

# **Subsidies and Other Government Policies in the Global Electric Vehicle Market**

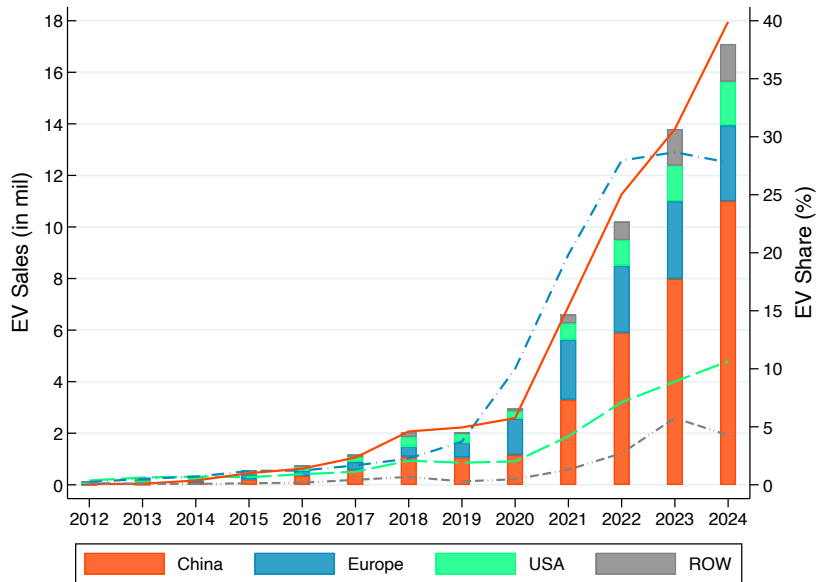
Shanjun Li  
Cornell University

March 10 2025  
University of Zurich  
Academic Perspectives on Industrial Policy

# Roadmap

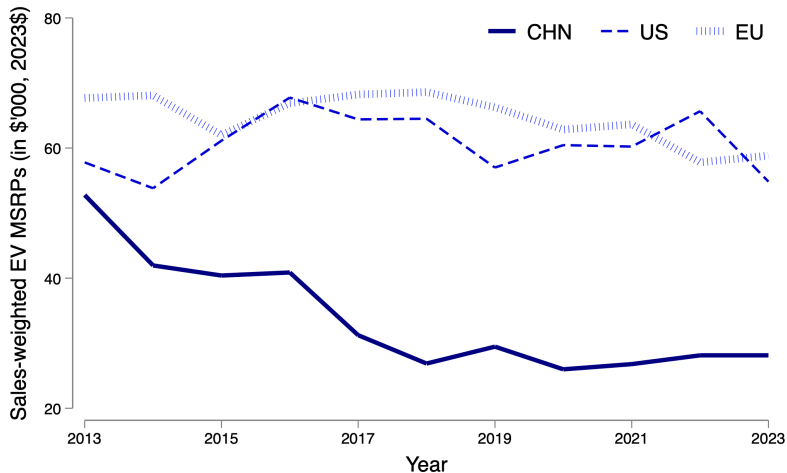
- ① Global EV Diffusion
- ② Policy Landscape
- ③ Key Lessons

# Global EV Sales by Region



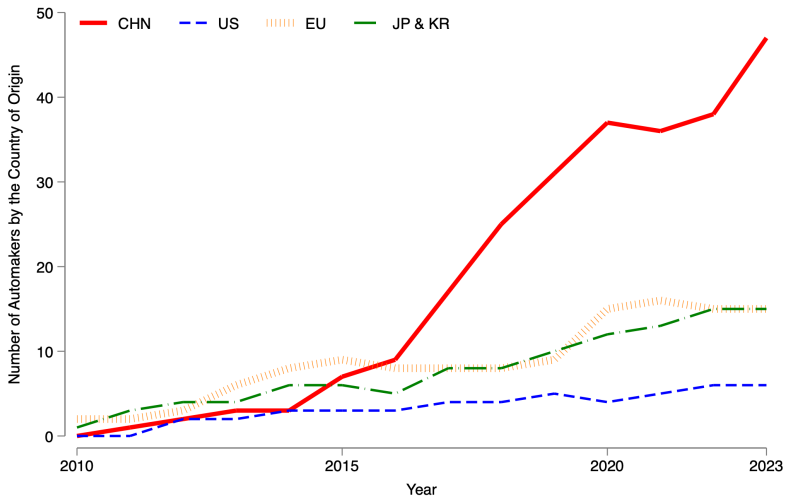
Note: New EV sales (BEV and PHEV) by region.

