Prepared Statement by Jackson Switzer, Senior Director, Redwood Materials

Before the House Committee on Energy and Commerce

Subcommittee on Energy and Subcommittee Environment and Climate Change

Securing America's Future: Supply Chain Solutions for a Clean Energy Economy

November 16, 2021

Chairmen Rush and Tonko, Ranking Members McKinley and Upton, members of the House Energy & Commerce Subcommittees on Energy, Environment and Climate Change, thank you for the invitation to testify at today's hearing.

My name is Jackson Switzer. I am the Senior Director for Business Development at Redwood Materials. I joined Redwood Materials a year and a half ago. Prior to joining Redwood, I spent over 7 years at Albemarle Corporation, the world's largest lithium mining and refining company, headquartered in North Carolina. I have a technical background, with a doctorate in chemical engineering from Georgia Tech and a bachelor's degree in chemistry from The University of Alabama. Additionally, I have a master's degree in strategic intelligence from the National Intelligence University here in Washington, DC and previously worked for the Department of Defense.

Redwood Materials was founded by Tesla Co-Founder and Chief Technology Officer, JB Straubel, in 2017 to create circular, domestic supply chains for electric vehicles and energy storage products, making them more sustainable and driving down the cost of their single most expensive component: batteries.

Today, two of the most critical and expensive components of lithium-ion batteries (the cathode and the anode) are produced via a convoluted supply chain based almost entirely in Asia. Redwood plans to transform the lithium-ion battery supply chain by offering large-scale domestic sources of these battery materials, produced from as many recycled batteries as available and augmented with sustainably-mined material. Quickly ramping a domestic battery materials supply chain and using the highest possible percent of local, recycled raw materials is the best way we can meet the U.S.'s electrification and clean energy goals.

The Electrification Opportunity

The world is rapidly transitioning to electric vehicles as a response to mitigating climate change, decreasing regional pollution, and capitalizing off continually improving electric vehicle (EV) performance and costs. EVs accounted for 5% of total new car sales in 2020 and are projected to account for 20% of total new car sales in 2025, 50% in 2030, and nearly all new cars sold in 2040.[1,2] American automobile manufacturers including Ford, General Motors, Stellantis, and others have each made declarations to go all-in on electrifying their fleet over the next decade and Tesla and Rivian plan to exponentially ramp their domestic EV production.[3]

As such, the demand for EVs in the United States is projected to skyrocket over the coming decade. Further, the U.S. Government has set ambitious plans to transform our nation by achieving carbon-pollution-free electricity by 2035 and economy-wide, net-zero emissions by 2050. President Biden's recent executive order calls for a national goal of 50% electric vehicle sales by 2030.

