

Greater China Auto, EV and EV battery

Year Ahead 2024 – look for bottom-up investment opportunity in a gloomy market

Industry Overview

Expect China auto wholesales to grow 3.7% in 2024

In 2024, we expect China auto wholesales to grow 3.7% but mainly be supported by export sales (+17.5% YoY to 5.7mn), and we expect EV wholesales to grow 23% YoY to 11.5mn units. Competition should remain high as some brands (Huawei alliance, Xiaomi) enter the market, which should continue triggering price competition in 2024. 1Q is a low season for auto companies, weighing on their share price performance. We see the period to mid-March as a good time to invest in companies from a bottom-up approach, given that 1) industry demand should pick up then, based on seasonality, 2) more new models/technology are likely to be launched before or during the Beijing Auto show; and 3) market consensus should be revised to a reasonable level when 2023 annual results are announced.

Key automotive/EV themes for 2024

Theme #1: Huawei and its alliance. Huawei's active participation in the EV industry creates more competition and slows industry consolidation, in our view. Huawei currently cooperates deeply with Changan (Avtar), Seres (AITO brand), Chery (Luxeed brand), BAIC BJEV (Stelato brand) and JAC (Aojie brand). In 2023, Huawei's alliance sold around 130k vehicles, and it intends to sell over 600k units in 2024.

Theme #2: Exports. SAIC, Chery, GWM and BYD are leading brands in the overseas market. We expect China auto brands to fare well in Russia, Thailand and Brazil in 2024.

Theme #3: PHEVs to outgrow BEVs. BYD's new DM-i technology launch in March 2024 should revamp its PHEVs sales. Li's L6, AITO's M7/M8/M9 and Changan Deepal brands should boost PHEVs sales in China in 2024 as well.

Key EV battery themes for 2024

EV battery theme #1: Battery overcapacity squeezes out small suppliers: the top-10 Chinese battery makers had 96% market share in 2023 and we expect the industry to further consolidate to 6-7 market leaders in 2024. Huawei's alliance mainly uses CATL's battery, thus we expect CATL to regain market share in China's battery industry in 2024.

EV battery theme #2: Companies are exploring overseas opportunities: The China market has an overcapacity of batteries. Thus, battery makers such as CATL, CALB, Gotion and EVE are expanding to foreign clients and plan to build plants, mainly in Europe and Southeast Asia.

EV battery theme #3: Technology innovation should maintain profitability: New battery technologies include high-nickel NCM, LMFP and large cylindrical batteries. Among all batteries, we see CATL's Shenxing battery (fast-charging LFP battery) as the most competitive, as it charges 4x faster than traditional LFP batteries, and cost is not higher.

Top picks in 2024: Li, Hesai

Li: share gain supported by more new products (1 EREV + 4 BEVs); Hesai: benefiting from strong LiDAR demand growth.

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ASP: average selling price
BEV: battery electric vehicle
EREV: extended range electric vehicle
k: thousand
LFP: Lithium iron phosphate
LiDAR: Light Detection and Ranging
NCM: Nickel, Cobalt and Manganese
PHEV: Plug in hybrid electric vehicle
vs.: versus

See Exhibit 68 for a full list of abbreviations used in this report. 

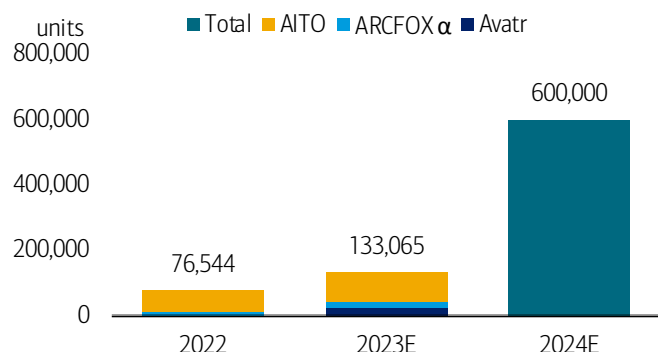
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Key charts

Exhibit 1: Volume sales of Huawei Alliance

Supply check suggests that Huawei targets its alliance to sell at least 600k units sales in 2024

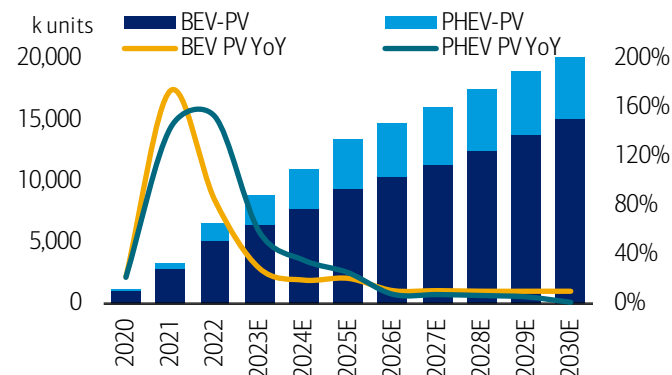


Source: Company report, Thinkercar, BofA Global Research estimates

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Exhibit 2: China EV sales breakdown by powertrain

PHEV volume sales growth > BEV's growth from late 2021

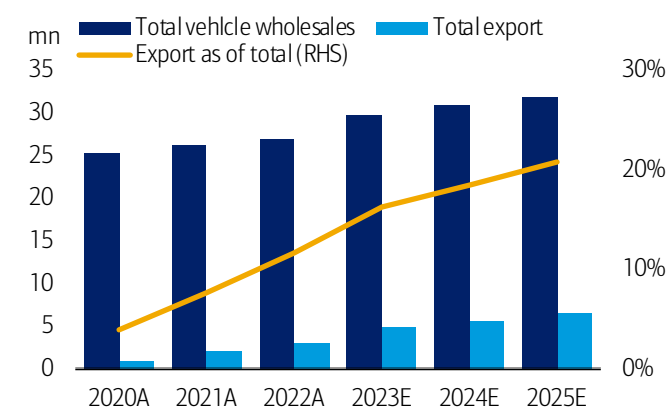


Source: CPCA, CAAM, BofA Global Research estimates

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Exhibit 3: Total vehicle wholesales vs. exports in China

We expect exports to account for 18% of wholesales in 2024

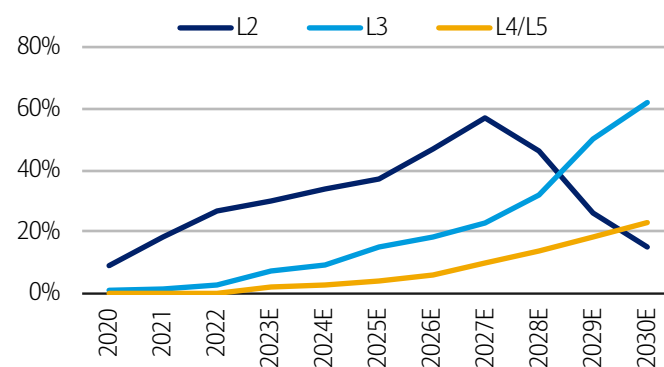


Source: CAAM, BofA Global Research estimates

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Exhibit 4: Autonomous driving penetration in China

L3 penetration is expected to rise from 3% in 2022 to 15% in 2025 and to 62% in 2030

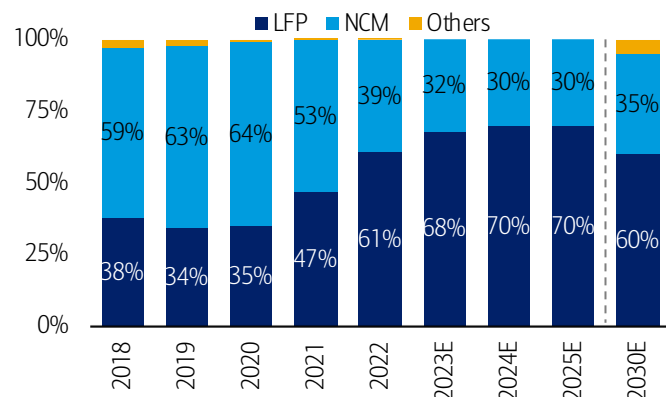


Source: Yiu, GGII, BofA Global Research estimates

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Exhibit 5: China EV battery breakdown by chemistry

We expect LFP to account for 68%/70%/70% market share in 2023-25E

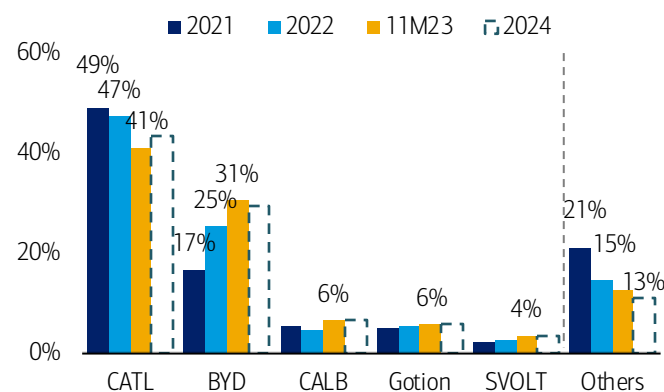


Source: RealLi, BofA Global Research estimates

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Exhibit 6: China EV battery market share by top 5 suppliers, 2021-24E

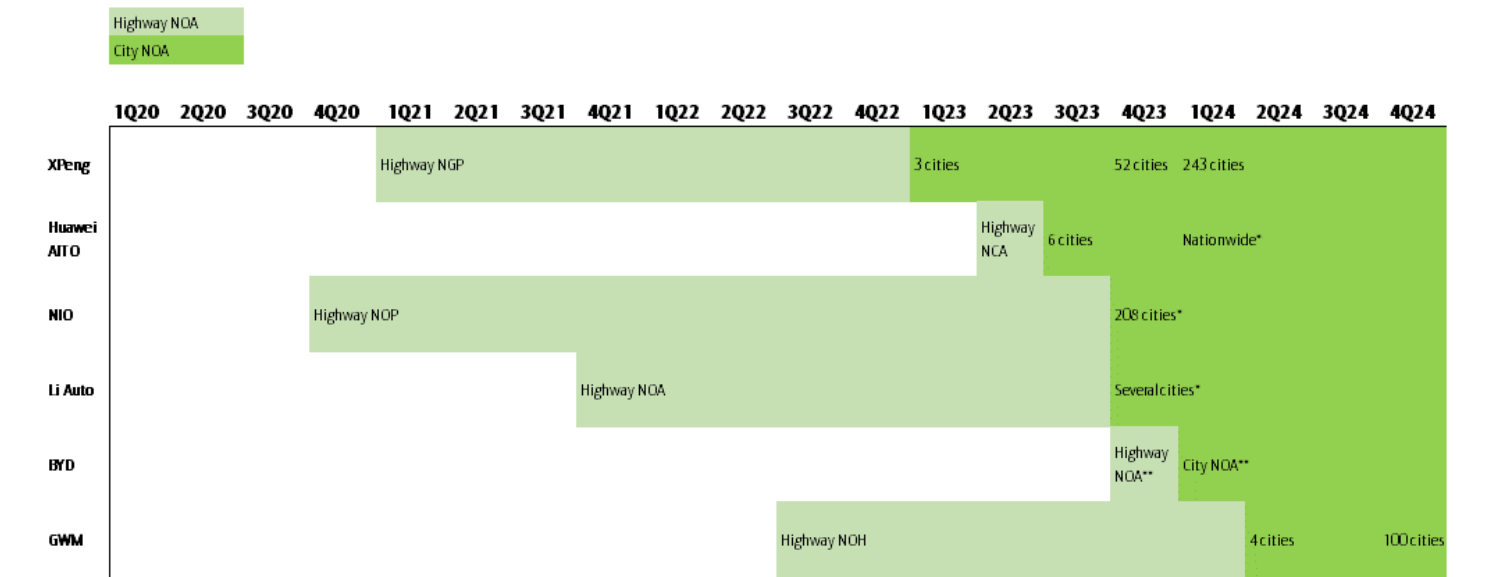
Market consolidation could continue into 2024, and small suppliers could be squeezed out



Source: RealLi, BofA Global Research estimates

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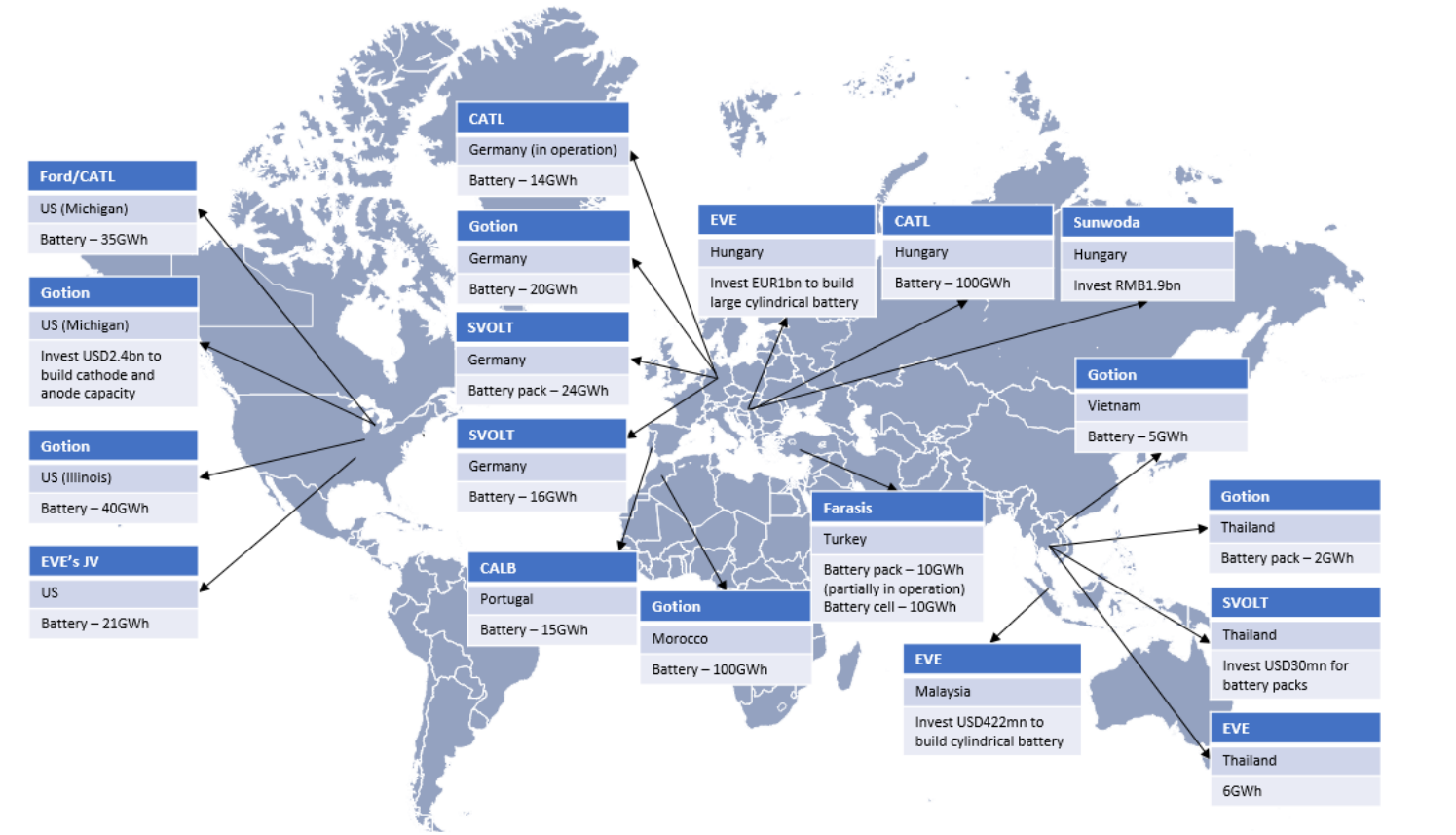
Exhibit 7: Highway/city NOA progress by EV brand
XPeng's city NOA progress is ahead of peers; Huawei AITO is only behind XPeng



Source: Company report
Note: *open for experience/ open to pioneer users/ selected areas in cities; ** BYD's Denza brand only

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Exhibit 8: Overseas expansion of Chinese EV battery makers
Chinese EV battery makers prefer to expand battery capacity in Europe and Southeast Asia areas



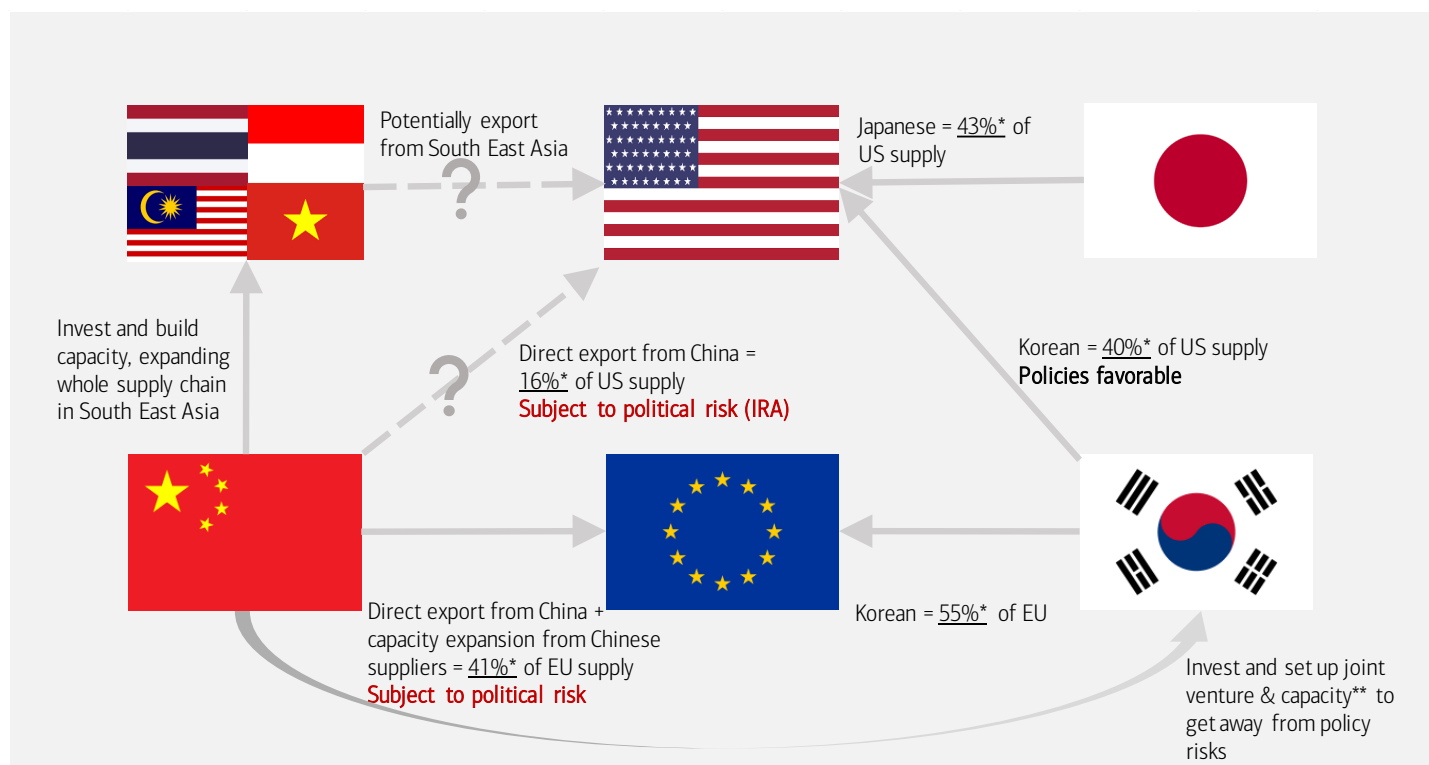
Source: BofA Global Research, company report

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Exhibit 9: China EV battery export and overseas expansion strategies

China accounted for 41% of battery supply to the EU and 16% of battery supply to the US (based on 10M23 data)



