AIS Forum on Trade
Critical Minerals and Battery Components

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Introduction

David is an International Economist who covers the automotive industry for the U.S. International Trade Commission (USITC).

The USITC is an independent quasi-judicial federal agency.

Opinions expressed in this presentation are my own, and not necessarily those of the Commission or any of its Commissioners.

Data is primarily from fall 2024, and does not include full-year 2024.

Outline of presentation

Why EV batteries are important and where we get them from

Battery components

- Trade
- U.S. investment/production

Critical minerals

- Trade
- Investment

Why are batteries important?

Important for competitiveness of EVs

High share of cost of EVs

Particularly battery-electric vehicles (BEVs)

Trade and regulatory rules and incentives for EVs have battery rules

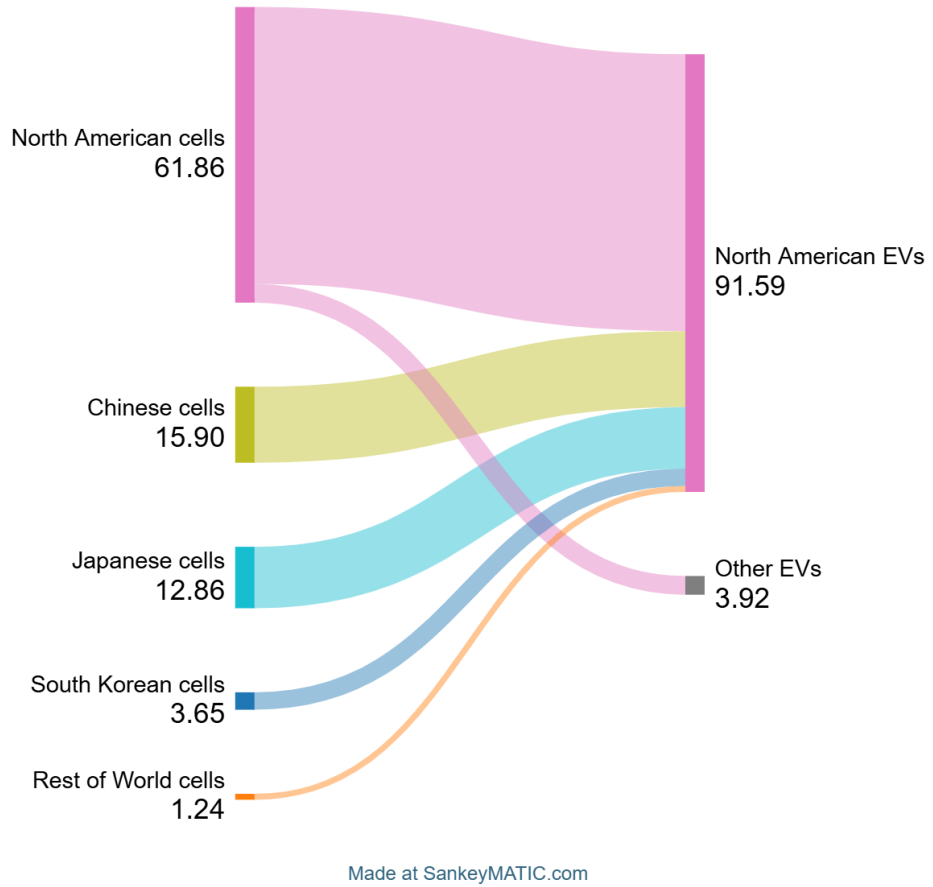
North American demand currently greater than supply

Reliance on foreign batteries

- U.S. relied on imported batteries to meet EV production demand in 2023
- U.S. battery cell production projected to surpass EV demand by 2027

