

U.S. BATTERY SUPPLY CHAINS: LOCALLY CHARGED?

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CREB SPRING BI-ANNUAL MEETINGS
JUNE 10, 2022**





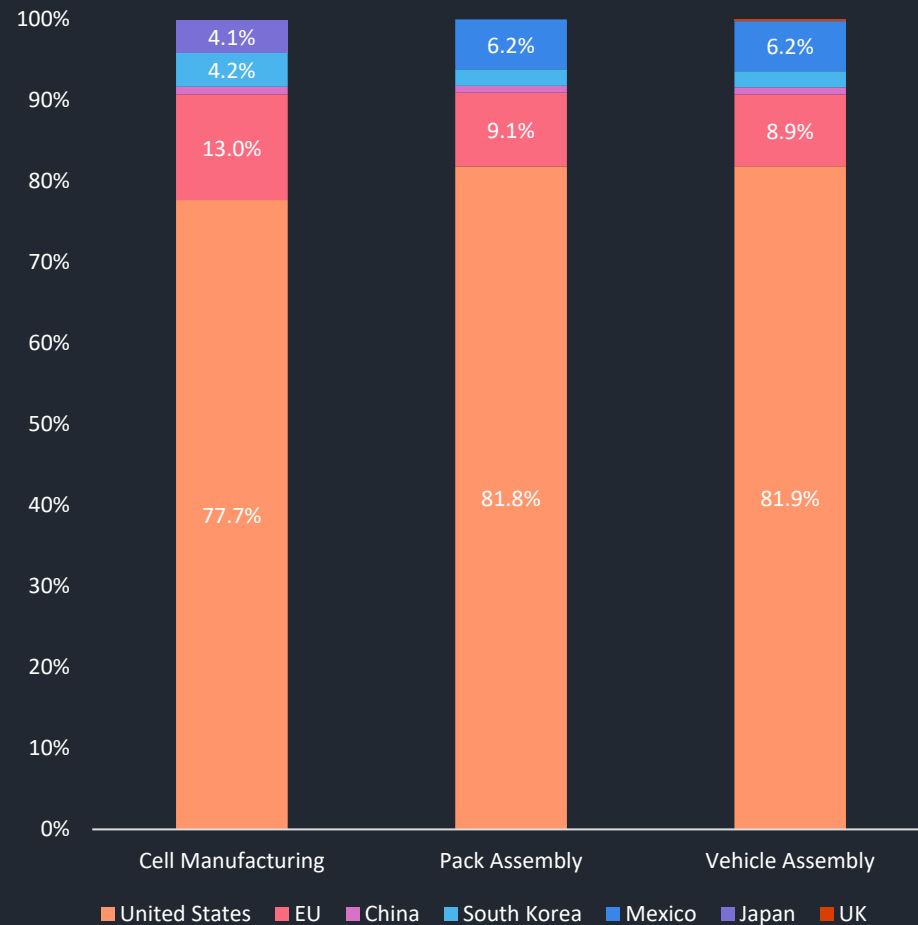
INTRODUCTION AND DISCLAIMER

- David and Jeff are International Trade Analysts who cover the automotive industry for the U.S. International Trade Commission
- The USITC is an independent quasi-judicial federal agency
- Opinions expressed in this presentation are our own, and not necessarily those of the Commission or any of its Commissioners.

PUBLICATION DETAILS

- Horowitz, Coffin, and Taylor. [“Supply Chain for EV Batteries: 2020 Trade and Value-Added Update,”](#) Office of Industries Working Paper, January 2021.
- Original paper published in the Journal of International Commerce and Economics in December of 2018