Source: BofA Global Research

* Note that the number suggest 10M23 data

** Note that the investment in Korea from Chinese participants currently mainly surround in the cathode only

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Global auto OEMs comparison

Exhibit 10: Global auto OEMs valuation comparison

Global auto OEM 2024-25E average P/E is 8.8/7.7x

		Last Price	Market Cap (\$ mn)	ADTV (\$mn)	P/E			EPS growth			EPS CAGR	PEG	EV/sales		ROE	Div yield
Company	Ticker				2023E	2024E	2025E	2023E	2024E	2025E	23-25E	24E	2024E	2025E	2024E	2024E
China Auto OEM																
BYD	1211 HK	208	78,012	212	17.3	14.8	13.0	77.7%	17.5%	13.4%	15.5%	1.0	0.8	0.7	24.3%	0.7%
Li Auto	LI US	34.0	36,074	233	28.5	20.6	12.7	NA	38.2%	62.6%	49.9%	0.4	1.0	0.7	20.8%	0.0%
Great Wall	2333 HK	9.0	22,739	34	11.5	10.1	9.2	-28.4%	13.3%	10.4%	11.8%	0.9	1.2	1.1	10.0%	4.5%
SAIC	600104 CH	13.2	21,574	42	10.1	9.7	8.6	-6.1%	4.2%	13.3%	8.7%	1.1	0.3	0.3	5.4%	3.6%
Changan	000625 CH	14.8	18,011	496	13.6	20.0	16.8	39.5%	-32.2%	19.6%	-10.0%	NA	0.6	0.5	10.1%	1.5%
NIO	NIO US	7.9	16,436	551	NM	NM	NM	NA	NA	NA	NA	NA	1.5	1.0	NA	0.0%
Seres	601127 CH	66.1	13,931	617	NM	NM	NM	NA	NA	NA	NA	NA	1.0	0.8	NA	NA
Xpeng	XPEV US	12.7	11,981	259	NM	NM	NM	NA	NA	NA	-77.4%	NA	1.0	0.7	NA	0.0%
GAC	2238 HK	3.4	9,986	7	5.3	5.5	5.4	-27.5%	-5.2%	1.8%	-1.7%	NA	0.6	0.5	5.0%	5.6%
Yadea	1585 HK	12.4	4,846	9	12.6	10.7	9.1	13.6%	17.8%	16.7%	17.2%	0.6	0.7	0.6	33.8%	4.7%
Leapmotor	9863 HK	31.9	4,562	21	NM	NM	NM	NA	NA	NA	NA	NA	0.9	0.6	NA	0.0%
Dongfeng	489 HK	3.5	3,687	5	8.2	6.5	5.6	-69.5%	27.6%	16.2%	21.8%	0.3	0.2	0.2	2.7%	6.2%
Brilliance	1114 HK	4.2	2,731	10	2.6	2.6	2.6	-1.3%	-0.6%	1.4%	0.4%	NA	NA	NA	13.2%	8.1%
BAIC	1958 HK	2.1	2,154	3	2.9	2.7	2.6	15.5%	8.4%	5.1%	6.7%	0.4	0.1	0.1	9.3%	11.8%
Average					12.7	11.0	8.9	1.5%	8.9%	16.0%	3.9%	0.7	0.8	0.6	13.4%	3.6%
Japan companies																
Toyota	7203 JP	2,694	305,332	505	8.7	8.1	7.8	72.9%	7.8%	3.8%	5.7%	1.4	1.4	1.4	13.9%	3.7%
Honda	7267 JP	1,518	57,287	178	7.4	7.1	6.5	55.5%	3.9%	10.2%	7.0%	1.0	0.6	0.5	8.6%	4.2%
Suzuki	7269 JP	6,059	20,671	71	10.6	9.2	8.6	25.5%	15.8%	6.0%	10.8%	0.8	0.5	0.5	13.4%	3.3%
Nissan	7201 JP	566	15,776	110	4.8	4.7	4.6	110.2%	0.9%	2.5%	1.7%	2.8	0.6	0.6	8.4%	6.4%
Subaru Corp	7270 JP	2,743	14,363	58	5.8	5.5	5.3	80.2%	6.6%	2.2%	4.4%	1.2	0.4	0.4	15.6%	5.5%
Isuzu	7202 JP	1,928	10,413	39	8.2	7.3	6.8	20.0%	11.8%	7.8%	9.7%	0.8	0.5	0.4	13.7%	5.4%
Yamaha Motor	7272 JP	1,291	9,418	52	7.0	8.6	7.6	8.3%	-18.8%	13.1%	-4.2%	NA	0.7	0.7	13.0%	3.5%
Mazda	7261 JP	1,631	7,159	60	5.6	4.2	3.8	29.6%	33.0%	8.9%	20.4%	0.2	0.2	0.2	14.7%	7.2%
Mitsubishi	7211 JP	459	4,748	52	4.4	4.8	4.5	-8.3%	-7.4%	5.7%	-1.1%	NA	0.3	0.3	14.9%	3.1%
Hino Motors	7205 JP	486	1,941	10	NM	8.0	4.9	NA	NA	64.8%	NA	NA	0.4	0.3	9.5%	1.2%
Average					8.2	7.7	7.3	43.8%	6.0%	12.5%	6.1%	1.2	0.6	0.5	12.6%	4.3%
Korea companies																
Hyundai Motor	005380 KS	185,600	29,777	67	3.5	3.4	3.1	75.6%	4.6%	8.8%	6.7%	0.5	1.0	0.9	14.2%	5.9%
Kia	000270 KS	89,100	27,169	69	3.7	3.9	4.0	77.1%	-3.8%	-3.8%	-3.8%	NA	0.2	0.2	17.0%	3.9%
Average					3.6	3.6	3.5	76.4%	0.4%	2.5%	1.5%	0.5	0.6	0.6	15.6%	4.9%
India companies																
Maruti Suzuki	MSIL IN	10,015	37,886	65	25.9	22.6	20.8	44.3%	14.5%	8.3%	11.4%	2.0	1.8	1.6	16.0%	1.3%
Tata Motors	TTMT IN	799	35,202	93	17.1	12.4	NA	633.1%	37.4%	12.7%	24.4%	NA	0.9	NA	33.2%	0.5%
M&M	MM IN	1,628	24,351	51	17.0	16.9	14.9	73.0%	0.5%	14.0%	7.0%	2.4	1.6	1.4	21.3%	2.4%
Bajaj Auto	BJAUT IN	7,100	24,730	30	28.4	24.6	21.9	23.8%	15.2%	12.4%	13.8%	1.8	3.9	3.5	29.1%	3.2%
Eicher	EIM IN	3,872	12,751	32	26.9	24.1	22.6	33.3%	11.4%	6.8%	9.1%	2.7	5.3	4.9	23.3%	1.4%
TVS	TVSL IN	2,019	11,539	20	47.3	38.1	31.2	37.4%	24.1%	21.9%	23.0%	1.7	2.8	2.4	29.2%	0.5%
Hero MotoCorp	HMCL IN	4,113	9,892	30	20.6	17.5	15.7	33.8%	17.5%	11.8%	14.6%	1.2	1.7	1.6	24.3%	3.7%
Ashok Leyland	AL IN	178	6,272	32	19.0	17.4	NA	99.7%	9.4%	-0.8%	4.1%	NA	1.3	NA	27.0%	1.7%
Average					24.0	20.6	15.4	49.3%	16.2%	10.9%	13.4%	2.0	2.4	2.6	25.4%	1.8%
US companies																
Tesla	TSLA US	240.5	764,372	29,010	77.1	58.6	49.1	-27.6%	36.6%	21.5%	28.9%	2.0	7.1	6.4	22.4%	0.0%
Stellantis	STLA US	22.8	72,008	121	3.2	3.4	3.6	28.1%	-4.7%	-5.7%	-5.2%	NA	0.3	0.3	19.7%	8.8%
GM	GM US	36.7	50,260	544	5.1	4.7	4.1	-5.7%	8.9%	13.5%	11.2%	0.4	0.3	0.3	15.0%	1.0%
Ford	F US	12.0	47,915	627	6.5	6.1	5.3	-1.6%	5.4%	15.4%	10.3%	0.6	0.2	0.2	4.5%	5.0%
Rivian	RIVN US	19.6	18,752	954	NM	NM	NM	NA	NA	NA	NA	NA	2.0	1.3	NA	0.0%
Lucid Group	LCID US	3.8	8,700	199	NM	NM	NM	NA	NA	NA	NA	NA	6.0	2.2	NA	0.0%
Average					4.1	3.9	3.7	-1.7%	11.6%	11.2%	11.3%	1.0	2.7	1.8	15.4%	2.5%
Europe companies																
Daimler	MBG GY	63.6	73,587	169	4.8	5.0	5.7	-3.6%	-3.6%	-12.7%	-8.3%	NA	0.3	0.3	13.9%	8.1%
BMW	BMW GY	101.0	70,023	102	5.1	5.6	6.0	-35.1%	-10.1%	-8.0%	-9.0%	NA	0.3	0.3	11.6%	5.7%
Volkswagen	VOW3 GY	113.1	64,795	114	3.8	3.7	3.4	1.2%	-1.7%	9.4%	3.7%	1.0	0.2	0.2	8.6%	7.8%
Volvo	VOLVB SS	249.3	49,769	63	8.2	12.4	11.5	66.0%	-34.3%	8.0%	-15.7%	NA	1.0	0.9	24.6%	4.0%
Renault	RNO FP	36.4	11,775	37	2.5	2.4	2.6	104.5%	2.1%	-5.7%	-1.9%	NA	0.1	0.1	11.5%	5.0%
Average					5.1	6.1	6.2	26.6%	-9.5%	-1.8%	-6.2%	NA	0.4	0.4	14.0%	6.1%
Industry average					9.5	8.8	7.7	28.7%	7.2%	10.6%	5.7%	1.2	1.2	1.0	16.1%	3.6%

Source: BofA Global Research estimates, Bloomberg, company reports. ADTV = average daily trading volume. ROE = return on equity. Div = dividend.

Note: that for A share companies, we source from Bloomberg



Global auto component suppliers comparison

Exhibit 11: Global auto component suppliers valuation comparison

Global auto component 2024-25E average P/E is 14/12x

		Last	Market	ADTV	PER			EPS growth			EPS CAGR	PEG	ROE		Div yield
Company	Ticker	Price	Cap (\$ mn)	(\$mn)	2023E	2024E	2025E	2023E	2024E	2025E	23-25E	24E	2023E	2024E	2024E
China Auto parts															
CATL	300750 CH	148.7	91,371	527	15.3	13.9	12.6	40.0%	10.6%	10.4%	10.5%	1.3	23.6%	21.5%	0.7%
Sanhua	002050 CH	26.3	13,702	100	33.2	25.9	20.3	9.5%	28.2%	27.8%	28.0%	0.9	20.9%	22.7%	1.2%
Fuyao	600660 CH	38.2	13,737	44	18.0	15.9	14.7	17.7%	13.2%	8.5%	10.8%	1.5	18.1%	17.8%	1.9%
EVE	300014 CH	39.2	11,187	116	18.3	15.0	11.4	24.3%	22.6%	31.2%	26.8%	0.6	13.6%	14.9%	0.7%
Tuopu	601689 CH	62.8	9,663	96	32.1	24.2	18.0	29.2%	32.9%	34.6%	33.8%	0.7	16.9%	19.5%	1.2%
Desay SV	002920 CH	113.7	8,818	91	45.1	34.8	24.4	16.4%	29.5%	42.3%	35.8%	1.0	19.6%	21.6%	0.9%
Huayu	600741 CH	16.2	7,134	25	7.4	6.4	5.6	-5.7%	17.1%	13.0%	15.0%	0.4	12.5%	13.6%	6.5%
Wuxi Lead	300450 CH	23.8	5,215	62	12.1	10.4	8.8	31.9%	16.9%	17.9%	17.4%	0.6	25.0%	24.6%	3.9%
CALB	3931 HK	16.5	3,733	1	35.9	23.9	15.8	-0.5%	50.2%	51.8%	51.0%	0.5	2.1%	3.1%	0.0%
Hongfa	600885 CH	25.0	3,640	22	18.8	17.6	15.1	10.4%	7.2%	16.2%	11.6%	1.5	16.9%	15.2%	1.7%
Joyson	600699 CH	16.4	3,217	78	21.7	16.0	12.8	160.1%	35.9%	24.5%	30.1%	0.5	8.2%	10.4%	2.2%
Shuanghuan	002472 CH	24.4	2,903	92	25.1	21.0	17.5	39.1%	19.1%	20.4%	19.7%	1.1	10.5%	11.4%	0.6%
Xusheng	603305 CH	17.6	2,294	35	19.8	15.5	12.2	13.0%	28.3%	27.0%	27.6%	0.6	12.9%	14.3%	0.9%
Minth	425 HK	14.0	2,085	5	7.8	6.3	5.1	20.2%	24.8%	22.9%	23.8%	0.3	10.9%	12.6%	6.4%
Nexteer	1316 HK	4.3	1,391	7	16.8	6.6	5.4	42.1%	155.4%	23.0%	77.2%	0.1	4.2%	10.2%	3.0%
Wencan	603348 CH	32.3	1,193	35	70.3	26.3	19.2	-48.7%	166.7%	37.3%	91.4%	0.3	3.9%	9.9%	0.8%
Jingda	600577 CH	4.1	1,182	21	19.5	16.3	12.7	12.8%	19.8%	27.7%	23.7%	0.7	8.4%	9.6%	3.1%
Hesai	HSAL US	7.8	978	4	NA	NA	23.5	NA	NA	NA	NA	NA	NA	NA	0.0%
LK Tech	558 HK	4.2	740	4	11.6	9.9	8.3	-2.3%	17.5%	19.7%	18.6%	0.5	12.8%	13.5%	2.0%
Average					20.0	16.4	13.8	22.7%	38.7%	25.3%	30.7%	0.7	13.4%	14.8%	2.0%
Japan companies															
Denso	6902 JP	2,178	47,676	130	13.4	11.3	10.7	56.0%	18.6%	5.8%	12.0%	0.9	10.7%	11.7%	2.6%
Bridgestone	5108 JP	5,928.0	29,391	77	11.7	10.0	9.8	17.3%	17.3%	1.3%	9.0%	1.1	11.3%	12.5%	4.0%
Aisin Seiki	7259 JP	5,159	10,561	32	9.6	8.4	8.5	282.5%	15.3%	-1.7%	6.5%	1.3	8.0%	8.7%	3.5%
Sumitomo	5110 JP	1,576.5	2,881	11	12.3	7.2	6.3	259.0%	70.4%	13.7%	39.2%	0.2	6.1%	9.9%	4.9%
Average					12.4	10.4	10.0	36.6%	30.4%	4.8%	16.7%	0.9	9.0%	10.7%	3.7%
Korea companies															
Hyundai Mobis	012330 KS	216,500.0	15,378	27	5.6	5.4	5.3	43.9%	2.8%	3.0%	2.9%	1.9	9.0%	8.5%	1.8%
Hankook Tire	161390 KS	43,750.0	4,110	8	6.2	4.7	4.4	21.3%	31.5%	7.1%	18.7%	0.3	9.3%	11.0%	1.8%
Mando	204320 KS	37,650.0	1,341	8	9.5	5.8	5.5	56.5%	65.3%	5.3%	31.9%	0.2	8.6%	13.3%	1.3%
Hyundai Wia	011210 KS	60,200.0	1,242	7	33.8	13.0	12.5	-5.6%	119.6%	3.9%	51.1%	0.3	1.4%	3.6%	1.2%
Average					7.5	5.7	5.5	29.1%	33.2%	4.8%	26.1%	0.6	7.1%	9.1%	1.5%
India companies															
Bharat Forge	BHFC IN	1,275	7,142	15	49.7	39.4	34.5	122.9%	26.2%	NA	19.9%	NA	16.6%	18.4%	0.7%
Sona BLW Precision Forgings	SONACOMS IN	637	4,495	11	NA	52.0	41.5	36.0%	33.7%	25.4%	29.5%	1.8	21.5%	23.9%	0.4%
Motherson Sumi	MSUMI IN	65	3,453	5	24.3	17.5	14.3	76.5%	39.2%	21.7%	30.1%	0.6	12.7%	16.1%	1.7%
Average					29.1	38.1	32.0	78.5%	33.0%	23.6%	26.5%	1.2	16.9%	19.5%	0.9%
US companies															
Aptiv	APTV US	84.6	23,919	196	17.8	13.0	10.6	127.3%	36.8%	23.1%	29.8%	0.4	13.2%	16.2%	0.0%
Magna	MGA US	57.3	16,419	64	10.5	8.0	6.2	126.2%	54.5%	27.8%	40.5%	0.2	13.6%	16.8%	3.1%
Borgwarner	BWA US	35.1	8,248	88	9.3	8.4	7.2	-29.6%	50.0%	15.5%	31.6%	0.3	9.9%	10.8%	2.2%
Lear	LEA US	137.3	7,997	79	11.6	7.6	6.3	116.5%	52.0%	21.1%	35.7%	0.2	14.4%	20.0%	3.6%
Gentex	GNTX US	32.1	7,490	44	18.1	14.9	12.6	28.3%	21.5%	18.6%	20.0%	0.7	18.7%	20.1%	1.8%
Average					13.5	10.7	8.7	73.7%	43.0%	21.2%	31.5%	0.4	14.0%	16.8%	2.2%
Europe companies															
Continental Ag	CON GY	75.2	16,463	26	16.0	8.7	6.3	NM	82.8%	39.3%	59.6%	0.1	17.1%	14.1%	3.4%
Autoliv	ALIV SS	1,072.5	8,657	14	15.5	11.1	9.9	19.3%	35.1%	33.9%	34.5%	0.3	23.9%	35.4%	2.6%
Schaeffler AG	SHA GY	5.7	4,143	2	6.8	5.9	5.4	-0.2%	15.4%	8.9%	12.1%	0.5	15.1%	13.8%	7.7%
Valeo	FR FP	13.2	3,531	21	10.9	7.8	5.0	28.1%	39.7%	55.0%	47.2%	0.2	7.8%	10.6%	3.9%
Average					14.1	8.9	7.0	15.7%	43.2%	34.3%	38.3%	0.3	16.0%	18.5%	4.4%
Industry					16.6	13.8	11.9	34.5%	40.1%	21.2%	29.3%	0.7	12.9%	14.8%	2.3%

Source: BofA Global Research estimates, Bloomberg, company reports

Note that for A share companies, we source numbers from Bloomberg

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Top picks

Li Auto (Li US, Buy)

Looking into 2024, Li Auto aims to achieve 650-800k units of volume sales (up 72-113% YoY). On the new products front, Li Auto also announced an update on the rollout plan for its flagship family BEV MPV, MEGA. MEGA is expected to launch on 1 March 2024 and commence delivery in early March 2024. In addition to MEGA, Li plans to launch L6 (4th EREV) and also another three new BEV models in 2024. We believe that such a strong model lineup should bode well for its growth in 2024. We have a Buy rating on Li Auto given 1) its rising EV penetration and robust demand in the luxury/premium segment, 2) its solid new model pipeline, 3) its fast point of sales (POS) expansion, 4) extended range EV (EREV), which we consider a practical solution to mitigate consumers' concern about range anxiety and which is proven by Li Auto to create demand in the China EV market.

Hesai (HSAI US, Buy)

Hesai announced that its monthly lidar shipment exceeded 50k units in December 2023, and Hesai's accumulated LiDAR shipments also exceeded 300k units. Both numbers mark new milestones in the LiDAR industry. Hesai has received orders from a total of 14 OEMs and 50 models, mostly focused in the China market. In 2024, the company will mass-produce for 13 OEMs and 40 models. Hesai has indicated that it is deeply engaged in 9 RFI/RFQ (request for information/quote) discussions with 6 leading global OEMs from North America and Europe. Of these, Hesai has announced order confirmation from 1 OEM, and we expect more to come. We have a Buy rating on Hesai as we believe that the company, as an industry leader, will benefit from strong LiDAR demand growth in coming years and also see positive breakthrough in overseas orders gain.

2024 China Auto/EV outlook

BEV: +23% YoY in 11M23; expect +19% YoY in 2024

In the first 11 months of 2023 (11M23), China EV sales (wholesales, including exports) rose 37% YoY to 8.3mn units, including BEV/PHEV sales of 5.8mn/2.4mn units, up 23%/82% YoY. 11M23 EV penetration was 30.8%, vs. 25.6% in 2022. In 2023/24/25, we expect EV wholesales to post 36%/23%/22% growth to 9.4mn/11.5mn/14.0mn units, including BEV sales growing at 29%/19%/20% and PHEV sales rising by 58%/35%/25%. Accordingly, we expect the EV penetration to surge to 31%/37%/44% in 2023/24/25 (see **Error! Reference source not found.**).

Exhibit 12: China auto wholesales forecasts

We expect PV/EV to post 4%/23% growth in 2024 and BEV/PHEV to register 19%/35% YoY growth to 8.3mn/3.3mn units in 2024

Forecast Volume	2020A	2021A	2022A	2023E	2024E	2025E
Total Passenger Vehicle Volume	20,177,731	21,481,537	23,563,287	25,854,131	26,879,199	27,771,439
Passenger ICEV	18,931,414	18,147,105	17,013,906	16,973,586	15,915,216	14,410,464
Passenger EV (PEV)	1,246,317	3,334,432	6,549,381	8,880,545	10,963,983	13,360,974
Domestic PV	19,418,168	19,868,017	21,034,716	21,757,846	21,963,657	21,971,099
Export PV	759,563	1,613,520	2,528,571	4,096,285	4,915,542	5,800,340
Total Commercial Vehicle Volume	5,133,338	4,793,283	3,300,458	3,894,540	3,976,326	4,051,876
Commercial ICEV	5,012,655	4,607,215	2,962,839	3,421,485	3,408,077	3,397,253
Commercial EV (CEV)	120,683	186,068	337,619	473,055	568,249	654,623
Domestic CV	4,898,338	4,391,283	2,718,458	3,137,940	3,189,462	3,233,537
Export CV	235,000	402,000	582,000	756,600	786,864	818,339
Total EV Volume	1,367,000	3,520,500	6,887,000	9,353,600	11,532,232	14,015,597
PEV	1,246,317	3,334,432	6,549,381	8,880,545	10,963,983	13,360,974
CEV	120,683	186,068	337,619	473,055	568,249	654,623
BEV	1,116,000	2,917,000	5,368,000	6,947,871	8,277,379	9,943,405
PHEV	251,000	603,500	1,519,000	2,405,729	3,254,853	4,072,192
Domestic EV	1,289,500	3,210,500	6,208,000	8,002,390	9,748,635	11,696,921
Export EV	77,500	310,000	679,000	1,351,210	1,783,597	2,318,676
Total Vehicle Volume	25,311,069	26,274,820	26,863,745	29,748,671	30,855,525	31,823,315
Total Overseas Volume	994,563	2,015,520	3,110,571	4,852,885	5,702,406	6,618,678
PEV as % of total PV (penetration)	6.2%	15.5%	27.8%	34.3%	40.8%	48.1%
EV as % of total Vehicle (penetration)	5.4%	13.4%	25.6%	31.4%	37.4%	44.0%
YoY	2020A	2021A	2022A	2023E	2024E	2025E
Total Passenger Vehicle Volume	-5.9%	6.5%	9.7%	9.7%	4.0%	3.3%
Passenger ICEV	-7.3%	-4.1%	-6.2%	-0.2%	-6.2%	-9.5%
Passenger EV (PEV)	21.6%	167.5%	96.4%	35.6%	23.5%	21.9%
Domestic PV	-6.3%	2.3%	5.9%	3.4%	0.9%	0.0%
Export PV	4.8%	112.4%	56.7%	62.0%	20.0%	18.0%
Total Commercial Vehicle Volume	18.7%	-6.6%	-31.1%	18.0%	2.1%	1.9%
Commercial ICEV	20.9%	-8.1%	-35.7%	15.5%	-0.4%	-0.3%
Commercial EV (CEV)	-32.6%	54.2%	81.4%	40.1%	20.1%	15.2%
Domestic CV	21.7%	-10.4%	-38.1%	15.4%	1.6%	1.4%
Export CV	-21.4%	71.1%	44.8%	30.0%	4.0%	4.0%
Total EV Volume	13.5%	157.5%	95.6%	35.8%	23.3%	21.5%
PEV	21.6%	167.5%	96.4%	35.6%	23.5%	21.9%
CEV	-32.6%	54.2%	81.4%	40.1%	20.1%	15.2%
BEV	14.8%	161.4%	84.0%	29.4%	19.1%	20.1%
PHEV	8.2%	140.4%	151.7%	58.4%	35.3%	25.1%
Domestic EV		149.0%	93.4%	28.9%	21.8%	20.0%
Export EV		300.0%	119.0%	99.0%	32.0%	30.0%
Total Vehicle Volume	-1.8%	3.8%	2.2%	10.7%	3.7%	3.1%
Total Overseas Volume	-2.9%	102.7%	54.3%	56.0%	17.5%	16.1%

Source: CAAM, CPCA, BofA Global Research estimates

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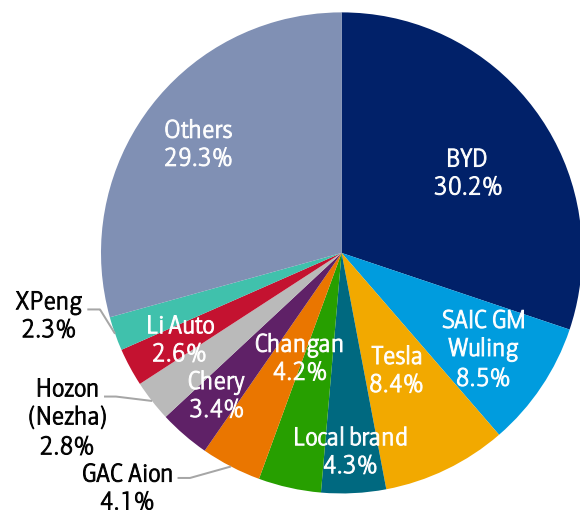
Top-10 share more concentrated; BYD, Li Auto, GAC Aion market share leaders

While traditional luxury brands and JV brands do not have attractive EV models yet, the market share of the top-10 OEMs rose from 70.7% in 2022 to 77.9% in 11M23 in China's EV market. The market share leaders were BYD (+4.6ppt in 11M23 vs. 2022's), Li Auto (+2.5ppt) and GAC Aion (+2.1ppt), while SAIC GM Wuling lost market share (-

2.4ppt), as EV penetration in the <RMB100k segment is more saturated. **Among EV brands, we expect Li to win more share in 2024 in the China market as its product count should increase from 3 to 8. On the other hand, some EV brands could lose market share as Huawei's alliance, including Seres (AITO brand), Chery, Changan, JAC and BAIC, launch more competitive EV models, and traditional auto OEMs, such as Changan and Great Wall Motor (GWM), also offer more competitive EVs.**

Exhibit 13: Top-10 OEM NEV insurance registrations in 2022

BYD ranked number 1, with 30.2% NEV market share in 2022

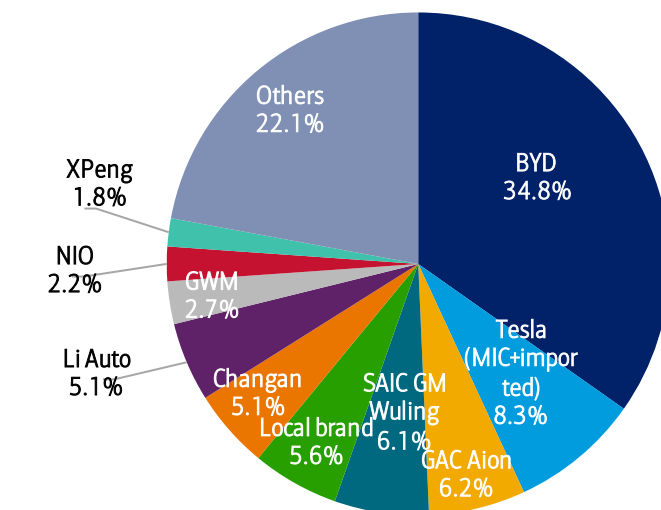


Source: Thinkercar

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Exhibit 14: Top-10 OEM NEV insurance registrations in 11M23

BYD ranked number 1, with 34.8% NEV market share in 11M23



Source: Thinkercar

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Expect price war and function/intelligence competition to continue in 2024

We note that auto OEMs had aggressive price cuts/subsidies in 2023, against the backdrop of newer EV model launches with a focus on ADAS functions, intelligent cockpits and performance-to-cost ratio. Looking into 2024, we expect price competition to persist, with more EV players launching attractive models and tapping into the niche markets, such as MPV and off-road vehicle segments. Meanwhile, we expect intensifying EV competition to drive customers' desire for better comfort and vehicle-driving intelligence. Advanced configuration, such as air suspension and heat pump's application, are gradually trickling down from luxury/high-end models to mass-market models. Vehicle intelligence also is becoming a factor impacting consumers' decisions. Over 20 brands claim that they launched highway navigation on autopilot (NOA) in 2023, while many brands target rolling out their city navigation functions in 2024 (XPeng and Huawei already offered these functions in 2023).

