



Think Energy and Environment

Quarterly Market Dynamics for EV & Battery

- 1Q 2023

SAMPLE

May 2023

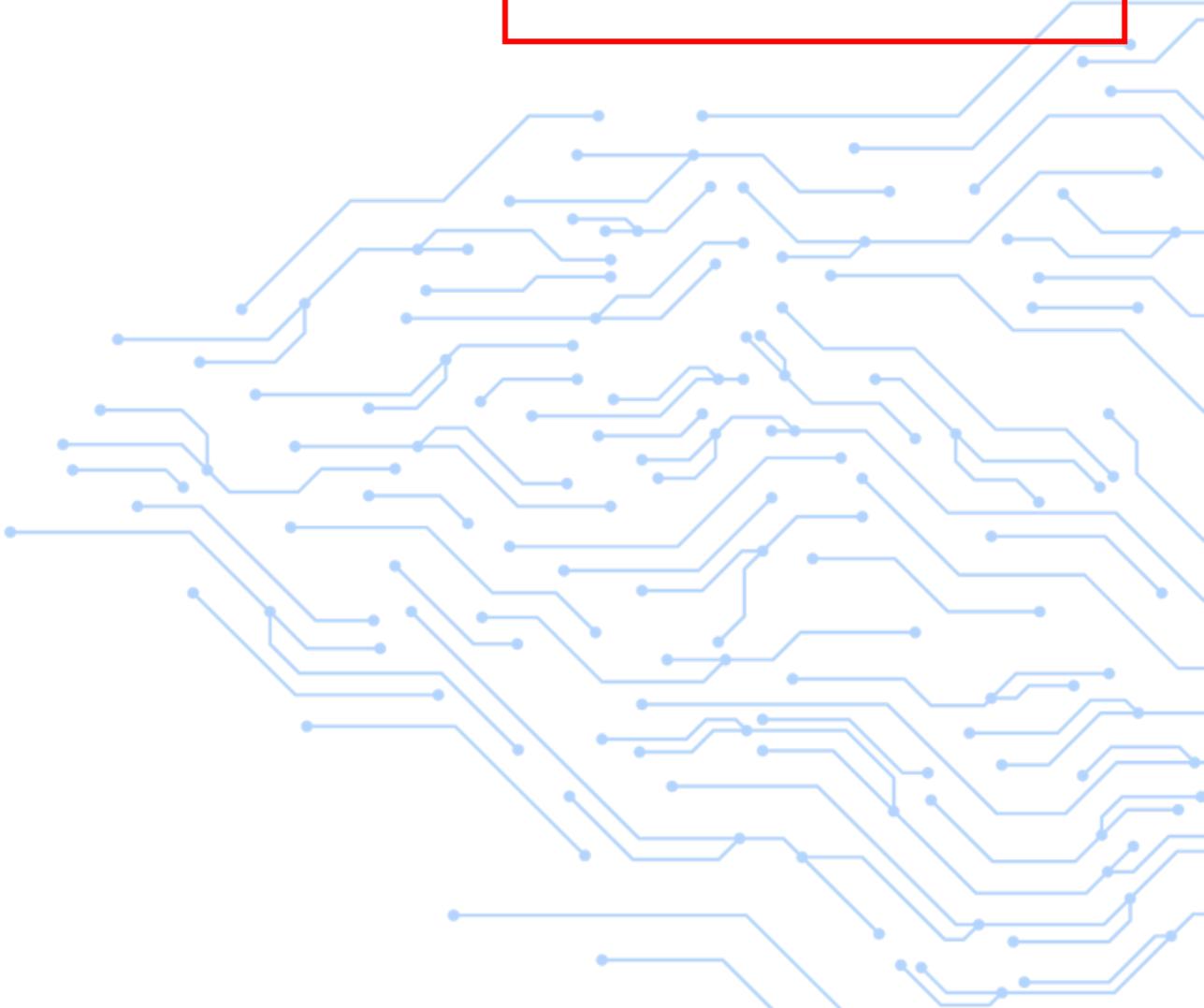


SAMPLE

1 EV Market Review & Outlook

2 EV Battery Installation Analysis

3 Look Inside

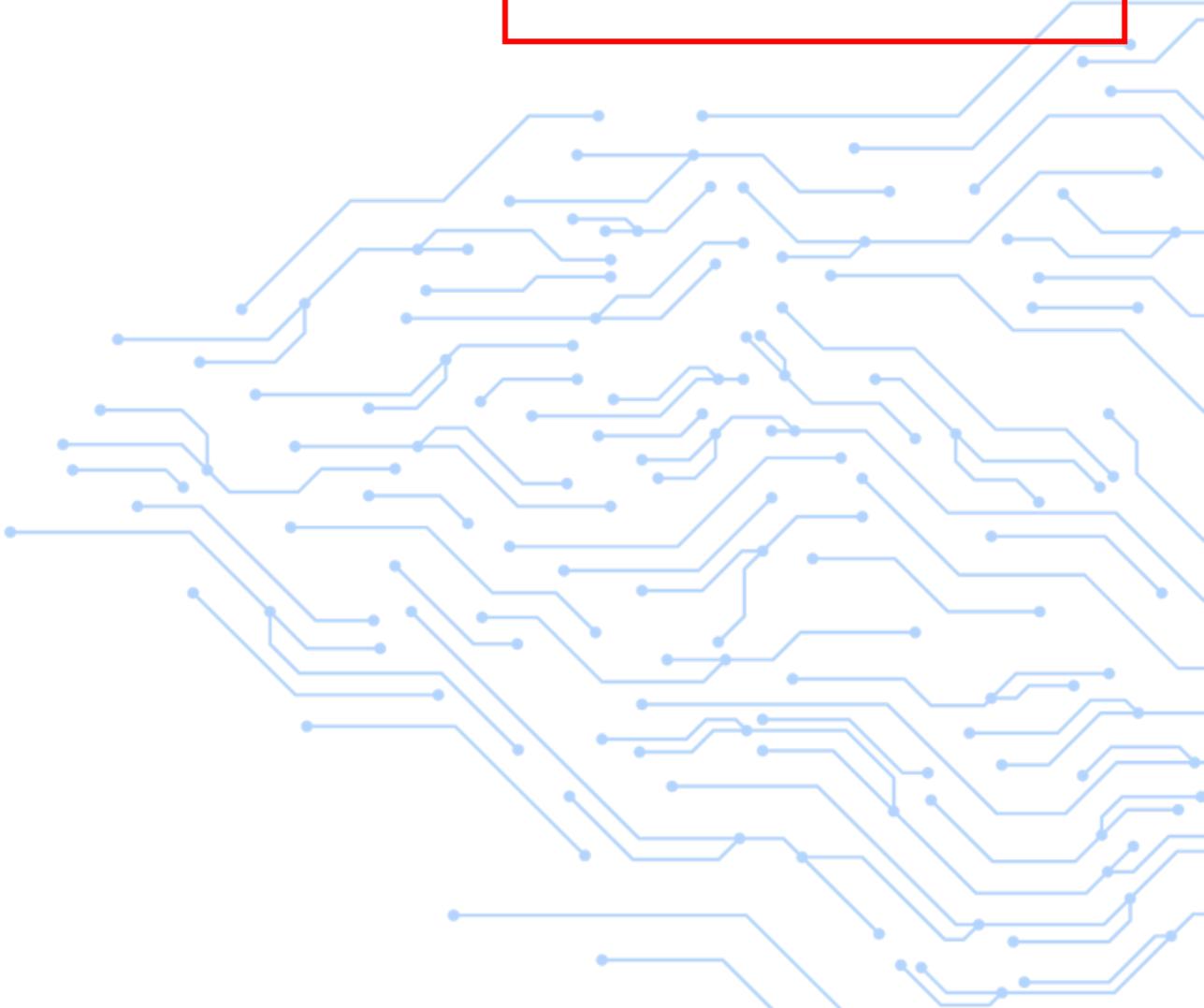




1 EV Market Review & Outlook

2 EV Battery Installation Analysis

3 Look Inside





1.1 EV Market Review Q1 2023 – Global

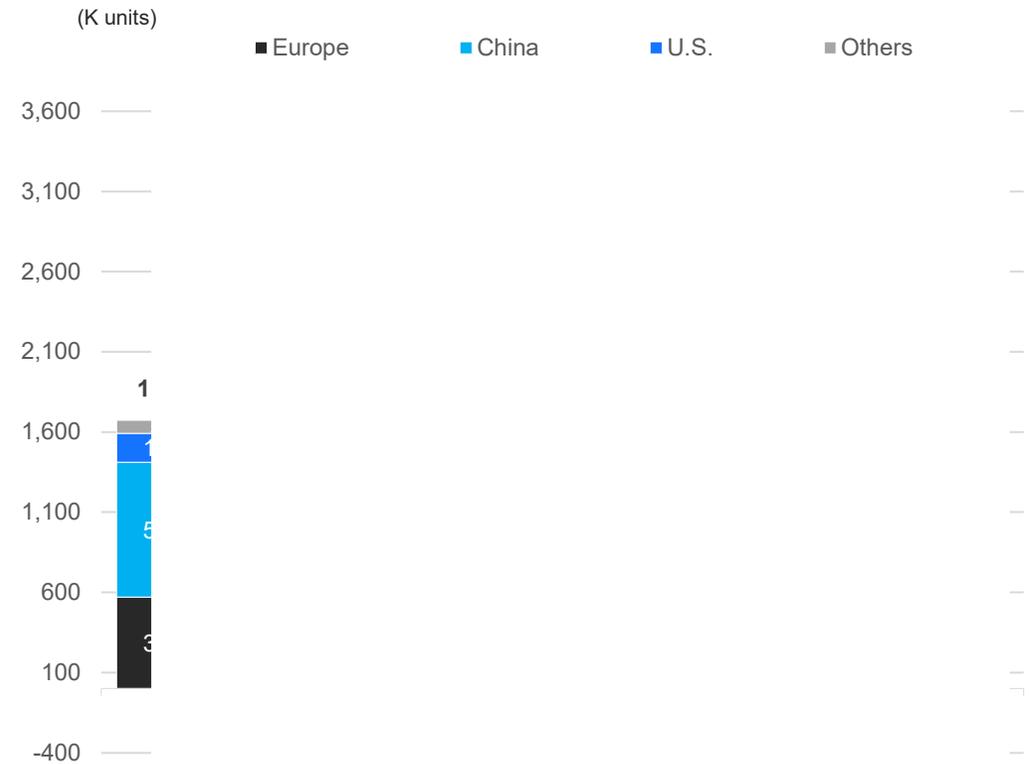
- In 2023, the global EV sales saw a XX% YoY growth. The growth in different regions are as follows: US (+XX%,YoY) Others (+XX%,YoY) China (+XX%,YoY), and Europe (+XX%,YoY) according to their growth rate. On the other hand, compared to the previous quarter, XX (-XX%, QoQ) and XX (-XX%, QoQ) experienced a decrease in sales. Even at the global level, the QoQ growth was -XX%.
- EV penetration rate posted XX%. During Q1, XX took up XX%, XX XX%, and the XX XX% of the entire market.