# Average EV Prices by Region



# No. of EV Firms by Country of Origin

▶ EV Model Availability

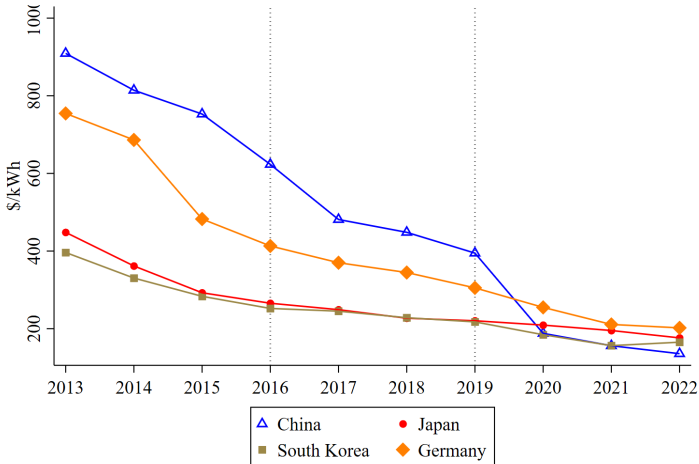


# Battery Prices by Country

▶ Global Battery Prices

▶ Battery Supply Chain

- Learning by doing (Wright's Law): unit cost of production decreases with experience



# Roadmap

## 1 Global EV Diffusion

## 2 Policy Landscape

- ▶ Industrial Policies [▶ Details](#)














- ▶ Mandates and Regulations [▶ Details](#)

- ▶ Consumer Incentives

## 3 Key Lessons

# Consumer Incentives in Major EV Countries

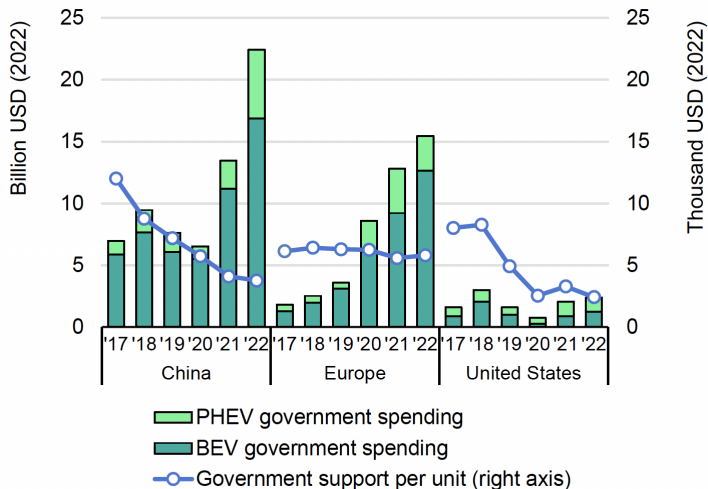
- Policies have focused on directly targeting consumer adoption
- Financial and non-financial incentives

	 Austria	 France	 Germany	 Netherlands	 Norway	 Spain	 Sweden	 Switzerland	 UK	 China	 Japan	 Canada	 US
Direct rebate	●					●	●		●	●	●	○	
Acquisition tax discount	●	●	●	●	●								●
Ownership tax discount	●		●	●		●	●	○	●				
Free parking	○	○	○	○	●	○			○	○			○
HOV lane		○	○	○	●	○	○		○	○	○	○	○
Green plate	○		○		●	○				○		○	○

Source: Li et al. 2021



# Consumer Subsidies for EVs by Region (Source:IEA)



- Global EV subsidies  $\approx$  \$43 bil.in 2022 (10% of total spending on EVs)

# Local Content Requirements

Preferential treatment of domestic/local suppliers and production

- China's whitelist policy (2016-19): batteries need to be sourced from government approved suppliers for subsidy eligibility [▶ Sales](#)

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- EU Green Deal Industrial Plan (March 2024): promote domestic supply of critical minerals and clean tech

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- EU Green Deal Industrial Plan (March 2024): promote domestic supply of critical minerals and clean tech
- India's Scheme to Promote Manufacturing of Electric Passenger Cars (SPMEPCI, March 2024): requirement on domestic value addition

# Roadmap

- 1 Global EV Diffusion
- 2 Policy Landscape
- 3 Key Lessons
  - ▶ Consumer Subsidies
  - ▶ Local Content Requirements

Based on:

Drive Down the Cost: Learning by Doing and Government Policy  
in the Global EV Battery Industry