Regulation support: China extends tax exemptions on NEV purchases until 2027

On 21 June 2023, the Chinese government announced that the NEV purchase tax (10%) will be exempt for purchases made between 2024 and 2025 and will be halved (5%) between 2026 and 2027. In addition, the tax exemption amount per car should not exceed RMB30k in 2024-25 and RMB15k in 2026-27, which means that NEVs with price (post VAT) below RMB339k ($300k \times 1.13 = 339k$) will benefit the most from this policy, as purchase tax is fully exempt on these EVs. The Chinese government first exempted NEVs from the purchase tax in September 2014, and the exemption was extended several times. We expect the extension of the EV purchase tax exemption policy to partially support the rising NEV penetration rate in 2024-27.

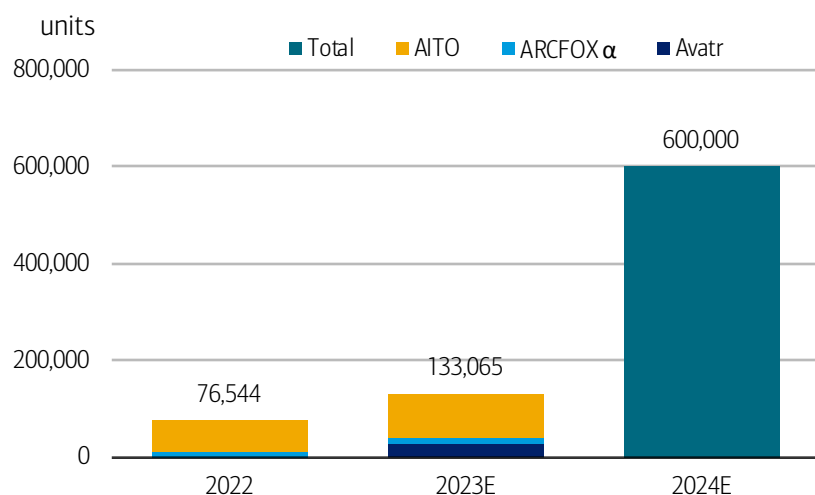
Auto/EV theme #1: Huawei more deeply involved in the EV battlefield

Huawei's active participation in the EV industry intensifies competition and also slows market consolidation. Huawei currently cooperates deeply with Seres (AITO brand), Chery (Luxeed brand), BAIC BJEV (Stelato brand) and JAC (Aojie brand) under Huawei Smart Selection and provides Huawei Inside (HI) solutions for Changan (Avatr). Furthermore, Huawei in November 2023 spun off its vehicle business unit (BU) and invited Changan to invest in the newly set-up company focusing on R&D and provide autonomous driving, ADAS (advanced driver assistance system), vehicle intelligence and connectivity solutions for vehicles' development. Huawei has shown a strong intention to expand the alliance/scope with more auto OEMs. **We expect that auto OEMs still struggling to transition from ICEV to intelligent EV might consider adopting Huawei's technology/system to enhance product quality in a short period of time. Huawei's alliances will likely increase competition in the China EV space.**

We estimate that Huawei's alliance (mainly AITO brands and Changan Avatr) together sold around 130k EVs in 2023. AITO targets to sell 600k EVs in 2024, and Huawei aims for its alliance to sell more than 600k vehicles through brands such as AITO, Luxeed, Stelato, Aojie, Avatr, etc.

Exhibit 15: Volume sales of Huawei Alliance

Supply check suggests that Huawei targets its alliance to sell at least 600k units sales in 2024



Source: Company report, Thinkercar, BofA Global Research estimates

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Huawei's cooperation with auto OEMs

The cooperation between Huawei and OEMs can be categorized into three types:

1) Auto parts/hardware supply: Huawei supplies auto components/hardware to OEMs (including electric motor, BMS, intelligent driving, intelligent cockpits, mmWave radar, AR-HUD, etc.) as a tier-1 supplier. Compared with traditional auto-parts suppliers, Huawei focuses on components for intelligent vehicles. Huawei has established cooperation with major automakers under this mode and supplies to BYD, GWM, GAC Aion/Trumpchi, FAW Bestune, SAIC Motor/GM Wuling, Hozon Auto (Nezha), etc.

2) Huawei inside solution (HI): Huawei supplies its full-stack ICV systems, such as intelligent cockpit system, autonomous driving system and computing/communication system to OEMs. These models are labeled with "HI" in their names. Currently, OEMs that have chosen the HI mode include a) BJEV's ARCFOX (ARCFOX αS is the first "HI" model, while it has suspended cooperation with Huawei for the 2023 version), and b) Avatr (Avatr 11 features Huawei's Drive ONE electric drive, Harmony OS intelligent cockpit and intelligent driving system AVATRANS).



3) Smart Selection partnership: Huawei is deeply involved in the vehicle/system design, product positioning, core component sourcing and sales and service networks. Huawei shares its smartphone sales network as a showroom for models under the Smart Selection mode. So far, its Smart Selection partners include BAIC BJEV, Chery, JAC and Seres. Seres was Huawei's first Smart Selection partner and launched Seres SF5 in April 2021. In 2021, Huawei and Seres jointly launched the AITO brand and introduced M5 in December 2021 and M7 in July 2022. Chery partnered with Huawei in August 2022 and presented the new brand "Luxeed" and the first model "S7" in November 2023.

Exhibit 16: Huawei's various cooperation models with China auto OEMs

Huawei cooperates deeply with BAIC BJEV, Chery, JAC, and Seres under Huawei Smart Selection mode

OEM partner	Auto part/hardware supplier	Huawei Inside solution	Huawei Smart Selection	Remarks
Audi	✓ Intelligent driving			Q7: MDC platform
Avatr (Changan)		✓		Avatr 11
BAIC BJEV		✓ ARCFox brand	✓ Stelato brand	
BYD	✓ Intelligent driving/connectivity			Song Pro, Qin Pro, Han: NFC car key, HiCar connectivity system
Chery			✓	Luxeed brand
FAW Bestune	✓ mPower			E05
GAC Aion/Trumpchi	✓ Intelligent connectivity			Aion V, Trumpchi GS4 Plus
GWM	✓ Intelligent driving			Saloon Ji Jia Long: intelligent driving system, LiDAR
JAC	✓ Intelligent driving		✓ Aojie brand	Currently cooperate on MDC platform, will join Smart Selection
Jetour	✓ Intelligent driving/connectivity			Dasheng: HiCar connectivity system, intelligent driving system
Hozon Auto (Nezha)	✓ Intelligent driving			Nezha S: MDC platform, camera, ultrasonic radar, LiDAR, etc.
SAIC GM Wuling	✓ Intelligent driving			Baojun Kiwi: MDC platform
SAIC Motor	✓ Auto component			R brand R7: AR-HUD; Marvel R: 5G chip
Seres (AITO)			✓	Seres SF5, AITO M5/M7/M9

Source: Company report

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Auto/EV theme #2: Exports still shining in 2024

In 2023, we expected exports to be the key growth driver of the China auto market (see our report, Year Ahead 2023: explore export opportunities to fuel growth), but China auto export growth was stronger than we expected at the beginning of 2023, thanks to strengthening brand equity, improved product quality, better specifications of Chinese EVs and aggressive sales channel/dealership expansion in the overseas market.

Export vehicle exports up 18% in FY24; NEV continues to be growth driver

According to CAAM, China's total vehicle exports (PV+CV) were 4.4mn in 11M23, up 56% YoY, including NEV exports at 1.1mn units, up 84% YoY, and ICEV export at 3.3mn units, up 52% YoY. Overall, we expect China domestic PV growth to be around 3.4% in 2023, while PV exports should grow at around 62% YoY in 2023. Looking into 2024, we expect total vehicle exports (PV+CV) to rise by 18% to 5.7mn units on a high base, including NEV exports at 1.8mn units, up 32% YoY. We expect NEVs to continue to be the growth driver for export sales.

PV export sales by OEM: Chery, SAIC, TSLA – the top 3

We summarize the top-15 OEMs in terms of export sales in 11M23, based on CAAM data. We note that Chery, SAIC Roewe+MG (own brand) and Tesla ranked as the top 3 in 11M23 export sales, accounting for 23%/16%/9% of total export sales, respectively. Chery's number-one position could be attributable to its customized product strategies in the overseas market, such as promoting medium-sized SUVs in Russian and Latin American markets. SAIC group, the largest auto manufacturer in China, took second place in the overseas market. MG sales in China are relatively mediocre due to fierce competition, but it is a competitive brand in the overseas market, thanks to its superior cost-to-performance ratio and good brand awareness in Europe, as it was a British brand when established. BYD is aggressively expanding in the overseas market, leveraging its popular mass-market models Yuan PLUS and Dolphin, which helped move its rank from number 10 in 2022 to number 6 in 11M23, with a 6% market share.

Exhibit 17: PV export sales by brand

Chery, SAIC Motor and Tesla ranked the top 3 in export sales in 2022/11M23

OEM	2022	Share % of export	OEM	11M23	Share % of export
SAIC Roewe + MG	478,753	19%	Chery	836,410	23%
Chery	449,935	18%	SAIC Roewe + MG	598,467	16%
Tesla	271,095	11%	Tesla	325,744	9%
Local OEM	198,242	8%	Local OEM	252,754	7%
SAIC GM Wuling	193,141	8%	GWM	241,289	7%
SAIC GM	136,226	5%	BYD	206,670	6%
Changan	126,340	5%	SAIC GM Wuling	188,276	5%
GWM	122,117	5%	Changan	185,342	5%
DF eGT	63,709	3%	SAIC GM	90,534	2%
BYD	55,916	2%	JAC	81,448	2%
JAC	50,982	2%	DF Yueda (Jiangsu)	75,282	2%
DF Yueda (Jiangsu)	42,045	2%	JMC	65,914	2%
JMC	41,915	2%	Polestar	56,199	2%
DF Xiaokang	39,950	2%	DF eGT	53,184	1%
PSA	37,104	1%	GAC Motor	51,043	1%
Others	216,970	9%	Others	353,507	10%
Total	2,524,440	100%	Total	3,662,063	100%

Source: CAAM

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Vehicle export sales by countries: Russia, Mexico, Australia – the top 3

We summarize the top 20 destinations of China vehicle exports. Russia, Mexico, Australia, Saudi Arabia and United Kingdom were the top five countries in 11M23. Among the top 10 destinations, Russia, Thailand and Spain posted the highest growth rate. Chery and GWM were strong in Russia, and BYD/GWM/SAIC also posted solid sales growth in Thailand. We present an analysis for Russia and Thailand in the later sections, while for Spain and other countries in Europe, we attribute the fast growth to a low base and the attractiveness of Chinese EV models.

Exhibit 18: China auto export sales by country

Russia, Mexico, Australia, Saudi Arabia, United Kingdom accounted for 16%/7.7%/4.2%/4.0%/3.8% of total export volume in 11M23

	2019	2020	2021	2022	11M23	YoY growth
Russia	39,305	42,629	121,252	154,465	772,358	525%
Mexico	113,129	34,687	93,769	252,196	368,383	70%
Australia	26,287	39,862	94,241	155,519	198,061	43%
Saudi Arabia	57,790	98,034	132,803	220,629	190,244	-6%
United Kingdom	18,850	26,050	73,989	136,815	181,370	44%
Belgium	1,378	18,703	91,960	156,651	179,923	24%
Philippines	42,927	31,285	57,052	143,758	159,020	23%
Thailand	5,806	3,973	48,357	87,439	157,145	109%
United Arab Emirates	8,865	9,658	24,348	89,098	130,693	70%
Spain	1,789	1,447	2,232	54,230	119,838	132%
Türkiye	1,115	4,510	5,489	29,794	105,004	298%
Uzbekistan	3,652	7,395	15,585	21,687	89,126	372%
Chile	76,685	56,594	191,045	210,264	86,292	-57%
Kazakhstan	6,889	7,318	9,106	25,840	86,124	321%
Italy	6,794	5,628	20,993	60,212	82,418	66%
Belarus	22,318	20,768	34,098	23,411	80,797	293%
Malaysia	41,188	37,708	43,616	93,137	73,531	-14%
Brazil	28,042	25,064	43,849	27,619	65,967	153%
Peru	41,578	28,392	58,252	75,577	60,666	-13%
India	84,144	49,442	55,200	61,552	59,464	3%
Total	1,232,632	1,078,697	2,119,088	3,326,312	4,762,612	59%

Source: China custom

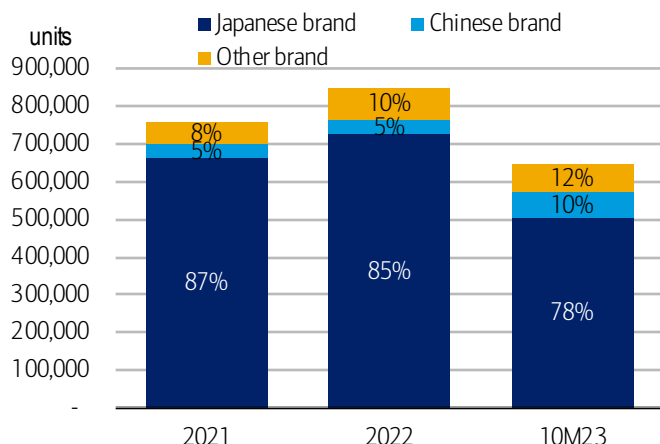
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Thailand: 80% of EV sales supplied by Chinese OEMs

In 10M23, Thailand vehicle market saw a sharp drop in CV sales at -24% YoY to 300k units and a slight decline in ICE PV sales at -1% YoY to 276k units, and robust growth in EV sales at +600% YoY to 56k units. In 10M23, EV accounted for 16.9% of total PV sales and 8.7% of total new car sales. While Thailand's PV market is dominated by Japanese brands, Chinese PV brands' market share rose from 5% in 2021 to 10% in 10M23, thanks to the rise of EV sales. In 10M23, around 80% of EV sales were supplied by Chinese OEMs, including 38% from BYD, 18% from Neta (Nezha's brand in overseas market), 17% from SAIC's MG and 8% from Great Wall's ORA. Looking into 2024, we expect EV sales in Thailand to continue to grow and penetration to reach 10%-15% of total new car sales due to (1) customers' rising interest in EVs, (2) EV price point becoming more affordable for the Thai market; (3) government support measures "EV 3.5 (2024-27)" that offer a subsidy of up to a maximum of 100,000 baht/car as well as an excise tax reduction from 8% to 2%, approximately 40,000-50,000 baht/car. Meanwhile, we expect Chinese OEMs to maintain the leading market share in Thailand, helped by more affordable EV models to be launched in Thailand in 2024.

Exhibit 19: Thailand PV sales breakdown by brand origination

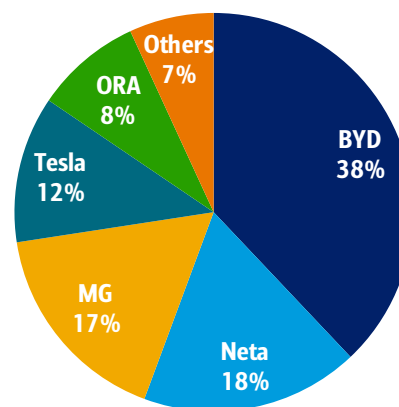
Chinese PV brands' market share rose from 5% in 2021 to 10% in 10M23



Source: Thailand Department of Land Transport, Company report, BofA Global Research
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Exhibit 20: Thailand EV sales breakdown by brand (10M23)

BYD was the best-selling EV brand in Thailand in 10M23



Source: Thailand Department of Land Transport, Company report, BofA Global Research
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To facilitate export sales in Thailand, Chinese auto OEMs already set up or are building factories in Thailand, including the following: (1) In 2013, SAIC Motor teamed with Charoen Pokphand Group to establish SAIC Motor-CP, a joint venture to set up a manufacturing base in Thailand, while in 2023, SAIC Motor-CP announced that it will build a new energy vehicle industrial park in Thailand, taking its total annual capacity to 150k units; (2) GWM acquired General Motor's (GM) factory in Thailand and started mass production in 2021 with a designed annual capacity of 80k units; (3) Hozon Auto's (Nezha) 20k capacity is scheduled to be put into production in early 2024; (4) Changan has a plan for 200k units of annual capacity, with the phase one of 100k units to be put into production in 2024; and (5) BYD signed a contract with WHA Industrial Park in Thailand to invest in a PEV factory with an annual production capacity of 150k units, which should be put into production in 2H24. Effective capacity in 2024 should be around 50k.

Exhibit 21: Chinese OEMs capacity plans in Thailand

We summarized major Chinese OEMs' capacity expansion plans in Thailand

OEM	Mass production time	Planned total capacity (unit)	Note
SAIC Motor	2023	150k	Already has production capacity in 2013
GWM	2021	80k	
Hozon Auto	2024	20k	Brand name Nezha in oversea market
Changan	2024	200k	Phase one of 100k units to start production in 2024
BYD	2024	150k	

Source: Company report

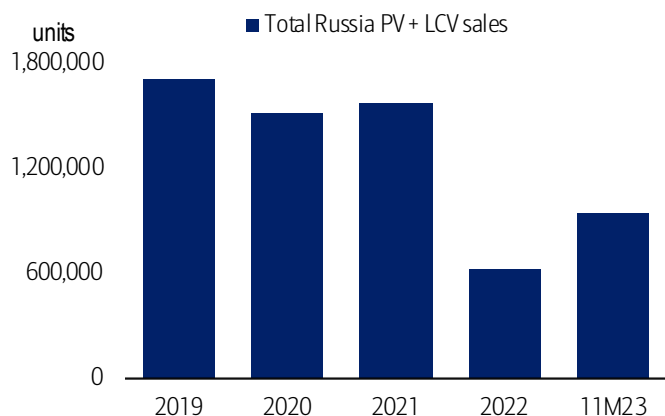
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Russia: Impact of Russo-Ukrainian military conflict on Chinese OEMs

Against the backdrop of Russo-Ukrainian military conflict, German/Korean/Japanese brands have gradually withdrawn from the Russian market, thus giving Chinese brands an opportunity to develop business locally. Russia PV + LCV sales tumbled from 1.5mn-1.8mn units levels during 2019-21 to 622k units in 2022 and slightly rebounded to 939k units in 11M23. Meanwhile, China vehicle and chassis exports to Russia rose from 39k units in 2019 to 154k units in 2022 and surged to 772k units in 11M23. Great Wall Motor and Chery are two popular brands in Russia. Great Wall Motor's market share rose from 2% in 2021 to 11% in 11M23, while Chery's market share surged from 3% in 2021 to 20% in 11M23, according to our estimate. As German/ Korean/ Japanese brands are unlikely to return to Russia in the near future, we expect Chinese brands to continue maintaining market share in 2024 and even in 2025.

Exhibit 22: Russia vehicle sales

In 11M23, Russia PV + LCV sales were 939k



Source: Bloomberg, marklines, Autostat

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Exhibit 23: China vehicle export to Russia

In 11M23, China vehicle & chassis export to Russia were 772k units

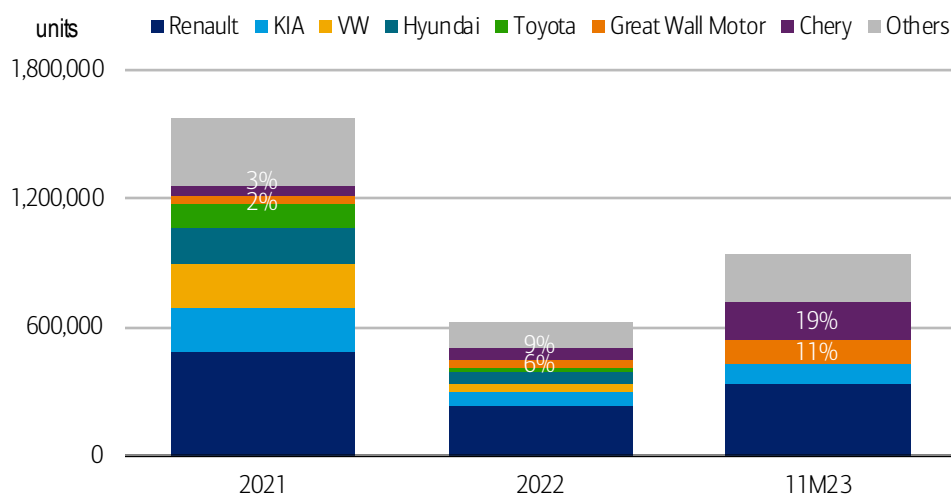


Source: China custom

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Exhibit 24: Russia vehicle sales (PV+LCV) sales breakdown by brand

Great Wall Motor's market share rose from 2% in 2021 to 11% in 11M23



Source: Company report, Bloomberg, Autostat

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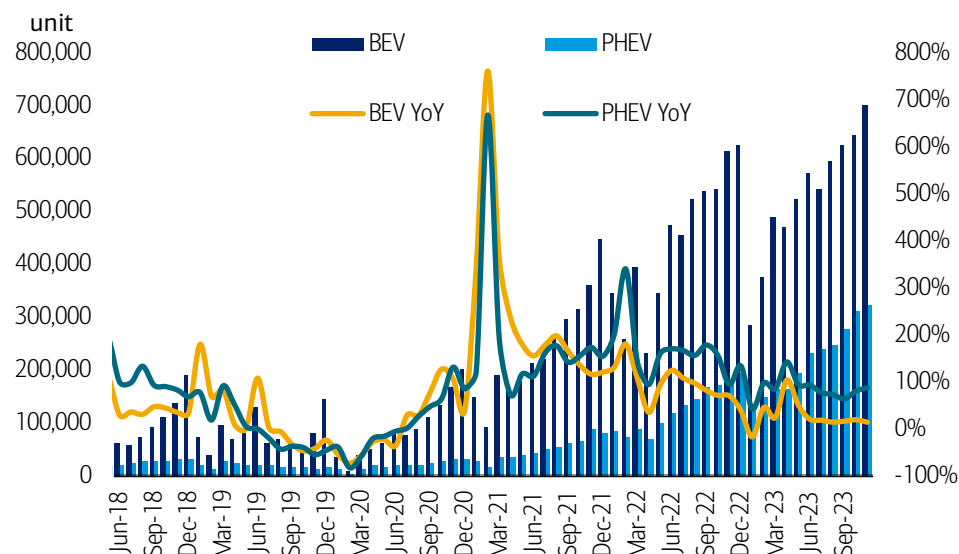
Auto/EV theme #3: PHEV growth > BEV growth in 2024-25

Expect market share of BEV:PHEV at 72%:28% in 2024

In China, PHEV volume sales growth has been outperforming BEV's since October 2021, and we expect this trend to continue in 2024, given that the range anxiety for BEV is still a key concern for customers, especially in low-tier cities, while PHEV can be replenished by charging and refueling. We expect BEV/PHEV to post 29%/58% YoY growth to 6.9mn/2.4mn units in 2023 (BEV:PHEV market share = 74%:26%) and 19%/35% YoY growth to 8.3mn/3.3mn units in 2024 (BEV: PHEV market share = 72%:28%).