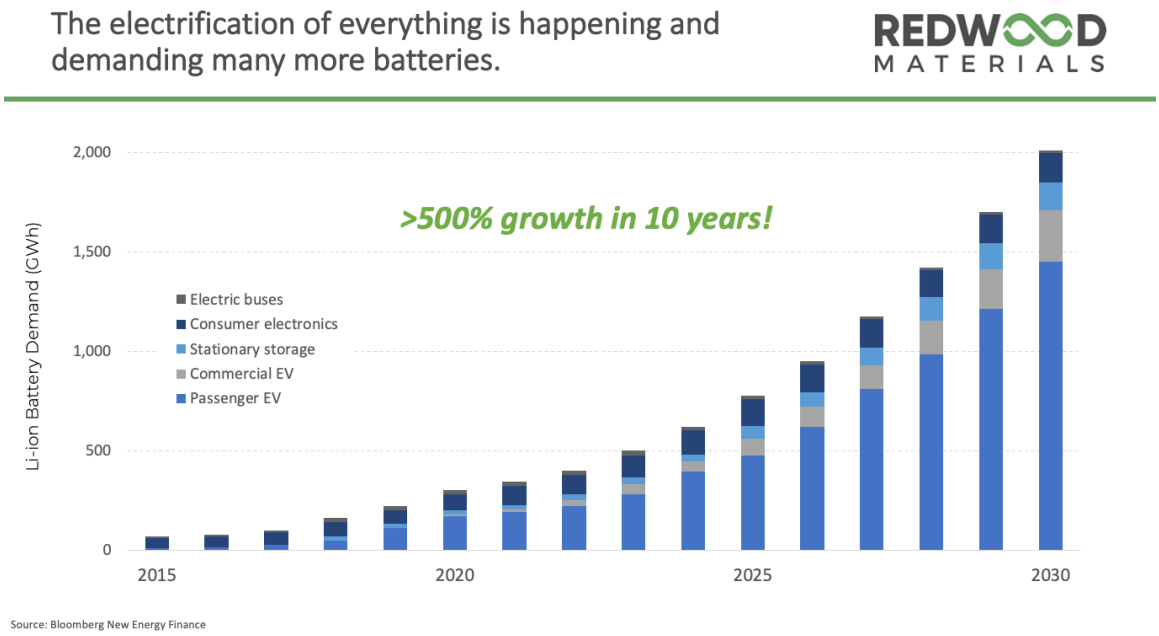
---

[1] *See* Rowlatt, J. (2021, June 1). *Why electric cars will take over sooner than you think*. Retrieved from BBC: https://www.bbc.com/news/business-57253947

[2] *See* UBS. (2021, March 3). *The electric vehicle revolution is shifting into overdrive*. Retrieved from UBS: https://www.ubs.com/global/en/investment-bank/in-focus/2021/electric-vehicle-revolution.html

This immense and expanding need for EVs presents a critical opportunity for the U.S. economy. The automotive sector has been a keystone of the U.S. economy, accounting for approximately 3% of our nation's GDP.[3] Building out domestic EV and lithium-ion battery manufacturing capabilities can help position the United States as a competitive international player in the global automotive manufacturing space and strengthen our nation's automotive sector as an increasing portion of cars transition to EVs.

Central to these goals is establishing U.S. leadership across the lithium-ion battery supply chain.[4]



Building a Domestic Supply Chain

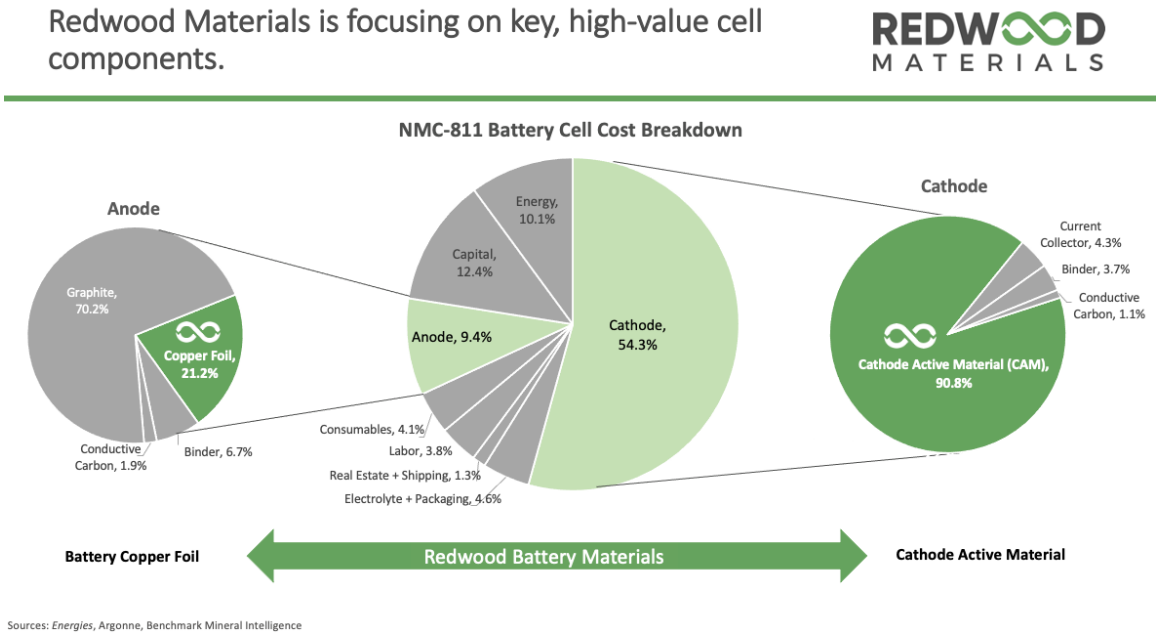
Redwood Materials is developing a fully closed-loop, domestic supply chain for lithium-ion battery materials. To close the loop and create a secure domestic supply chain, Redwood will (a) collect and recycle end-of-life lithium-ion batteries from consumer devices, electric vehicles, and energy storage systems, (b) refine the materials we recover, and (c) re-manufacture them into battery materials – specifically, cathode active materials and battery copper foils – that can go directly to U.S. battery manufactures, including our current publicly-announced partners like Panasonic and Ford.