Sources of battery cells for North American EVs, 2023

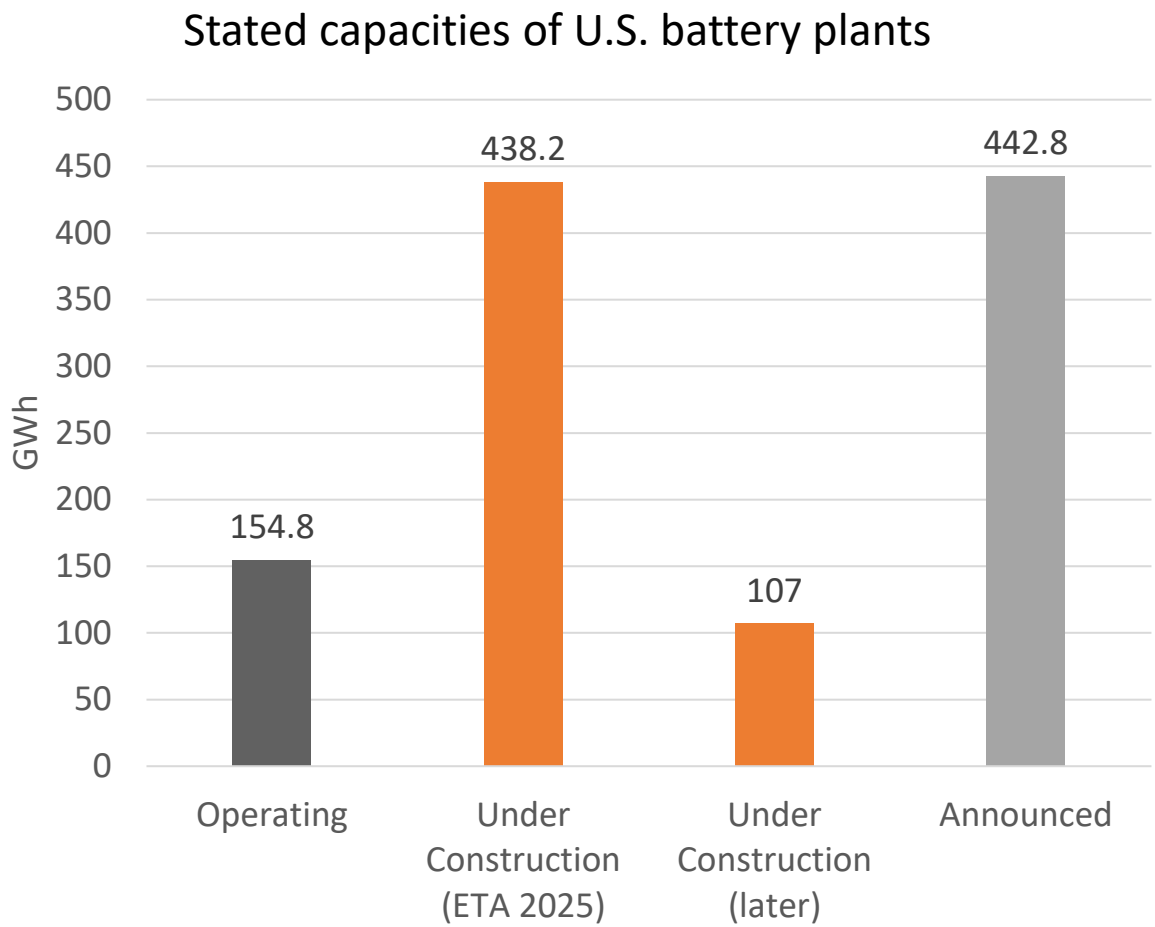
In GWh



Source: Adapted from IEA, Global EV Outlook 2024, April 2024.

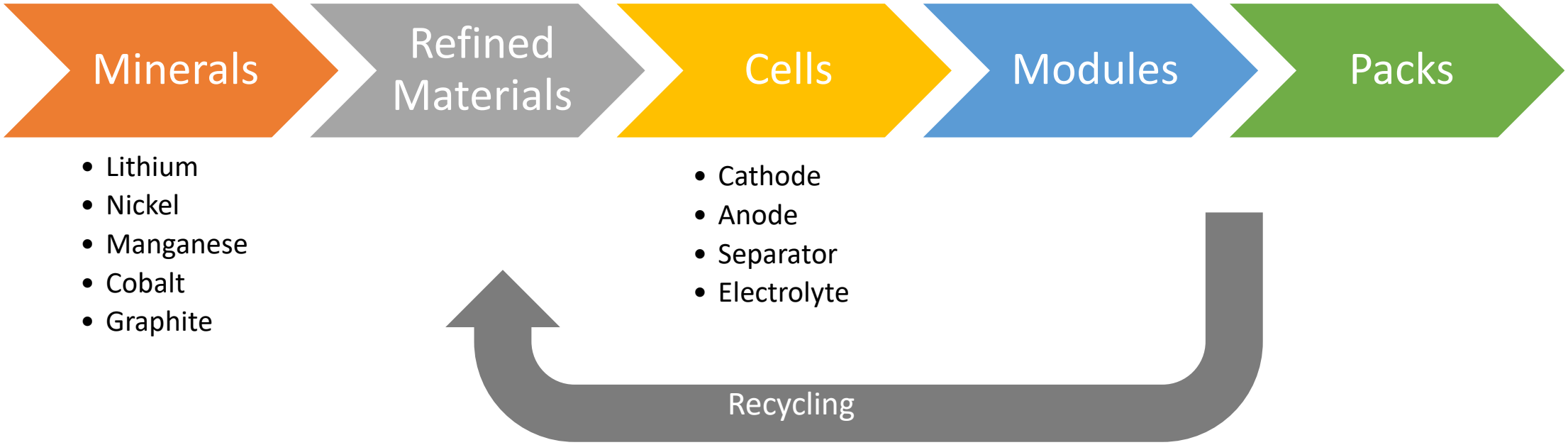
U.S. battery capacity

- May take several years for a battery plant to reach full capacity after becoming fully operational
- 1 GWh is equivalent to 10,000 BEVs with 100kWh batteries
- Current stated capacity is enough for 1.5 million such BEVs; equivalent of 5.4 million more under construction
- 4.4 million more has been announced, but unclear how much will eventually be built