Exhibit 25: China EV sales breakdown by powertrain

PHEV volume sales have outgrown BEV since October 2021



Source: CAAM

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PHEV history in China: BYD DM-i, GWM Lemon hybrid DHT, Changan iDD

Chinese OEMs have developed their PHEV technology, and BYD was the first mover in PHEV. BYD started to sell Tang PHEV in 2015 and then Qin PHEV in 2016 and Song PHEV in 2017. However, BYD's volume sales in PHEV were not high in the early years as fuel consumption efficiency and driving range were not long enough. BYD's PHEV sales improved significantly in 2020-21, when the company developed DM-i PHEV technology and started to sell PHEV models in April 2021, gradually transitioned its DM (old PHEV) models to DM-i (new PHEV) models, and witnessed its PHEV sales volume ramp up quickly since then. The DM-i technology uses LFP blade battery and adopts DM-i hybrid technology, which enables lower costs, in turn lowering selling prices (close to ICEV models).

Other good PHEV products include GWM's Lemon hybrid DHT and Changan iDD, etc. In December 2020, Great Wall Motor launched Lemon hybrid DHT. The DHT technology adopts one highly integrated fuel-electric hybrid system, two power architectures and three power assemblies, which enables good performance as well as low energy consumption under different scenarios. Changan introduced iDD (intelligent Dual Drive) hybrid technology in June 2021 and launched its first iDD powered model UNI-K in 2021. The iDD technology can be applied to different car sizes and boasts of great adaptability to all speeds, all scenarios, all temperatures and all times.

BYD's PHEV sales growth started to slow in 2H23 amid product aging and more competitive peers' products in the market. BYD plans to introduce its fifth-generation DM technology in 2024. The new technology adopts a brand-new engine and motor, which has stronger power and lower fuel consumption. Meanwhile, it can perceive

driving scenarios and road conditions in real time through algorithms and sensors, so that it can automatically adjust the output of engines and motors to achieve the optimum energy efficiency and driving performance. The new PHEV technology and new product launch will be BYD's next catalyst, in our view.

EREV (a type of PHEV) gaining traction in China

Worth noting is that EREV, a type of PHEV product, has been gaining traction in China since 2021, and we expect the trend to continue in 2024. Li Auto is the early adopter of EREV technology, which introduced Li One in 2020, L7/L8/L9 in 2022, while other OEMs followed suit to launch EREV models, such as AITO M7 in 2022 and M9 in 2023, Changan Deepal S7, Leapmotor C11, and VOYAH Free in 2023.

EREV adopts series connection whereby the vehicle is purely driven by electric motors, while its energy source and power come from both its battery pack and range extension system. In contrast, regular PHEV adopts series-parallel connection, whereby (1) the gasoline engine mainly generates electric power for the electric motor to drive the car when running at medium and low speeds in the city environment, which ensures lower fuel consumption, and (2) the gasoline engine can also directly drive the car under appropriate conditions.

Despite that, EREV has lower fuel economy, as some energy gets wasted during energy transition from the range-extension system to electric motor. However, the advantages of EREV models are noticeable: (1) compared to BEV models, EREV models offer lower cost (retail price), similar driving experience and less range anxiety; (2) compared to regular PHEV models, EREV models have a simpler structure and lower entry barriers (in terms of manufacturing and R&D), and thus, EREVs are suitable for EV start-up brands. Based on the product pipelines of various auto OEMs, we believe that a solid EREV growth trajectory will continue in 2024-25 back by Avatr 12 EREV, Deepal off-road SUV EREV, Leapmotor C10 EREV, AITO M9 EREV, Nezha L EREV and Li L6, etc.

Exhibit 26: Popular EREV models in China

Li Auto is the early adopter of EREV technology, introducing Li One in 2020 and L7/L8/L9 in 2022

	Li L9	Li L8	Li L7	AITO M9	AITO M7	Changan Deepal S7	Leapmotor C11
Launch Time	2023.08 / 2022.06	2023.02 / 2022.09	2023.02 / 2022.09	2023.12	2023.09	2023.06	2023.03
Vehicle segment	C class SUV	C class SUV	C class SUV	EREV	C class SUV	B class SUV	B class SUV
MSRP (RMB)	430-460k	340-400k	320-380k	510-570k	258-330k	150-170k	150-186k
Length/Width/Height (mm)	5218/1998/1800	5080/1995/1800	5050/1995/1750	5230/1999/1800	5020/1945/1760	4750/1930/1625	4780/1905/1675
Wheelbase (mm)	3105	3005	3005	3110	2820	2900	2930
Max No of Seats	6	6	5	6	5/6	5	5
Electric Motor	Permanent magnet synchronous	Permanent magnet synchronous	Permanent magnet synchronous	Permanent magnet synchronous/induction motor	Permanent magnet synchronous/induction motor	Permanent magnet synchronous	Permanent magnet synchronous motor
Horse Power (hp)	449	449	449	675	272/449	238	272
Maximum Power (kw)	330	330	330	496	200/330	175	200
Maximum Torque (N.m)	620	620	620	675	360/660	320	NA
Acceleration time from 0 to 100km/h (s)	5.3	5.3	5.3	4.9	4.8/7.8	7.6/7.7	8.5/9
Top Speed (km/h)	180	180	180	200	190	180	170
Capacity of Battery (kWh)	42.6	40.9	40.9	42/52	40	19/32	30.1/43.7
Driving Range (km)	215 (CLTC)	210 (CLTC)	210 (CLTC)	225/275 (CLTC)	210/240 (CLTC)	121/200 (CLTC)	180/285 (CLTC)
Charging Time	NA	NA	NA	NA	NA	NA	NA
Electricity Consumption (kWh/100 km)	22.2	24.2	22.7	22.2	23/24	14.3/14.5	15.3
Fuel consumption under low battery mode (L/100km)	7.8	7.7	7.6	6.9	6.85/7.45	4.95	6.8
Autonomous Driving	Level 3	Level 3	Level 3	Level 3	Level 2+	Level 2+	Level 2+

Source: company report

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Exhibit 27: AITO M9's external design

AITO M9 is a flagship full-sized SUV



Source: Company report

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Exhibit 28: AITO M9's internal design

AITO M9 measures 5,230mm /1,999mm /1,800mm in length/width/height



Source: Company report

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Exhibit 29: Fang Cheng Bao 5's external design

Bao 5 is a mid-sized offroad SUV



Source: Company report

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Exhibit 30: Fang Cheng Bao 5's internal design

Bao 5 measures 4,890mm /1,970mm /1,920mm in length/width/height



Source: Company report

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Exhibit 31: Changan Qiyuan A07's external design

A07 is a mid-to large-sized sedan



Source: Company report

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Exhibit 32: Changan Qiyuan A07's internal design

A07 measures 4,905mm /1,910mm /1,480mm in length/width/height



Source: Company report

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Auto/EV theme #4: Autonomous driving: hard to monetize in near term but a more important function in 2024-25

“HD map + Lidar” vs. “Pure vision”

Autonomous driving will likely becoming a more important focus for OEMs in 2024 in order to differentiate their products/brands, especially after XPeng launched XNGP in China in April 2023 and TSLA launched full FSD in the US. Currently, advanced assisted driving can be divided into two technology routes: (1) “pure vision,” led by Tesla, which heavily depends on algorithm, and (2) “HD map (high definition) + LiDAR,” mostly adopted by other EV makers, which uses hardware, such as LiDAR, to enhance perception abilities and HD map to improve route planning abilities – this combination can compensate for the premature algorithm and insufficient data. HD maps are widely used in closed (simple) scenes, such as highways and parks, enabling EV makers to achieve highway NOA. However, HD maps started to face more obstacles when EV makers rolled out city NOA, as HD maps require time to update, involve high development and maintenance costs and face tightening supervision in China.

Perception > maps

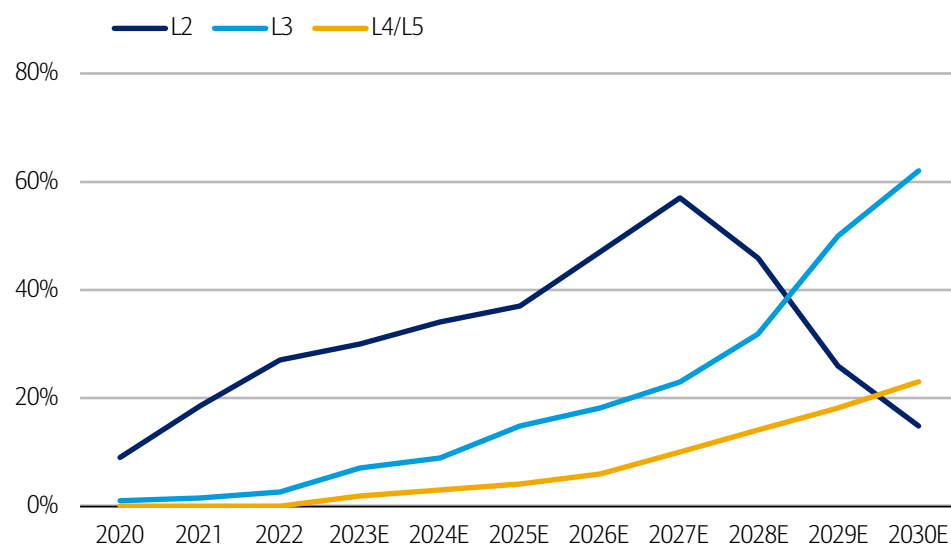
Against such a backdrop, EV makers are gradually switching to a similar route as Tesla’s “pure vision,” which attaches greater importance to perception and focuses less on maps (轻地图 · 重感知). Before October 2023, XPeng only provided city NGP (named XNGP) functions in five cities, based on “HD map” route. To speed up the cities coverage rollout, XPeng adopted the “no HD map” route (technology) and rolled out city NGP in 52 cities in end-2023 and expanded to 243 cities in January 2024.

L3+4/5 penetration is expected to rise from 3% in 2022 to 85% in 2030

L2 ADAS penetration in passenger vehicles in China rose from 9% in 2020 to 27% in 2022 and is expected to increase to 37% in 2025E, before peaking at 57% in 2027E and then gradually being replaced by more advanced autonomous driving. L3 penetration is expected to rise from 3% in 2022 to 15% in 2025 and to 62% in 2030. L4/L5 penetration is expected to rise from 0% in 2022 to 4% in 2025 and to 23% in 2030. L3 + 4/5 penetration is expected to rise from 3% in 2022 to 85% in 2030.

Exhibit 33: Autonomous driving penetration in China

L3 penetration is expected to rise from 3% in 2022 to 15% in 2025 and to 62% in 2030



Source: Yiou, GGII, BofA Global Research estimates

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Exhibit 34: ADAS technology route/progress by OEM summary (as of January 2024)

Most EV companies started to roll out NOA in 2H23-1H24

	ADAS current product	ADAS level*	ADAS partner	Algorithm supplier	ADAS system processor	ADAS Simulation service provider	ADAS progress/future plan
Tesla	Autopilot/FSD (full self driving)	Level 3 equivalent*	TSMC, Samsung (chip manufacturer)	Self-developed	Tesla's FSD chip	NA	To roll out to more users and expand outside US and Canada
XPeng	XPILOT3.0/3.5 XNGP	Level 3 equivalent*	NVIDIA (XPILOT3.0)/Desay SV/Jabil	Self-developed	P5: NVIDIA Drive Xavier G9/G6/P7i/X9: NVIDIA Orin-X	Alibaba Cloud	Introduced the city NGP in 5 cities (Guangzhou, Beijing, Shanghai, Shenzhen, Foshan) in Aug 2023. Expanded XNGP's coverage to 52 cities by end 2023. Expanded XNGP's coverage to 243 cities in early Jan 2024
NIO	NOP+/NAD	Level 3 equivalent*	Mobileye/Bosch	Cooperate with Mobileye; self-developed from ET7	ES8/ES6/EC6: Mobileye EyeQ4 ET7/ES7/EC7/ET5/ET5T/new ES8/new ES6/new EC6: NVIDIA Orin-X	Tencent Cloud	Launched NOP+ in July 2023; city main road coverage grew to 320,000km, in 208 cities; target city main road coverage to increase to 400,000km by 2Q24
Li Auto	NOA	Level 3 equivalent*	NVIDIA/Bosch/Desay SV	Self-developed starting from 2021 Li ONE	L8 Pro/L7 Pro: Horizon Journey 5 MEGA/L9/L8 Max/L7 Max: NVIDIA Orin-X	Baidu Cloud, Alibaba Cloud	Target city NOA to cover 100 cities by end-2023
GWM	COFFEE Intelligence/Hpilot 3.0/NOH/Coffee Pilot	Level 2.5-3 equivalent*	NVIDIA/Mobileye/Qualcomm/Horizon	Cooperate with external partners; self-developed with Haomo AI	High end: Qualcomm Snapdragon Ride 8540/9000, NVIDIA Orin; Mid end: Horizon, TI; Low end: Mobileye EyeQ4	Volc Engine	Highway NGP on Tank/WEY/Haval Xiaolong Max/Ora Shandian Mao; To roll out City NGP (little reliance on HD map) on high end and mid end platform in 1H24
GAC	ADiGO 4.0	Level 2.5-3 equivalent*	NVIDIA/Bosch/Aptiv/Didi/Huawei/WeRide	Self-develop + cooperate with external partners (Holomatic, Momenta)	Hyper HT/GT: Huawei MDC610, NVIDIA Orin Trumpchi/Aion: Horizon Journey 2	NA	Target to launch high way NOA in 2024 and launch city NOA in 2H24
BYD	DiPilot/Denza Pilot/Yangwang Pilot	Level 2-2.5 equivalent*	Bosch/Horizon/Momenta/NVIDIA	Self-develop + cooperate with external partners (Horizon, Momenta, etc)	High end: NVIDIA Orin-X; Mid end: Horizon Journey 5	Huawei Cloud	Denza/Yangwang: to roll out highway NOA by end-2023, and city NOA in 1Q24
Huawei AITO	ADS 2.0	Level 2.5-3 equivalent*	Self-developed by Huawei	Self-developed by Huawei	Huawei MDC610	Huawei Cloud	Launched City NCA in Shanghai, Shenzhen, Guangzhou, Hangzhou, Chongqing, Beijing in Aug 2023. To roll out City ADS (no HD map) to 45 cities by end 2023
Huawei Avatr	ADS 2.0	Level 2.5-3 equivalent*	Self-developed by Huawei	Self-developed by Huawei	Huawei MDC810	Huawei Cloud	Launched City NCA in Shanghai, Shenzhen, Guangzhou, Hangzhou, Chongqing, Beijing in Oct 2023. To roll out to 16 cities and across China gradually
SAIC IM	IM AD	Level 2.5-3 equivalent*	Momenta/NVIDIA/Desay SV	Cooperate with Momenta	L7: NVIDIA Drive Xavier LS6/LS7: NVIDIA Orin-X	Alibaba Cloud	Launched high way NOA in 333 cities in 2023. To roll out city NOA in 100 cities in 2024

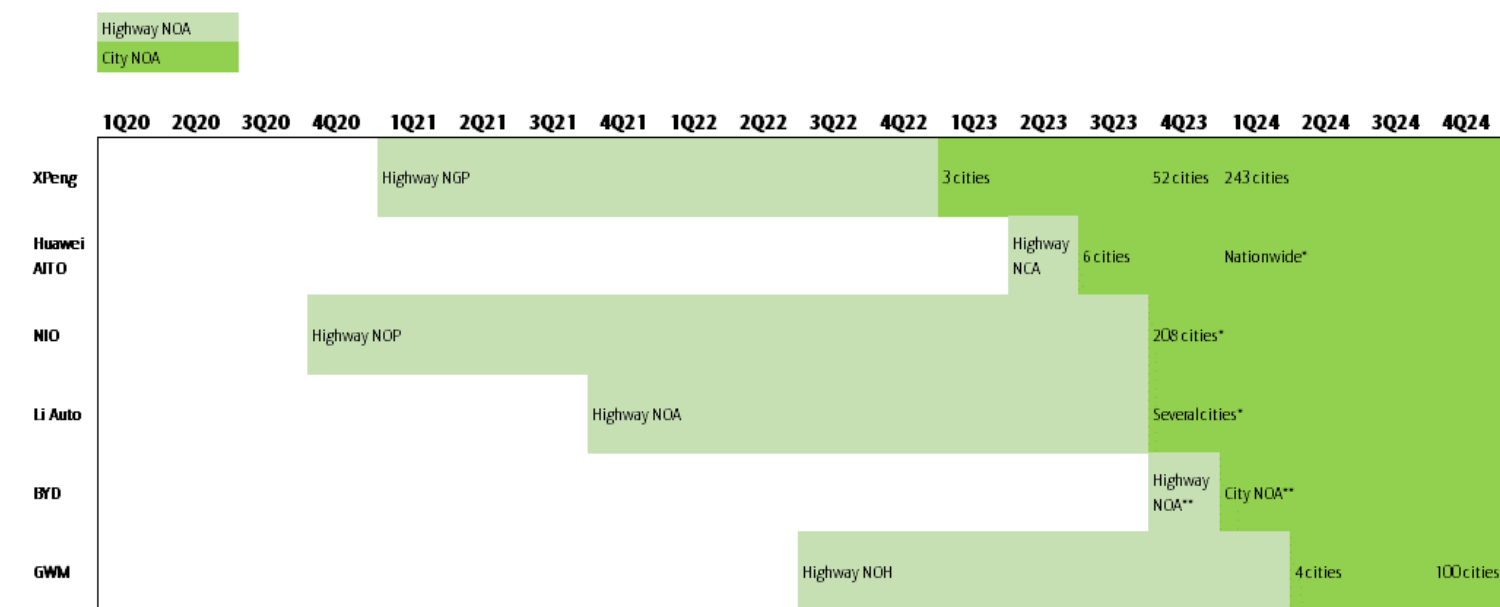
Source: BofA Global Research, Company report *Autonomy level subjects to BofA Securities's own definition

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XPeng's city NOA progress is ahead of peers. XPeng launched City NGP in three cities in 1Q23 and rolled out to five cities in 3Q23 under "HD map" route. Then XPeng switched to "no HD map" route and expanded its city NGP in 52 cities by end-2023 and 243 cities on 2 January 2024. Huawei AITO seems to catch up with peers swiftly – it introduced highway NCA functions along with the launch of new M5 in April 2023, launched City NCA in 6 cities in August 2023 and now is making city NCA available nationwide, for pioneer users in 1Q24. NIO and Li Auto are also in the progress of rolling out their city NOA progress to more cities in 4Q23 for selected roads/areas in the city. BYD/GWM plan to launch city NOA in 1Q24/2Q24, respectively.

Exhibit 35: Highway/city NOA progress by EV brand

XPeng's city NOA progress is ahead of peers; Huawei AITO is able to catch up swiftly



Source: Company report

Note: *open for experience/ open to pioneer users/ selected areas in cities; ** BYD's Denza brand only

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Auto parts: emerging suppliers to compete in the area

Among the smart vehicle components, chip (semiconductor), domain controller and sensors (camera, radar, LiDAR, etc) are key. The average number of (electronic control units (ECUs) in high-end models is 50-70 based on the car, and some even exceed 100 per car. Looking ahead to industry development, we expect the upgrade and consolidated Electrical/Electronic (E/E) architecture to require fewer ECUs. Domain control unit (DCU) or domain controller will help to centralize ECUs' control. DCU will likely gain more importance, and therefore, we see increasing suppliers tapping into this area. Within the ADAS domain controller, there are four types: 1) OEM, 2) global tier-1 auto parts supplier, 3) local (Chinese) auto parts supplier and 4) ADAS software solution provider.

China EV battery outlook: expect 30% demand growth in 2024

BEV sales +19% and PHEV sales +35% growth in 2024E

In 2023/24/25, we expect China EV wholesales to post 36%/23%/22% growth to 9.4mn/11.5mn /14.0mn units, including BEV sales to grow at 29%/19%/20%, and PHEV sales to increase by 58%/35%/25%. Accordingly, we expect PEV penetration to surge to 34%/41%/48% in 2023/24/25. Furthermore, looking into 2030, we expect nearly 70% PEV penetration in China. The NEV market share consolidated: top 10 OEMs at 77.9% in 11M23 from 70.7% in 2022 in China. The biggest market share gainer is BYD, with market share up 4.6ppt in 11M23 compared to 2022. This also led to significant share gain of its EV battery in the overall EV battery market in 2023.

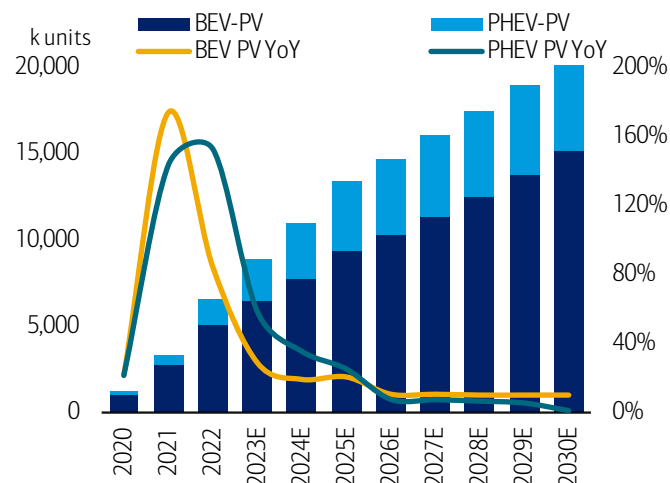
EV battery demand likely to see 30% growth in 2024

According to our NEV wholesales forecast and battery capacity installation per car assumption, we come up with 30% battery demand growth in 2024E, among which PEV battery demand growth is likely to be 28%, while CEV battery demand growth should be 37%. We expect PHEV sales to continue growing strongly into 2024, with an unfavorable mix as PHEV carries smaller battery capacity than BEV. However, we expect both PHEV and BEV battery capacity installation per car to grow YoY, thanks to more vehicle intelligence and connectivity-related functions.

If we include all the different demand from 1) EV battery, 2) ESS battery, 3) auto companies' R&D use battery, 4) E-scooter, E-ship, etc. and 5) inventory-related, we estimate China's battery (excluding consumer electronic-related) demand to be around 650GWh-700GWh in 2023, and this number is expected to grow around 30-35% YoY in 2024, in our view, as we expect ESS to continue outgrowing EV battery demand.