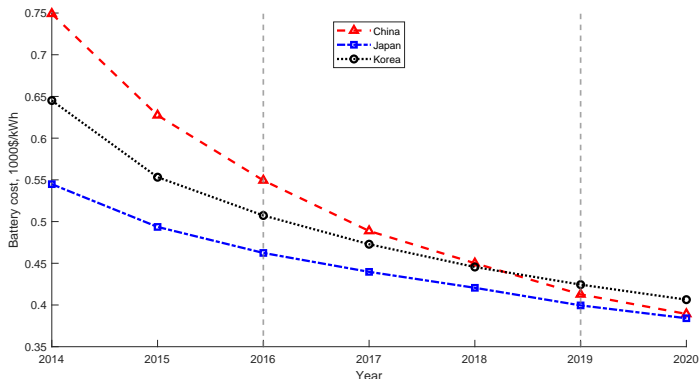
by Panle Barwick, Hyuk-soo Kwon, Shanjun Li, Nahim Bin Zahur

# Data and Analytical Framework

- Global EV sales and battery supply network
  - ▶ Annual EV sales by model for 13 countries from 2013 to 2020, accounting for 95% of global EV sales
  - ▶ Battery supplier for each EV model: battery supplier network
  - ▶ Consumer EV incentives offered in different countries
- Model of the Global EV Market
  - ▶ Demand: consumers decide whether and which EV model to buy
  - ▶ Supply: automakers and battery suppliers jointly decide battery prices, and automakers choose vehicle prices
- Policy Analysis
  - ▶ Estimate the model parameters to fit the data
  - ▶ Simulate market outcomes under different scenarios

# Learning-by-Doing (LBD) in Battery Production

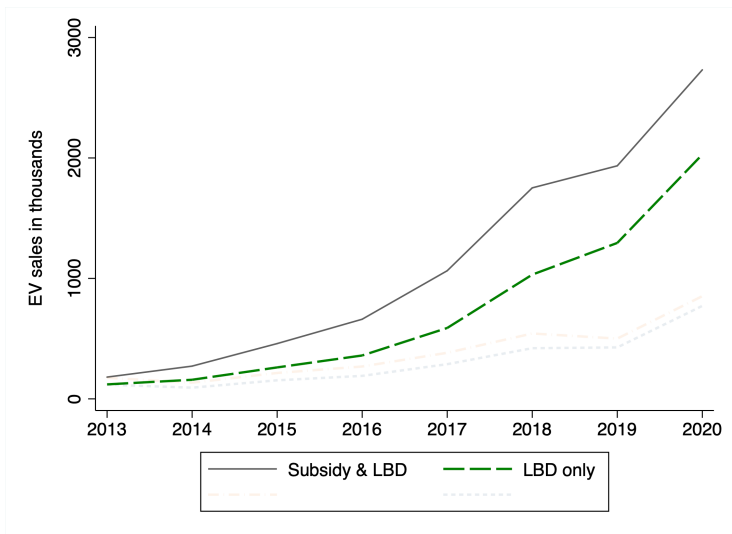
- Learning rate: 7.5%, accounting for 36% of overall cost reduction
- Chinese firms move faster down the learning curve due to subsidies and the whitelist policy





# Effectiveness of Consumer Subsidies

▶ No LBD



- Subsidies ↑ sales by 3.4 mil. (80%) during 2023-20, effect amplified by LBD

- US subsidies benefited US EV buyers and EV firms, and increase EV sales

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- JP and KR battery suppliers benefited from US subsidies through accelerated learning
- Lower battery costs in JP and KR benefited Europe EV consumers and firms, increasing EV adoption
- Limited spillover benefit to Chinese consumers and EV firms: EVs sold in US mainly source batteries from JP & KR.

Mirror the impacts of US subsidies:

- European subsidies benefited European consumers and EV firms, and increased EV sales

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- European subsidies benefited European consumers and EV firms, and increased EV sales
- JP and KR battery suppliers benefited from European subsidies through accelerated the learning
- Significant spillover benefits to the US, which shares the same battery suppliers with European EV firms
- Almost no spillover benefits to Chinese consumers and EV firms due to limited overlap in battery suppliers

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  - ▶ Benefited Chinese EV consumers and firms by reducing battery costs via learning
  - ▶ Exhibited small spillover benefits to other markets due to limited supplier overlap

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  - ▶ Benefited Chinese EV consumers and firms by reducing battery costs via learning
  - ▶ Exhibited small spillover benefits to other markets due to limited supplier overlap
- China's Whitelist policy:
  - ▶ Whitelist benefited domestic battery suppliers by accelerating its learning
  - ▶ Significant market diversion from JP&SK suppliers. Slowed down their learning, and EV adoption in other markets
  - ▶ Results likely hold for local content requirements used by other regions