SHARE OF U.S. PRODUCTION IN GIVEN STAGE

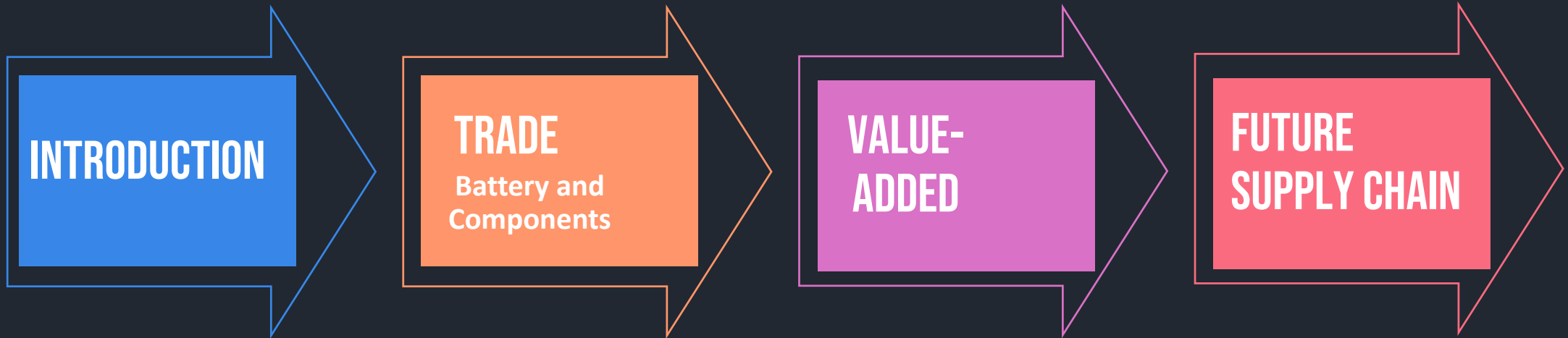


A Tale of Two Supply Chains

1. The U.S. produces the vast majority of the EVS sold to U.S. consumers, and the cells and packs also come from the US
2. However, it is well-known that the U.S. is heavily reliant on foreign materials and inputs; varies from material to material but is consistently 50+ percent according to the recent Biden Administration EO:

Sources: Author Calculations and White House, "Building Resilient Supply Chains," June 2021.
<https://www.whitehouse.gov/wp-content/uploads/2021/06/100-day-supply-chain-review-report.pdf>.