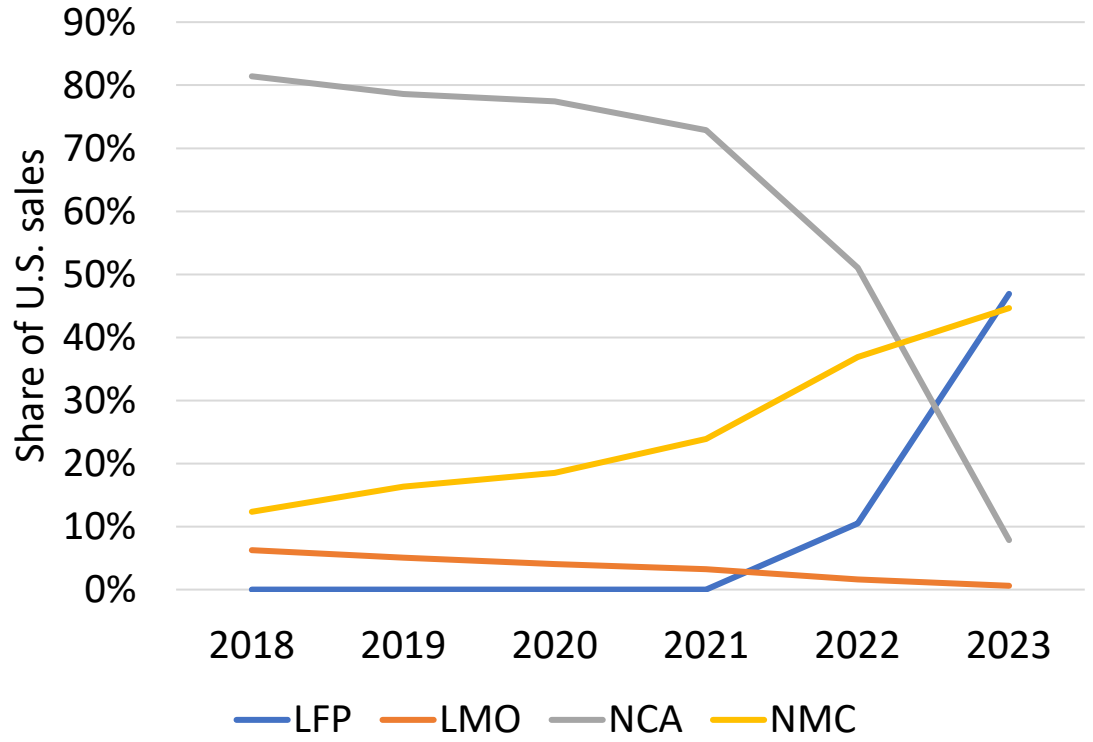
Source: adapted from Turner, Big Green Machine, August 16, 2024.

Lithium-ion battery supply chain



Changing battery chemistries

U.S. BEV sales, by battery chemistry, in share of U.S. BEV sales, 2018–23



LFP= lithium-iron-phosphate; LMO= lithium-manganese oxide;

NCA= nickel-cobalt-aluminum; NMC= nickel-manganese-cobalt

LFP increase is due to Tesla, Ford, and others increasingly switching to it.

- *LFP-lower energy density and more sensitive to temperature, but no cobalt and can be cycled more.*

LMO not used much in automotive.

NCA decrease is due to Tesla's declining market share and transition to LFP.

- *NCA-lower cost than NMC, but better energy density than LFP.*

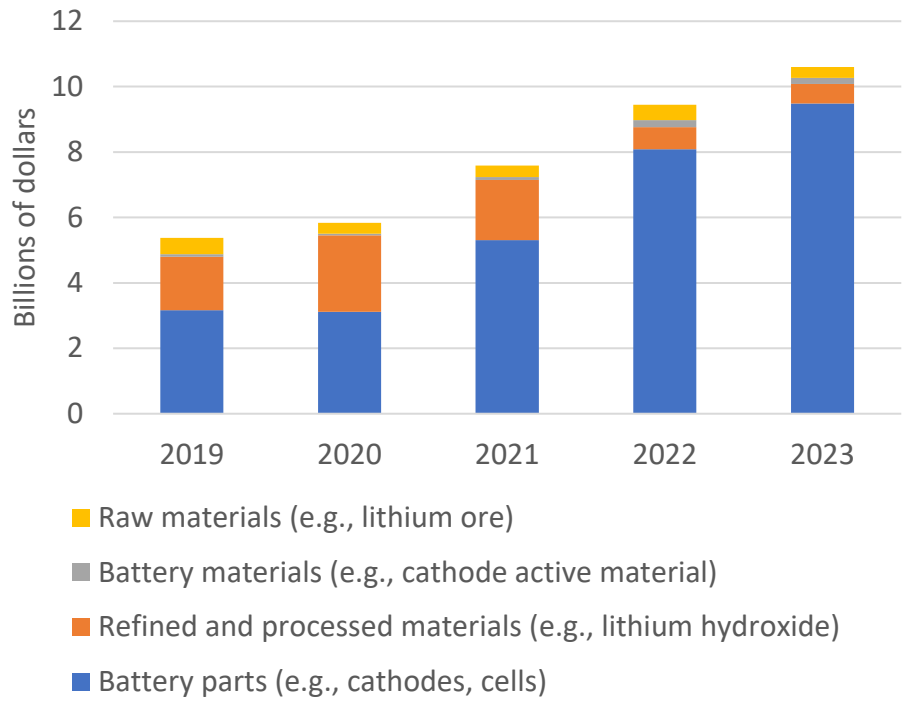
NMC increase is due to increased BEV sales by traditional OEMs (who all tend to use NMC).