## Main Takeaways

- EV penetration varies dramatically across markets with China having emerged as the dominant player in sales, production and supply chain

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- Consumer subsidies explained 45% of global EV sales during 2013-2020. LBD in battery production magnified the effectiveness

## Main Takeaways

- EV penetration varies dramatically across markets with China having emerged as the dominant player in sales, production and supply chain
- Governments have increased the use of industrial policies in the auto sector especially to target EVs. Consumer EV subsidies are prevalent
- Consumer subsidies explained 45% of global EV sales during 2013-2020. LBD in battery production magnified the effectiveness
- Consumer subsidies in one country could generate global spillovers via shared supply chain, but local content requirements inhibit spillovers

**THANKS!**

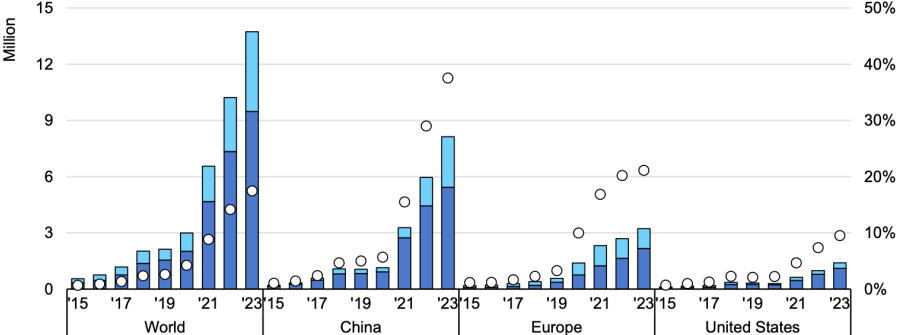
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# APPENDIX

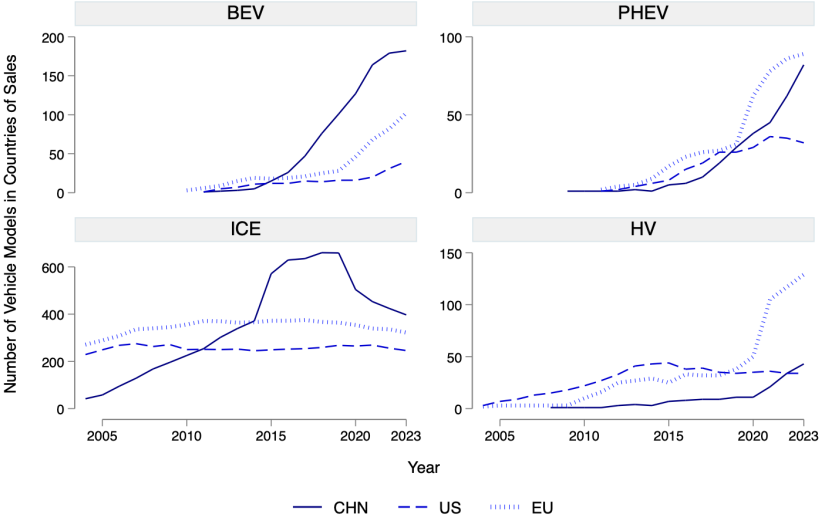
# EV sales and market shares

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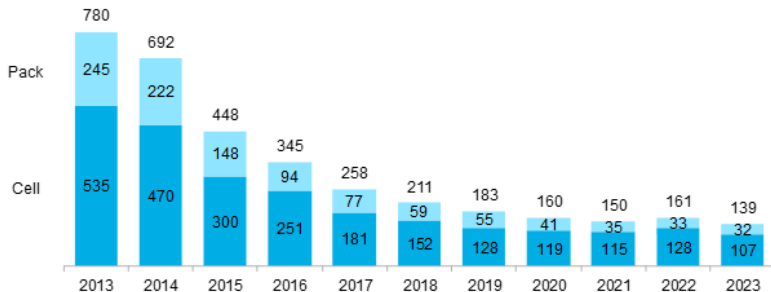
# Model Availability by Fuel Type

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# Sales-weighted Average Battery Prices