Exhibit 36: BEV/PHEV sales growth in China

We expect NEV wholesales to grow by 23% in 2024E

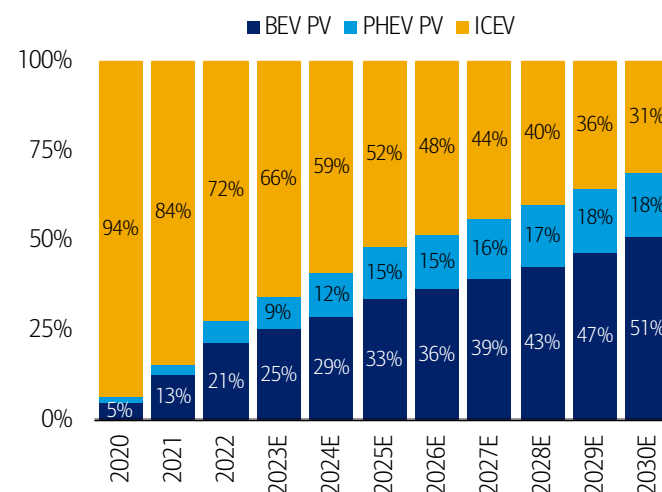


Source: CPCA, CAAM, BofA Global Research estimates

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Exhibit 37: Passenger BEV/PHEV sales breakdown % in China

We expect PEV penetration to surge to from 34% in 2023 to 41% in 2024



Source: CPCA, CAAM, BofA Global Research estimates

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Exhibit 38: China EV battery demand forecasts

We see 30% growth in EV battery demand in 2024E

Battery demand (MWh)	2020A	2021A	2022A	2023E	2024E	2025E
PEV	47,998	137,530	268,670	376,581	483,061	611,035
B-PEV	43,632	126,446	236,768	310,888	392,396	496,479
PH-PEV	4,366	11,084	31,902	65,692	90,665	114,556
CEV	15,584	22,005	35,196	60,574	83,200	103,277
Bus	11,515	12,316	14,332	20,932	27,702	33,904
BEV Bus	11,235	12,281	14,315	20,893	27,641	33,812
PHEV Bus	281	35	17	40	60	92
Others	4,069	9,689	20,864	39,642	55,499	69,373
Total	63,582	159,535	303,866	437,155	566,261	714,312
Forecast YoY	2020A	2021A	2022A	2023E	2024E	2025E
PEV	12.8%	186.5%	95.4%	40.2%	28.3%	26.5%
B-PEV	9.3%	189.8%	87.2%	31.3%	26.2%	26.5%
PH-PEV	65.9%	153.9%	187.8%	105.9%	38.0%	26.4%
CEV	-24.8%	41.2%	59.9%	72.1%	37.4%	24.1%
Bus	-23.8%	7.0%	16.4%	46.1%	32.3%	22.4%
BEV Bus	-24.3%	9.3%	16.6%	46.0%	32.3%	22.3%
PHEV Bus	8.6%	-87.7%	-51.4%	136.0%	52.2%	52.0%
Others	-27.4%	138.1%	115.3%	90.0%	40.0%	25.0%
Total	0.5%	150.9%	90.5%	43.9%	29.5%	26.1%

Source: RealLi, BofA Global Research estimates

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EV battery theme #1: Overcapacity squeezes out small suppliers

Overcapacity: elevated competition and pricing pressure

Looking at major battery suppliers in China, we expect the total year-end (theoretical) capacity to grow 22% from 1,534GWh in 2023 to 1,866GWh in 2024.

However, **we estimate that effective capacity in 2023 was around 1,100GWh**: 1) BYD's EV battery and ESS battery installation is 151GWh (+68% YoY) in 2023, and we estimate its effective capacity at around 200-220GWh in 2023. 2) EVE, CALB, etc. expanded capacity aggressively through 2023; thus their effective capacity is lower than the year-end capacity. 3) The China EV battery industry is consolidating, and the top 10 companies already had 96% market share in 2023 as the battery industry is capital and technology intensive, and small players are not able to catch up with the industry leaders. For 2024, we expect the top leaders to further get consolidated into 6-7 companies in China. When we calculate effective battery capacity, we should exclude the smaller batter makers' capacity, as their market share is low and only focuses on the low-end market. **We estimate both year-end capacity and effective capacity in China to grow around 22-25% in 2024**, as some battery makers are slowing capacity expansion and look forward to selling more battery in the overseas market.

Although we expect a lower growth rate on capacity expansion, this still implies overcapacity and low utilization among the EV battery suppliers. Originally, some Chinese EV battery capacity was supporting demand overseas through exports. Under the Inflation Reduction Act (IRA) in the US and Critical Mineral Act in Europe, there could be rising challenges for battery producers to export from China directly and not be able to digest the excessive capacity domestically. In such cases, we believe that 1) competition in the industry and 2) pricing pressure will continue in 2024.

Exhibit 39: China EV battery capacity expansion by key suppliers

We expect CATL, BYD and CALB to still have the most EV battery capacity in China in 2025E

Year-end capacity (GWh)	2020	2021	2022	2023E	2024E	2025E
CATL	69	170	390	600	700	700
BYD	53	100	200	300	400	450
CALB	4	12	35	75	120	150
EVE (NCM Prismatic + Cylindrical + LFP)	8	22	93	113	143	143
EVE SKI (NCM Pouch)	9	20	37	37	37	37
Gotion	16	50	60	60	60	80
LG Chem	23	40	46	53	61	71
Farasis	13	13	28	28	58	60
Samsung SDI	8	9	10	12	17	20
Others China	118	172	243	257	270	290
China total	321	607	1,142	1,534	1,866	2,000
Year-end capacity (YoY growth %)	2020	2021	2022	2023E	2024E	2025E
CATL	30%	146%	129%	54%	17%	0%
BYD	33%	89%	100%	50%	33%	13%
CALB	39%	190%	194%	114%	60%	25%
EVE (NCM Prismatic + Cylindrical + LFP)	0%	175%	320%	22%	27%	0%
EVE SKI (NCM Pouch)	200%	122%	85%	0%	0%	0%
Gotion	14%	213%	20%	0%	0%	33%
LG Chem	53%	74%	15%	15%	16%	15%
Farasis	160%	0%	115%	0%	107%	3%
Samsung SDI	15%	20%	11%	20%	42%	18%
Others China	50%	45%	42%	5%	5%	7%
China total	42%	89%	88%	34%	22%	7%

Source: Company data, BofA Global Research estimates

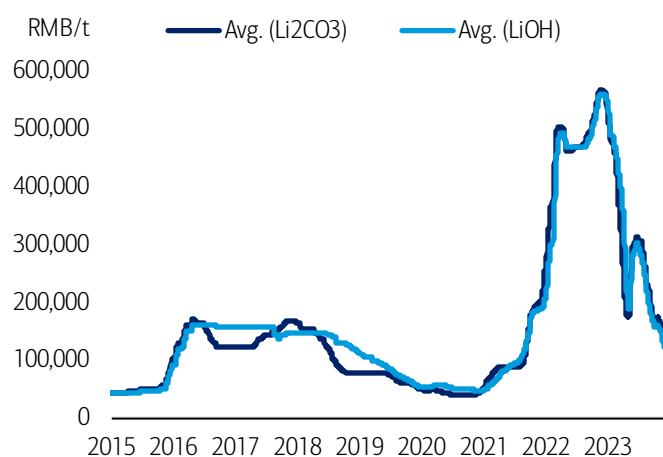
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Lithium price came down; battery price should decline in 2024

As of mid-October 2023, the ASP was RMB740/RMB670 per kWh for NCM 811/NCM 622, down 15%/21% YoY. The ASP was RMB560 per kWh for LFP battery cells, down 23% YoY, according to RealLi. The pricing mechanism (between battery suppliers and OEMs) was more associated with a formula that consisted of metal and battery material cost in 2023 as the BOM cost fell sharply. According to our check with battery makers, the pricing mechanism or negotiation now is more based on bidding and lithium price only. Lithium price (both Li₂CO₃ and LiOH) came down to a record-breaking low in 2.5 years at RMB93-100k per ton. Based on RealLi Research Institution, the lithium price may fall to the cash-cost level of RMB70-80k per ton in 2024. The BofA Global Research Basic Materials team forecasts the average 2024 Li₂CO₃/LiOH price to decline by 60%+ to RMB108k/104k. We expect battery prices to continue to drop in 2024, reflecting 1) weak lithium prices and 2) increasing competition in China from overcapacity.

Exhibit 40: Lithium price trend

Both Li₂CO₃ and LiOH came down to RMB93-100k per ton (record low in 2.5 years)

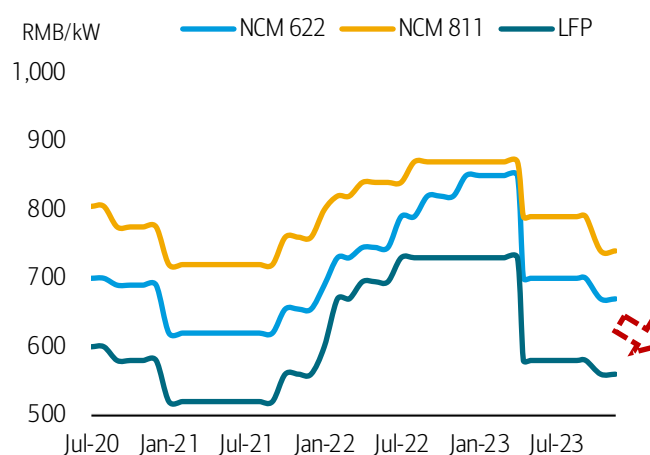


Source: SMM, BofA Global Research

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Exhibit 41: EV battery price in China: NCM 622/NCM811/LFP

We expect battery prices to continue to drop in 2024 along with the Lithium price



Source: RealLi, BofA Global Research

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Exhibit 42: China Lithium price forecast

We expect 2024E Li₂CO₃/LiOH prices to decline by 60%+ to RMB108k/104k, respectively

RMB/t	2021	2022	2023	2024E	2025E	2026E
China Li ₂ CO ₃ - BofAe	121,386	482,746	259,094	107,955	134,470	128,138
China LiOH - BofAe	114,395	468,986	263,871	104,220	127,160	137,183
YoY %						
China Li ₂ CO ₃ - BofAe	175.9%	297.7%	-46.3%	-58.3%	24.6%	-4.7%
China LiOH - BofAe	120.8%	310.0%	-43.7%	-60.5%	22.0%	7.9%

Source: SMM, BofA Global Research estimates

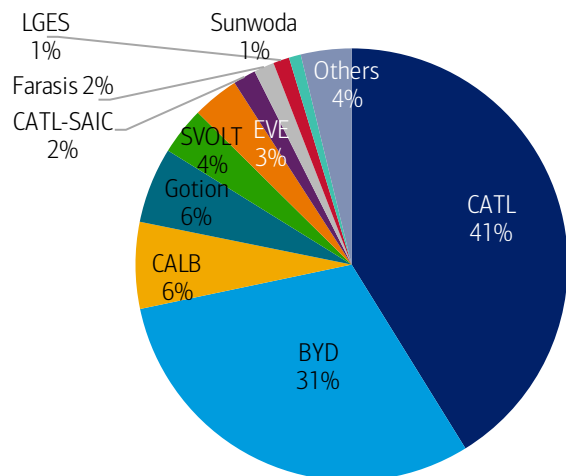
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Top 5 likely to maintain/enhance market share, while small suppliers squeezed out

In 11M23, CATL/BYD/CALB were the top 3 suppliers, accounting for 41%/31%/6% market share, while Gotion/SVOLT/EVE/Farasis accounted for 6%/4%/3%/2%. Over the past three years, EV battery makers' market share concentration has continued, and market share outside the top-5 suppliers has fallen from 21% in 2021 to 15%/13% in 2022/11M23. Looking into 2024, we believe that the small-scale EV battery suppliers will continue to struggle in the market and potentially have lower market share, as it would be challenging for them to secure orders amid such demand/supply dynamics and pricing competition, in our view.

Exhibit 43: China EV battery market share by top 10 suppliers, 11M23

CATL/BYD accounted for 41%/31%

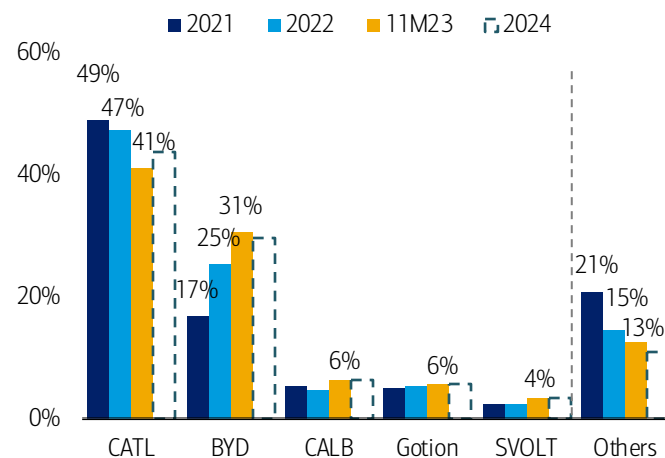


Source: RealLi, BofA Global Research

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Exhibit 44: China EV battery market share by top 5 suppliers, 2021-24E

Market consolidation could continue into 2024, while small suppliers could be squeezed out



Source: RealLi, BofA Global Research estimates

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EV battery theme #2: Exploring overseas opportunities amid challenges

Chinese makers have expanded capacity in Europe and took significant share

Given the early development of EV and EV battery supply chain, Chinese suppliers occupy a vital position in global supply. Chinese battery suppliers took up **41%** market share in the Europe market, while Korean battery suppliers accounted for 55% market share (in 10M23). The EU government has urged for more local production and supply-chain relocation. We have seen growing new projects kicking off in Europe in the past few years, including both leading battery makers and key material suppliers. CATL has built its first overseas plant in Germany with 14GWh and is constructing the second one in Hungary. Some Chinese battery makers and battery materials companies are also building capacity in Europe. We believe that the possibility of trade tensions will be low for Chinese EV/ EV battery supply chain in European market.

German EV subsidies' sudden stop – a risk to battery demand

Germany's government announced that its EV subsidy program would end with immediate effect in late December 2023 (see the report, [European Automobiles: Electric Vehicles: Sudden stop of German subsidies, significant price cuts ahead... 18 December 2023](#)). It was originally intended to extend until the end of 2024. So far, the German government has granted €4,500 for any new BEV with a list price (ex VAT) of not higher than €40,000 and €3,000 for BEV's with a list price (ex VAT) between €40,000 and €65,000. On top of that came a pre-defined price discount of €1,500-2,250, which every dealer had to grant, taking the total subsidy from €4,500 to €6,750 per BEV. The BofA Global Research European Auto team estimates that for the mass-market compact SUVs, the government subsidy accounted for c10% of the total BEV purchase price. The European Auto research team believes that the NEV sales growth in Germany and Europe could be negatively impacted and EV battery demand growth could be slower.

Battery supply to US disrupted by IRA and FEOC requirement

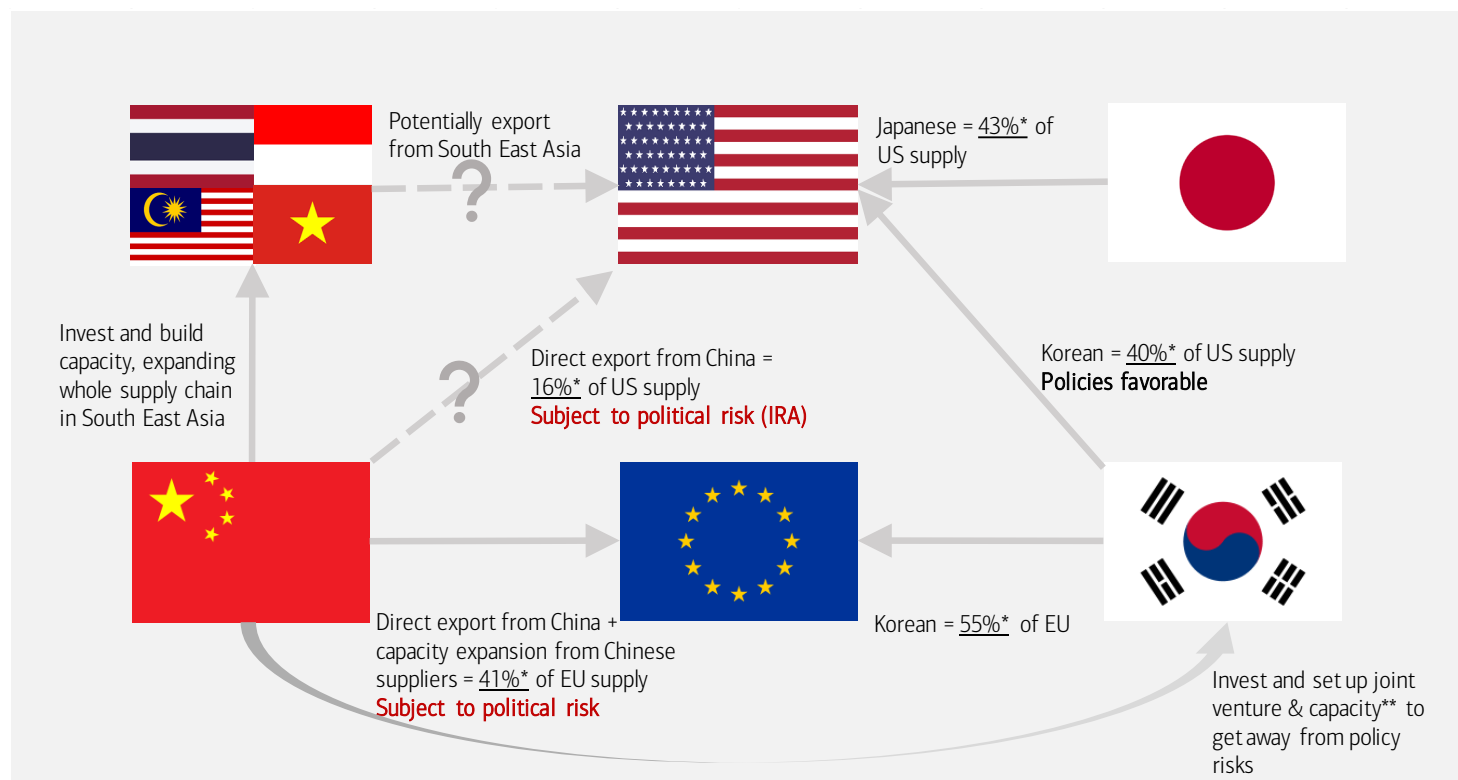
Chinese battery suppliers (mainly CATL) took **16%** market share in the US (in 10M23), while Japanese battery suppliers (mainly Panasonic) took 43% market share and Korean battery suppliers had 40% market share. In the US, CATL has around mid-teens market share via shipping to TSLA Shanghai and then exporting vehicles to the US. TSLA enjoyed the full amount of the IRA tax credit from May 2023 to December 2023, as only a small portion of TSLA's EV sold in the US use CATL's batteries. Under the recently proposed IRA guidelines, EVs with China batteries will be ineligible for a tax credit in the US.

Chinese EV battery competitive on cost level vs. IRA credit

According to our checks, around 3-4% of CATL total battery shipments are for EV battery use in the US, which will be impacted starting in 2024. We note that TSLA has announced on its website that starting from 2024, consumers who purchase Model 3 and Model Y will not be able to enjoy the tax credit. We expect TSLA to likely opt to source cheap batteries from China and give up on tax credits for the time being. Only 38 of all 83 EV models currently available are eligible for the IRA EV tax credit, but some non-qualified ones are still selling well, as of 3Q23, such as Hyundai, Mercedes, Kia and Audi, accounting for 6.3%, 3.3%, 3% and 2.4% market share, respectively. None of their EV models are qualified under the IRA EV tax credit currently (see the report, [Basic Materials - Asia-Pacific: Demystifying US IRA #3: FEOC-compliant material price premium & EV leasing](#)). Furthermore, we are unsure about IRA's total budget (how many EVs could be subsidized in the long term). If made-in-China batteries turn out to be much cheaper and the IRA tax credit per car decreases along with rising EV penetration in the future, some auto companies may still consider sticking with batteries from China in the US market without enjoying the IRA tax credit, in our view.

Exhibit 45: China EV battery export and overseas expansion strategies

China accounted for 41% of battery supply to the EU and 16% of battery supply to the US (based on 10M23 data)



Source: BofA Global Research

* Note that the number suggest 10M23 data

** Note that the investment in Korea from Chinese participants currently mainly surround in the cathode only

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Details revealed on FEOC/IRA for battery component/minerals in US

On 1 December 2023, the US Department of the Treasury released the Proposed Guidance on the clean vehicle provisions of the IRA. The Notice of Proposed Rulemaking provides clarity and certainty around the IRA's foreign entity of concern (FEOC) requirements, which classify 1) an entity incorporated in, headquartered in, or performing relevant activities in a covered nation (China, Russia, North Korea, and Iran); 2) entities owned by, controlled by, or subject to the jurisdiction or direction of a government of a covered nation by 25% or more (in terms of board seats, voting rights, or equity interest); and 3) an entity controlled by licensing agreements or other contractual agreements by a government of a covered nation. Starting from 2024, an eligible clean vehicle may not contain any battery components that are manufactured or assembled by a FEOC, and beginning in 2025, an eligible clean vehicle may not contain any critical minerals that were extracted, processed or recycled by a FEOC.

Chinese EV battery material supply-chain relocation sped up

Despite all the regulation and geopolitical/trade tension still bringing uncertainty on the potential opportunities to penetrate into the US market, we believe that this will not stop the EV battery supply chain from continuing expansion/relocation in overseas markets. Both Chinese EV battery makers and EV battery material suppliers are seeking opportunities to build capacity in either Europe or Southeast Asia and potentially export products from these countries to the US.