- *NMC-higher energy density.*

Source: Wards Intelligence, "U.S. Vehicle Sales by Model, 2018–2022," February 9, 2023; Wards Intelligence, "U.S. Car and Light Truck Sales by Model by Month 2023," January 30, 2024; Wards Intelligence, "% Powertrain Installations," various years.

U.S. imports of battery inputs

U.S. imports of battery inputs by value, 2019-23

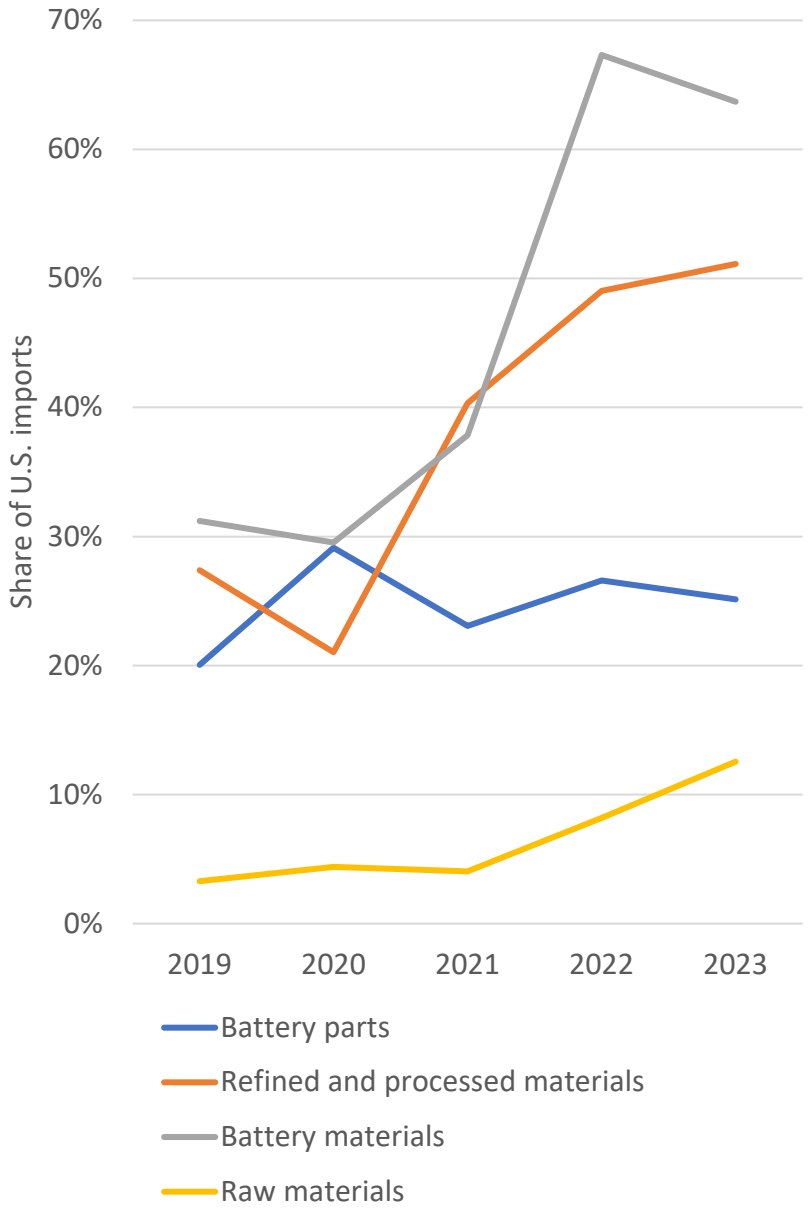


- U.S. imports primarily battery parts, to support cell production and pack assembly
- As U.S. production moves upstream, imports of downstream inputs declines
- Difficult to fully separate battery-related imports from others, particularly upstream

Source: USITC/Dataweb, general imports, "Raw Materials (HTS 2530.90.8050, 2805.19.9000, 7501.20, and 8105.20.60), Refined and Processed Materials (HTS 2820.10.0000, 2825.20, 2826.19.0000, 2827.39.90, 2833.29.51, 3801.10.5000, 3824.90.3900, and 8111.00.4910) Battery Materials (HS 2501.10, HTS 2842.90.9000, HTS 3801.20.0000), Cell Components (HTS 3824.99.9297, 3919.10.2055, 7607.20.50, 7616.99.5190, 8507.90.8000)," accessed May 31, 2024.