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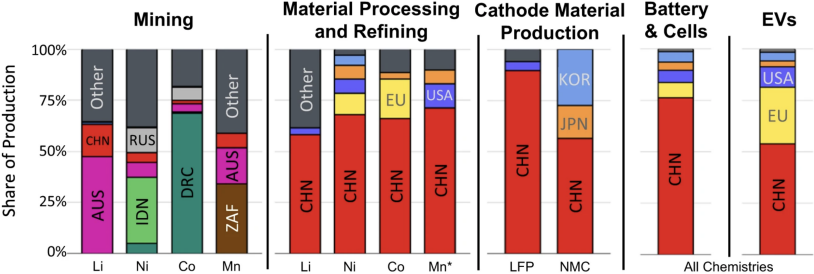


Source: Bloomberg New Energy Finance

- Wright's Law: unit cost of battery production decreases by 20-30% with doubling of production

# EV Battery and Material Supply Chains

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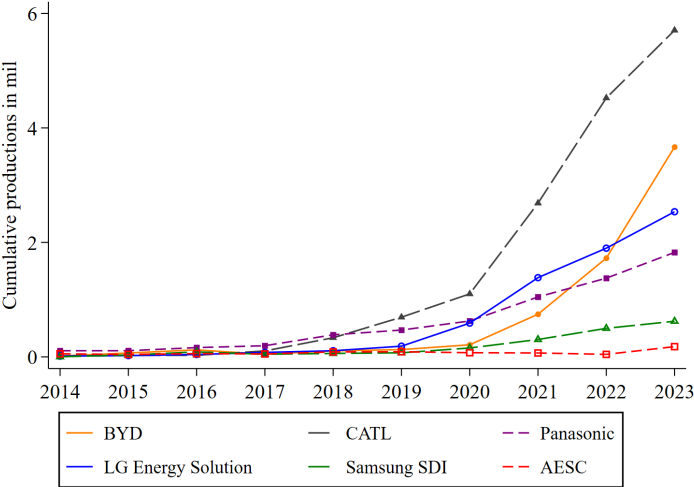


Li lithium, Ni nickel, Co cobalt, Mn manganese (\*electrolytic manganese dioxide represents refined manganese). The following codes are used to represent countries or regions: CHN China, AUS Australia, IDN Indonesia, RUS Russia, DRC Democratic Republic of the Congo, ZAF South Africa, KOR Republic of Korea, JPN Japan, USA United States of America, Other any other country not explicitly listed here.

Source: Cheng et al. (2024)

# Major Battery Suppliers

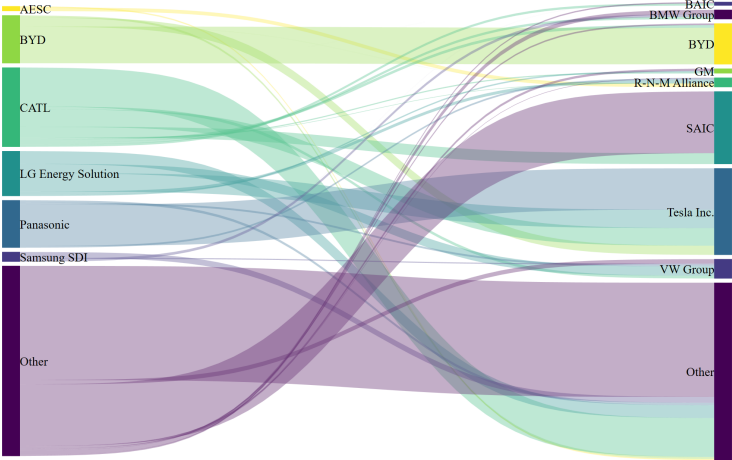
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- Top 6 battery suppliers have a market share of nearly 72% in 2023

# Battery Supply Network 2013-2023

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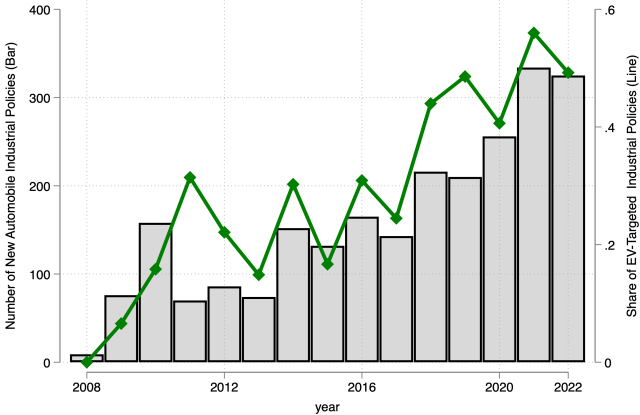