Global EV Market Review Q4 2022

(K units)	Q1 2022	Q4 2022	Q1 2023	YoY (%)	QoQ (%)
Global	2,074	2,500	2,707	(XX)	(-XX)
BEV					
PHEV					
Europe					
BEV					
PHEV					
China					
BEV					
PHEV					
U.S.					
BEV					
PHEV					
Others					
BEV					
PHEV					

Plug-In EV(BEV+PHEV) Sales By Region



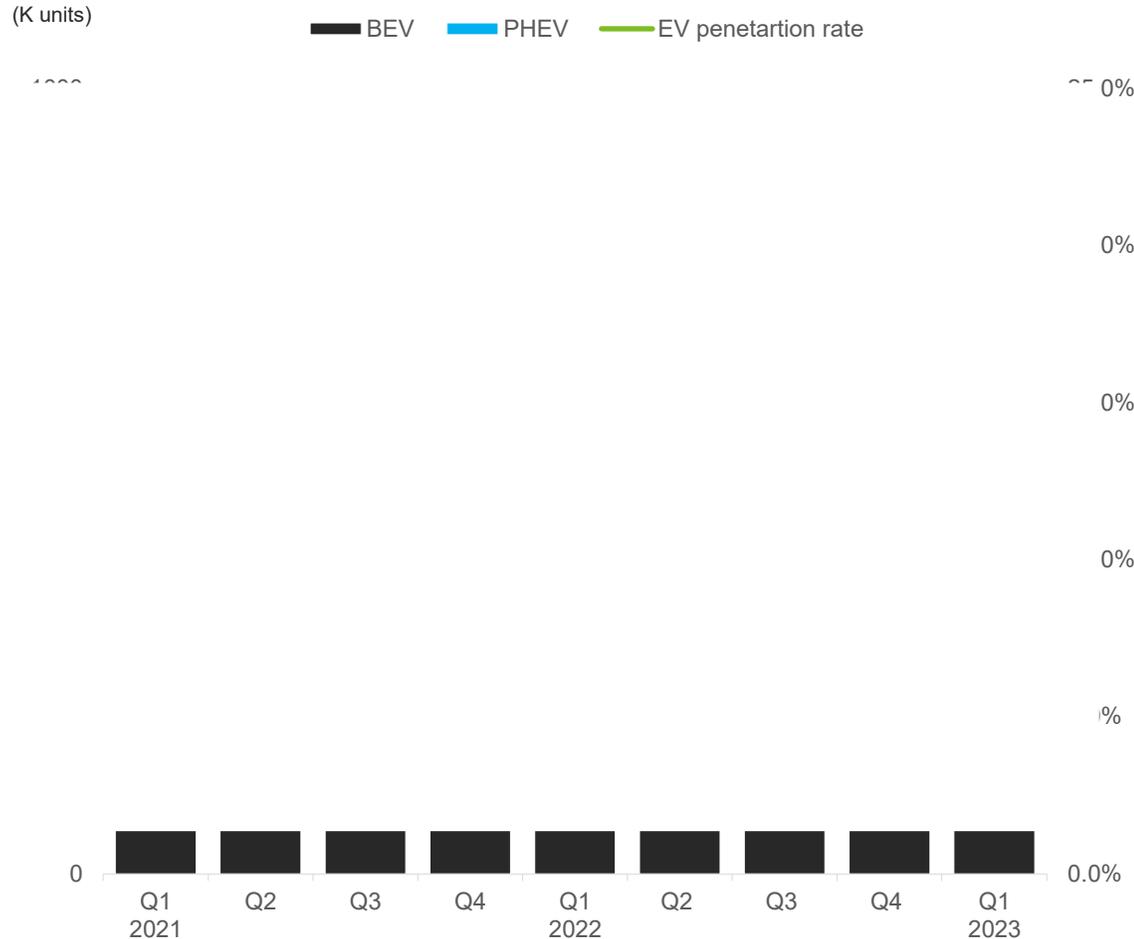
Source: SNE Research

EV penetration rate



1.1 EV Market Review Q1 2023 – Europe

Plug-In EV(BEV+PHEV) Sales In Europe (Q1 2023)



Source: SNE Research



The EV sales in Europe during Q1 2023 recorded around XXX units, a YoY +XX% and QoQ XX% growth. The EV penetration rate was XX%, XXX from Q4 2022.

Key points in 1Q 2023 are as follows :

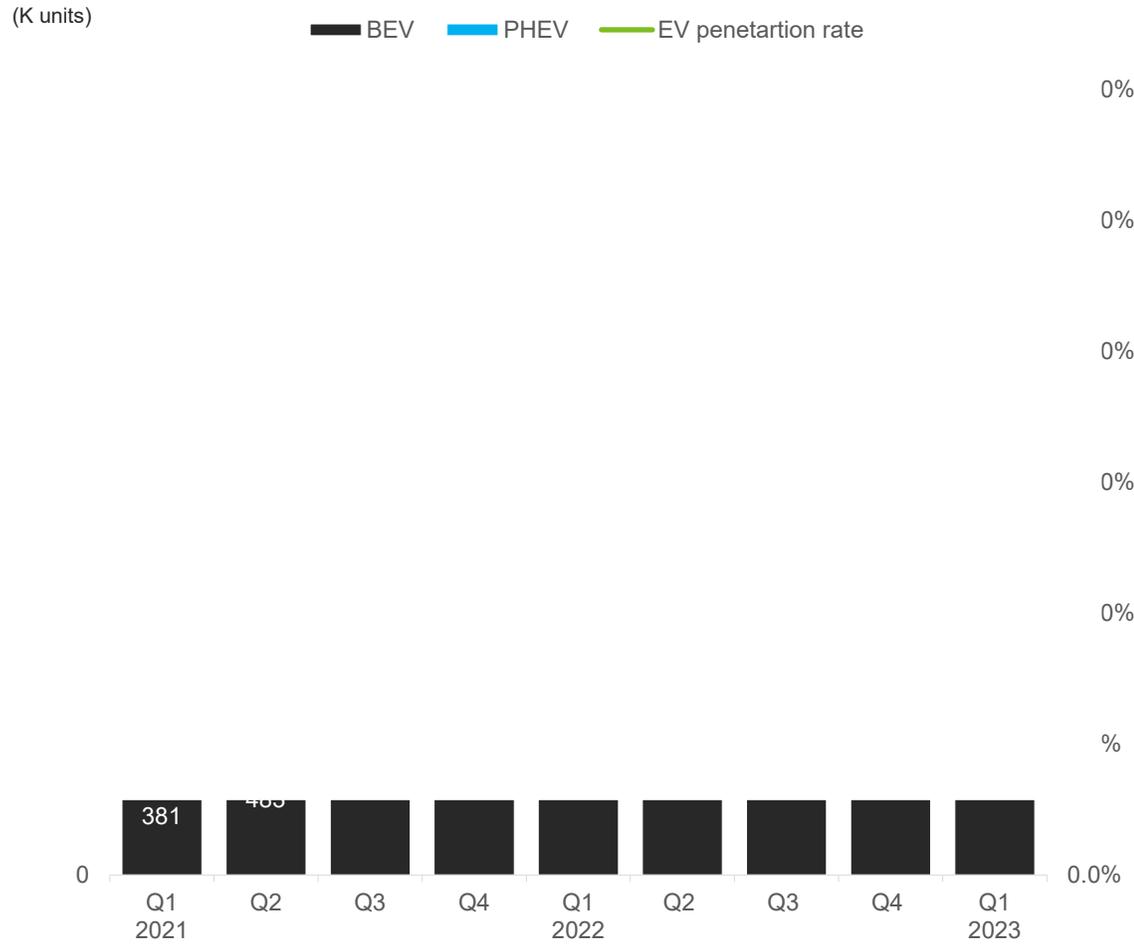
- The EV sales in Europe during Q1 2023 can be said to have a steady





1.1 EV Market Review Q1 2023 – China

Plug-In EV(BEV+PHEV) Sales In China (Q1 2023)



Source: SNE Research



Chinese Market Review

The Chinese EV sales in Q1 2023 posted XX% YoY and XX% QoQ growths with the penetration rate of XX%.

Key points in Q1 2023 are as follows:

- The EV sales in China recorded approx. XXX million units, showing a
-
-

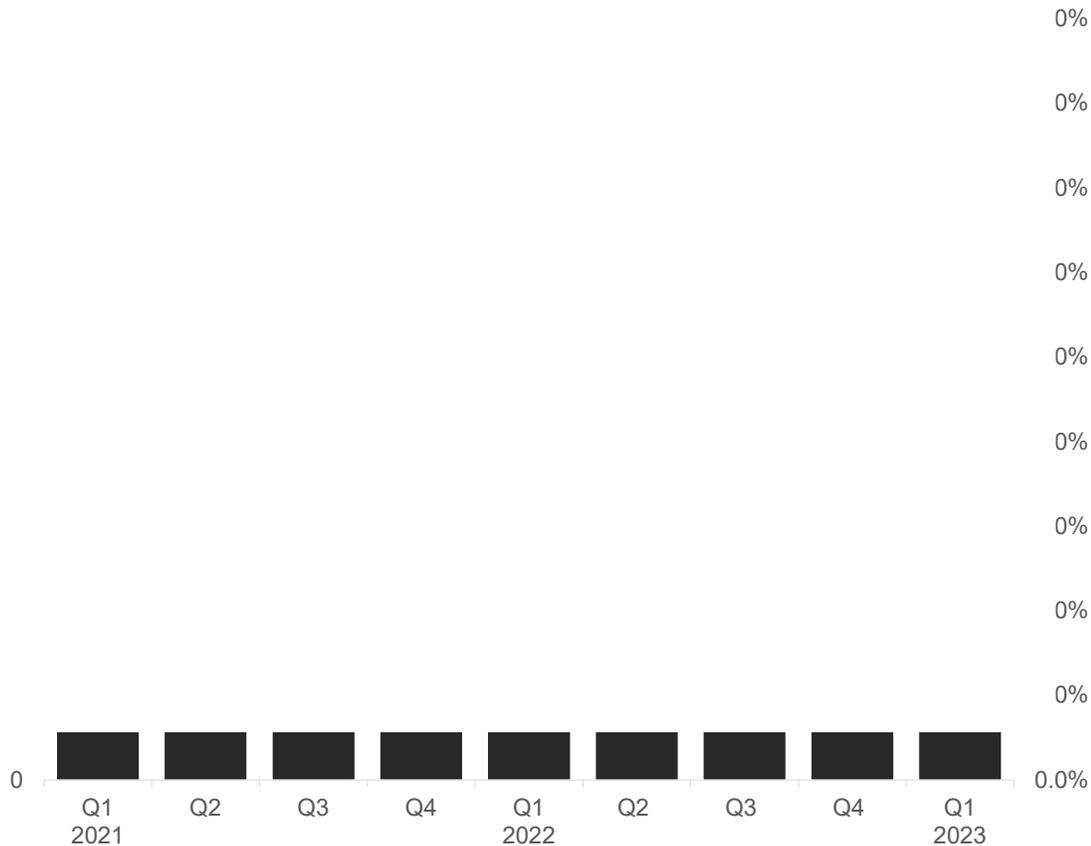


1.1 EV Market Review Q1 2023 – U.S.

Plug-In EV(BEV+PHEV) Sales In U.S. (Q1 2023)

