OIES CHINA PROGRAMME:

An update on China’s EV Revolution

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20 February 2023
About the OIES China Programme

- Launched in 2019, the OIES China Energy Research Programme, is a centre of analytical excellence offering **insights into the factors that inform China’s energy policies and choices** and their pivotal role in global energy markets.

- Providing **academic expertise and rigor to inform business players and governments** on China’s energy policies, on clean energy advances and challenges and on their implications for markets.

- **Independent experts** with decades of **experience working in and with China**, with extensive contacts in the private sector, government and NGO community in Europe, the US and China.

- **Research Fellows** include: Michal Meidan, Anders Hove, Philip Andrews-Speed, Mike Chen, Barbara Finamore, Yan Qin and David Sandalow.

- The China programme also draws on the wider OIES network, offering a **unique combination of deep technical energy expertise with extensive China knowledge**.
Background and contents

• Updates on the latest 2022 EV statistics from various Chinese organizations:
  – EV sales and market share: China and the world
  – EV sales by vehicle price, type, size
  – EV batteries and the growth of LFP share
  – EV emissions
  – EV charging: number of chargers, electricity consumption
  – Charging experience

• Additional analysis from the author’s prior research,

• Summary of 2023 research questions

The contents also discussed on the OIES podcast of February 2023, “An update on China’s EV Revolution”:
China EV sales continue to grow

China New Energy Vehicle (NEV) sales, 2017-2022, and market share

- 10 million possible in 2023, almost 40% market share

Source: CAAM 2023
China remains well ahead of other major auto markets in EV penetration.
Several factors other than subsidies at work

- Local subsidies and license plate restrictions contributed to high urban EV sales, above 50% market share in Shanghai and Hangzhou in December.
- NEVs perform better on customer satisfaction metrics; NIO, BMW, Mercedes, BYD, and Tesla scoring well, smaller and lower-end vehicles scoring below fossil vehicles.
Mid-range NEVs showed strongest growth

- RMB 150,000 – 200,000 is roughly US$ 24,000 – 30,000
- All categories showed strong growth, led by mid-range categories

Source: CAAM 2023
Larger-size NEVs showed strongest growth

- Micro-EVs (class A00) continued to lose market share, while other categories grew
- Strongest growth of A-class sedans

Source: CAAM 2023
Larger-size NEVs showed strongest growth

<table>
<thead>
<tr>
<th>Year</th>
<th>Sedan Share</th>
<th>MPV Share</th>
<th>SUV Share</th>
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<tr>
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<td>52.0%</td>
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<td>2022</td>
<td>61.8%</td>
<td>2.2%</td>
<td>36.0%</td>
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</tbody>
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Source: CPCA 2023

- SUV share rising in both BEV and PHEV categories
- PHEV capturing more of SUV market
Monthly market share reached 36% in Nov

Monthly passenger NEV market share, 2021 and 2022

- NEV market share slipped in Dec 2022, possibly due to inventory timing and early consumer rush to lock in subsidies

Source: CPCA 2023
Affected by Chinese New Year, all vehicle sales fell in January 2023, but NEV sales fell more.

January NEV sales still strong versus prior year numbers.

Source: CAAM 2023

- Monthly sequential vehicle and NEV sales

2023 subsidy end hit NEV sales
PHEVs making a comeback as SUV sales rise

China NEV sales by size category, 2021 versus 2022, thousands

- PHEV sales grew by around 150%, compared to 80% for pure EVs
- Main reason appears to be more SUV models in the PHEV category

Source: CAAM 2023
LFP greatly increased its market share

LFP captured 62% of NEV battery market in 2022, up from just over one-third in 2020

- LFP and NMC production both grew, by 155% and 144%, respectively

Source: China Car Stats, 2023
Larger vehicles use more NMC batteries

China NEV sales by size category, 2021 versus 2022

- LFP market penetration rose most in smaller, cheaper vehicles
- Still, LFP captured over 60% share in all categories except C-class vehicles (C-class = 10% share)

Source: China Car Stats, 2023
**EV adoption contributes to carbon neutrality goals**

- NEV push initially began as an industrial strategy, but increasingly can contribute to carbon targets
- EV life-cycle emissions falling dramatically due to improved energy density, lower grid carbon
- EV emissions are at least 40% lower than ICEV emissions in all regions of China
- This assumes EV charging uses the average kWh produced by the grid in these regions, and does not account for time-of-use charging characteristics

**EV, ICEV life-cycle well-to-wheels CO\(_2\), 2015-2030**

![Graph showing CO\(_2\) emissions for China's BEV in national grid and sub-grids (g/km\(^2\)).](chart1.png)

**CO\(_2\) of different battery types, 2015-2030**

![Graph showing CO\(_2\) emissions for China's BEV by battery type.](chart2.png)

Source: Tsinghua School of the Environment, 2022
EVCIPA estimates China has 1.7 million public chargers, of which 800,000 are DC chargers. Almost 3.5 million chargers installed with vehicle purchase, indicating at least half of EV buyers have private charging access. Numbers likely omit some private chargers installed separately.
Coastal provinces lead on charging infrastructure

Number of public charging points per province, in thousands, 2022

Source: EVCIPA, 2023
Public chargers delivered 213.3 TWh in 2022, just 0.25% of total electricity consumption

2H may have been affected by pandemic situation

Assuming 15 million NEVs at year-end, December consumption represents 140 kWh per vehicle, sufficient for 1000 km – suggesting large fraction of drivers use public charging regularly

May be over-weighted towards larger vehicles and fleet vehicles

Source: EVCIPA, 2023
Utilization numbers are low

The average charging post is used about once per day

- Officials report average utilization of 10% across all public chargers, 1% for highway chargers
- EVCIPA publishes monthly charging numbers and electricity use data, shown above
- Clusters around 40-50 kWh/day, but several lower than this amount

Source: EVCIPA, 2023
Charging payment seamless, but given low utilization, operations and maintenance not always good

- Interoperability: Most EV charging uses WeChat or AliPay, does not require app download or RFID card
- Long-distance charging on highways controlled by State Grid, reports of queues and broken chargers
- Apps and chargers still don’t communicate, broken chargers still shown as visible on apps
- Charging providers have inadequate incentive to maintain chargers or communicate with apps
- Battery swap has issues with queues and is limited to certain brands

At left, CAMS charger with WeChat QR code for unlocking space, payment
Below, non-operating X-Charge station shown as available in car navigation, apps

Source: Anders Hove photos, Beijing, 2022
2023 EV research questions

• **China EV critical minerals** supply chain, policies, markets, and institutions – and how can Western governments respond to Chinese dominance?

• **EV charging experience in China** versus Europe and U.S.: how do policy makers, market participants, and EV customers evaluate progress in their local markets?

• **EVs and the grid in China**: While numerous smart charging and V2G pilots have taken place, the lack of a wholesale power market could hinder grid integration of EVs in China. How can we evaluate and track progress on EV grid integration policy and technology in China?