Battery Supplier

EV Manufacturer

2013-2023 Total Battery Packs Flow

# No. of New Automotive Industrial Policies



Source: Global Trade Alert Database

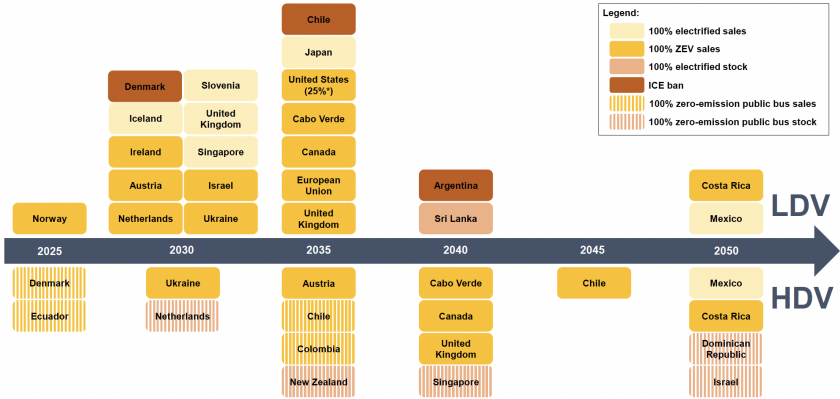


- Defining (national-level) Industrial Policy (IP): (1) **State action** (2) **Shift the composition of economic activity** (targeting specific industry)
- Measuring IP 1: using Global Trade Alert database and natural language processing (NLP) techniques (Juhász et al. 2022)
  1. Manually label a training dataset to either IP or non-IP
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- Measuring IP 2: using country-by-model-level EV Subsidy
  - ▶ Compile a database of **model-level** EV subsidies and supply chain data for 13 counties from 2013 to 2020 (account for 95% of global EV sales).

# Global ZEV Mandates and ICE Bans

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Source: IEA

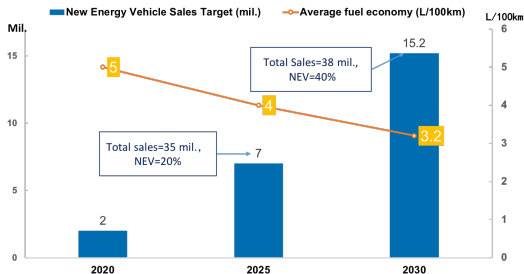
# Fuel Economy and GHG Emissions Standards

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Region	Target Year	Regulated Metric	Unadjusted Fleet Target/Measure	Attribute-based	Corporate Average	Test Cycle
EU	2025 2030 2035	CO <sub>2</sub>	93 g/km 49 g/km 0 g/km	Curb Weight	Yes	WLTP
China	2021 - 2025	Fuel consumption	5.7 - 4.6 l/100km	Curb Weight	Yes	WLTP
U.S.	2024 - 2026 (proposal)	Fuel economy	49.2 - 58.1 mpg 60.0 - 66.4 mpg	Footprint	Yes	U.S. combined
U.S.	2023 - 2026 2027 - 2032 (proposal)	GHG	166 - 132 g/mi 134 - 73 g/m mpg	Footprint	Yes	U.S. combined
Canada	2023 - 2026	GHG	161 - 148 g/mi	Footprint	Yes	U.S. combined
India	FY 2022 - 2023	Fuel consumption	4.77 l/100km	Curb Weight	Yes	NEDC
Brazil	2022	Energy consumption	1.62 MJ/km	Curb Weight	Yes	U.S. combined
South Korea	2021 - 2030	GHG	97 - 70 g/km	Curb Weight	Yes	U.S. combined
UK	2024 - 2035 (proposal)	CO <sub>2</sub>	120 - 0 g/km	Flat targets for ICE vehicles	Yes	WLTP
New Zealand	2023 - 2027	CO <sub>2</sub>	145 - 63.3 g/km	Tare Weight	Yes	3P-WLTP
Mexico	2025 - 2027 (proposal)	GHG	104.4 - 88.9 g/km	Footprint	Yes	U.S. combined
Japan	2030	Fuel efficiency	25.4 km/l	Curb Weight	Yes	3P-WLTP

Source: ICCT

- US CAFE Standards (since 1975) and GHG Emissions Standards (since 2012)
- China CAFC Standards (2012) and New Energy Vehicle Credit (2017)



2020年-2025年节能与新能源目标来自《汽车产业中长期发展规划》  
The energy conservation and new energy targets for 2020-2025 come from the medium and long-term development plan of the automobile industry.

