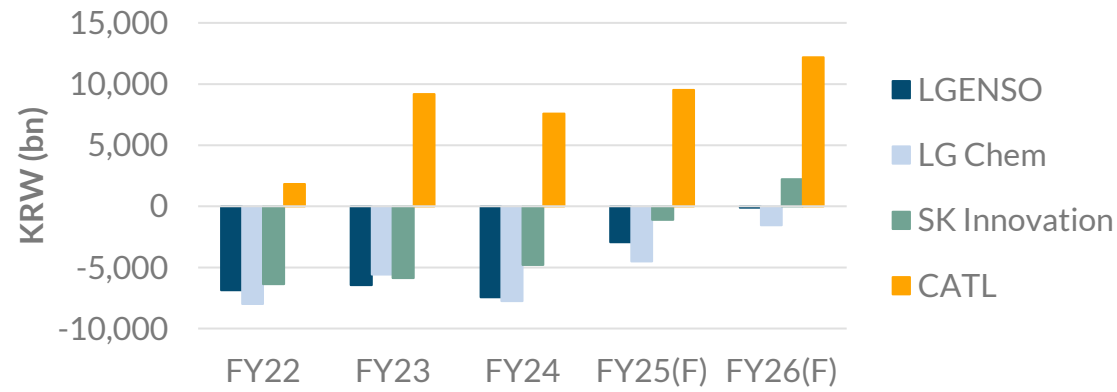
Revenue



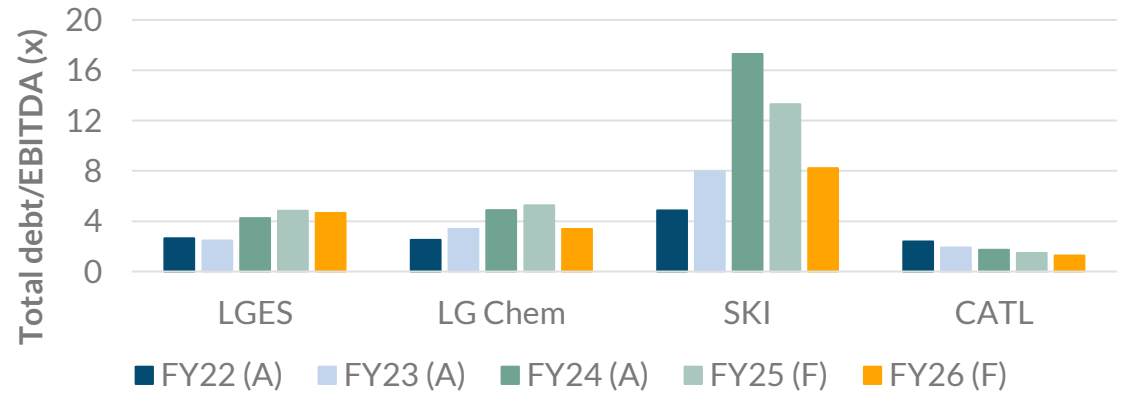
EBITDA Margin



FOCF



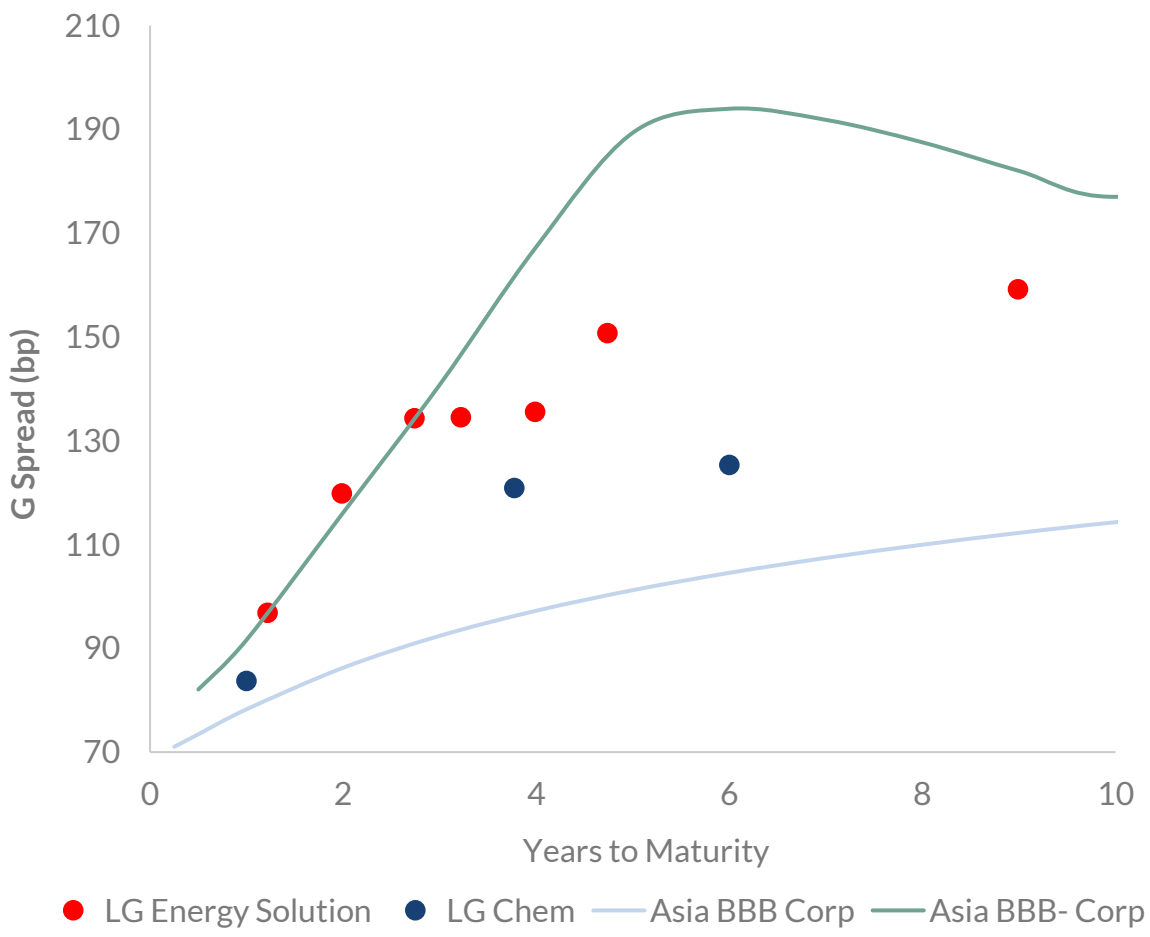
Debt Metrics



Source: Company filing, CreditSights

Outperform: LG Energy Solution

LGENSO Scatter



Asia Battery Issuers: Major Bonds Outstanding

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Issuer	CPN	Maturity	Next Call Date	Amt. Out. ($ mn)	Bond Ratings	Mid Price	G-spd (bp)	Mid YTW	Rec.
LG Chem (Green)	4.375%	14-Jul-25	Bullet	300	Baa1/BBB/NR	100.0	56	4.88%	
LG Chem (Green)	1.375%	7-Jul-26	Bullet	500	Baa1/BBB/NR	96.7	77	4.85%	M/P
LG Chem (Green)	3.625%	15-Apr-29	Bullet	700	Baa1/BBB/NR	100.6	116	5.05%	
LG Chem (Green)	2.375%	7-Jul-31	Bullet	500	Baa1/BBB/NR	85.3	121	5.27%	
LG Energy Solution (LGENSO) (Green)	5.625%	25-Sep-26	Bullet	400	Baa1/BBB/NR	100.8	92	4.96%	
LGENSO	5.375%	2-Jul-27	Bullet	700	Baa1/BBB/NR	100.6	116	5.05%	O/P