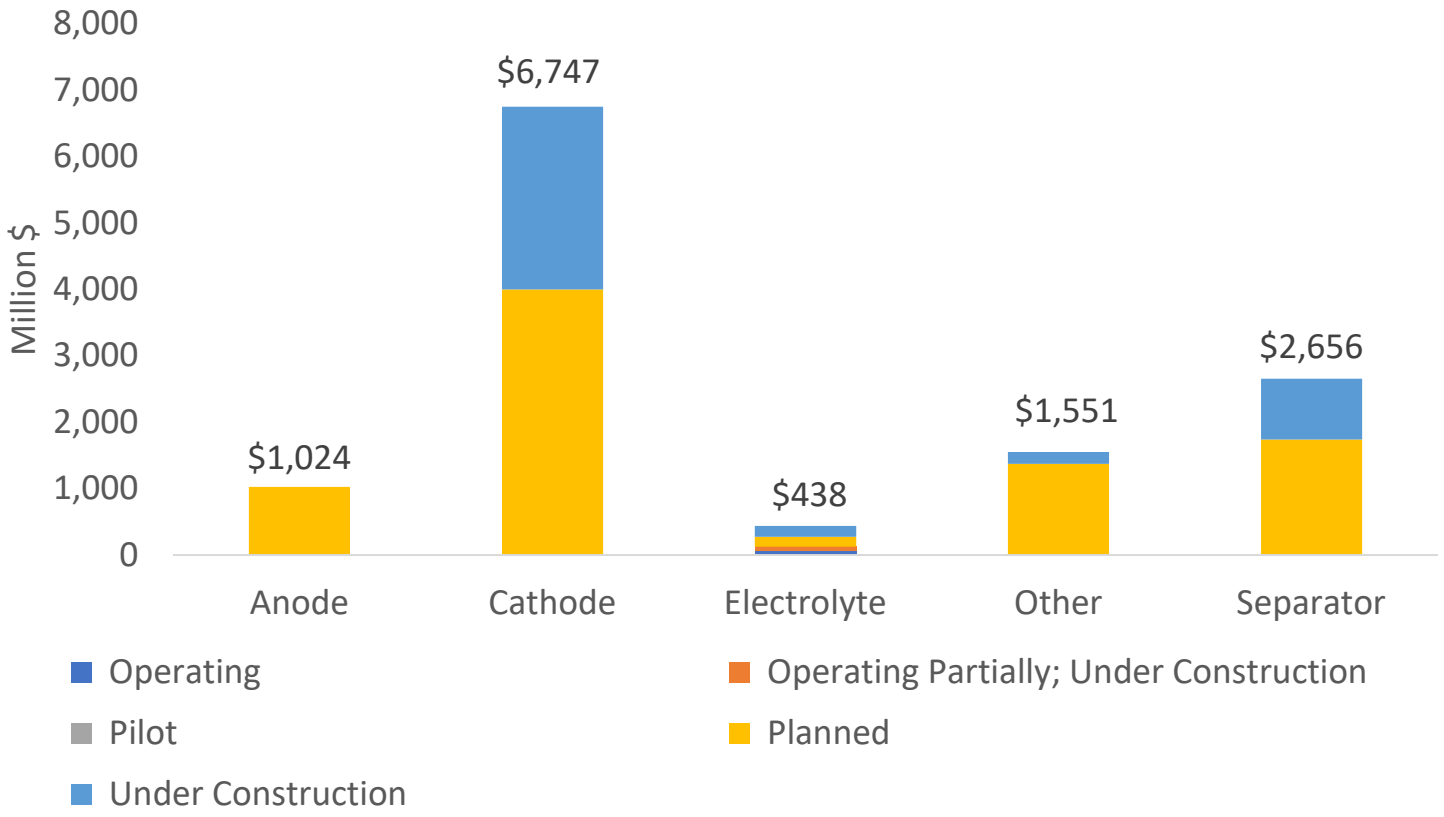
Chinese share of imports of U.S. battery inputs

- Chinese share of midstream inputs is much higher than raw and downstream.
- Raw depends on local factors
- U.S. preference for non-Chinese cells and/or cathodes