Combined, cathode active material and copper foil make up nearly 65% of the cost of a battery. Integrated lithium-ion battery recycling and manufacturing of cathode active materials and battery copper foils is critical not only to reduce the costs of lithium-ion batteries but to secure our nations' environmental, sustainability, and geostrategic goals, as well.

[3] *See* Forbes. (2021, October 4). *Every Automaker's EV Plans Through 2035 And Beyond.* Retrieved from Forbes: https://www.forbes.com/wheels/news/automaker-ev-plans/

[4] *See* Federal Consortium for Advanced Batteries, *Executive Summary National Blueprint for Lithium Batteries* (2021).

Accomplishing this will transform the lithium-ion battery supply chain by offering, for the first time, large-scale sources of domestic cathode active materials and battery copper foils to U.S.-based battery manufacturing partners. These materials, which are critical for the manufacture of lithium-ion batteries, will be produced from recycled batteries and materials. Increasing our nation's production of these resources will serve as a key enabler to decrease the products' environmental footprint and scale-up U.S. manufacturing of lithium-ion batteries. In turn, this will increase domestic production of electric vehicles and decrease our foreign reliance. Creating a comprehensive component supply chain for EV manufacturing in the United States will fuel both technology development and the local monetization for domestically-developed technologies.



Cathode Active Materials

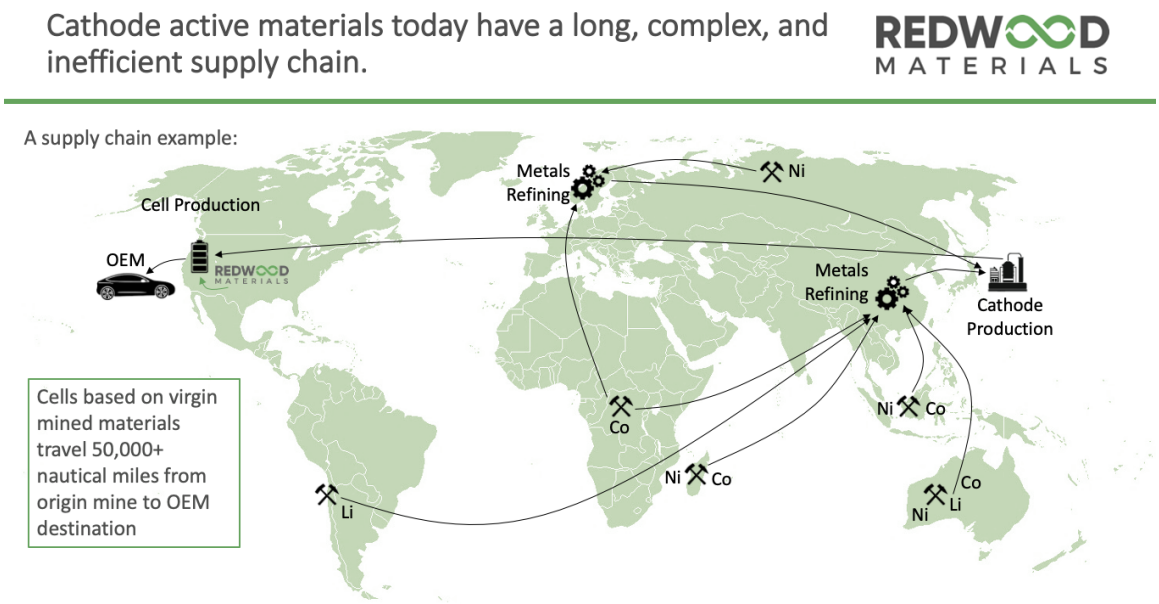
Cathode active material demand growth is following battery demand growth and is expected to increase by 600% over the decade in the United States, from roughly 50,000 MT in 2020 to nearly 450,000 MT by 2030.

Cathode active materials have a long and complex supply chain. The supply chain typically involves mining and refining metal ores on multiple continents, manufacturing cathode precursors, and the final production of cathode active materials. Batteries based on virgin mined materials typically travel over 50,000 nautical miles before reaching an electric vehicle in the United States.

Further, cathode active materials, present in most EVs today, typically contain greater than 30% nickel, 7% cobalt, and 7% lithium. These minerals come from mining today in diverse, and sometimes complex, places. However, there is tremendous opportunity to recover and recycle these elements, as they are infinitely reusable.