2030年为非约束性目标，来自《节能与新能源汽车技术路线图》  
2030 is a non-binding target, from 'road map of energy conservation and new energy vehicle technology'

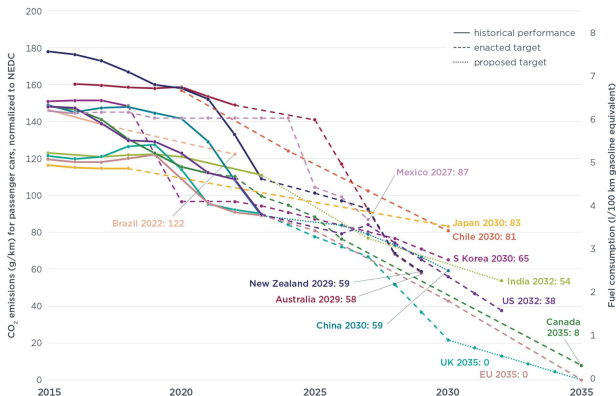
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# Fuel Economy and GHG Emissions Standards



Note: UK fleet-average targets estimated based on non-ZEV CO<sub>2</sub> emissions and ZEV mandate.  
 Canada 2035 target is estimated based on Canada's 2035 ZEV mandate.  
 The U.S. 2027 target and beyond reflect the changes in the credits flexibilities including off-cycle and A/C credits.

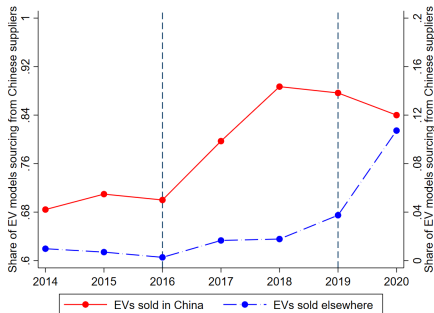
Updated Nov 2024

Source: ICCT

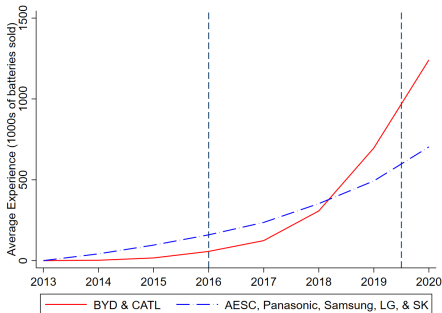
# China's Whitelist policy

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(a) Domestic sourcing of batteries



(b) Battery sales



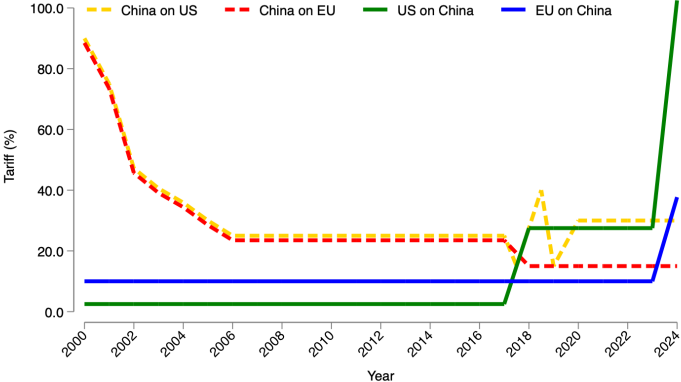
- Led to large increase in domestic procurement of batteries among Chinese EV firms
- BYD and CATL sales increased rapidly during this period



		Consumer
Maximum		\$7500, of which: \$3750 is for critical minerals \$3750 is for battery content
Assembly Requirement		North America
Critical Minerals		Increasing each year
No critical minerals from China or other “foreign entities of concern”		From 2025
Battery Components		Increasing each year
No battery components from China, other “foreign entities of concern”		From 2024
MSRP Cap	Truck/SUV/Van Car	\$80K \$55K

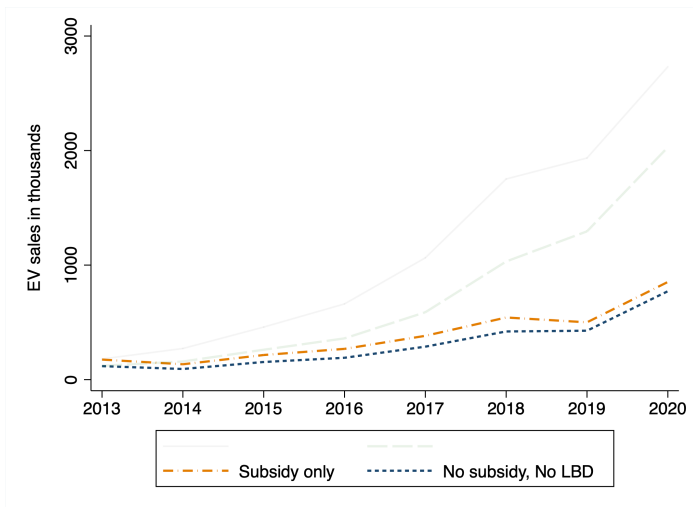
- Min. % of critical minerals by value from N.A. or other FTA partners, from 40% in 2023 to 80% in 2027 and on
- Min. % of battery components by value from N.A. from 50% in 2023 to 100% in 2029 and on