(K units)

BEV PHEV EV penetration rate



Source: SNE Research

U.S. Market Review

SAMPLE

The US EV sales in Q1 2023 recorded XX% YoY and XX% QoQ growths, reaching XXX units with the EV penetration of XX%.

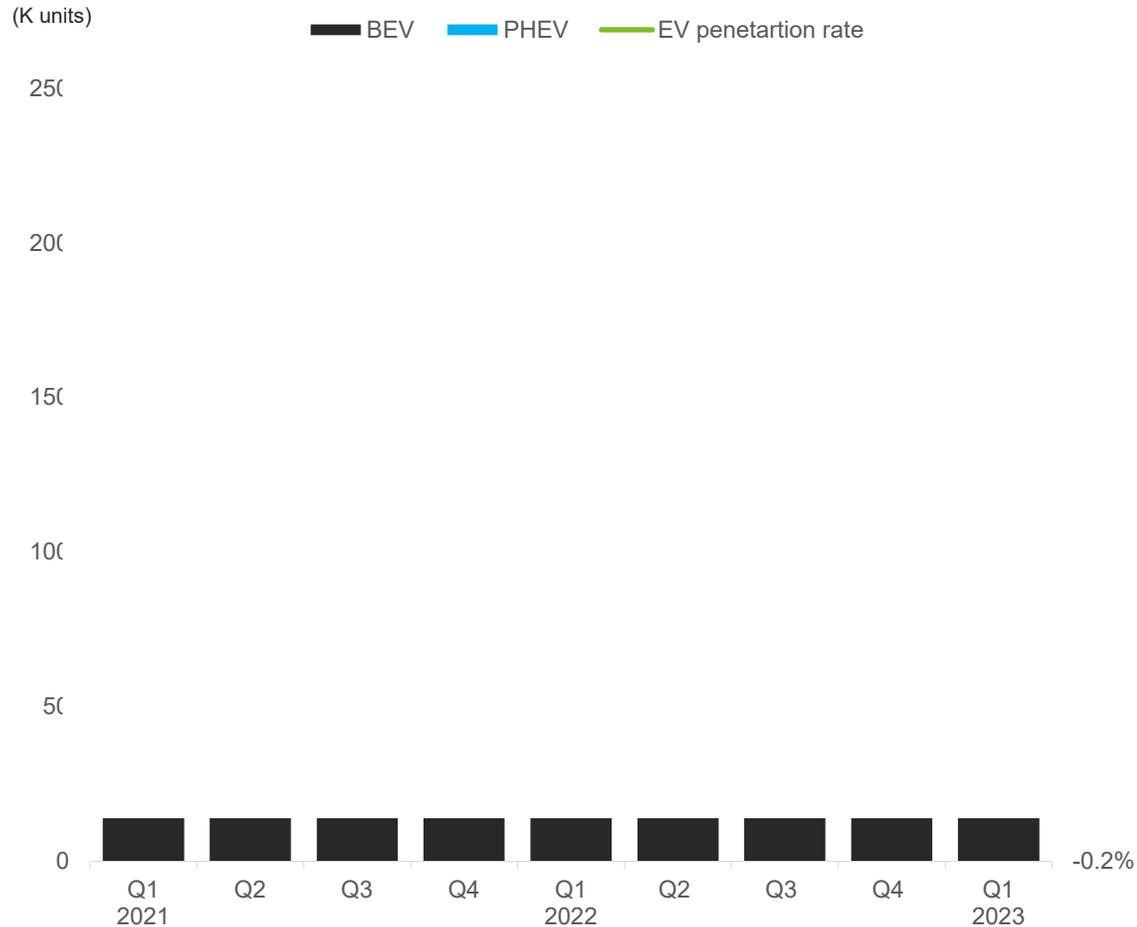
Key points in Q1 2023 are as follows:

-
-
- Model Y and 3, Wrangler PHEV, Bolt, ID.4, Grand CHEROKEE, Bolt, and R1T all ranked high in the ranking of sales, which led to an interpretation that, thanks to the IRA and its details announced, the US OEMs have been able to see good results in their EV sales.



1.1 EV Market Review Q1 2023 – Others

Plug-In EV(BEV+PHEV) Sales In Others (Q1 2023)



Source: SNE Research

Other Regional Market Review



The Q1 2023 EV sales in other regions recorded XX % YoY and XX 8% QoQ growth, with the EV penetration rate of XX %.

Key points in Q1 2023 are as follows:

- Japan (YoY XXX%, QoQ XXX%) and Korea (YoY XXX%, QoQ XX%) sold many EVs, followed by XXX , XXX, XXX, and XXXX. In terms of market growth, these markets have been showing a similar growth rate to that of the XX market.



1.2 EV Market Outlook 2023

- The overall EV sales in 2023 is
- By reflecting the EV sales dur



Global EV Market Outlook 2023

	Q1 Actual	Q2 Forecast	Q3 Forecast	Q4 Forecast	2023 Forecast
Global					
BEV					
PHEV					
Europe					
BEV					
PHEV					
China					
BEV					
PHEV					
U.S.					
BEV					
PHEV					
Others					
BEV					
PHEV					

EV Penetration Rate By Region





1.2 EV Market Outlook 2023 – Major Issues

Major Issues

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Europe

- The CRMA proposal was presented on March 16. The major goal of the Act is to make sure not more than 65% of the Union’s annual consumption of each

• [Redacted]

countries.

China

- [Redacted]
- [Redacted]

major EV markets in the world.

U.S.

- [Redacted]
- [Redacted]

Comment

- [Redacted]
- [Redacted]



SAMPLE

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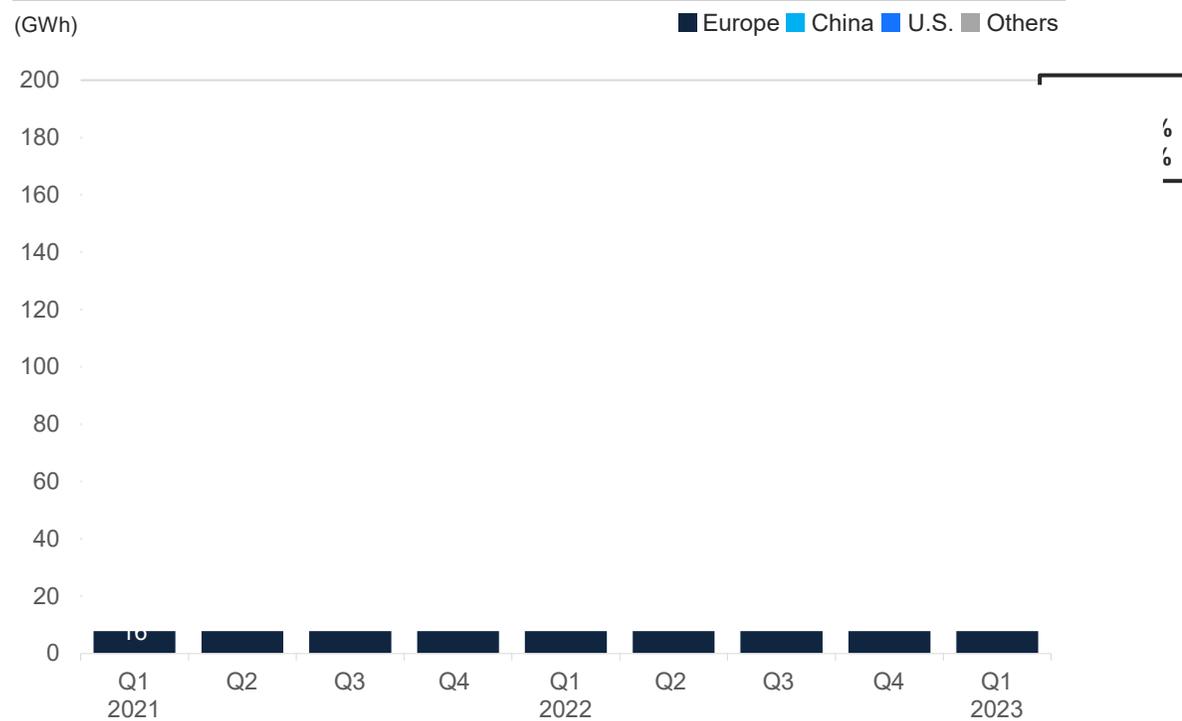