U.S. battery component investment

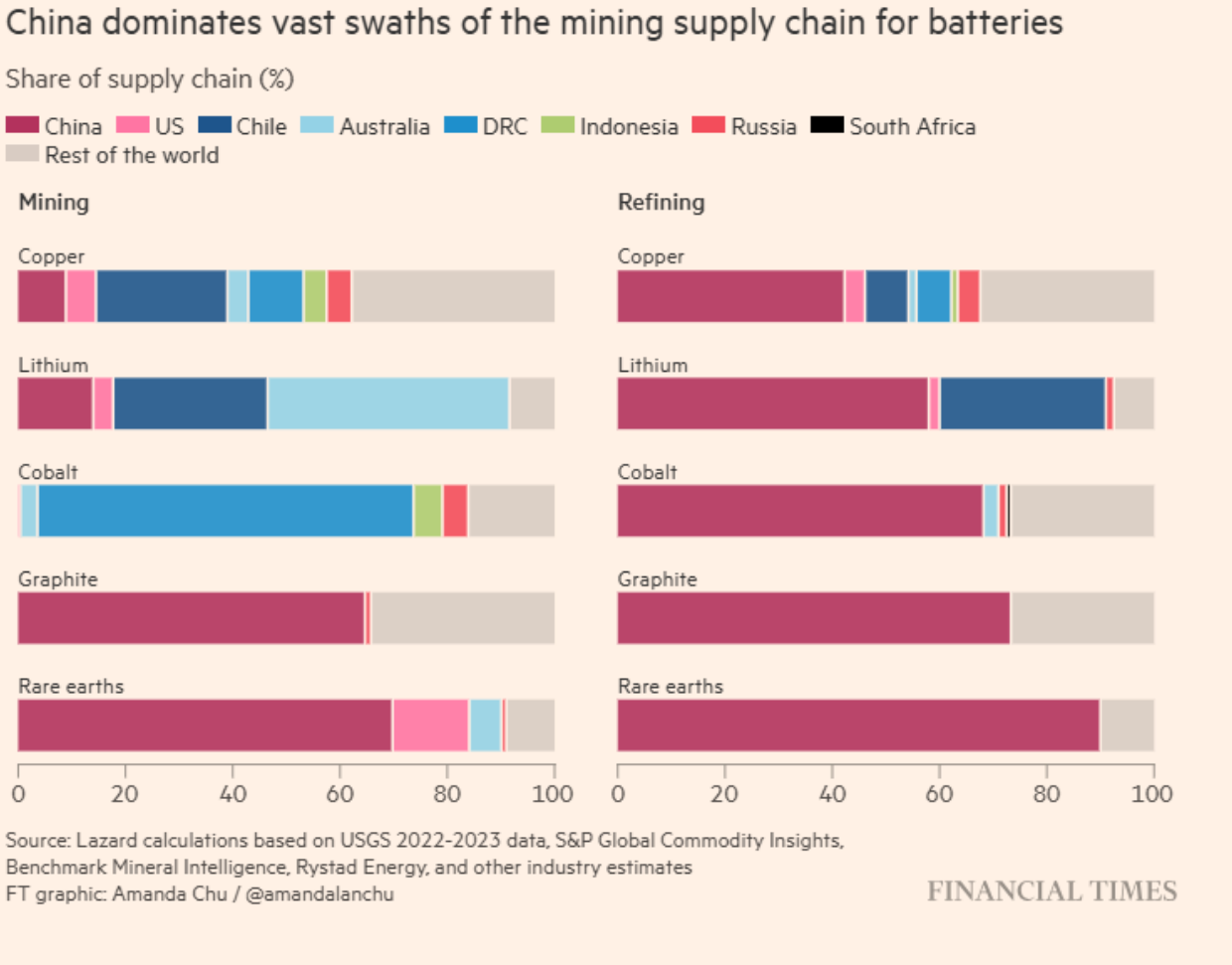
U.S. battery component investment by stage



Source: adapted from Turner, Big Green Machine, August 16, 2024.

- Total currently under construction: $4 billion
- $8 billion more planned
- Only $120 million currently operating, all electrolyte