ROADMAP



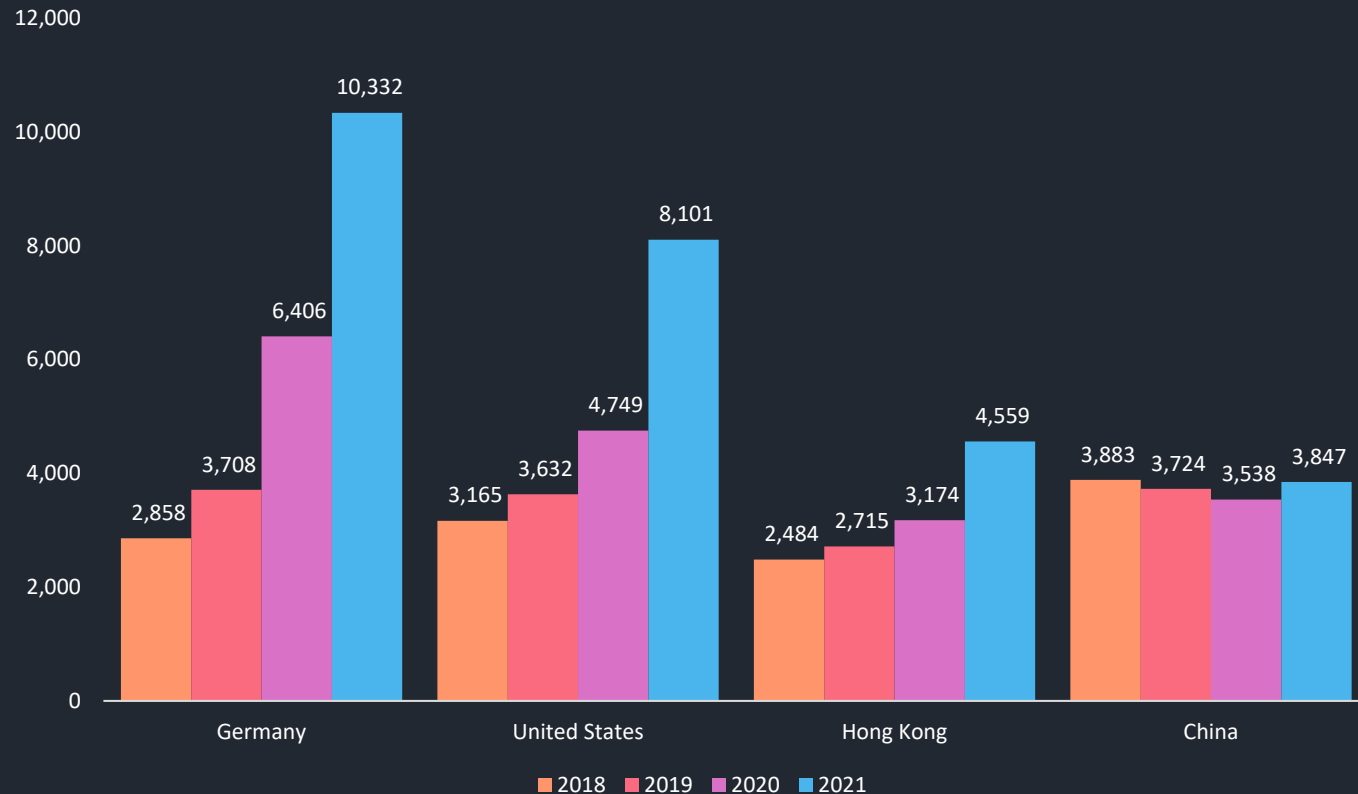
INTERNATIONAL TRADE

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GLOBAL BATTERY IMPORTS INCREASED SIGNIFICANTLY

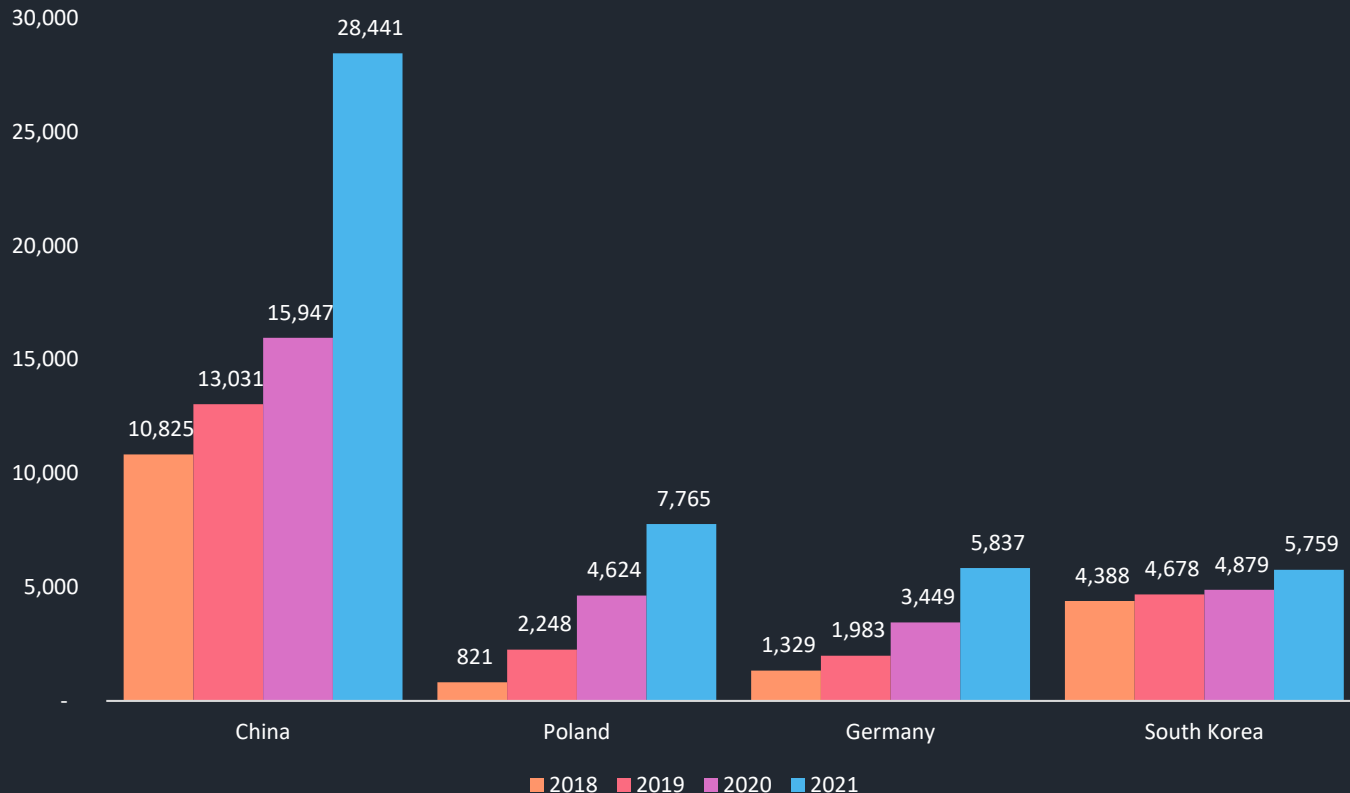
Li-Ion battery imports, 2018-2021, millions of \$



- Total imports up 137 percent (over \$33 billion since 2018)
- Germany, the United States, and Hong Kong overtaken China
- German imports are primarily (over 60%) from within the EU; but nearly one-third from China and South Korea.

CHINA MAJOR SOURCE OF GLOBAL BATTERY EXPORTS

Li-Ion battery exports, 2018-2021, millions of \$



- Total exports up 133 percent (over \$39 billion since 2018)
- Differences in unit prices; Chinese, South Korean, and Japanese exports are all valued at less than \$8.29 per unit in 2021
- U.S. exports were only \$1.6 billion in 2021 but were valued at \$90.37 in the same year.
- Polish exports valued at \$213.08 per unit, and Germany were \$25.73 per unit.