2.1 EV Battery Installation Trend – Region

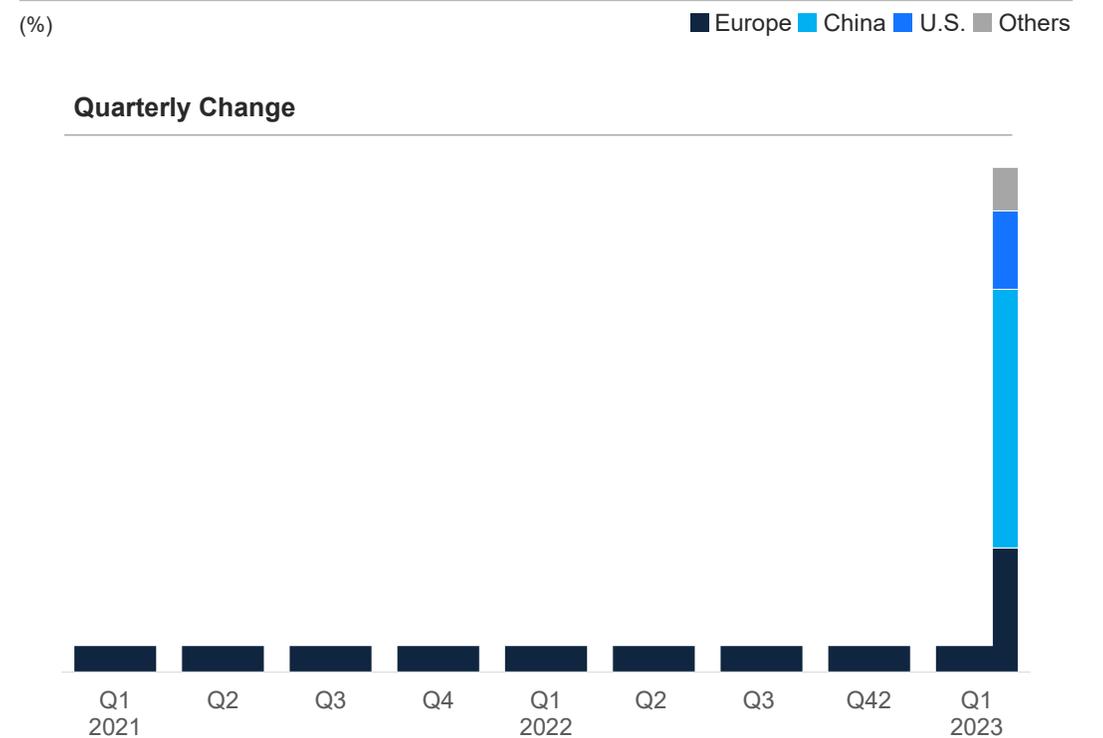
- The global EV battery installation posted XX% YoY and XX% QoQ growth, recording XXX GWh. China accounted for XX %, followed by Europe with XX % and the US with XX %.
- China: Q1
- Europe: Q
- U.S.: Q1 2

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xEV* Battery Installation By Region



Change In Share By Region



* BEV/PHEV/HEV/Truck/Bus



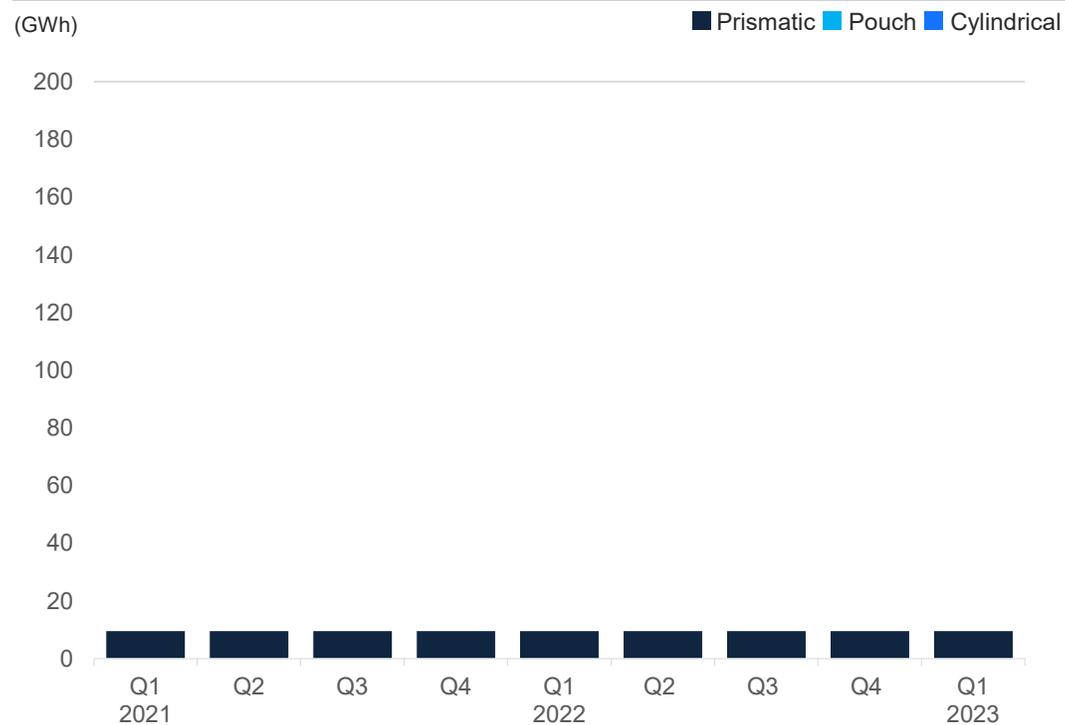
2.1 EV Battery Installation Trend – Battery Type

- By battery usage, the XX M/S has increased, leading to a slight increase in the portion of XXXX battery usage (YoY XX%, QoQ XX %). XXX and XXX type batteries all saw a YoY increase in usage. The share of XXX type has slightly declined.

- Prismatic: Q
- Pouch: Q1 2
- Cylindrical: C

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xEV* Battery Installation By Battery Type



Change In Share By Battery Type



* BEV/PHEV/HEV/Truck/Bus



2.1 EV Battery Installation Trend – Average Battery Capacity

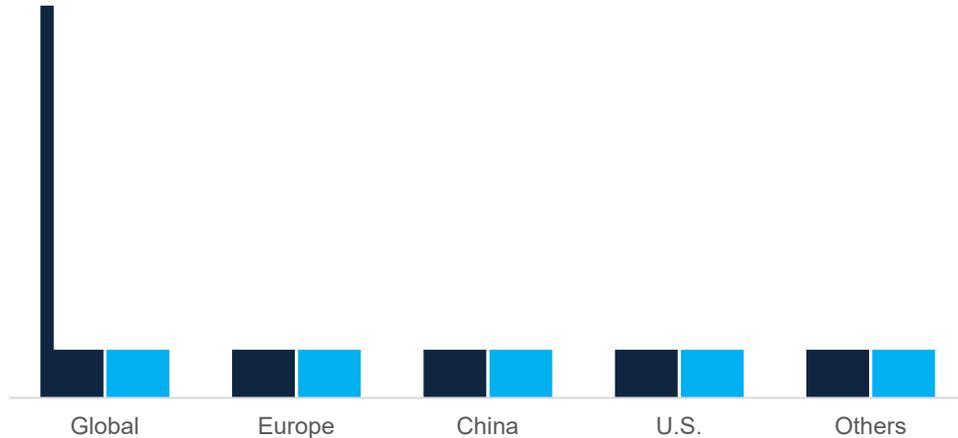
- BEV average battery capacity was global average (
- PHEV average battery capacity was global average (

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BEV Average Battery Capacity By Region