Big picture on critical minerals

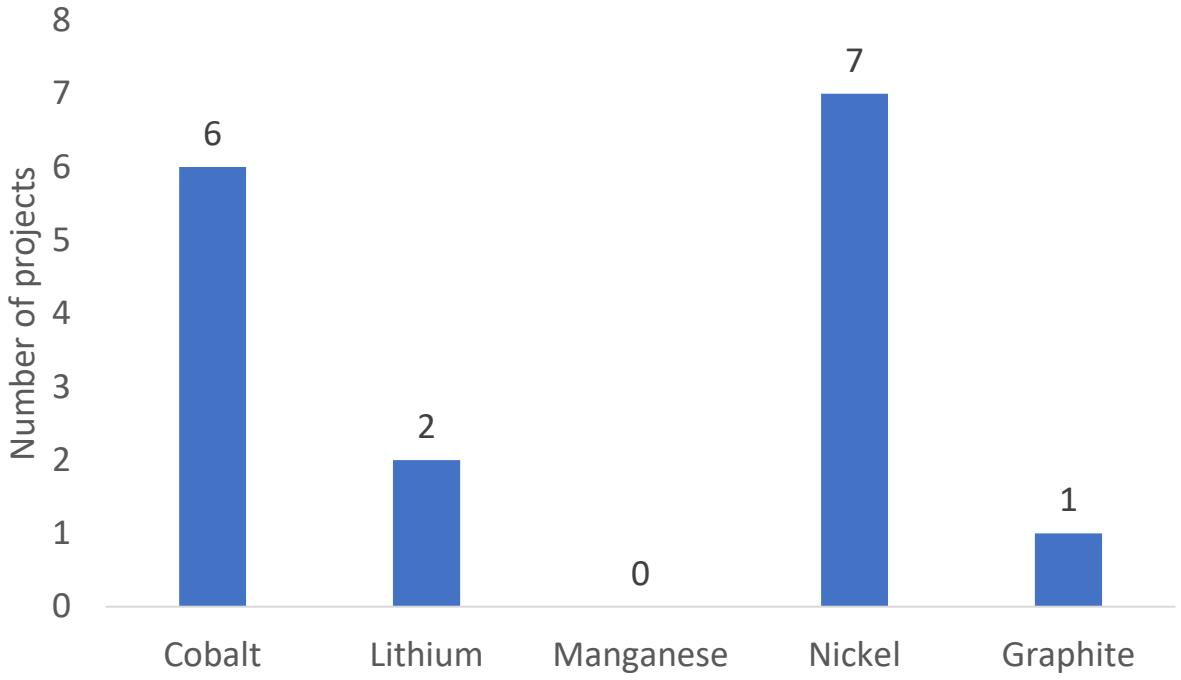


Source: Chu et al., "$1bn US battery plant plan shows race to reduce reliance on China," October 15, 2024.

- Challenging to make a battery without minerals from China
- IRA rules delayed graphite requirement because so little access to non-Chinese graphite
- U.S. shares of global reserves:
  - Cobalt- 0.6 percent
  - Lithium- 3.9 percent
  - Graphite- ?
  - Nickel- 0.3 percent

Source: USGS, Mineral Commodity Summaries, 2024.

U.S. battery critical mineral projects

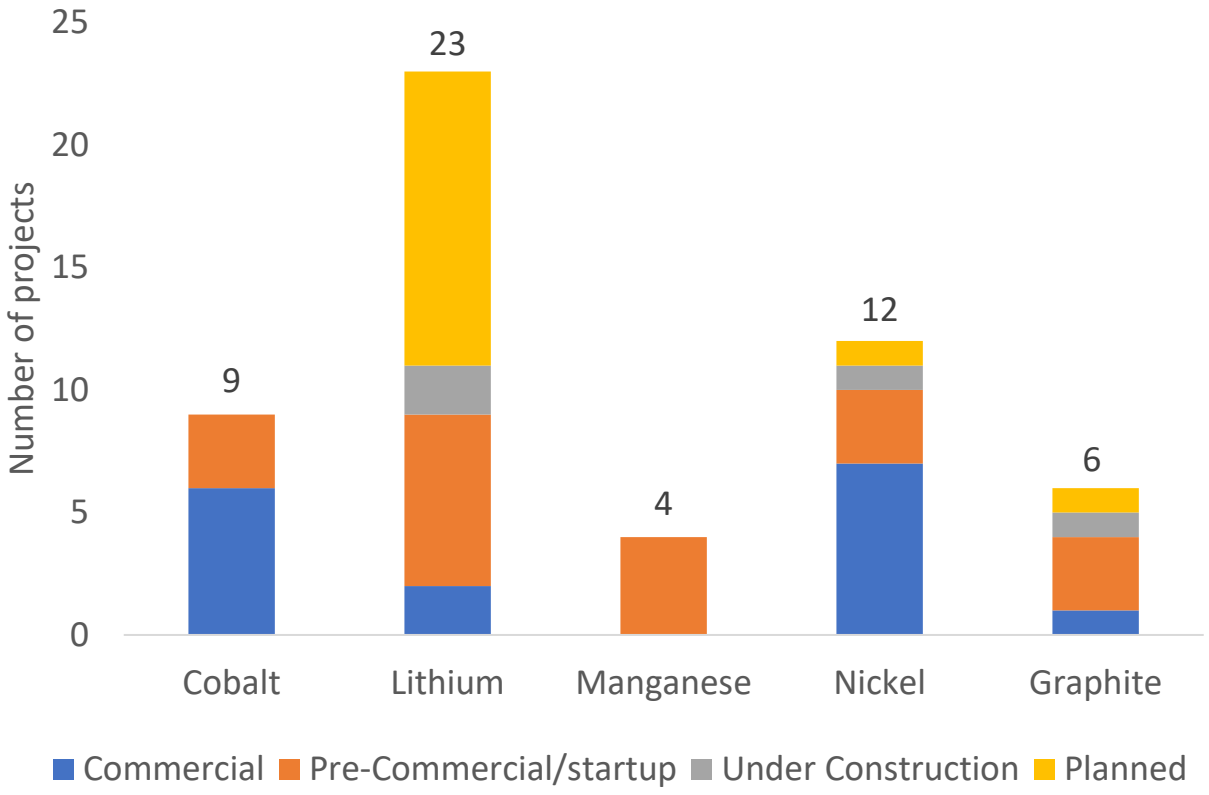


NAATBAAT Database, September 26, 2024.