U.S. BATTERY IMPORTS (A SUBSET OF LI-ION IMPORTS)

U.S. Battery imports, 2021, millions of \$

EV Batteries	Type	Chinese EV Batteries	Japan	South Korea	RoW
	Li-Ion Batteries for EVs	602	184	74	298
Li-Ion Batteries for Non-EVs	3,766	659	1,331	6,943	
Parts of Batteries (excluding lead-acid storage)	581	1,198	787	534	
Total imports	4,989	2,045	2,192	2,019	

BATTERY INPUT TRADE DATA

Battery input trade data limited

- Most inputs included in “basket” category with other products or grades of raw material not useful for batteries

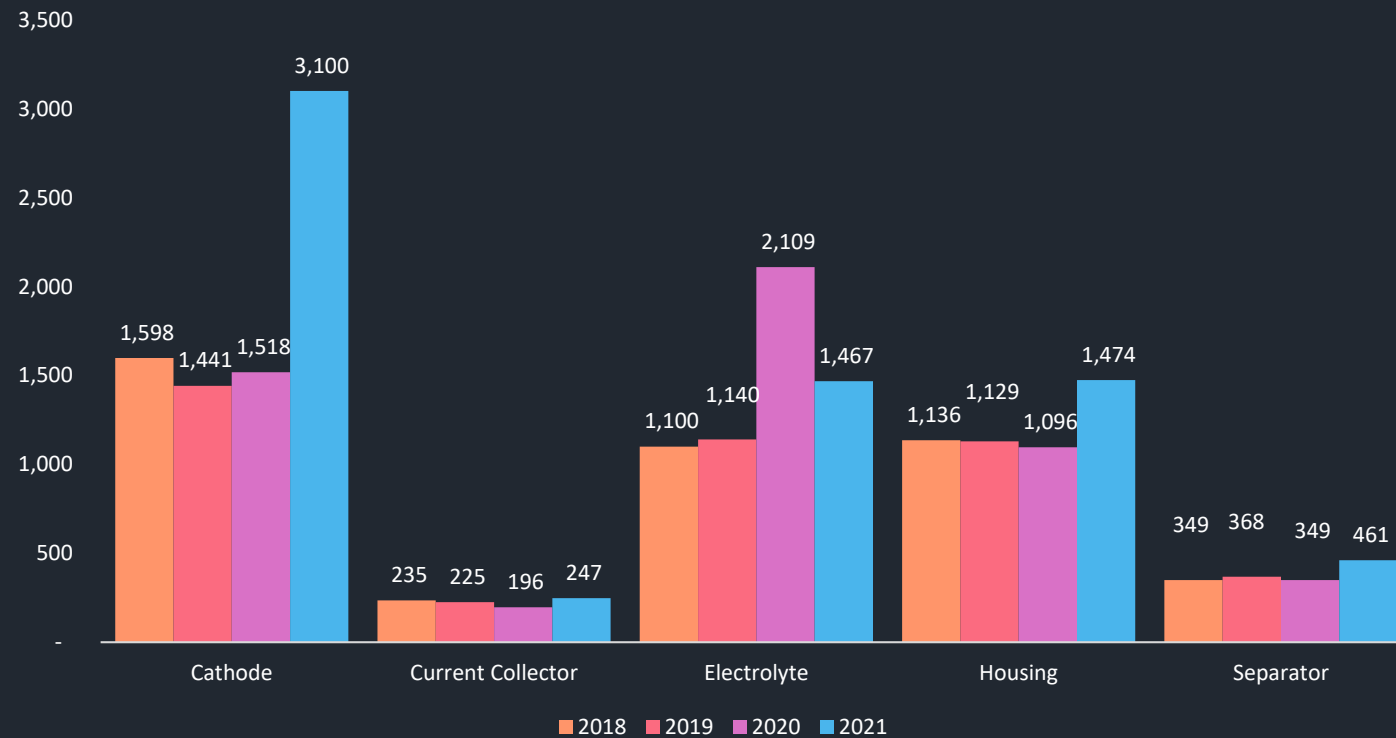
US Geological Survey List categorized battery inputs into:

- Raw materials
- Refined and processed materials
- Battery materials, and
- Cell components