Exhibit 46: Overseas expansion of Chinese EV battery makers

CATL, EVE and Gotion are considered most aggressive in terms of capacity expansion in the overseas market

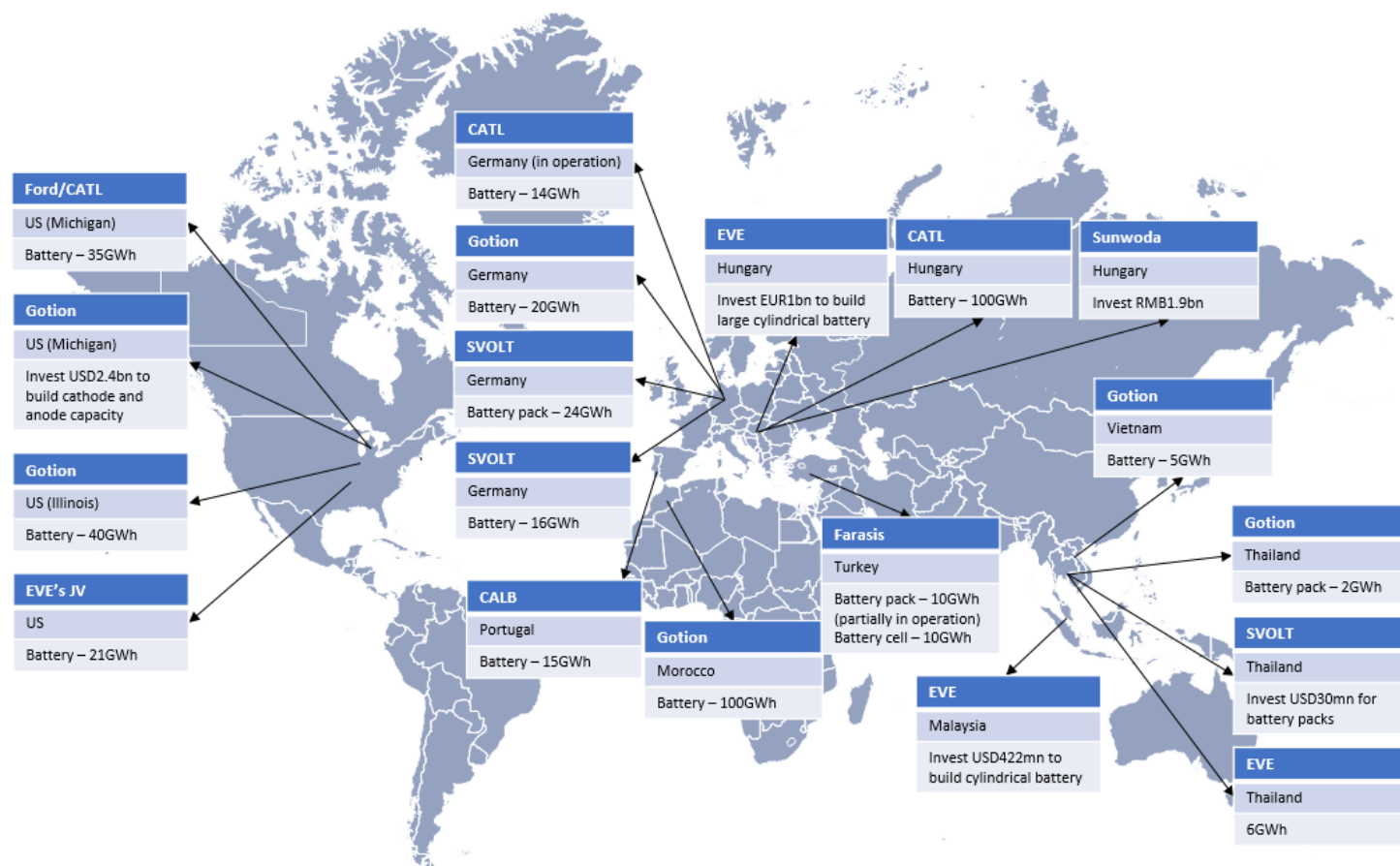
Battery makers	Country	Capacity size	Details
CATL	Germany	14GWh	Ready for mass production
	Hungary	100GWh	Announced in Aug 2022. Plant is still under construction
	US	35GWh	Cooperation with Ford and will collect royalty fee. Mass production timeline will be 2026
CALB	Portugal	15GWh	Announced in Nov 2022 and phase 1 capacity is expected to mass produce in 2025
EVE	Thailand	6GWh	Signed MOU with Energy Absolute to build JV and capacity in Thailand
	Malaysia	-	Signed MOU with PEMAJU KELANG LAMA (PKL) to invest USD422mn and build cylindrical battery capacity for power tool, E-scooter
	Hungary	-	Plan to invest EUR1bn to build large cylindrical battery. Mass production is scheduled in 2026
	US	21GWh	Set up a joint venture with Daimler Truck, Paccar, and Cummins to produce LFP battery
Gotion	Morocco	100GWh	Planning for 100GWh capacity in long term
	Germany	20GWh	Plan to construct 20GWh capacity in 4 phases. Some production lines are ready to mass produce
	Thailand	2GWh battery pack	Set up joint venture, NVGOTION, with Nuovo. Phase 1 is ready for mass production
	Vietnam	5GWh	Set up a joint venture with VinGroup to build LFP battery capacity
	US	40GWh	Plan to build 40GWh capacity in Illinois
	US	-	Plan to invest USD2.4bn and set up capacity of cathode and anode in Michigan
Farasis	Türkiye	10GWh battery pack + 10GWh battery cell	Cooperated and set up JV with local EV maker TOGG. The plant is expected to mass produce in 2026
SVOLT	Thailand	Battery pack	Cooperated with Banpu and plan to invest USD30mn
	Germany	24GWh	Plan to invest total of EUR2bn on battery pack plant
	Germany	16GWh	Announced in Sep 2022. Plant is still under construction, and will mass produce battery cell from 2025
Sunwoda	Hungary	-	Plan to invest RMB1.9bn

Source: BofA Global Research, company report

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Exhibit 47: Overseas expansion of Chinese EV battery makers

Chinese EV battery makers prefer to expand battery capacity in Europe and Southeast Asia areas



Source: BofA Global Research, company report

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CATL

CATL has set up its first overseas plant in Germany and will construct the second plant in Hungary. Currently, around 3-4% of CATL total battery shipments are for EV battery use in the US (export through TSLA's Shanghai plant indirectly). On the other hand, Ford-CATL cooperation and licensing business model seems to be potentially workable based on the latest Proposed Guidance on IRA/FEOC. Ford's 100%-owned battery plant should still take 2-3 years to be completed.

CALB

CALB only announced an EV battery construction plan (15GWh) in Portugal so far. It is taking a more prudent approach to the US market and will focus on the China and Europe markets first.

EVE

EVE started to set up a plant in Hungary. It also cooperates with partners in Thailand and Malaysia for battery capacity expansion. In the US, EVE set up a joint venture with Daimler Truck, Paccar and Cummins to produce LFP batteries locally. Daimler Truck, Paccar and Cummins will own 30% each in the JV, and EVE will hold the remaining 10% stake. The JV has planned a total investment of US\$2-3bn for a total capacity of 21GWh. The JV will source technology from EVE and pay royalty fees for LFP battery used in commercial vehicles.

Gotion

Gotion has multiple projects globally, including Germany, Thailand, Vietnam, the US and Morocco. Gotion will cooperate with partners to build capacity in Thailand and Vietnam. It will set up capacity in Germany and Morocco. It plans to construct battery plant construction (40GWh) in Illinois, US, and also announced that it will set up cathode and anode capacity with the state government and other third parties in Michigan.

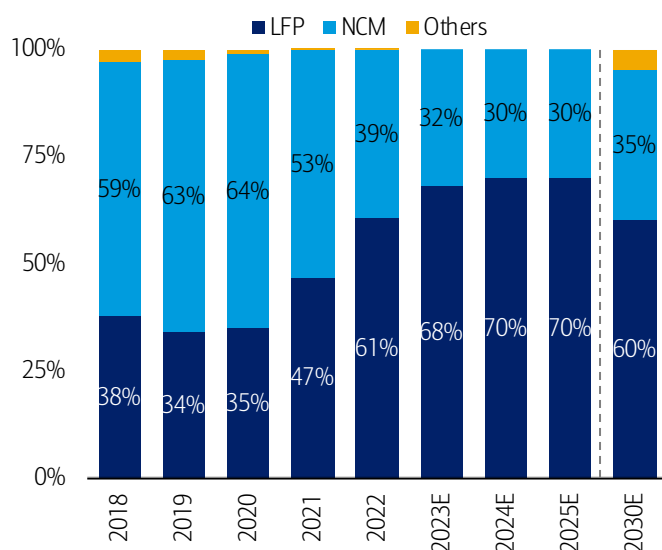
EV battery theme #3: Technology innovation to maintain market share and pricing

Battery chemistry: LFP will take bigger market share in 2024

The market share of batteries with LFP chemistry was up from 47% in 2021 to 61%/68% in 2022/2023E, thanks to 1) CTP (cell to pack) technology's invention by CATL; LFP chemistry can achieve higher energy density and better cost performance; 2) BYD's commitment to blade battery (also using LFP CTP technology) and its market share gain over the past two years in EV market. Looking into 2024, we note that LFP chemistry should still be prevailing against NCM, as we continue to see more R&D in LFP, which has sped up upgrades on LFP batteries (such as LMFP and Shenxing 4C fast charging battery). We also see overseas battery makers catching up on R&D and capacity construction on LFP batteries. In the next 2-3 years, LFP should still be able to offer better cost performance, which effectively lowers the EV BOM for OEMs and offers a higher level of safety, in our view.

Exhibit 48: China EV battery breakdown by chemistry

We expect LFP to account for 68%/70%/70% market share in 2023-25E

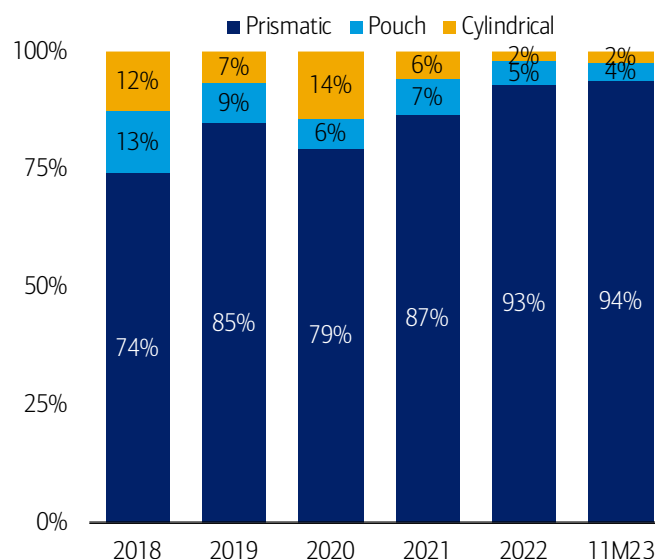


Source: RealLi, BofA Global Research estimates

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Exhibit 49: China EV battery breakdown by form factor

Prismatic battery took 94% share in 11M23



Source: RealLi, BofA Global Research

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Standardized design – is 4680 large cylindrical battery the right solution?

Cost reduction will be crucial for battery suppliers in 2024, as there is a limited room for raw material prices to decline, while we believe that auto OEMs will continue to ask for price cuts from battery suppliers. Currently, the prismatic form factor still accounted for the majority of the market at 94%, with various different battery cell size and specs in 11M23 in China. Pouch/cylindrical battery form factor accounted for only 4%/2% in 11M23. A uniform battery cell design might be the solution for the industry developing in the longer term. For battery makers, the benefits include that 1) the production line is simplified with the same product offering, 2) it is easier to scale up, 3) it is easier to achieve battery recycling. On the other hand, for auto OEMs, the benefits include 1) simple battery cell sourcing and 2) more flexibility when switching battery suppliers. Besides Tesla and Panasonic, CATL, EVE and Gotion are all devoting R&D to the 4680 battery cell, and potentially, we could see more suppliers mass produce 4680 in 2024.

CTB or CTC – structural parts cost down further for OEMs

Apart from CTP (cell to pack) simplifying the structure and enhancing energy density at the pack level, there are CTB (cell to body) or CTC (cell to chassis) solutions to simplify

the battery/vehicle structure further. Currently, Tesla, Leapmotor and BYD have mass produced either the CTB or CTC design. However, they are all adopting different approaches to simplify the structure between the battery pack and vehicle floor. Based on the upcoming product launches (i.e., Feng Cheng Bao, Xiaomi, etc) in 2024, we believe that CTC technology will continue to be a key focus.

Exhibit 50: CTC/CTB comparison across OEMs

OEMs have different approaches to achieve simpler structure

	Tesla - CTC	Leapmotor - CTB	BYD - CTB
Vehicle floor assembly	No	Yes	Yes, only retain crossmember
Battery top cover	Yes, consolidate with seat and crossmember	No	Yes
Difficulty level to seal the battery	★	★★★	★
Easier for maintenance	★★★★★	★★★★	★★★
Level of lightweight	★★★★★	★★★★	★★★★

Source: BofA Global Research, company report

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New battery technology differentiator in EV battery market on increasing competition

We have listed the major battery launches/mass production from the key Chinese EV battery suppliers. For the upcoming new technology, focus on higher energy density is still a key theme. However, we see more new designs made to cover further aspects, including fast-charging, low temperature operation, cathode/anode material revolution, structure simplification, cooling technology innovation, etc. We expect battery suppliers to face intensified competition, and battery suppliers would have to offer more differentiated technology to gain/sustain market share.

CATL – a wide range of new technology offering

We see CATL still has the most comprehensive new technology pipeline from entry-level/low-end to high-end battery demand. It could offer 1) sodium-ion battery for entry-level models, 2) Shenxing battery (LFP with 4C fast charging), M3P battery (LFP with Manganese and other minerals), Qiling battery (CTP cell to pack 3.0 technology with NCM chemistry), covering mass market to premium models, and 3) condensed battery of semi-solid state battery for battery, which requires even higher energy density. Among all battery technology CATL launched, we think that Shenxing battery could be the most competitive product. We expect CATL to replace most of its traditional LFP battery with this new battery for its clients, as the Shenxing battery will have a similar price with fast-charging speed and better performance even in a low temperature environment. We believe that CATL will regain market share in China's battery industry, as we do not expect peers to be able to launch similar products in the near term.

Shenxing battery from CATL likely to take share in 2024

Shenxing battery is the world's first LFP battery that achieves 4C fast charging. Key metrics include (1) fast charging over a wide temperature range, with the new battery allowing a 0-80% charge in 30 minutes even in temperatures as low as -10°C; (2) long range up to 700km and 0-100km/hour acceleration performance unchanged even at low temperatures; (3) high standard of a safe driving experience. With the introduction of the Shenxing battery, CATL's battery product portfolio is further enriched. Shenxing battery (LFP) for fast charging at affordable prices is suitable for entry-level and mass-market EV models. EV models equipped with Shenxing batteries are expected to be launched in 1Q24. In the longer term, Shenxing battery should help CATL gain more orders in the overseas market, given its superior cost to performance.

Exhibit 51: Latest battery technology from major battery suppliers (January 2024)

We see many new battery technology innovation coming up to maintain market share and pricing

Battery suppliers	Technology	Mass production time	OEM clients	Spec details
CATL	Shenxing (神行) LFP battery	2024	Arcfox, Nezha, Avatr	The world's first LFP battery that achieves 4C fast charging, enabling a 400km drive on a 10-minute charge
	M3P (LMFP)	2H23-1H24	Tesla, Luxeed, Chery	Lithium Manganese Iron Phosphate (LMFP) cell is expected to mass produce in 2024 with lower cost and higher energy density vs. LFP
	Qilin battery (CTP 3.0 battery)	2H23	Li Auto, AITO	Qilin battery achieves record-breaking volume utilization efficiency of 72%, an energy density of up to 255Wh/kg and fast charging in 10 mins with innovative water-cooling design
	Sodium-ion battery	1H23	Chery, A00 models	Advantages: 1) outperformance under low temperature, 2) fast-charging capability (takes 15 minutes to reach 80% of capacity), and 3) higher metal reserve in China than Lithium. Disadvantage: 1) low energy density, 2) shorter lifespan, 3) production cost is still high, and 4) supply chain is not ready
	Condensed battery (凝聚态)	2025	-	Condensed battery could achieve both high energy density (500Wh/kg) and high level of safety, enabling electrification of passenger aircrafts
CALB	One-Stop(OS) battery (new gen CTP)	1H23	GAC Aion	OS Hi-Mn LFP battery system can reach 180Wh/kg in energy density and 700km in single-charge driving range. CALB has started mass production in 1H23
	"U" type battery (顶流) (cylindrical battery)	2024	-	The "U" type structure allows the battery to reduce structural component resistance by 50%, achieve an energy density of 300Wh/kg, and support fast charging beyond 6C
	LMFP battery	2024	-	The OS technology could apply onto LMFP chemistry, and the cell level energy density could reach 230Wh/kg while pack level energy density could reach 180Wh/kg
EVE	Large cylindrical battery	2024	-	The system employs n-shaped three-dimensional liquid cooling technology, efficiently addressing fast charging of the battery system in 9-minutes
SVOLT	Dragon Armor battery (龙鳞甲) (new gen CTP)	2Q24	EV start-ups	Compatible with all common cathode materials, including lithium iron, NCM, cobalt-free NMX and more. With a range of up to 1000+km and fast-charge capability of rates in the 1.6C-6C range
Farasis	Super Pouch Solution (SPS) battery (large pouch battery)	2H23	GAC, DFG	SPS achieves a 75% volume utilization and reduces component count by half and lower 33% material cost. It supports charging and discharging rates from 2C to 6C and above

Source: BofA Global Research, company report

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EV battery theme #4: Battery materials: overcapacity still loom on margin

LFP cathode (contributed by Edward Leung)

2023 has been a tough year for LFP cathode producers, with utilization dropping by half yoy to a mere 35%. Entering 4Q23, LFP producers were again hurt by a rapid collapse of lithium prices and faced high inventory costs with lithium carbonate feedstocks on hand. Meanwhile, the processing fee has essentially fallen to breakeven levels for average producers, and downstream battery makers have repeatedly demanded additional discounts based on lithium prices, showing much stronger pricing power vs LFP producers. The overcapacity in LFP should only worsen further in 2024-25, as many capacity expansion pipelines originally targeting launch in 2023 have been delayed, but the construction has been ongoing, so outright cancellation would be difficult. The likelihood of margin turnaround should be remote, but producers in 2024 are unlikely to suffer from inventory cost drag again, as lithium carbonate has dipped to >RMB100k/t already, leaving little room for further contraction.

In China, the LFP penetration has risen and stabilized at 70% lately, and further growth would be challenging, given its disadvantage over ternary cathode, making it unattractive for the mid- to high-end EVs. With the advent of various optimized versions, such as the CATL's Shenxing battery, improving fast charging, or Shenzhen Dynanoic's LMFP, we think that penetration gradually increasing to 80% is visible within 2-3 years, rendering limited volume growth beyond overall the EV market growth. Separately, the Foreign Entities of Concerns (FEOC) exclusion of the IRA discourages the Chinese capacity to supply to the US EV market, limiting the export growth prospects of China's LFP producers. In sum, there is no clear pathway to resolve the excess capacity issue at present. LFP producers need to differentiate themselves to earn an above-average margin, such as upstream integration with lower-cost suppliers of various specialized and optimized versions offering superior electrochemical performance.

Exhibit 52: Global LFP + LMFP supply-demand model

Potential supply additions in 2024+2025 remain significant

Supply-Demand of LFP + LMFP Cathode	2018	2019	2020	2021	2022	2023E	2024E	2025E
Supply forecast*								
LFP capacity (kt)	278	298	403	762	1,893	4,956	10,879	12,019
Incumbents	278	298	403	762	1,630	3,301	4,341	4,791
Phosphorus producers					20	120	1,120	1,220
Other battery (parts) producers					10	260	760	1,060
Titanium dioxide producers					100	300	900	1,050
Other new entrants					133	975	3,758	3,898
LMFP capacity (kt)				12	167	442	717	847
Total LFP + LMFP capacity (kt)	308	328	433	804	2,060	5,403	11,636	13,436
Change %	97.4%	6.5%	32.0%	85.7%	156.2%	162.3%	115.4%	15.5%
Demand forecast								
Total battery demand (GWh):	113	149	204	399	739	1,085	1,540	2,087
BofA Global EV Battery Demand (GWh)	92	115	150	301	580	877	1,270	1,744
Other e-Mobility (GWh)	14	20	29	41	67	85	97	107
ESS (GWh)	7	14	25	58	91	123	172	236
LFP penetration rate:								
Baseline EV LFP penetration rate	12%	10%	9%	17%	32%	42%	46%	50%
Other e-Mobility	50%	50%	55%	60%	65%	70%	75%	75%
ESS	90%	90%	90%	90%	90%	90%	90%	90%
Baseline - LFP reaching 70% in China, 15% overseas => globally 50% by 2025								
LFP end demand (kt)	57	80	121	300	732	1,265	1,908	2,737
Change %	48.5%	40.8%	51.2%	147.2%	144.1%	72.8%	50.9%	43.4%
Inventory change (kt)	22	26	34	152	331	107	138	-456
LFP production (kt)	79	107	156	452	1,063	1,372	2,046	2,281
UTR based on average capacity	34.1%	33.5%	40.9%	73.0%	74.3%	35.0%	24.0%	18.2%

Exhibit 52: Global LFP + LMFP supply-demand model

Potential supply additions in 2024+2025 remain significant

Supply-Demand of LFP + LMFP Cathode	2018	2019	2020	2021	2022	2023E	2024E	2025E
Bull case - LFP reaching 80% in China, 25% overseas => globally 60% by 2025								
Increased penetration rate vs. baseline					+4%	+8%	+12%	+16%
Implied EV LFP penetration rate					36%	50%	58%	66%
LFP end demand (kt)					787	1,430	2,267	3,392
Change %					162.3%	81.8%	58.5%	49.7%
Inventory change (kt)					107	139	188	-565
LFP production (kt)					894	1,569	2,454	2,827
UTR based on average capacity					62.4%	40.1%	28.8%	22.6%

Source: Baiinfo, Ze Consulting, SMM, BofA Global Research estimates

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LMFP marketing proposition still uncertain

We find that the demand for LMFP is questionable, as it is not used in the entry models, which is usually the best-selling ones, and blended formulation with NMC means only partial usage of LMFP. At present, LMFP fails to address the two key concerns: battery cost of EV OEM and range anxiety of customers. During the 3Q conference call, Dynanonic revealed that LMFP battery was still being tested by Tesla, but mathematically, it did reduce the battery cost in terms of \$/kWh vs. LFP. Its missed appearance in the Tesla Model 3 Highland release earlier led us to re-examine the battery performance of LMFP without the NMC blending, as industry experts have been voicing mixed results. Before LMFP-only EV models reach the market, we stay conservative on the demand and margin prospects of LMFP. Even if LMFP-only batteries have been proven ultimately viable, the prolonged delay in mass commercialization also gives much room for competitors to catch up on their LMFP progress.

Anode: oversupply continues in 2024 (contributed by Jessie Lo)

Back in 2021-22, the industry experienced a serious shortage of graphitization (a key process of making synthetic graphite), resulting in price hikes for both graphitization processing fee and anode product. As more capacity rolled out, oversupply emerged and disrupted the pricing and profitability of anode suppliers in 2023. Most anode suppliers were suffering from destocking the high-cost inventory accumulated from 2022. As most existing suppliers have expanded in-house graphitization capacity, the graphitization price is close to the cost level, suggesting limited profit from this end. The market is still crowded, with existing suppliers and new suppliers emerging 2+ years ago. Looking into 2024, we believe that the oversupply will continue, which should continue to pressure pricing and profitability.

Looking more into the overseas market, even though local anode sourcing will be required in the US starting from 2025, we are skeptical if there could be sufficient supply outside China. First of all, there are limited anode suppliers overseas. Second, bringing new mines to commercial production in Europe could take 5+ years, depending on permits. Further, building new refining facilities would be highly energy intensive. Chinese suppliers are eager to enter markets outside China. BTR plans to build 80k tons anode capacity in Indonesia. Putailai plans to invest/build 100k tons synthetic graphite capacity in Sweden. Shanshan plans to build anode capacity of 100k tons in Finland.

Exhibit 53: Anode supply and demand in China

We believe that oversupply in anode will be even worse in 2024

	2020	2021	2022	2023E	2024E	2025E
China anode						
China capacity (supply)	850,000	1,400,000	1,522,020	2,680,000	3,820,000	4,800,000
China production	493,378	815,900	1,245,700	1,715,428	2,099,918	2,554,787
China shipment	435,387	720,000	1,099,282	1,513,799	1,853,096	2,254,500
EV	76,000	214,700	518,605	664,475	806,922	950,035
Consumer	48,735	56,050	61,750	67,925	74,718	82,189
ESS, others	15,390	45,600	42,750	90,942	142,909	228,019
Export	295,262	403,650	476,177	690,456	828,548	994,257
Utilization %	58%	58%	82%	64%	55%	53%

Exhibit 53: Anode supply and demand in China

We believe that oversupply in anode will be even worse in 2024

China anode	2020	2021	2022	2023E	2024E	2025E
China anode YoY	2020	2021	2022	2023E	2024E	2025E
China capacity (supply)	13%	65%	9%	76%	43%	26%
China production	124%	65%	53%	38%	22%	22%
China shipment	124%	65%	53%	38%	22%	22%
EV	13%	183%	142%	28%	21%	18%
Consumer	26%	15%	10%	10%	10%	10%
ESS, others	71%	196%	-6%	113%	57%	60%
Export	271%	37%	18%	45%	20%	20%

Source: RealLi, BofA Global Research estimates

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Electrolyte: oversupply issue persists into 2024, bottom for longer (contributed by Miriam Chan)

Based on our electrolyte supply/demand model, we expect the total demand for electrolyte to grow at around 40% per annum to 2.5mnt in 2025, vs. planned effective production capacity of 6.6mnt, indicating an oversupply issue. The electrolyte price has trended down by 61% in 2023 to RMB22k/t at spot, led by declining raw material prices and capacity ramp-up. The LiPF6 price was down 69% in 2023 to RMB76k/t at spot. Although margins have already dropped below the breakeven point for second/third tiers and new entrants, we expect the situation to continue into 2024. The current electrolyte capacity utilization rate is only 26%, and we are seeing new project delays.