- Very few critical mineral projects at commercial stage in United States
- This includes mining and processing
- USGS Mineral Commodity Summaries list 500 tons of cobalt, and a withheld amount of lithium

Source: USGS, Mineral Commodity Summaries, 2024.

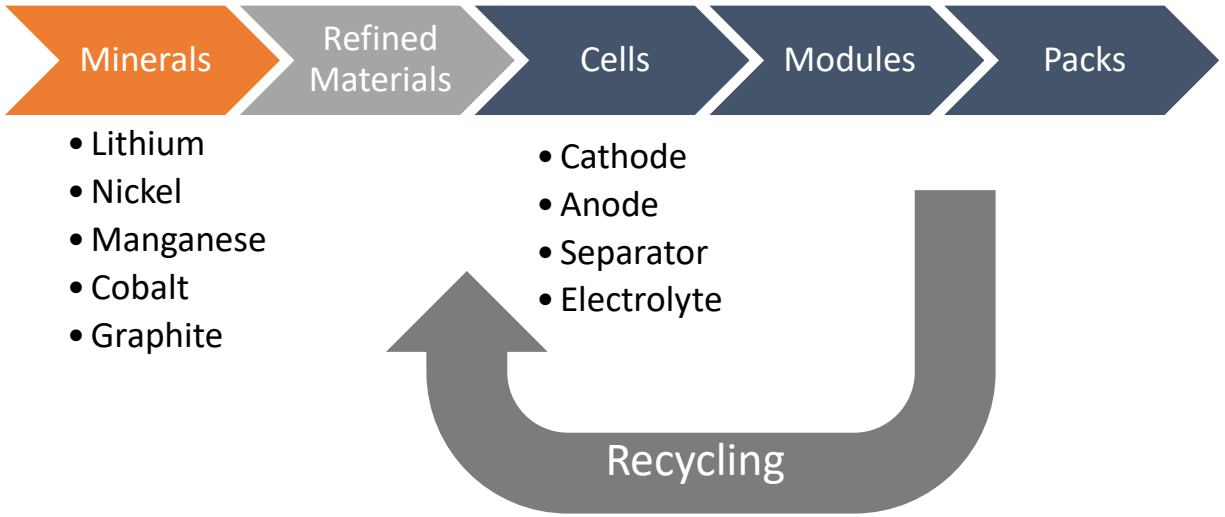
U.S. battery critical mineral investment



NAATBAAT Database, September 26, 2024.

- More U.S. investment has been announced
- New administration focused on making it easier to get permits and begin mining
- Current process takes more than a decade to get a new mine up and running

Reduced foreign reliance by end of decade



- U.S. EV production reliance on foreign inputs increases as you look farther up the battery supply chain
- Battery production and component production increasingly occurring in the U.S. (batteries more than components)
- Changes to critical mineral sourcing will take longer

China and EV supply chain research

- Coffin, David and Jeffrey Walling. “Electrifying the Global Battery Electric Vehicle Landscape.” June 2024.
- Coffin, et al. “The impact of Changes in Trade Policies on the Electric Vehicle (EV) Sector – a CGE Analysis.” May 2024
- Coffin, David and Jeff Walling. “Chinese Vehicle Exports: Electrified.” April 2024.
- Coffin, David. “National Automotive Competitiveness.” January 2024.
- Coffin, et al. “A Preliminary Examination of the Trade Competitiveness and Climate Objectives in the Inflation Reduction Act of 2022.” February 2023.
- Coffin, et al. “New U.S. Law May Impede Imports of Wide Range of Products from Xinjiang, China.” October 2022.
- Coffin, David. “How Does Increased EV Production Affect U.S. Automotive Employment?” May 2022.
- Coffin, David. “The Forgotten Middle: Manufactured Inputs for Electric Vehicle (EV) Batteries.” February 2021.
- Horowitz, Jeff, David Coffin, and Brennan Taylor. “Supply Chain for EV Batteries: 2020 Trade and Value-add Update.” January 2021.

Battery critical mineral research

Critical Minerals

- Cobalt
- Lithium
- Nickel
- Manganese
- Graphite

See webinar that our colleagues participated in: "Lithium-Ion Batteries and their Global Value Chains"

- Guberman, David Samantha Schreiber, and Anna Perry. "Export Restrictions on Minerals and Metals: Indonesia's Export Ban of Nickel," February 2024.
- Tsuji, Karl. "Global Value Chains: Graphite in Lithium-Ion Batteries for Electric Vehicles," June 2022.
- Guberman, David, "Nickel in Indonesia: A Story of Trade Restraints and Emerging Technologies (Part 1)," and "(Part 2)," May 2021.
- LaRocca, Gregory M. "Global Value Chains: Lithium in Lithium-ion Batteries for Electric Vehicles," July 2020.
- Scott, Sarah and Robert Ireland. "Lithium-Ion Battery Materials for Electric Vehicles and their Global Value Chains," June 2020.
- Matthews, Daniel. "Global Value Chains: Cobalt in Lithium-ion Batteries for Electric Vehicles," May 2020.