U.S. CELL COMPONENT IMPORTS

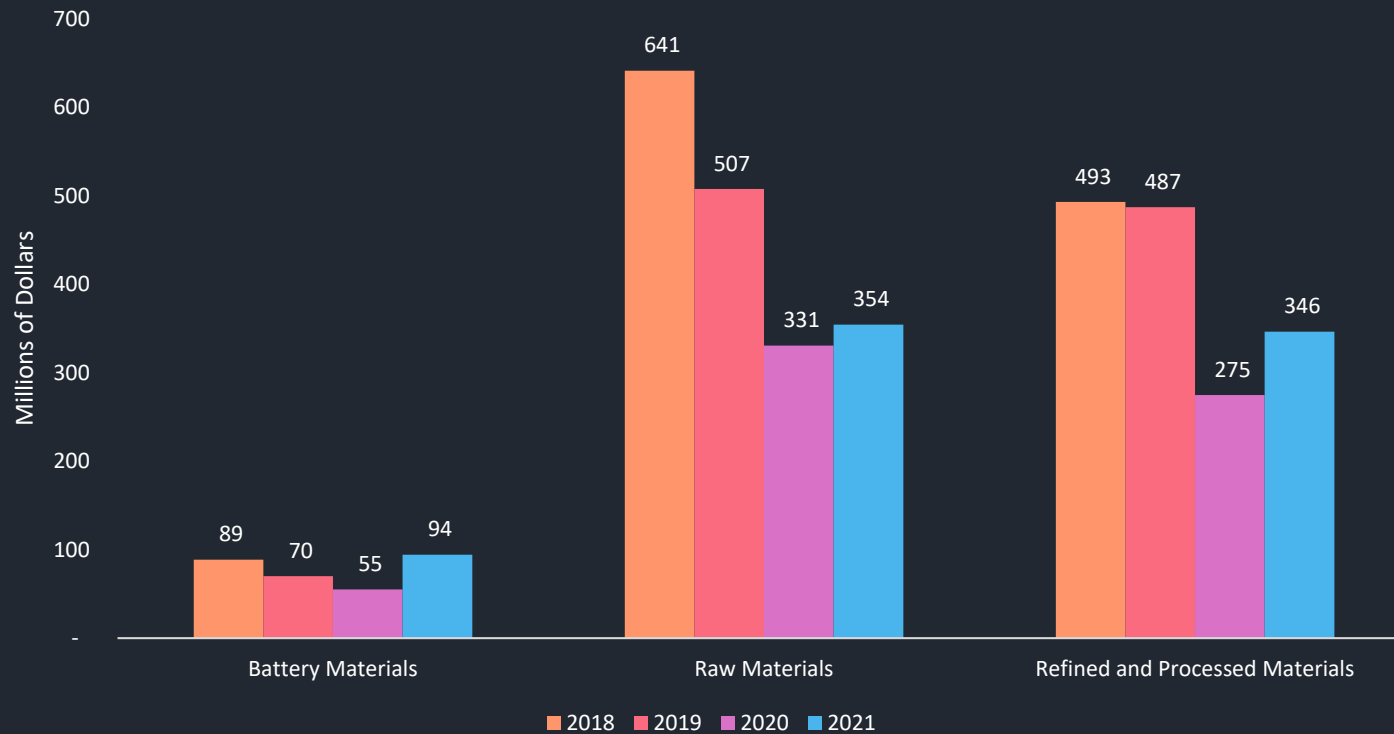
U.S. battery cell component imports, millions of \$



- **U.S. imports of cell components are much higher than other battery inputs, and have been rising in recent years (over \$6 billion in 2021)**
- **This is likely because U.S. is a significant battery cell producer, but has limited upstream involvement earlier in the supply chain**
- **Increased imports likely because of increased battery production.**
- **Top sources: Japan (\$1.5 billion) and China (\$1.2 billion) making up 40 percent of total**

IMPORTS OF OTHER U.S. BATTERY INPUTS LOWER

Other U.S. battery input imports, millions of \$



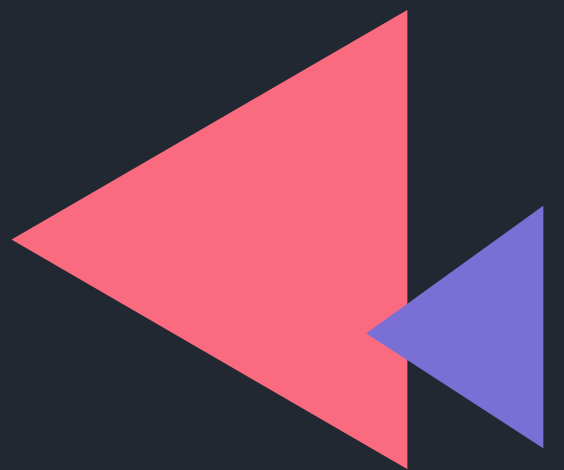
- **U.S. imports of other battery inputs are much lower**
- **Total exports down from \$1.2 billion to \$795 million**
- **In 2021 China was the top source, making up 24 percent of U.S. imports**
- **Other top sources include Japan, Norway, and Canada**



https://commons.wikimedia.org/wiki/File:Lithium-Ion_Battery_for_BMW_i3_-_Battery_Pack.JPG