Exhibit 54: BofA proprietary electrolyte supply/demand model

We expect the total demand for electrolyte to grow at around 40%p.a. to 2.5mnt in 2025, vs. planned effective production capacity of 6.6mnt, indicating an oversupply issue

Electrolyte	unit	2018	2019	2020	2021	2022	2023E	2024E	2025E
Electrolyte S/D									
Total global capacity- ex.Others		398	421	706	1,095	1,665	5,555	7,233	8,293
Effective electrolyte capacity- ex.Others kt		318	337	565	876	1,332	4,444	5,787	6,635
Global production	kt	212	268	334	563	1,043	1,316	1,867	2,540
Effective operation rate	%	67%	80%	59%	64%	78%	30%	32%	38%
Global electrolyte demand	kt	171	209	296	523	905	1,320	1,867	2,540
Ternary %	%	67%	67%	68%	64%	55%	48%	45%	41%
LFP %	%	13%	15%	16%	26%	38%	47%	51%	56%
Supply-Demand surplus/(deficit)	kt	41	59	38	40	138	(4)	-	-

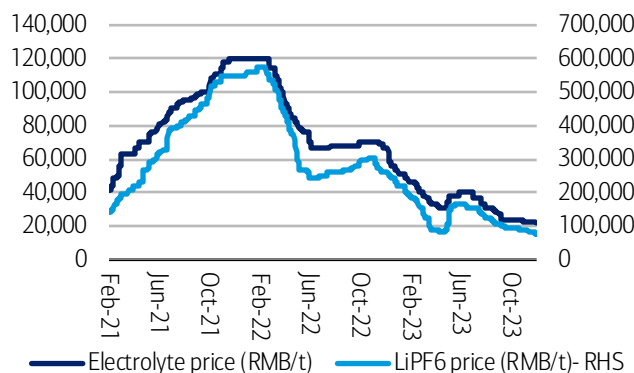
Source: Baichuan, GGII, ICCSino, SNE Research, EV tank, SPIR, Wind, Company data, BofA Global Research estimates

Note: We exclude non major players/ expected new entrants from the calculation of effective capacity

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Exhibit 55: China electrolyte price

Electrolyte price began to trend down since 1H22, led by declining raw material prices and capacity ramp-up

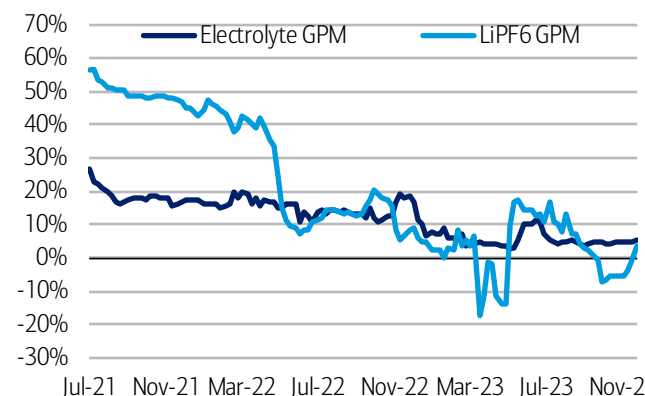


Source: BailInfo, Wind, BofA Global Research

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Exhibit 56: China electrolyte and LiPF6 gross margin

Electrolyte average margin is hovering at 5%, and LiPF6 margin recently rebounded to 4%

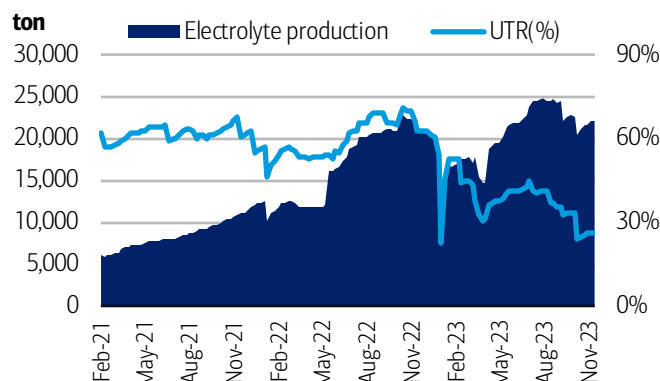


Source: BailInfo, BofA Global Research

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Exhibit 57: Electrolyte production and UTR

Currently, electrolyte UTR is only 26%

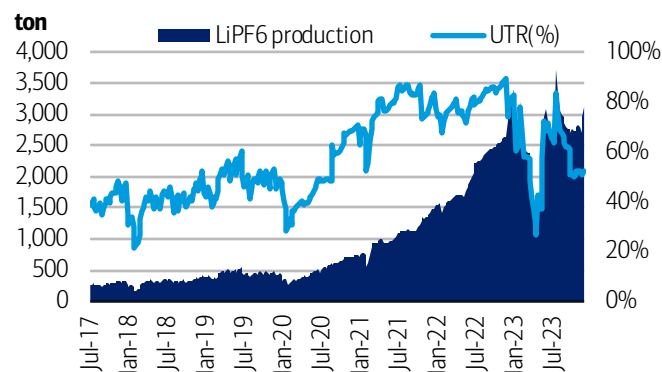


Source: Bailinfo, Wind, BofA Global Research

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Exhibit 58: LiPF6 production and UTR

Currently, LiPF6 UTR is 52%



Source: Bailinfo, Wind, BofA Global Research

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Separator – leading suppliers' fight for order, price continue to decline (contributed by Jessie Lo)

Despite the oversupply, the situation in the separator industry is not as serious as for other battery materials. Supply/demand dynamics still pushed the separator ASP down by at least 20%+ in 2023. Dry-process separators gained share over wet-process separators, and the demand for dry-process separators was supported by growing BYD battery demand and also energy storage system (ESS) battery demand in 2023. Looking into 2024, even though the oversupply might not worsen much, we believe that pricing competition will be fierce as 1) separator suppliers would like to secure orders from key clients and 2) overall gross margin still looks healthy. We believe that the separator ASP will continue to fall in 2024.

Looking at overseas market, we note that there are currently two Chinese suppliers expanding capacity: 1) Yunnan Energy has built a separator plant with 400mn square meters (sqm) of coating capacity in Hungary and 700mn sqm coated film in US, and 2) Shenzhen Senior invested in Sweden for both base-film and coated-film capacity and announced plans to invest a max of RMB5bn in building capacity in Malaysia.

Exhibit 59: Separator supply and demand in China

We still expect pricing pressure, despite comparably more balanced supply/demand in separator

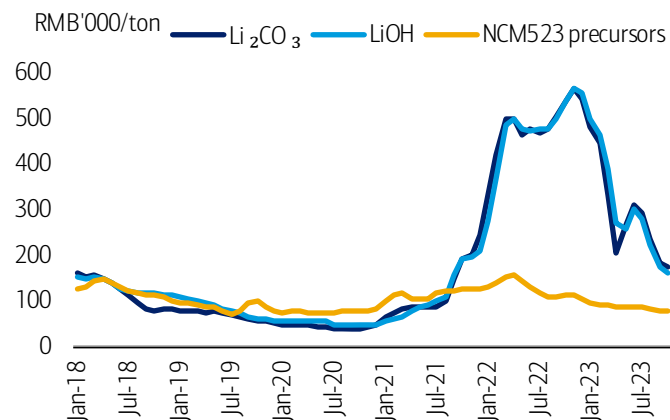
China separator	2020	2021	2022	2023E	2024E	2025E
China capacity (supply)	10,980	13,041	17,625	25,345	32,682	40,619
Capacity from major suppliers	7,905	9,505	16,225	23,525	30,225	37,425
Others	3,075	3,536	1,400	1,820	2,457	3,194
China production	3,492	7,379	15,234	19,234	23,292	28,369
Wet process	2,600	5,830	10,494	12,278	13,506	15,667
Dry process	892	1,549	4,740	6,956	9,786	12,701
China shipment	3,161	6,791	13,745	17,014	20,199	24,120
Utilization % (assume 20% discount)	40%	71%	108%	95%	89%	87%
China separator YoY	2020	2021	2022	2023E	2024E	2025E
China capacity (supply)	28%	19%	35%	44%	29%	24%
Capacity from major suppliers	41%	20%	71%	45%	28%	24%
Others	3%	15%	-60%	30%	35%	30%
China production	25%	111%	106%	26%	21%	22%
Wet process	24%	124%	80%	17%	10%	16%
Dry process	29%	74%	206%	47%	41%	30%
China shipment	22%	115%	102%	24%	19%	19%

Source: RealLi, BofA Global Research estimates

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Exhibit 60: Cathode raw material price trend

Lithium price fell dramatically in 2023

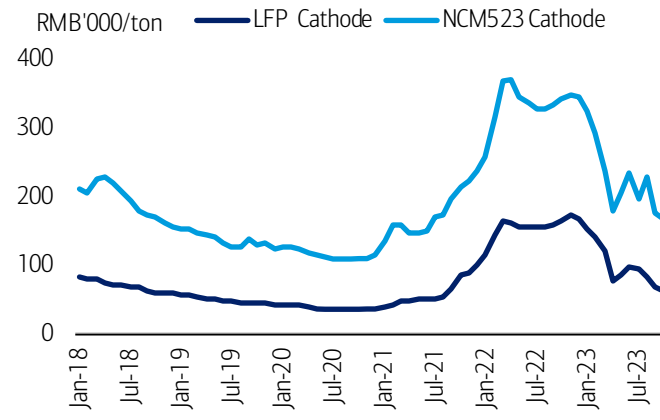


Source: RealLi, BofA Global Research

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Exhibit 61: Cathode price trend

Cathode price mainly fluctuated with lithium price

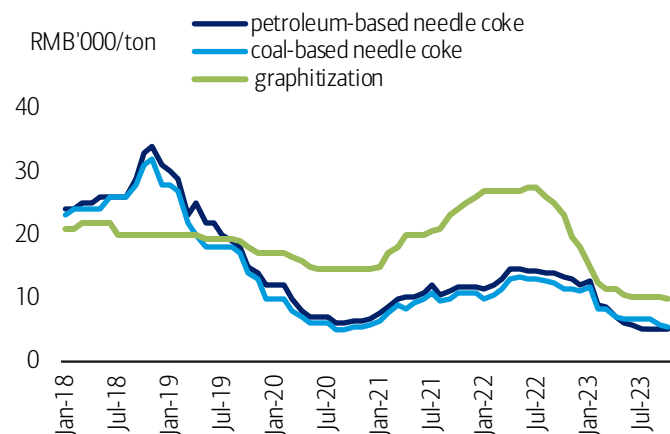


Source: RealLi, BofA Global Research

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Exhibit 62: Anode raw material price trend

Needle coke and graphitization price fell in 2023

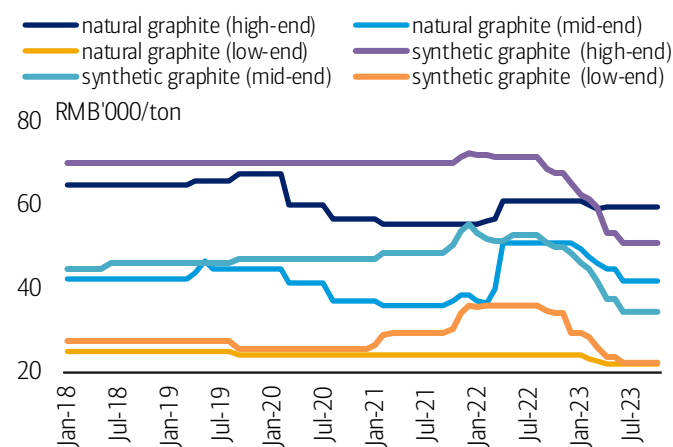


Source: RealLi, BofA Global Research

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Exhibit 63: Synthetic and natural graphite price trend

Graphite price declined along with materials price and oversupply

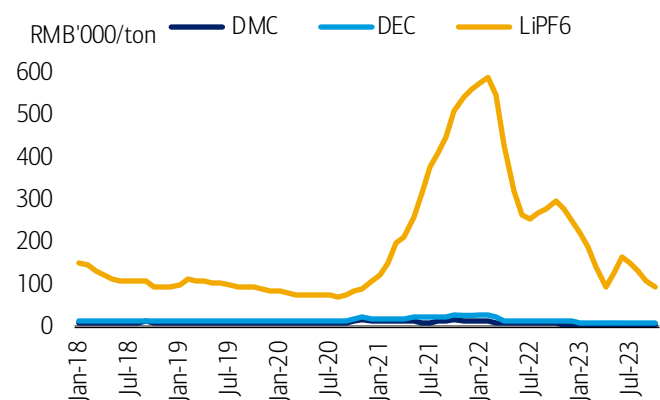


Source: RealLi, BofA Global Research

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Exhibit 64: Electrolyte raw material price trend

Electrolyte materials price dropped back to pre-hike level

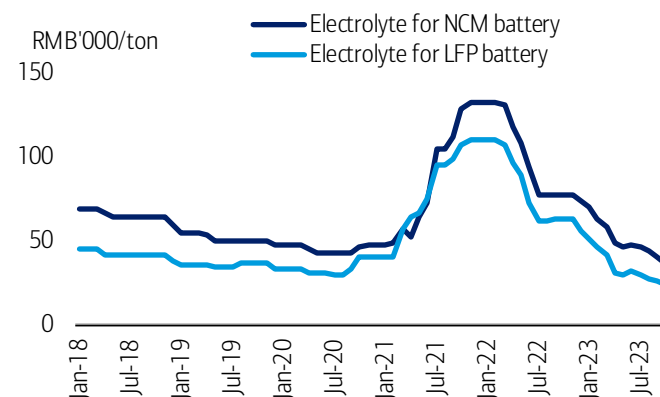


Source: RealLi, BofA Global Research

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Exhibit 65: Electrolyte price trend

Electrolyte price fell back to pre-hike level

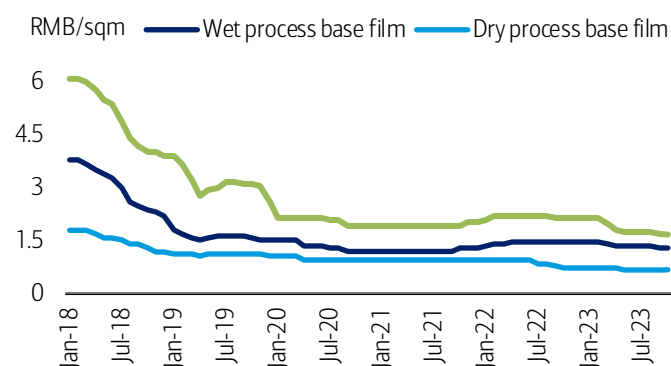


Source: RealLi, BofA Global Research

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Exhibit 66: Separator price trend

Separator price decline was milder than that for other battery materials



Source: RealLi, BofA Global Research

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Appendix: New model pipeline in 2024

Exhibit 67: New model pipeline in 2024

There are total 130 new models in late 2023 to 2024 based on our channel check

OEM	Brand	Model name	Vehicle type	ICEV/PHEV/BEV	Est. deliver time	Note	Vehicle size	MSRP (RMBk)
BAIC								
BAIC-Benz	Benz	E class	sedan	ICEV/PHEV	4Q23	Facelifted	B class	333.2-376.5k
BJEV								
BJEV-Huawei	Stelato	New model	Sedan	BEV	1H24	New model	B class	NA
BMW								
BMW	BMW	X2/iX2	SUV	ICEV/BEV	2024	New model	A class	NA
Brilliance BMW								
Brilliance-BMW	BMW	5 series	Sedan	BEV	1Q24	New generation	C class	NA
Brilliance-BMW	BMW	i5	Sedan	BEV	1Q24	New model	C class	NA
BYD								
BYD	Yang Wang	U9	Supercar	BEV	2024	New model	D class	NA
BYD	Yang Wang	U6	Supercar	BEV	2024	New model	NA	NA
BYD	Fang Cheng Bao	Bao 8	SUV	PHEV	2024	New model	C class	NA
BYD	Fang Cheng Bao	Bao 3	SUV	PHEV	2024	New model	B class	NA
BYD	BYD	Song L	SUV	BEV	4Q23	New model	B class	189.8-249.8k
BYD	BYD	Sea Lion	SUV	BEV	2024	New model	B class	NA
BYD	BYD	Qin L	Sedan	BEV/PHEV	2024	New model	A class	NA
BYD	BYD	Yuan up	SUV	BEV	2024	New model	A class	NA
BYD	BYD	Big Song	SUV	EV	2024	New model	B class	NA

Exhibit 67: New model pipeline in 2024

There are total 130 new models in late 2023 to 2024 based on our channel check

OEM	Brand	Model name	Vehicle type	ICEV/PHEV/BEV	Est. deliver time	Note	Vehicle size	MSRP (RMBk)
BYD	Denza	N7	SUV	BEV	2024	New version	B class	NA
BYD	Denza	NA	Sedan	NA	2024	New model	NA	NA
BYD	Denza	NA	Sedan	NA	2024	New model	NA	NA
Changan								
Changan own brand	Qiyuan	A06	Sedan	PHEV	4Q23-2024	New model	B class	NA
Changan own brand	Qiyuan	CD701	SUV	BEV	2024	New model	NA	NA
Changan own brand	Qiyuan	NA	SUV	BEV/PHEV	4Q24	New model	A class	NA
Changan own brand	Avatr	Avatr 12	Sedan	BEV	4Q23	New model	C class	300.8-400.8k
Changan own brand	Avatr	Avatr 12	Sedan	EREV	2024	New model	C class	NA
Changan own brand	Avatr	Avatr 15	SUV	EV	1H24	New model	B class	NA
Changan own brand	Avatr	Avatr 16	Sedan	EV	2H24	New model	B class	NA
Changan own brand	Deepal	SL03i	Sedan	BEV/EREV	4Q23	New version	B class	NA
Changan own brand	Deepal	S7i	SUV	BEV/EREV	4Q23	New version	B class	NA
Changan own brand	Deepal	C318	Off-road SUV	EREV	2024	New model	A class	NA
Chery								
Chery	Chery	Small Ant	Sedan	BEV	4Q23	Facelifted	A00 class	59.9-92.9k
Chery	Chery	Tiggo 9 C-DM	SUV	PHEV	4Q23-2024	Facelifted	B class	NA
Chery	iCar	iCar 03	SUV	BEV	4Q23-2024	New model	A class	129.8k+
Chery	Fengyun	A8	Sedan	PHEV	1Q24	New model	A0 class	NA
Chery	Fengyun	A9	Sedan	PHEV	2024	New model	B class	NA
Chery	Fengyun	T11	SUV	PHEV	2024	New model	C class	NA
Chery	Exeed	Sterra ES	Sedan	BEV/EREV	4Q23	New model	B class	226-340k
Chery	Exeed	Yaoguang C-DM	SUV	PHEV	1Q24	New model	A class	NA
Chery	Exeed	Sterra ET	SUV	BEV/EREV	1Q24	New model	B class	200-300k
Chery	Exeed	New model	SUV	BEV/EREV	2H24	New model	C class	NA
Chery-Huawei	Luxeed	S7	Sedan	BEV	4Q23	New model	C class	249.8-349.8k
Chery-Huawei	Luxeed	S9	SUV	BEV	2H24	New model	C class	NA
DFG								
DFG-Nissan	Nissan	Murano	SUV	ICEV	2024	New generation	C class	NA
DFG-Nissan	Venucia	NA	SUV	PHEV	2024	New model	NA	NA
DFG-Nissan	Venucia	NA	Sedan	BEV	2024	New model	NA	NA
DFG	Nami	Nami01	Sedan	BEV	2024	New model	A0 class	NA
DFG	eπ	eπ007	Sedan	BEV/EREV	2024	New model	C class	NA
DFG	Fengshen	NA	NA	PHEV	2024	New model	NA	NA
DFG	Fengshen	NA	NA	PHEV	2024	New model	NA	NA
DFG	VOYAH	NA	SUV	BEV/PHEV	2024	New model	B class	NA
DFG	Mengshi	M800	SUV	BEV/EREV	2024	New model	C class	NA
FAW VW								
FAW VW	VW	ID.7 Vizzion	SUV	BEV	4Q23	New model	B class	NA
FAW VW	VW	ID3	Sedan	BEV	1Q24	Facelifted	A class	NA
FAW VW	VW	Magotan	Sedan	ICEV	1H24	New generation	A class	NA
FAW Audi								
FAW Audi	Audi	Q6 e-tron	SUV	BEV	2024	New model	C class	NA
FAW Audi	Audi	A4	Sedan	NA	2024-25	New generation	A class	NA
FAW Toyota								
FAW Toyota	Toyota	Crown	Sedan	ICEV	1H24	New generation	B class	NA
FAW Toyota	Toyota	Prado	SUV	ICEV	2024	New model	B class	NA
FAW Toyota	Toyota	bZ Sport Crossover Concept	CUV	BEV	2024	New model	NA	NA
GAC								
GAC	Hyper	AH8	SUV	BEV	2024	New model	C class	NA
GAC	Aion	Aion S	Sedan	BEV	2024	New generation	A class	NA
GAC	Aion	Aion V	SUV	BEV	2024	New generation	A class	NA
GAC	Trumpchi	NA	SUV	PHEV	2H24	New model	C class	NA
GAC Honda	Honda	e:NP2	SUV	BEV	1H24	New model	A class	NA
GAC Honda	Honda	NA	NA	BEV	4Q24	New model	NA	NA
GAC Toyota	Toyota	Camry	Sedan	ICEV	2024	New generation	B-class	NA
GAC Toyota	Toyota	NA	SUV	BEV	2024	New model	A class	NA
Geely								
Geely	Galaxy	E8	Sedan	BEV	1Q24	New model	B class	NA
Geely	Galaxy	E7	SUV	BEV	2Q24	New model	A class	NA
Geely	Galaxy	E6	Sedan	BEV	3Q24	New model	A/A0 class	NA
Geely	Galaxy	L5	SUV	PHEV	2Q24	New model	A/A0 class	NA
Geely	Lynk & Co	Lynk 07	SUV	PHEV	2024	New model	A class	NA
Geely	Lynk & Co	NA	Sedan	BEV	2024	New model	NA	NA