### Annual Unilateral EV Tariffs



US on EU: 2.5%, EU on US: 10%

# Effectiveness of Consumer Subsidies without LBD



- Without LBD, subsidies ↑ sales by 1.29 mil. (30.1%) during 2013-20

Welfare with US subsidy – without US subsidy				
	China	Europe	JP&KR	N. A.
Δ Welfare (\$ bn.)	0.06	1.91	5.70	8.80
Consumer surplus (+)	0.14	0.96	0.04	13.35
Battery profit (+)	-0.21	-	4.59	-
EV profit (+)	0.08	1.34	1.08	8.56
Gov't expenditure (-)	-0.05	0.39	0.01	13.10
Δ EV sales	6,646	50,224	2,266	754,788

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Welfare with EU subsidy – without EU subsidy				
	China	Europe	JP & KR	N.A.
Δ Welfare (\$ bn.)	0.26	3.73	5.32	2.29
Consumer surplus (+)	0.15	14.63	0.04	0.89
Battery profit (+)	-0.11	-	3.97	-
EV profit (+)	0.18	5.52	1.32	1.76
Gov't expenditure (-)	-0.04	16.44	0.01	0.36
Δ EV sales	8,650	751,021	2,766	50,749



	Welfare with EU subsidy – without EU subsidy			
	China	Europe	JP & KR	N.A.
$\Delta$ Welfare (\$ bn.)	0.26	3.73	5.32	2.29
Consumer surplus (+)	0.15	14.63	0.04	0.89
Battery profit (+)	-0.11	-	3.97	-
EV profit (+)	0.18	5.52	1.32	1.76
Gov't expenditure (-)	-0.04	16.44	0.01	0.36
$\Delta$ EV sales	8,650	751,021	2,766	50,749

	Welfare with CN subsidy – without CN subsidy			
	China	Europe	JP & KR	N. A.
$\Delta$ Welfare (\$ bn.)	30.69	0.69	-0.06	0.95
Consumer surplus (+)	27.04	0.67	0.01	0.33
Battery profit (+)	7.52	-	-0.11	-
EV profit (+)	18.39	0.26	0.04	0.76
Gov't expenditure (-)	22.27	0.24	0.00	0.13
$\Delta$ EV sales	2,696,916	30,267	732	18,780

	Welfare with CN subsidy – without CN subsidy			
	China	Europe	JP & KR	N. A.
$\Delta$ Welfare (\$ bn.)	30.69	0.69	-0.06	0.95
Consumer surplus (+)	27.04	0.67	0.01	0.33
Battery profit (+)	7.52	-	-0.11	-
EV profit (+)	18.39	0.26	0.04	0.76
Gov't expenditure (-)	22.27	0.24	0.00	0.13
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# Impacts of China's Whitelist Policy

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	Welfare with whitelist – without whitelist				
	China	Europe	JP & KR	N. America	Global
$\Delta$ Welfare (\$ bn.)	3.35	-0.52	-3.82	-1.24	-2.23
Consumer surplus (+)	-0.80	-0.48	-0.01	-0.58	-1.87
Battery profit (+)	3.17	-	-3.73	-	-0.56
EV profit (+)	-0.11	-0.25	-0.07	-0.89	-1.33
Gov't expenditure (-)	-1.08	-0.21	0.00	-0.24	-1.53
$\Delta$ EV sales	-61,375	-26,162	-742	-33,196	-121,475

# Impacts of China's Whitelist Policy

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	Welfare with whitelist – without whitelist				
	China	Europe	JP & KR	N. America	Global
$\Delta$ Welfare (\$ bn.)	3.35	-0.52	-3.82	-1.24	-2.23
Consumer surplus (+)	-0.80	-0.48	-0.01	-0.58	-1.87
Battery profit (+)	3.17	-	-3.73	-	-0.56
EV profit (+)	-0.11	-0.25	-0.07	-0.89	-1.33
Gov't expenditure (-)	-1.08	-0.21	0.00	-0.24	-1.53
$\Delta$ EV sales	-61,375	-26,162	-742	-33,196	-121,475