(kWh/car) ■ 2022 ■ 2023

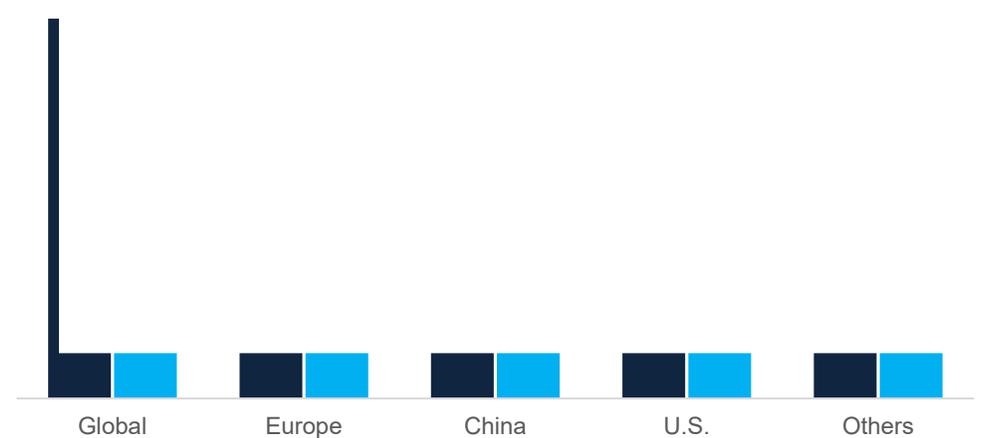
Change



PHEV Average Battery Capacity By Region

(kWh/car) ■ 2022 ■ 2023

Change



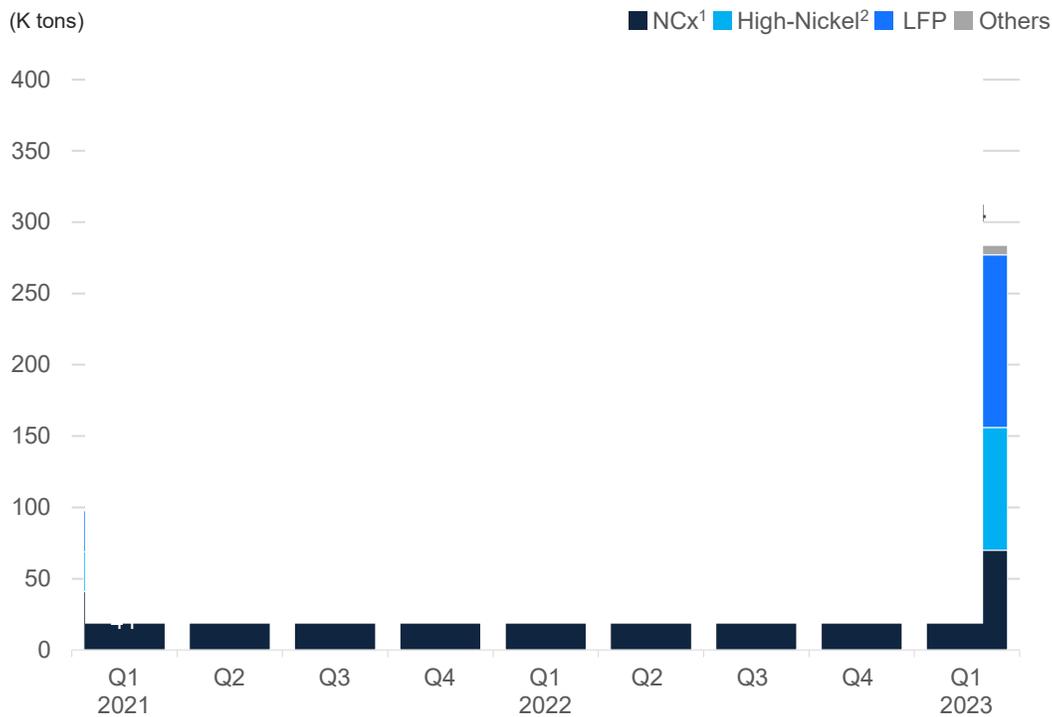


2.1 EV Battery Installation Trend – Cathode Material

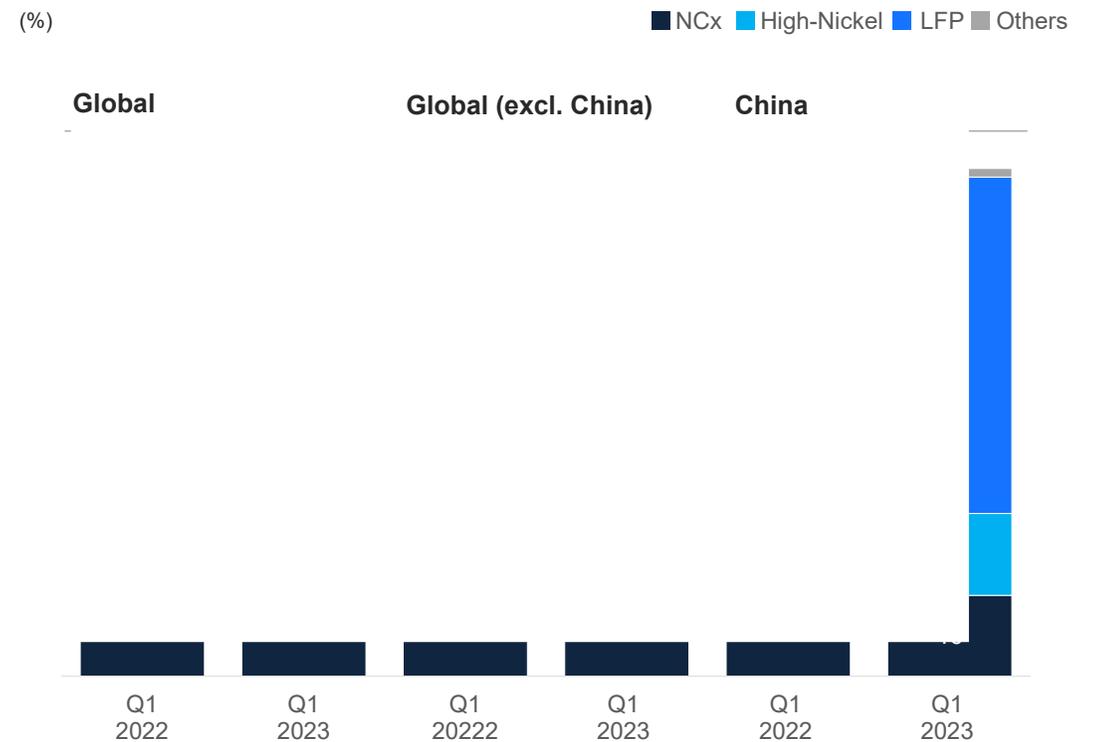
- Cathode material consumption for xEV battery was XXXX ton in Q1 2023, with XXX YoY XXX %, QoQ XX %, XXX YoY XXX %,QoQ XXX % growths.
 - NCx: Q1
 - High-Nick
 - LFP: Q1

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Cathode Material Consumption For xEV Battery



Change In Share Of Cathode Material By Region



¹NCM other than High-Nickel, ² NCx cathode material with more than 80% nickel content



2.2 Top 10 Battery Makers

- In the ranking of battery installation in Q1 2023, XXX took the 1st place, followed by XXX, XXX, XXXX, and XXXX.
- Continuing from the previous quarter, the CATL + BYD M/S combined hovered over XXX % and the combined M/S of LGES, SK On, and SDI reached XX %.

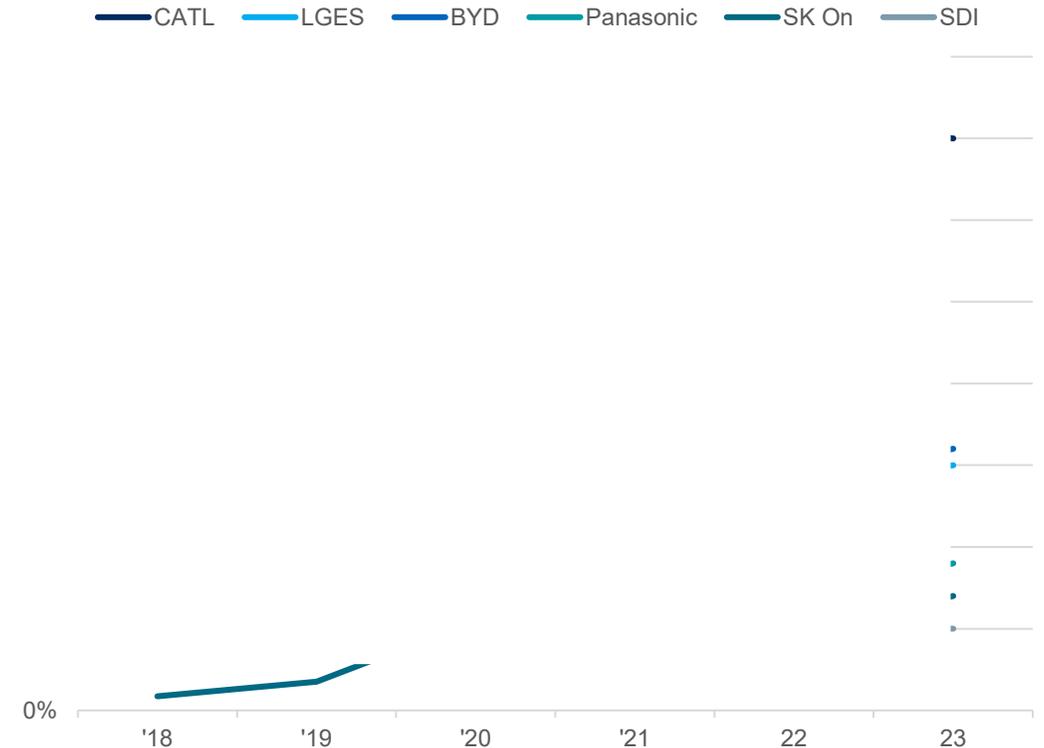
SAMPLE

Top 10 Battery Makers

xEV(BEV/PHEV/HEV/Bus/Truck) Battery Installation – Q1 2023

	xEV Battery Installation , GWh	YoY Change, %	Market Share, %
CATL			
BYD			
LGES			
Panasonic			
SK On			
SDI			
CALB			
Guoxuan			
EVE			
Sunwoda			

Change In EV Battery Market Share



Source: SNE Research



2.2 Top 10 Battery Makers – Market Share by Region (Europe/China)

- In Europe,
- In the China market,

SAMPLE

Change In Market Share By Region (Europe/China)

xEV(BEV/PHEV/HEV/Bus/Truck) Battery Installation – Q1 2023

● Q1 2022 ● Q1 2023

	Europe Market Share Q1 2023 , %	Change in M/S, %
LGES		
CATL		
SDI		
SK On		
Panasonic 2		
Others		

	China Market Share Q1 2023 , %	Change in M/S, %
CATL		
BYD		
CALB		
Guoxuan 4		
EVE 3		
Sunwoda		



2.2 Top 10 Battery Makers – Market Share by Region (U.S./Others)

- In the US market,
- In other regions,

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Change In Market Share By Region (U.S./Others)

xEV(BEV/PHEV/HEV/Bus/Truck) Battery Installation – Q1 2023

● Q1 2022 ● Q1 2023

U.S. Market Share Q4 2022		Other Regions Market Share Q4 2022	
, %	Change in M/S, %	, %	Change in M/S, %
Panasonic		CATL	
LGES		SK On	
CATL		LGES	
SDI		BYD	
SK On		Panasonic	
AESC		AESC	



2.2 Top 10 Battery Makers – CATL

- CATL's EV battery installation recorded XXX GWh in Q1, up XXX % YoY, and XXX % QoQ.
 - By region: In Q1,
 - By automaker: In Q1,

SAMPLE

CATL

xEV(BEV/PHEV/HEV/Bus/Truck) Battery Installation – Q1 2023

Battery Installation by Region, GWh

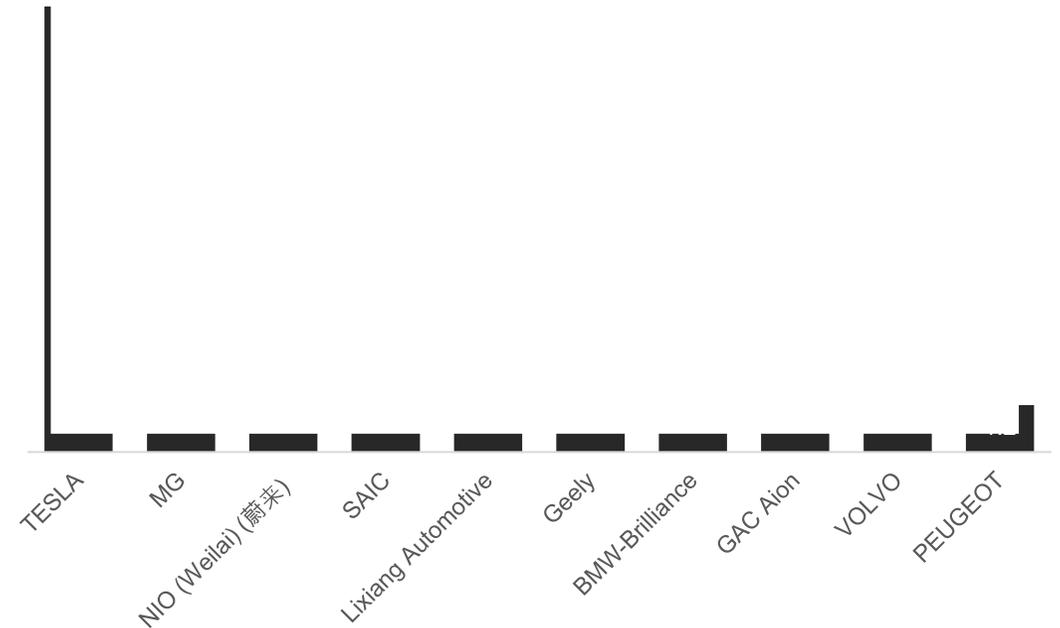
■ Europe ■ China ■ U.S. ■ Others

Q1: Y



Battery Installation by Automaker, GWh

■ Q1 2023 ■ Share





2.2 Top 10 Battery Makers – BYD

- BYD's EV battery installation recorded XXX GWh in Q1, up XXXX% YoY, XXX% QoQ.
 - By region:
 - By automaker:

SAMPLE

BYD

xEV(BEV/PHEV/HEV/Bus/Truck) Battery Installation – Q1 2023

Battery Installation by Region, GWh

■ Europe ■ China ■ U.S. ■ Others

Battery Installation by Automaker, GWh

■ Q1 2023 ○ Share





2.2 Top 10 Battery Makers – LGES

- LGES's EV battery installation recorded XXX GWh in Q1, Up XXX % YoY, XXX % QoQ.
 - By region:
 - By automaker:

SAMPLE

LGES

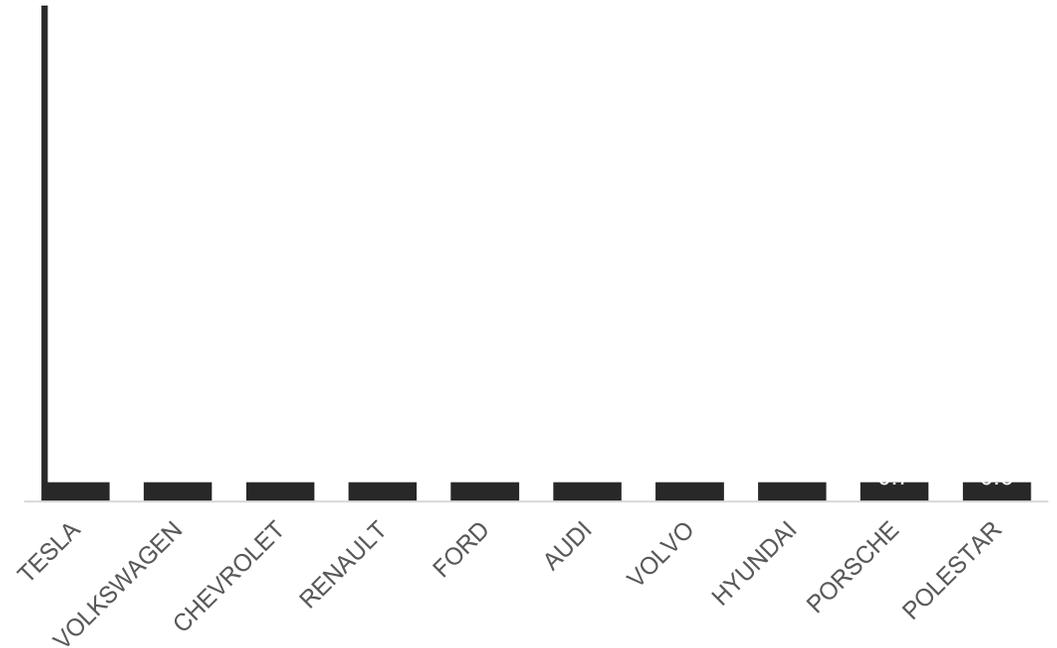
xEV(BEV/PHEV/HEV/Bus/Truck) Battery Installation – Q1 2023

Battery Installation by Region, GWh

■ Europe ■ China ■ U.S. ■ Others

Battery Installation by Automaker, GWh

■ Q1 2023 ● Share





2.2 Top 10 Battery Makers – Panasonic

- Panasonic’s EV battery installation recorded XXX GWh in Q1, Up XXX % YoY, XX % QoQ.
 - By region: In Q1,
 - By automaker: In Q1,

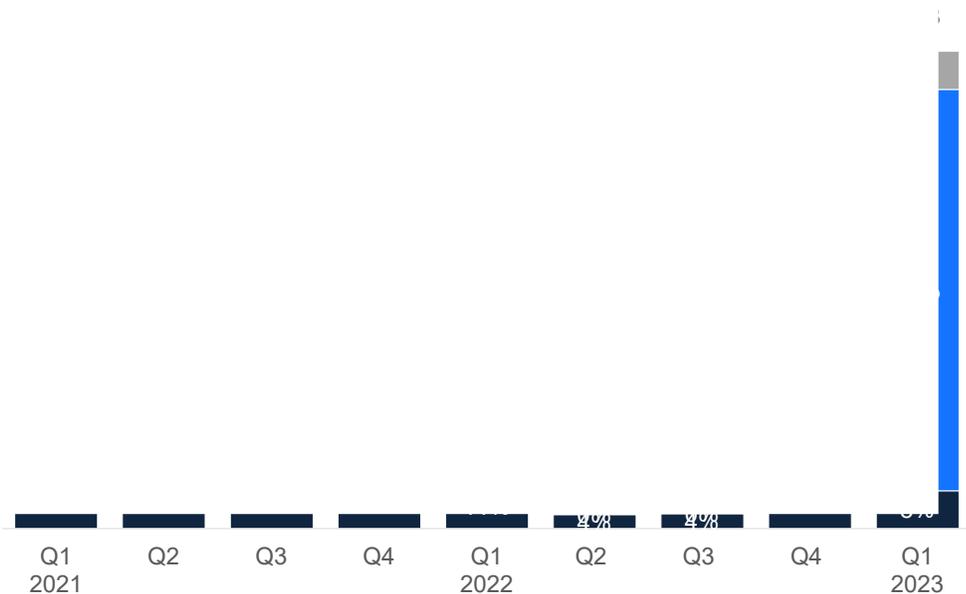
SAMPLE

Panasonic

xEV(BEV/PHEV/HEV/Bus/Truck) Battery Installation – Q1 2023

Battery Installation by Region, GWh

■ Europe ■ China ■ U.S. ■ Others



Battery Installation by Automaker, GWh

■ Q1 2023 ○ Share





2.2 Top 10 Battery Makers – SK on

- SK on’s EV battery installation recorded XXX GWh in Q1, up XX % YoY, and XX % QoQ.
 - By region: In Q1,
 - By automaker: In Q1,

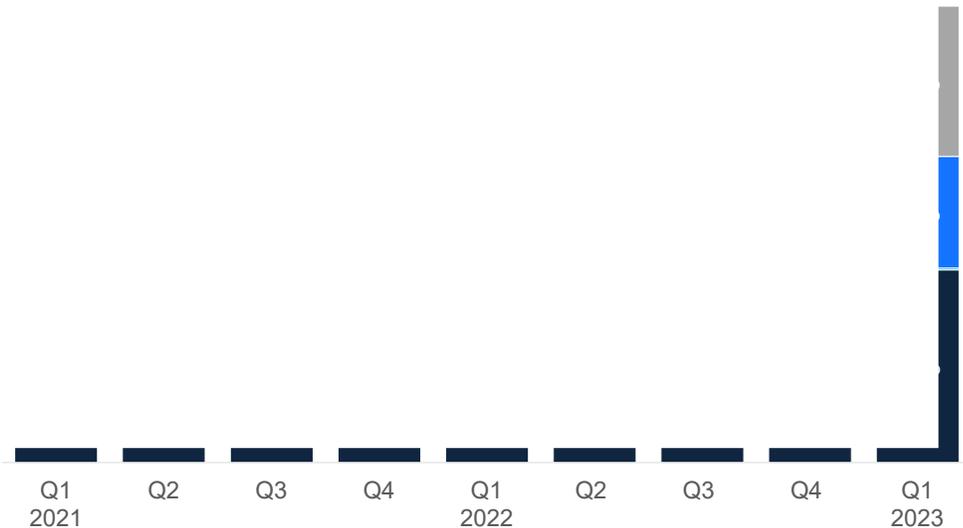
SAMPLE

SK on

xEV(BEV/PHEV/HEV/Bus/Truck) Battery Installation – Q1 2023

Battery Installation by Region, GWh

■ Europe ■ China ■ U.S. ■ Others



Battery Installation by Automaker, GWh

■ Q1 2023 ○ Share





2.2 Top 10 Battery Makers – SDI

- SDI's EV battery installation recorded XXX GWh in Q1, up XX % YoY, and up XXX % QoQ.
 - By region: In Q1,
 - By automaker: In Q1,

SAMPLE

SDI

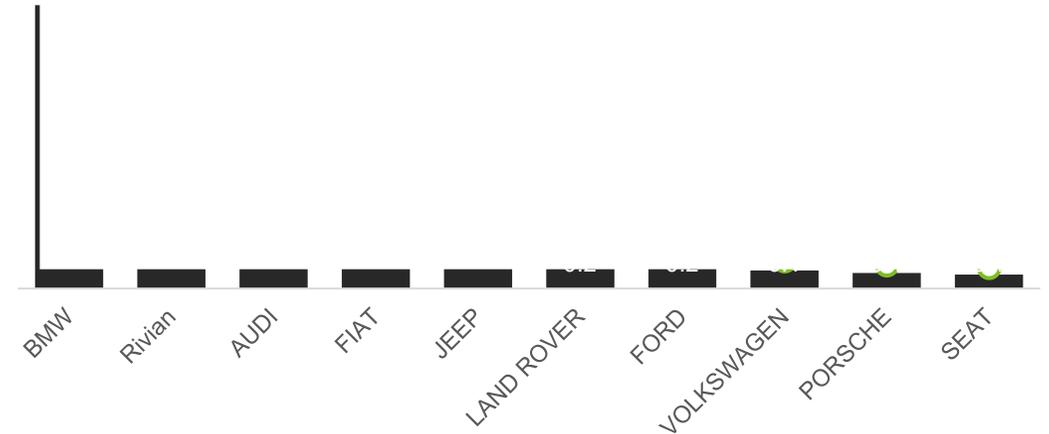
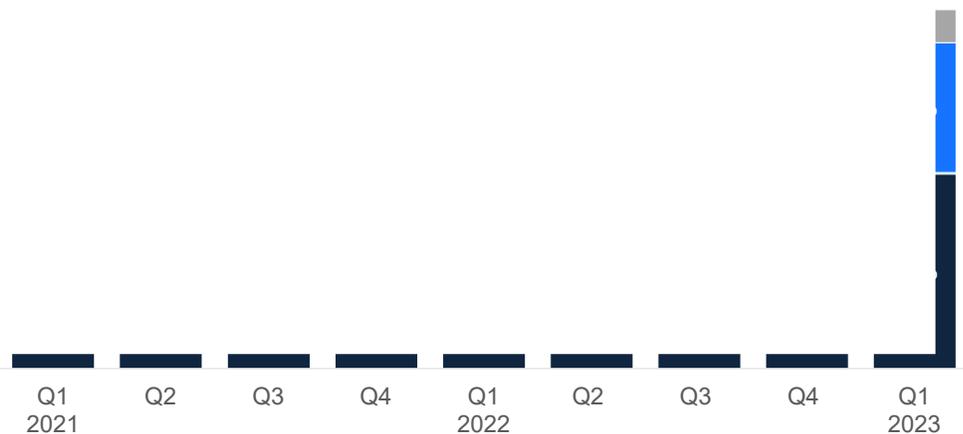
xEV(BEV/PHEV/HEV/Bus/Truck) Battery Installation – Q1 2023