VALUE-ADDED



VALUE-ADDED METHODOLOGY

Estimate EV Battery value-added
(cell forward) using:

- Per kWh pack cost- some reported cost, rest BNEF average from 2021
- ANL Batpac 4.0 estimates of value-added distribution between cell and pack assembly
- Split value-added for each U.S. sale to country of cell production and battery location

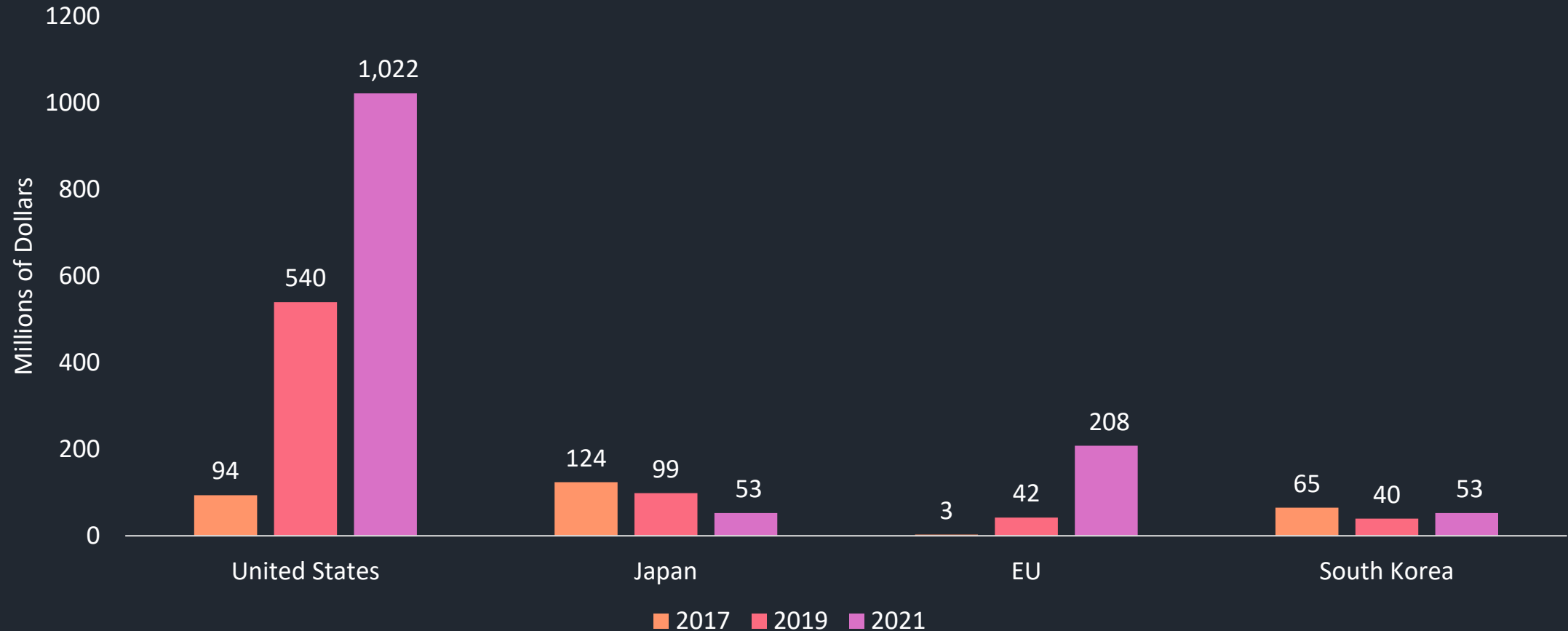


TESLA ACCOUNTS FOR THE MAJORITY OF U.S. EV SALES

Model	Vehicle assembly	Pack Assembly	Cell Assembly	2021 Sales
Tesla Model Y	United States	United States	United States	162,968
Tesla Model 3	United States	United States	United States	139,503
Mustang Mach E	Mexico	Mexico	Poland	27,140
Chevrolet Bolt EV	United States	United States	United States	22,073
Volkswagen ID.4	Germany	Germany	Poland	16,742
Tesla Model S	United States	United States	Japan	16,672
Nissan LEAF	United States	United States	United States	14,239
Audi e-tron	Belgium	Poland	Poland	9,695
Porsche Taycan	Germany	Germany	South Korea	9,419
Kia Niro EV	South Korea	South Korea	South Korea	8,717
Polestar 2	China	China	China	3,766
Chevrolet Bolt EUV	United States	United States	United States	2,755
Other	Various	Various	Various	5,960