LGENSO	5.250%	2-Apr-28	Bullet	400	Baa1/BBB/NR	100.2	131	5.17%	
LGENSO (Green)	5.750%	25-Sep-28	Bullet	600	Baa1/BBB/NR	101.7	130	5.17%	
LGENSO (Green)	5.375%	2-Jul-29	Bullet	800	Baa1/BBB/NR	100.6	131	5.22%	
LGENSO	**5.375%**	**2-Apr-30**	**Bullet**	**600**	**Baa1/BBB/NR**	**99.7**	**149**	**5.44%**	
LGENSO (Green)	5.500%	2-Jul-34	Bullet	500	Baa1/BBB/NR	97.5	155	5.87%	
LGENSO (Green)	**5.875%**	**2-Apr-35**	**Bullet**	**700**	**Baa1/BBB/NR**	**98.5**	**170**	**6.08%**	
CATL	1.875%	17-Sep-25	17-Aug-25	1,000	A3/A-/NR	99.5	40	4.73%	
CATL	1.500%	9-Sep-26	Bullet	500	A3/NR/NR	96.5	61	4.67%	M/P
CATL	2.625%	17-Sep-30	17-Jun-30	500	A3/A-/NR	90.9	64	4.62%	
SK On [1]	5.375%	11-May-26	Bullet	900	Aa3/NR/NR	100.5	58	4.72%	
SK Innovation	2.125%	26-Jan-26	Bullet	700	Ba1/NR/NR	97.8	199	6.27%	M/P
SK Innovation	4.875%	23-Jan-27	Bullet	500	Aa3/NR/NR	100.2	77	4.75%	

Source: Bloomberg, CreditSights


Q&A

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