Battery Installation by Region, GWh

■ Europe ■ China ■ U.S. ■ Others

Battery Installation by Automaker, GWh

■ Q1 2023 ● Share





2.2 Top 10 Battery Makers – CALB

- CALB's EV battery installation recorded XXX GWh in Q1, up XX % YoY, and up XX % QoQ.
 - By region: In Q1,
 - By automaker: In Q1,

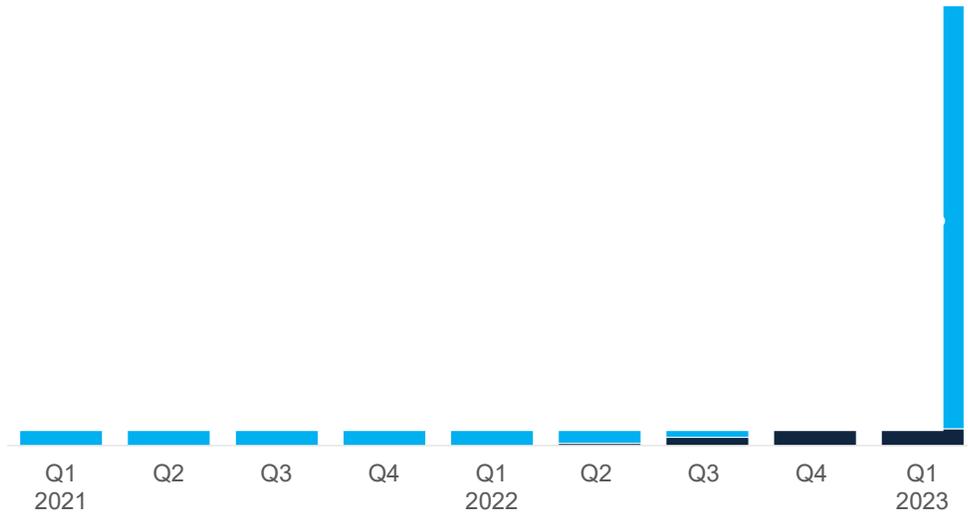


CALB

xEV(BEV/PHEV/HEV/Bus/Truck) Battery Installation – Q1 2023

Battery Installation by Region, GWh

■ Europe ■ China ■ U.S. ■ Others



Battery Installation by Automaker, GWh

■ Q1 2023 ■ Share





2.2 Top 10 Battery Makers – Guoxuan

- Guoxuan’s EV battery installation recorded XX GWh in Q1, up XXX % YoY, XXXX% QoQ.
 - By region: In Q1,
 - By automaker: In Q1,

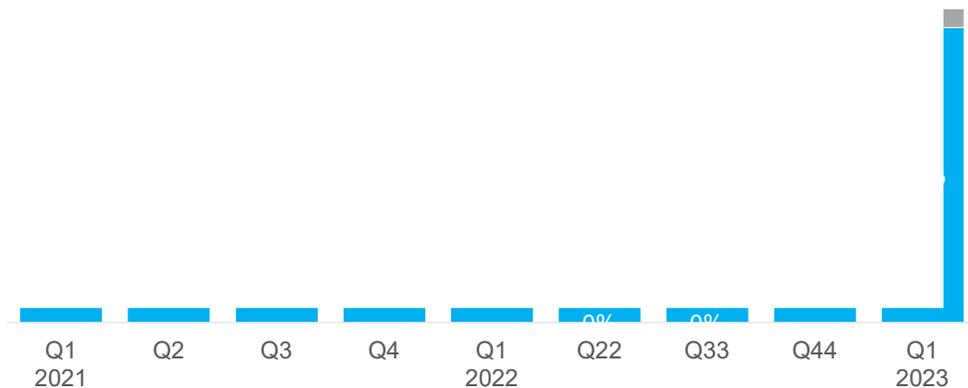
SAMPLE

Guoxuan

xEV(BEV/PHEV/HEV/Bus/Truck) Battery Installation – Q1 2023

Battery Installation by Region, GWh

■ Europe ■ China ■ U.S. ■ Others



Battery Installation by Automaker, GWh

■ Q1 2023 ■ Share





2.2 Top 10 Battery Makers – EVE

- EVE’s EV battery installation recorded XX GWh in Q1, up XX % YoY XX % QoQ.
 - By region: In Q1,
 - By automaker: In Q1,

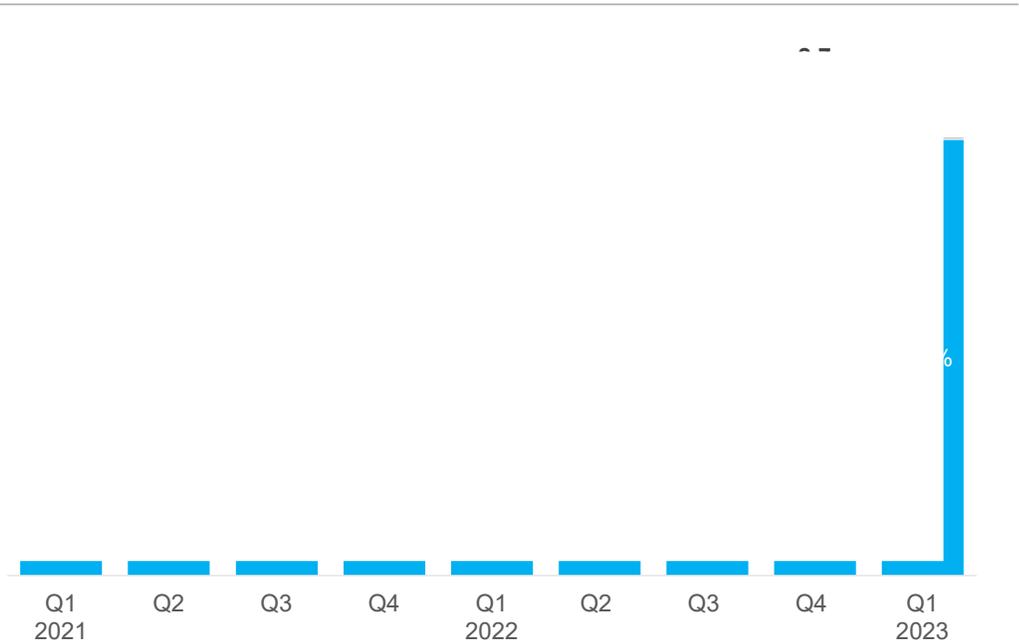
SAMPLE

EVE

xEV(BEV/PHEV/HEV/Bus/Truck) Battery Installation – Q1 2023

Battery Installation by Region, GWh

■ Europe ■ China ■ U.S. ■ Others



Battery Installation by Automaker, GWh

■ Q1 2023 ■ Share





2.2 Top 10 Battery Makers – Sunwoda

- Sunwoda EV battery installation recorded XX GWh in Q1, up XX % YoY, XX % QoQ.
 - By region: In Q1,
 - By automaker: In Q1,



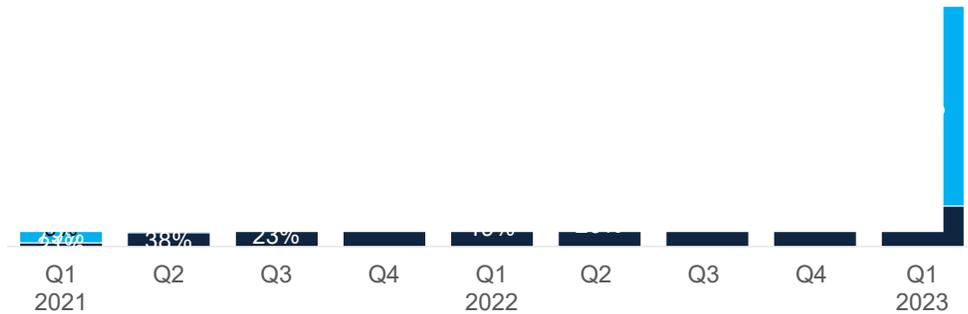
Sunwoda

xEV(BEV/PHEV/HEV/Bus/Truck) Battery Installation – Q1 2023

Battery Installation by Region, GWh

■ Europe ■ China ■ U.S. ■ Others

Q1: YoY +20%, QoQ -49%



Battery Installation by Automaker, GWh

■ Q1 2023 ■ Share





SAMPLE

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3 **Look Inside**

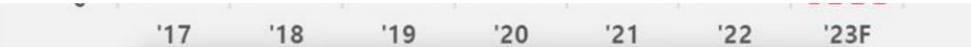


Sodium-Ion Battery (SIB)

- According to SNE, the battery usage from 2017 to 2022 has increased at XXXX.
- In accordance with the increasing battery usage, battery makers recently XXXX.

SAMPLE

Global xEV Battery Installment Trend



Source: SNE Research

Material Cost Structure of LIBs-LFP and NIBs

Lithium-ion batter
(LFP)

Sodium-ion Batter

Source: SNE



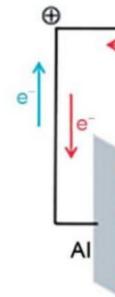
Overview of Sodium Ion Battery (SIB)

- Sodium-ion battery is XXX.
- SIB shares the similarity with LIB in terms of XXX

SAMPLE

	Li-ion	Na-ion
Structure		
Energy Density (Wh/kg)		
Anode Current Collector		
Advantage		
Shortcoming		
Player		

	Lithium Ion Battery	Sodium Ion Battery
Cathode		
Anode		



Source: SNE Research



Characteristics of Sodium Ion Battery (SIB)

- Using Na in the same Group 1 XXX.
- Compared to LIB, SIB has XXXX.