U.S. EV BATTERY VALUE-ADDED INCREASED SIGNIFICANTLY

EV battery value-added for U.S. EV sales, 2017, 2019, and 2021



SHORTAGES AND THE DOMESTIC SUPPLY CHAIN

- EV demand for many materials and metals may outstrip supply
 - Benchmark Minerals predicts lithium demand to expand to 2.4 million tons in 2030 (600k tons in 2022)
 - Need \$42 billion in investment.
 - North American lithium likely to be more expensive
- In that situation, who loses? Likely foreign sources of demand
- This can be seen in semiconductors, where the shortage has affected Asia (the source of a large share of auto semiconductors) less than the EU and the United States

INVESTMENTS

- Automotive battery investments in US totaled over \$18 billion from 2018 to 2022 (add'l \$16 billion Ford and Hyundai battery and vehicle)
- NA battery parts investments several hundred million
- Battery input investment has also expanded significantly
 - Cathodes- two new cam plants in Canada
 - Anodes- Three companies announced plans to expand
 - Separators- two companies announced plans to expand production
 - Electrolyte- one company has plans to expand production
- Mine and Material investments
 - Cobalt- Refinery in Canada
 - Lithium- Several US mines
 - Nickel- targeting refining
 - Manganese- DOE investing in manganese from coal byproduct
- Recycling

OTHER USITC STAFF RESEARCH

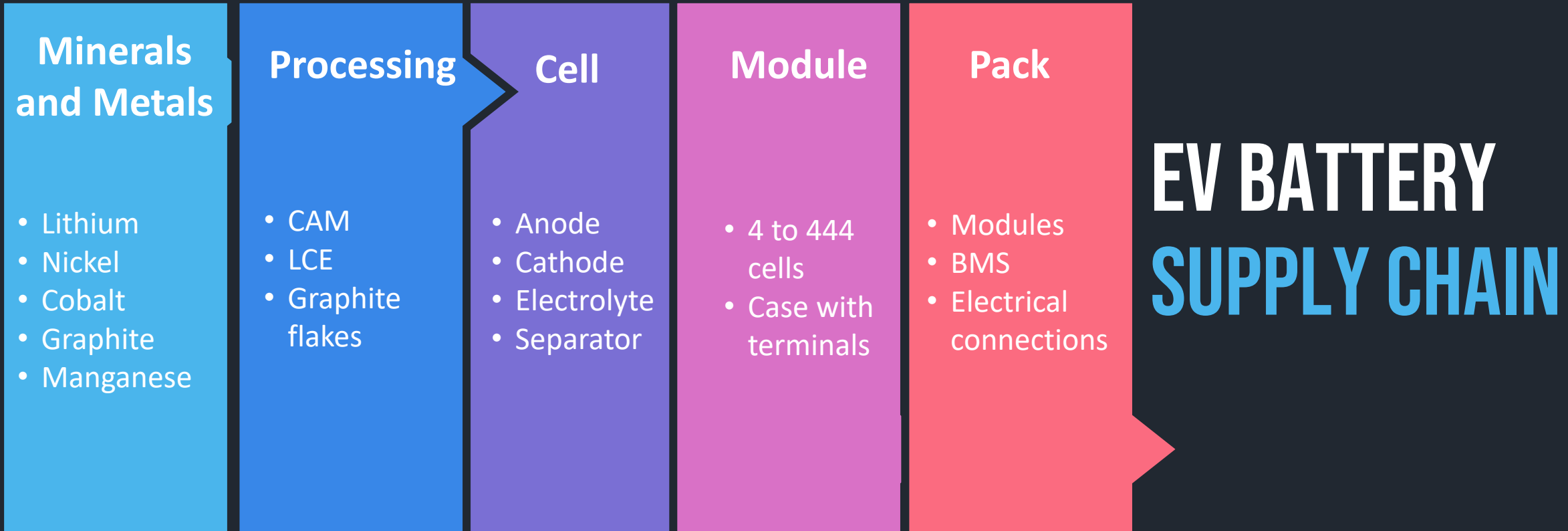
- **Daigle, Brian and Samantha DeCarlo, “Rare Earths and the U.S. Electronics Sector: Supply Chain Developments and Trends,” Working Paper,” June 2021**
- **Coffin, David, “The Forgotten Middle: Manufactured Inputs for Electric Vehicle (EV) Batteries,” Executive Briefing on Trade, February 2021.**
- **LaRocca, Greg, “Global Value Chains: Lithium in Lithium-ion Batteries for Electric Vehicles,” USITC Staff Working Paper, July 2020.**
- **Scott, Sarah and Rob Ireland, “Lithium-Ion Battery Materials for Electric Vehicles and their Global Value Chains,” USITC Staff Working Paper, June 2020.**
- **Matthews, Dan, “Global Value Chains: Cobalt in Lithium-ion Batteries for Electric Vehicles,” USITC Staff Working Paper, May 2020.**
- **DeCarlo, Samantha and Dan Matthews, “More Than a Pretty Color: The Renaissance of the Cobalt Industry,” Journal of International Commerce and Economics, February 2019.**
- **Guberman, David. “Nickel in Indonesia: A Story of Trade Restraints and Emerging Technologies (Part 1, Part 2) ,” Executive Briefing on Trade, May 2021.**
- **Other forthcoming papers on graphite and storage batteries.**