Exhibit 67: New model pipeline in 2024

There are total 130 new models in late 2023 to 2024 based on our channel check

OEM	Brand	Model name	Vehicle type	ICEV/PHEV/BEV	Est. deliver time	Note	Vehicle size	MSRP (RMBk)
Geely	Zeekr	NA	MPV	BEV	2024	New model	NA	NA
Geely	Zeekr	NA	SUV	BEV	2024	New model	B class	NA
GWM								
GWM	Tank	Tank 700	SUV	ICEV/PHEV	2Q24	New model	C class	NA
GWM	Tank	Tank 800	SUV	ICEV/PHEV	2H24	New model	D class	NA
GWM	Tank	Tank 300	SUV	PHEV	1Q24	New model	B class	NA
GWM	Ora	New model	Sedan	BEV	2H24	New model	C class	NA
GWM	Ora	New model	SUV	BEV	2H24	New model	A class	NA
GWM	Haval	H6	SUV	PHEV	3Q24	Facelifted	A class	NA
GWM	Haval	Xiaolong Max	SUV	PHEV	2Q24	New generation	B class	NA
GWM	Haval	H9	SUV	ICEV	1Q24	New generation	B class	NA
GWM	WEY	Lanshan	SUV	PHEV	2Q24	New generation	C class	NA
GWM	WEY	Latte	SUV	PHEV	1Q24	New generation	A class	NA
GWM	WEY	Mocha	SUV	PHEV	1Q24	Facelifted	B class	NA
GWM	WEY	New model	SUV	BEV	2H24	New model	NA	
GWM	Pao	Great Wall Pao	Pickup truck	ICEV	2024	New generation	NA	NA
GWM	Pao	Great Wall Pao	Pickup truck	PHEV	2024	New model	NA	NA
JAC								
JAC-Huawei	Aojie	Ultimate Design series	MPV	BEV	1H24	New model	C class	NA
Leap								
Leap	Leap	C10	SUV	BEV/EREV	1Q24	New model	B class	NA
Leap	Leap	C16	SUV	BEV/EREV	3Q24	New model	C class	NA
Li								
Li	Li	Mega	MPV	BEV	1Q24	New model	C class	> 500k
Li	Li	L6	SUV	EREV	2Q24	New model	NA	NA
Li	Li	NA	SUV	BEV	2H24	New model	NA	NA
Li	Li	NA	SUV	BEV	2H24	New model	NA	NA
Li	Li	NA	SUV	BEV	2H24	New model	NA	NA
NIO								
NIO	Alps	New model	Sedan	BEV	2H24	New model	NA	200-300k
SAIC								
SAIC-VW	VW	ID. NEXT	SUV	BEV	3Q24	New model	B class	NA
SAIC-VW	VW	Passat	Sedan	ICEV	3Q24	New generation	B class	NA
SAIC-VW	VW	Tiguan	SUV	ICEV	3Q24	New generation	A class	NA
SAIC-VW	VW	Teramont	SUV	ICEV	4Q24	New generation	C class	NA
SAIC-GM	Cadillac	XT5	SUV	ICEV	1Q24	New generation	B class	NA
SAIC-GM	Cadillac	New model	SUV	BEV	2Q24	New model	NA	NA
SAIC-GM	Buick	Enclave	SUV	PHEV	3Q24	New model	B class	NA
SAIC-GM	Buick	GL8	MPV	PHEV	3Q24	New model	C class	NA
SAIC-GM	Chevrolet	New model	SUV	BEV	3Q24	New model	NA	NA
SAIC-GM	Chevrolet	Blazer	SUV	HEV	1Q24	New model	B class	NA
SAIC-GM Wuling	SAIC-GM Wuling	Bingo	Sedan	BEV	1Q24	Facelifted	A0 class	NA
SAIC-GM Wuling	SAIC-GM Wuling	New model	Sedan	BEV	1Q24	New model	NA	NA
SAIC-GM Wuling	SAIC-GM Wuling	2B logistic car	CV	BEV	1H24	New model	NA	NA
SAIC-GM Wuling	SAIC-GM Wuling	EQ-2 version	Sedan	BEV	3Q24	New model	B class	NA
SAIC-GM Wuling	SAIC-GM Wuling	Xingguang	Sedan	PHEV/BEV	4Q23	New model	B class	89-106k
SAIC-GM Wuling	SAIC-GM Wuling	Mini (cheaper version)	Sedan	BEV	2024	New model	A00 class	NA
SAIC-PV	R Auto	F7	Sedan	BEV	2Q24	Facelifted	B class	NA
SAIC-PV	R Auto	New model	SUV	BEV	3Q24	New model	NA	NA
SAIC-PV	R Auto	R7	SUV	BEV	3Q24	New generation	SUV	NA
SAIC-PV	IM	L6	Sedan	BEV	1Q24	New model	NA	NA
SAIC-PV	IM	L7	Sedan	BEV	1Q24	New generation	B class	NA
SAIC-PV	IM	LS7	SUV	BEV	2H24	New generation	B class	NA
SAIC-PV	IM	LS6	SUV	BEV	2H24	New generation	B class	NA
SAIC-PV	Roewe	D7	Sedan	PHEV/BEV	4Q23	New generation	B class	123-171k
SAIC-PV	Roewe	D5X	SUV	PHEV/BEV	2Q24	New model	A class	NA
SAIC-PV	Roewe	IMAX8	MPV	PHEV	3Q24	New model	B class	NA
SAIC-PV	MG	MG5	Sedan	ICEV	1Q24	New generation	A class	NA
SAIC-PV	MG	New model	SUV	BEV	4Q24	New model	A class	NA
Seres								
Seres-Huawei	AITO	M9	SUV	BEV/EREV	1Q24	New model	D class	469.8-569.8k
Seres-Huawei	AITO	M8	SUV	BEV/EREV	1Q24	New model	C class	NA
Xiaomi								

Exhibit 67: New model pipeline in 2024

There are total 130 new models in late 2023 to 2024 based on our channel check

OEM	Brand	Model name	Vehicle type	ICEV/PHEV/BEV	Est. deliver time	Note	Vehicle size	MSRP (RMBk)
Xiaomi	Xiaomi	SU7	Sedan	BEV	2024	New model	C class	NA
XPeng								
XPeng	XPeng	X9	MPV	BEV	1Q24	New model	C class (7-seater)	359.8-419.8k
XPeng	XPeng	NA	NA	BEV	2H24	New model	NA	NA
XPeng	XPeng	NA	NA	BEV	2H24	New model	NA	NA
XPeng	Mona	NA	Sedan	BEV	2H24	New model	A class	NA

Source: Company data

BofA GLOBAL RESEARCH

Exhibit 68: Stocks mentioned

Prices and ratings for stocks mentioned in this report

BofA Ticker	Bloomberg ticker	Company name	Price	Rating
HSAI	HSAI US	Hesai	US\$ 7.85	C-1-9
LAAOF	2015 HK	Li Auto	HK\$ 131	C-1-9
LI	LI US	Li Auto	US\$ 33	C-1-9

Source: BofA Global Research

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Exhibit 69: Abbreviations

We list abbreviations used in the report

Abbreviation	Description
ADAS	Advanced driver assistance systems
AR-HUD	augmented-reality head-up display
ASP	Average selling price
BEV	Battery electric vehicle
BOM	Bill of materials
CAAM	China association of automobile manufacturer
CEV	Commercial electric vehicle
CTB	Cell to body
CTC	Cell to chassis
CTP	Cell to pack
CV	Commercial vehicle
DCU	Domain control unit
DHT	Dual-motor hybrid technology
E/E	Electrical/Electronic
ECU	Electronic control unit
EREV	Extended-range electric vehicle
ESS	Energy storage system
EV	Electric vehicle
FEOC	Foreign entity of concern
FePO ₄	Iron phosphate
FSD	Full self-driving
GWh	Gigawatt hour
HD	High definition
HI	Huawei inside
ICEV	Internal combustion engine vehicle
CV	Intelligent connected vehicle
DD	Intelligent Dual Drive
RA	Inflation Reduction Act
LCV	Light commercial vehicle
K	Thousand
kWh	Kilowatt hour
LFP	Lithium iron phosphate
Li ₂ CO ₃	Lithium carbonate
LiDAR	Light detection and ranging
LiFSI	Lithium Bis(fluorosulfonyl)imide
LiOH	Lithium hydroxide
LiPF ₆	Lithium hexafluorophosphate
LMFP	Lithium manganese iron phosphate
MDC	Multi-datacenter controller
MWh	Megawatt hour
NCA	Navigation cruise assist
NEV	New energy vehicle
NMC/ NCM	Nickel manganese cobalt
NOA	Navigate on autopilot
NP/t	Net profit per ton
NPAT	Net profit after tax
OEM	Original equipment manufacturer
PEV	Passenger electric vehicle
PHEV	Plug-in hybrid electric vehicle
PV	Passenger vehicle
JTR	Utilization rate
VAT	Value-added tax
v.s.	Versus
XNGP	XPeng - Navigation guided pilot

Source: BofA Global Research

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Price objective basis & risk

Hesai (HSAI)

Our PO of USD16 is based on average from DCF valuation and EV/sales valuation.

DCF valuation methodology:

The fair value of USD15.2 is derived from our DCF calculation, with an assumption of 2% FCF perpetuity growth and 15.3% WACC. We come up with WACC of 15.3%, consisting of 2.7% risk free rate and 12% expected market return. Lastly, we assigned 3.5% perpetual growth rate to the company, which is reasonable, in our view, given the overall LiDAR penetration in ADAS is still relatively low and CAGR growth could be sustained in longer term.

EV/Sales methodology:

The fair value of USD16.8 is derived from our EV/sales valuation, as we assign 4x EV/sales to Hesai's 2024E sales, in line with its peers' average. We believe that Hesai deserves a valuation premium considering its leading position in the industry (market share in terms of shipment, order gain), superior margins, faster breakeven timeline, and stronger B/S management. This characteristic set Hesai a solid foundation to survive through industry shuffling and remain as one of the top suppliers in the segment. However, this is offset by the stock's low liquidity, resulting in a peers' average multiple.

Risk: client concentration, ASP/GPM downside, slower EV/ smart vehicle growth

Li Auto (LI / LAAOF)

We derive our PO of USD55 per ADS (HKD215 per share) using an average of EV/sales valuation method and DCF valuation method.

DCF-based fair value: We derive a fair value of USD57.7 from our DCF calculation, with assumptions of 2% FCF perpetuity growth. For WACC, we use a 4.0% risk-free rate, 12% market return and Beta of 1.1 to calculate and derive the discount rate (WACC) of 12.2%.

EV/sales-based fair value: We derive a fair value of USD53 from our DCF calculation. We apply a target EV/sales multiple of 1.6x to 2024E sales. The 1.6x target multiple is based on updated one standard deviation below historical average one-year forward EV/sales since IPO.

Downside risk: weak macro, competition from Tesla and other EV startups, policy change on subsidy, raw material cost hike.

Analyst Certification

We, Ming Hsun Lee, CFA and Jessie Lo, hereby certify that the views each of us has expressed in this research report accurately reflect each of our respective personal views about the subject securities and issuers. We also certify that no part of our respective compensation was, is, or will be, directly or indirectly, related to the specific recommendations or view expressed in this research report.

APR - Autos Coverage Cluster

Investment rating	Company	BofA Ticker	Bloomberg symbol	Analyst
BUY				
	Aima Technology	XHBF	603529 CH	Joey Yang, CFA
	Ashok Leyland	XDBVF	AL IN	Gunjan Prithyani
	Bajaj Auto	XBJBF	BJAUT IN	Gunjan Prithyani
	BYD	BYDDF	1211 HK	Ming Hsun Lee, CFA
	BYD	XYMPF	002594 CH	Ming Hsun Lee, CFA
	BYD	BYDDY	BYDDY US	Ming Hsun Lee, CFA
	CATL	XMOQF	300750 CH	Ming Hsun Lee, CFA
	DENSO	DNZOF	6902 JP	Kei Nihonyanagi
	Desay SV	XGDFF	002920 CH	Jessie Lo
	EVE	XEVF	300014 CH	Ming Hsun Lee, CFA
	Fuyao Glass	XFGIF	600660 CH	Edward Leung, CFA
	Fuyao Glass	FIGIF	3606 HK	Edward Leung, CFA
	GAC	GNZUF	2238 HK	Ming Hsun Lee, CFA
	Great Wall Motor	GWLLF	2333 HK	Ming Hsun Lee, CFA
	GS Yuasa	GYUAF	6674 JP	Kentaro Hosoda
	Hankook Tire	XHTRF	161390 KS	KJ Hwang
	Hero Motocorp	HRHDF	HMCL IN	Gunjan Prithyani
	Hesai	HSAL	HSAL US	Jessie Lo
	HL Mando	XMADF	204320 KS	KJ Hwang
	Honda Motor	HMC	HMC US	Kei Nihonyanagi
	Honda Motor	HNDAF	7267 JP	Kei Nihonyanagi
	Huayu	XHASF	600741 CH	Jessie Lo
	Hyundai Motor	HYMLF	005380 KS	KJ Hwang
	Isuzu Motors	ISUZF	7202 JP	Kei Nihonyanagi
	Leapmotor	XZSSF	9863 HK	Ming Hsun Lee, CFA
	Li Auto	LI	LI US	Ming Hsun Lee, CFA
	Li Auto	LAAOF	2015 HK	Ming Hsun Lee, CFA
	Maruti	MUDGF	MSIL IN	Gunjan Prithyani
	Mazda Motor	MZDAF	7261 JP	Kei Nihonyanagi
	Minth	MNTHF	425 HK	Jessie Lo
	Nissan Motor	NSANF	7201 JP	Kei Nihonyanagi
	Nissan Motor	NSANY	NSANY US	Kei Nihonyanagi
	PARK24	PKCOF	4666 JP	Kei Nihonyanagi
	SAMIL (Motherson International)	XMSUF	MOTHERSO IN	Gunjan Prithyani
	Shenzhen Kedali	XWCSF	002850 CH	Jessie Lo
	Shuanghuan Driveline	XZSHF	002472 CH	Jessie Lo
	Sumitomo Rubber Industries	SMTUF	5110 JP	Kentaro Hosoda
	Suzuki Motor	SZKMF	7269 JP	Kei Nihonyanagi
	Tata Motors	XTTSF	TTMT IN	Gunjan Prithyani
	Toyo Tire	TOTTF	5105 JP	Kentaro Hosoda
	Toyota Motor	TOYOF	7203 JP	Kei Nihonyanagi
	Toyota Motor	TM	TM US	Kei Nihonyanagi
	Wuxi Lead	XZSRF	300450 CH	Ming Hsun Lee, CFA
	XPeng Inc	XPEV	XPEV US	Ming Hsun Lee, CFA
	XPeng Inc.	XPNGF	9868 HK	Ming Hsun Lee, CFA
	Yadea	YADGF	1585 HK	Joey Yang, CFA
	Yongda	CYYHF	3669 HK	Joey Yang, CFA
	Yunnan Energy	XLGFF	002812 CH	Jessie Lo
	Zhejiang Sanhua	XZSIF	002050 CH	Jessie Lo
	Zhongsheng Auto	ZHSHF	881 HK	Joey Yang, CFA
NEUTRAL				
	Aisin	ASEKF	7259 JP	Kei Nihonyanagi
	Bridgestone	BRDCF	5108 JP	Kei Nihonyanagi
	Bridgestone	BRDCY	BRDCY US	Kei Nihonyanagi
	CALB	XCLSF	3931 HK	Ming Hsun Lee, CFA
	Dong Feng	DNFGF	489 HK	Ming Hsun Lee, CFA
	Eicher Motors	XEIMF	EIM IN	Gunjan Prithyani
	Hino Motors	HINOF	7205 JP	Kei Nihonyanagi
	Hyundai Mobis	HYPLF	012330 KS	KJ Hwang
	Kia Corp	KIMTF	000270 KS	KJ Hwang
	Mahindra & Mahindra (M&M)	XKQRF	MM IN	Gunjan Prithyani
	MeiDong Auto	CMEIF	1268 HK	Joey Yang, CFA
	Mitsubishi Motors	MMTOF	7211 JP	Kei Nihonyanagi

APR - Autos Coverage Cluster

Investment rating	Company	BofA Ticker	Bloomberg symbol	Analyst
	Motherson Sumi Wiring	XMWDF	MSUMI IN	Gunjan Prithyani
	NIO	NIO	NIO US	Ming Hsun Lee, CFA
	NIO	NIOIF	9866 HK	Ming Hsun Lee, CFA
	NIO	XLTFW	NIO SP	Ming Hsun Lee, CFA
	Shenzhen Senior	XHYRF	300568 CH	Jessie Lo
	Subaru Corp	FUJHF	7270 JP	Kei Nihonyanagi
	Subaru Corp	FUJHY	FUJHY US	Kei Nihonyanagi
	Toyota Industries Corporation	TYIDF	6201 JP	Kentaro Hosoda
	Toyota Industries Corporation	TYIDY	TYIDY US	Kentaro Hosoda
	TVS Motors	XFKMF	TVSL IN	Gunjan Prithyani
	Wencan	XSCDF	603348 CH	Joey Yang, CFA
	Yokohama Rubber	YORUF	5101 JP	Kentaro Hosoda

UNDERPERFORM

	Astra International	PTAIF	ASII IJ	Paul Dewberry
	BAIC Motor	BMCLF	1958 HK	Ming Hsun Lee, CFA
	Bharat Forge	XUUVF	BHFC IN	Gunjan Prithyani
	China Grand Auto	XMURF	600297 CH	Joey Yang, CFA
	Escorts Kubota	XSCOF	ESCORTS IN	Gunjan Prithyani
	GAC	XGNHF	601238 CH	Ming Hsun Lee, CFA
	Great Wall Motor	XGWMF	601633 CH	Ming Hsun Lee, CFA
	Hyundai Wia	XWHYF	011210 KS	KJ Hwang
	Joyson	XQMWF	600699 CH	Jessie Lo
	Nextage	XIOIF	3186 JP	Kentaro Hosoda
	Nexteer	NTXVF	1316 HK	Jessie Lo
	Putailai	XVHGF	603659 CH	Jessie Lo
	SAIC Motor	XZJNF	600104 CH	Ming Hsun Lee, CFA
	Sona Comstar	XBNXF	SONACOMS IN	Gunjan Prithyani
	Tinci Materials	XCVHF	002709 CH	Miriam Chan, CFA
	Yamaha Motor	YAMHF	7272 JP	Kei Nihonyanagi

RVW

	Geely	GELYF	175 HK	Ming Hsun Lee, CFA
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Disclosures

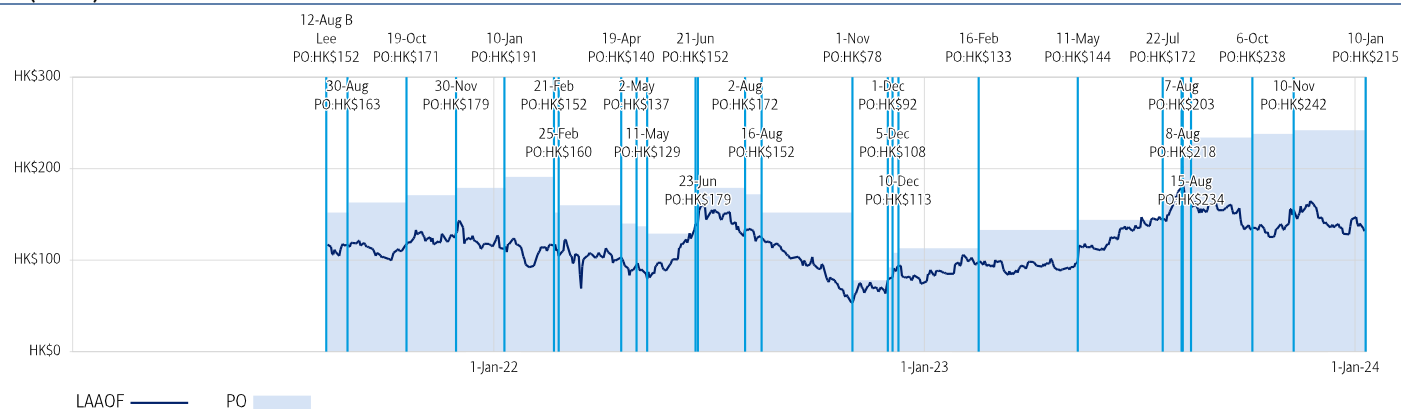
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Hesai (HSAI) Price Chart



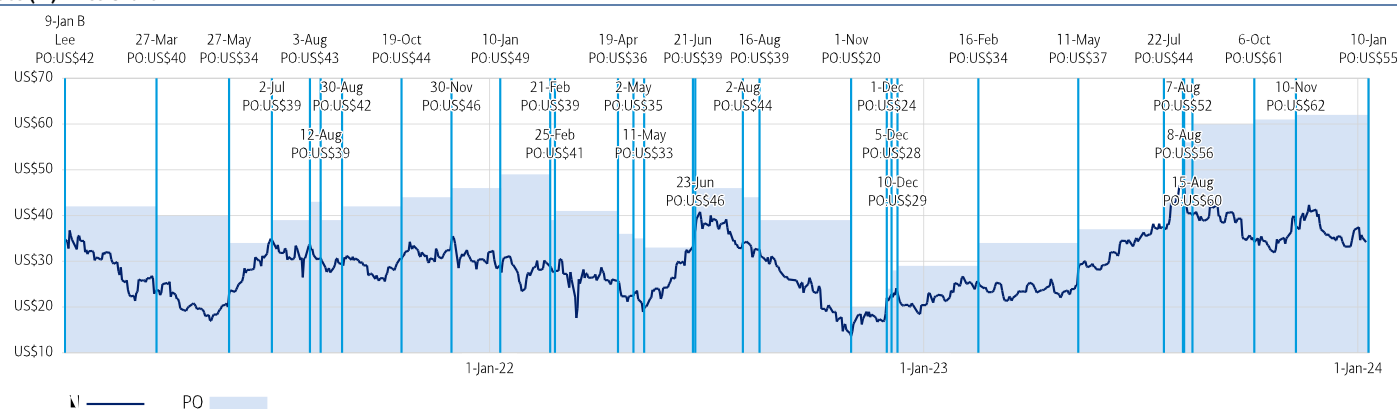
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The Investment Opinion System is contained at the end of the report under the heading "Fundamental Equity Opinion Key". Dark grey shading indicates the security is restricted with the opinion suspended. Medium grey shading indicates the security is under review with the opinion withdrawn. Light grey shading indicates the security is not covered. Chart is current as of a date no more than one trading day prior to the date of the report.

Li Auto (LAAOF) Price Chart

B: Buy, N: Neutral, U: Underperform, PO: Price Objective, NA: No longer valid, NR: No Rating

The Investment Opinion System is contained at the end of the report under the heading "Fundamental Equity Opinion Key". Dark grey shading indicates the security is restricted with the opinion suspended. Medium grey shading indicates the security is under review with the opinion withdrawn. Light grey shading indicates the security is not covered. Chart is current as of a date no more than one trading day prior to the date of the report.

Li Auto (LI) Price Chart

B: Buy, N: Neutral, U: Underperform, PO: Price Objective, NA: No longer valid, NR: No Rating

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Coverage Universe	Count	Percent	Inv. Banking Relationships ^{R1}	Count	Percent
Buy	67	55.83%	Buy	39	58.21%
Hold	30	25.00%	Hold	15	50.00%
Sell	23	19.17%	Sell	12	52.17%

Equity Investment Rating Distribution: Chemicals Group (as of 31 Dec 2023)

Coverage Universe	Count	Percent	Inv. Banking Relationships ^{R1}	Count	Percent
Buy	66	47.83%	Buy	33	50.00%
Hold	33	23.91%	Hold	16	48.48%
Sell	39	28.26%	Sell	20	51.28%

Equity Investment Rating Distribution: Global Group (as of 31 Dec 2023)

Coverage Universe	Count	Percent	Inv. Banking Relationships ^{R1}	Count	Percent
Buy	1895	53.62%	Buy	1083	57.15%
Hold	832	23.54%	Hold	454	54.57%
Sell	807	22.84%	Sell	383	47.46%

^{R1} Issuers that were investment banking clients of BofA Securities or one of its affiliates within the past 12 months. For purposes of this Investment Rating Distribution, the coverage universe includes only stocks. A stock rated Neutral is included as a Hold, and a stock rated Underperform is included as a Sell.

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Neutral	≥ 0%	≤ 30%
Underperform	N/A	≥ 20%

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