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	SIB	LIB
Energy Density		
Raw Material Cost		
Safety		
Low-temperature performance		
Recycling		

Source: SNE Research

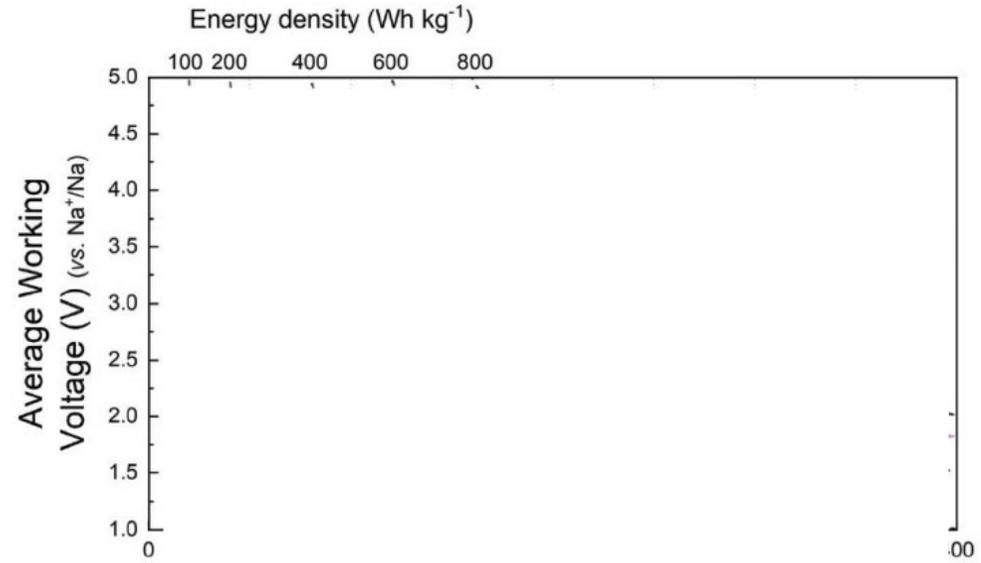
Sol



SIB Manufacturing (1) – Cathode Material

- Cathode materials used for SIB are three materials; Prussian Blue Analogues (PBA), interlayered oxides, and Polyanion.
- XXXX.

SAMPLE



- Layered O3
1. Na[Ni_{0.2}Fe_{0.4}Mn_{0.4}]O₂
 2. Na[Li_{0.22}(Ni_{0.22}Fe_{0.22}Mn_{0.34})]O₂
 3. Na[Ni_{0.22}Fe_{0.22}Mn_{0.56}]O₂
 4. Na[Fe_{0.3}Co_{0.3}]O₂
 5. NaCrO₂
 6. Na[Ni_{0.4}Co_{0.22}Mn_{0.38}]O₂
 7. NaMnO₂
 8. Na_{0.22}Cr_{0.66}Sb_{0.11}O₂
 9. NaLi_{0.3}Mn_{0.7}O₂

Source: Recent Progress of Cathode Materials for Na-ion batteries, 2022

• Prussian Blue

Despite its low production cost, it has a low volumetric energy density.

• Interlayered oxides

Many manufacturers who wish to choose interlayered oxides.

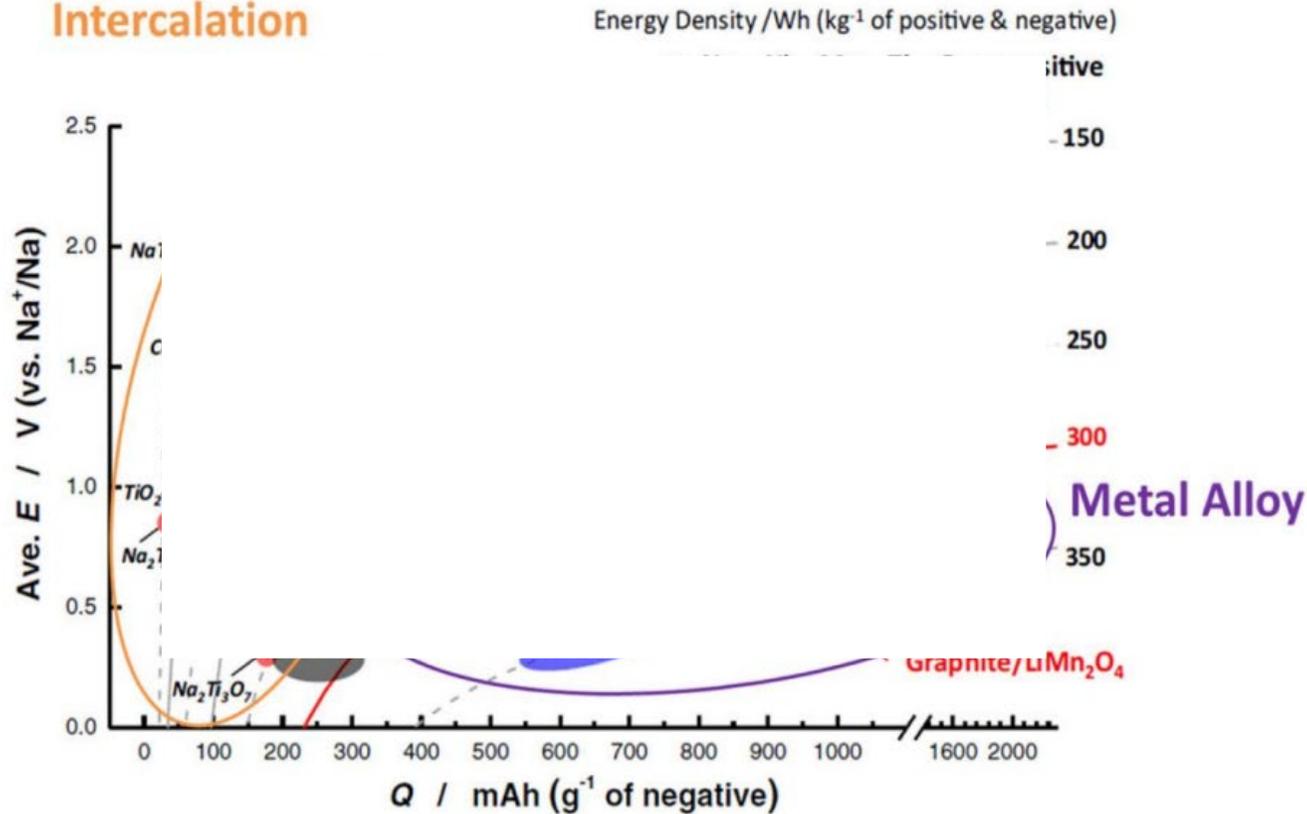
• Polyanion



SIB Manufacturing (2) – Anode Material

- Anode materials used for SIB are categorized into three types in accordance with material mechanism; Intercalation, Alloy, and Conversion.
- Anode material that is mainly used at present is XXXX

Intercalation



SAMPLE

Source: Research Trend on Conversion Reaction Anodes for Sodium-iron Batteries, 2019



SIB Manufacturing (2) – Anode Material

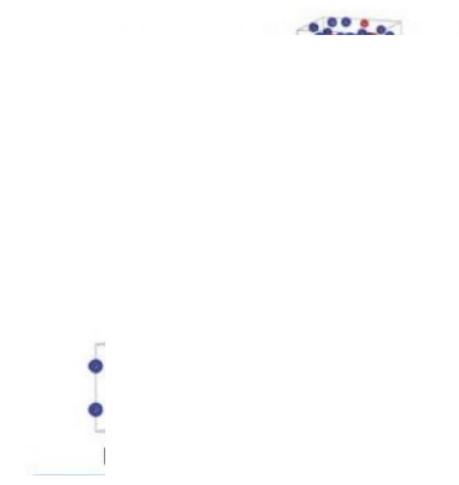
- Anode materials used for SIB are categorized into three types in accordance with material mechanism; Intercalation, Alloy, and Conversion.
- Anode material that is mainly used at present is XXX.

SAMPLE

(a) Intercalation reaction



(b) Alloy reaction



(c) Conversion reaction



(a) Intercalation

Intercalation is the process by which a mobile ion or molecule is

(b) Metal Alloy

Metal alloys is based on the metal-alloy reaction through

V
 E
 I
 C
 F
 C
 C
 Metal such as manganese, is developed.

(c) Conversion

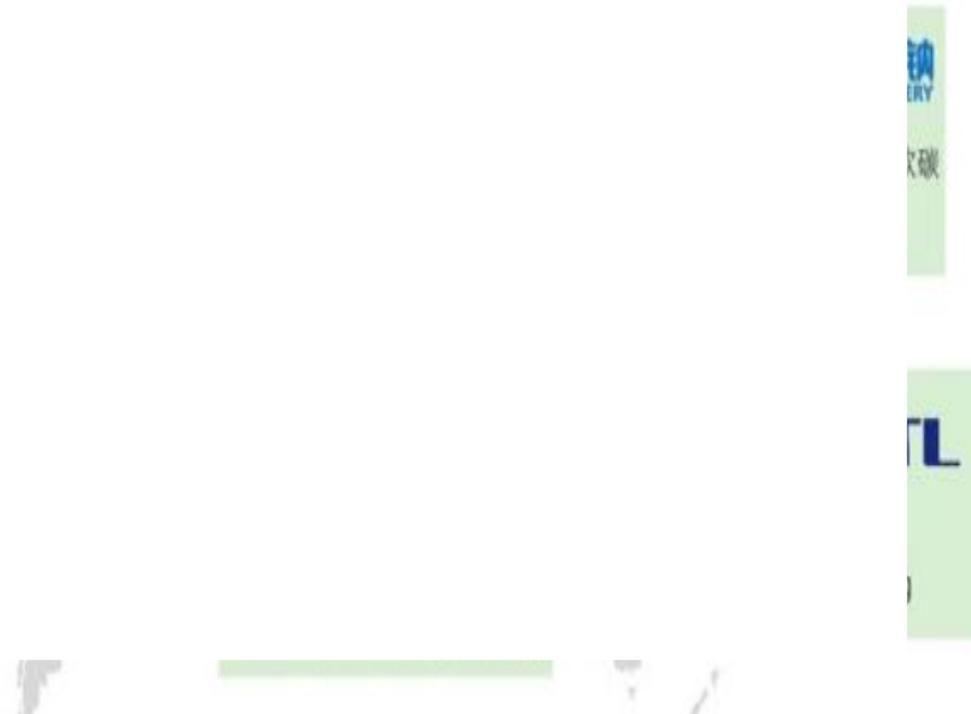
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SIB Market Trend

- CATL , XXXX, XXXX, XXX, XXX are known to be major players in the SIBs.
- China is the XXXX.

SAMPLE



SIB Main Player, Source: China ESS



SIB Manufacturing Industry Chain

SAMPLE

- Many from existing battery component manufacturers such as cathode, anode, and electrolyte have been trying to enter the market for SIB raw materials and related material supply.

China Sodium-iron Battery Industrial Chain



Source: Guotai securities

Material	Maker	Start of Mass production	Raw material	Capa	Customer
Cathode					
Anode					
Electrolyte					

Source: SNE Research