Today, finished cathode active material is imported into the U.S. today from Asia for local integration into batteries. **To keep plans with EV plans domestically, the U.S. would need to import greater than 2,000,000 MT of cathode active material through 2030 with a lost economic value of greater than 85 billion USD.**[5]

[5] Redwood Materials conducted its own internal analysis.



Battery Copper Foil

Lithium-ion battery manufacturing capacity, and the resulting demand for battery copper foil, is projected to skyrocket worldwide over the coming decade. The United States is projected to see a 600% increase in battery copper foil demand from 2020 to 2030.[6]

Both the production and mining of battery copper foil is currently dominated by other countries. Copper raw materials are predominantly mined in Chile, Peru, and China, while production occurs in China, Japan, and South Korea. Together, Chile and Peru control a larger share of this critical market than OPEC+ does of oil. China imports copper concentrate from both Chile and Peru, refining nearly 40% of the global supply.[7]

Finished foils are imported into the U.S. for local integration into batteries. **To keep pace with the announced EV plans domestically, the U.S. would need to import greater than 800,000 MT of copper foil through 2030 with a lost economic value of greater than 13 billion USD.**[8] To establish secure and robust battery supply chains and manufacturing capabilities capable of meeting our nation's rapidly growing demand, it is imperative that copper foil production within the United States expands.

In addition to enabling technology leadership across the battery supply chain and driving down costs, **U.S.-based copper foil manufacturing presents an opportunity for utilizing the greater than 800,000 metric tons of scrap copper that the U.S. exports to Asia every year.**

[6] *See* Melin, H. E. (2021). Batteries Placed on the Market: Latest Update: 1 August, 2021. London, UK: Circular Energy Storage. Redwood Materials also conducted its own internal analysis.
[7] *See* Els, F., *Copper mining is Opec on crack, so why is the price falling?*, Mining, (July 13, 2021), https://www.mining.com/copper-mining-is-opec-on-crack-why-is-the-price-falling/.
[8] Redwood Materials conducted its own internal analysis.

A Domestic Manufacturing Base

Redwood Materials plans to build U.S.-based production facilities for cathode active materials and battery copper foils. By producing critical battery materials domestically at scale, Redwood will help decouple U.S.-based battery production from a shock-prone international supply chain, enabling the growth of reliable, large-scale U.S.-based cell production. In addition, the proximity will enable faster cycles of learning between battery makers and Redwood Materials, resulting in faster and meaningful technology and cost improvements.

In production facilities based in the United States, Redwood Materials will manufacture 100 GWh of cathode active materials and battery copper foil by 2025, enough for about 1.3 million long range electric vehicles a year. By 2030, Redwood intends to increase production of both materials to 500 GWh, enough material to supply over 6 million electric vehicles.

By producing battery materials domestically through processes that convert waste products into feedstock, Redwood Materials will help drive electrification of the U.S. economy and put our nation on the path towards net-zero emissions through domestic, sustainable manufacturing.

The construction of a domestic supply chain will help capture greater than 100 billion USD of economic value through 2030 that will otherwise be lost if we leave battery materials manufacturing to others abroad.

A Policy Opportunity

The transition to electric transportation and clean energy is coming. As a nation we must ask ourselves if we want to create the infrastructure and jobs to support that shift here in the United States or allow other nations to develop the manufacturing capacity overseas, as has happened with the clean energy economy to date.

Redwood is committed to localizing this supply chain in the U.S., but we're just one of many innovative, American companies developing cutting-edge technologies to produce advanced batteries. In the next few years, these companies will need to decide whether to invest billions of dollars to establish manufacturing hubs, either here or abroad. Implementing the right policies today can help these companies drastically scale their production in America to meet this moment.

Policies like the Battery Manufacturing and Recycling Grant program, which was spearheaded by Representative Doyle and included in the Bipartisan Infrastructure Investment and Jobs Act, will help launch innovative solutions to address the supply chain. Other proposals, like reinstituting the 48C tax credit to support clean energy manufacturing, as proposed in the Build Back Better Act, would also help companies invest in the United States and create thousands of high-quality jobs.

Creating a circular supply chain for electric vehicles and clean energy products in the United States is a win-win, allowing the country to counteract an important environmental risk, while creating economic security, tens of thousands of jobs, bolstering our supply chain and ensuring that the billions of dollars that will be invested in the battery industry happens here in the US.

I thank both Subcommittees for holding this important hearing and look forward to the discussion.

Jackson Switzer
Redwood Materials