THANK YOU

QUESTIONS?

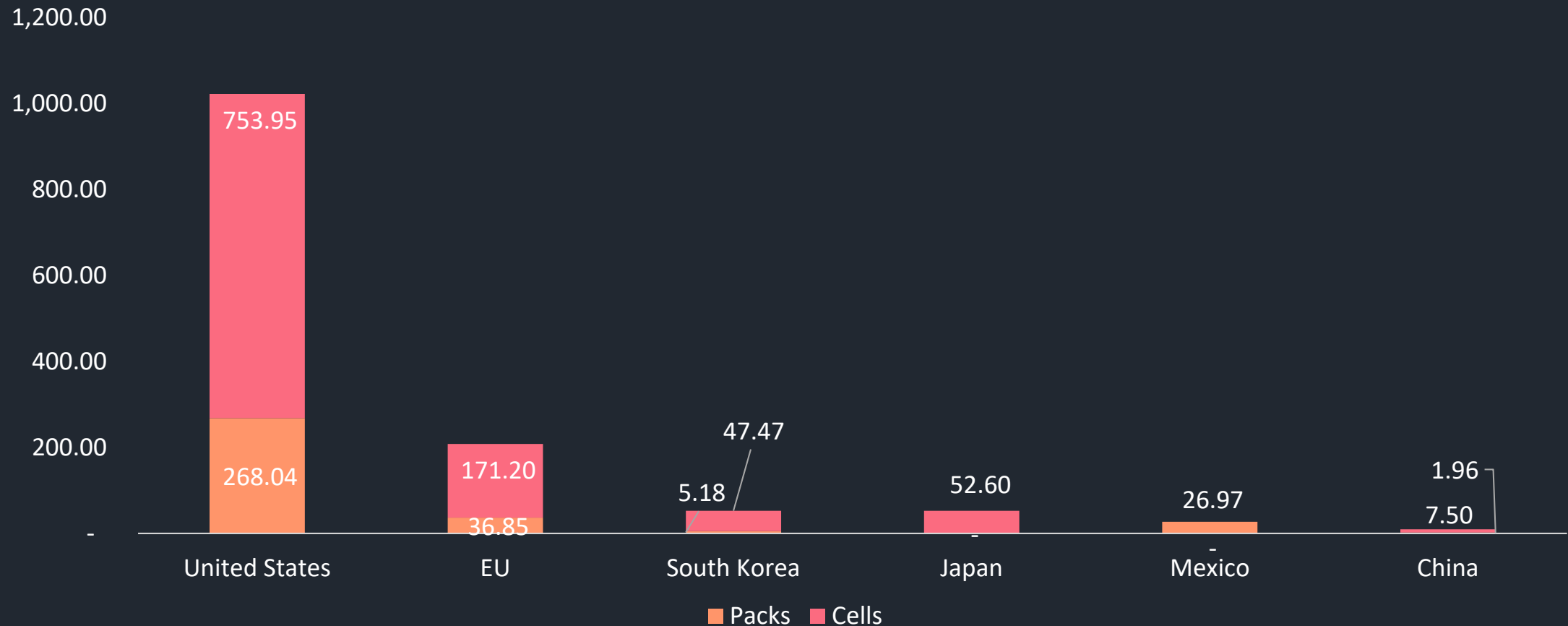
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CELLS MAKE UP LARGER SHARE OF VALUE-ADDED

EV Battery value-added for U.S. EV sales by type, 2021



LIMITATIONS TO THIS ANALYSIS



1. Only U.S. Coverage

Have not yet expanded value-added analysis to sales in other markets

2. International trade data

6-digit trade data only in aggregate categories

3. U.S. trade data

Cells in aggregate category in U.S. data, and import data is more disaggregated than export data.

4. Cell Forward

But other members of USITC staff have done research on other aspects of the supply chain