MEMORANDUM

November 12, 2021

To: **Subcommittee on Environment and Climate Change and Subcommittee on Energy Members and Staff**

Fr: **Committee on Energy and Commerce Staff**

Re: **Hearing on "Securing America's Future: Supply Chain Solutions for a Clean Energy Economy"**

On **Tuesday, November 16, 2021, at 10:30 a.m. (EST) in the John D. Dingell Room, 2123 of the Rayburn House Office Building, and via Cisco Webex online video conferencing**, the Subcommittee on Environment and Climate Change and the Subcommittee on Energy will hold a joint hearing entitled, "Securing America's Future: Supply Chain Solutions for a Clean Energy Economy." The hearing will examine opportunities to develop domestic supply chains for clean energy technologies and their components.

I. BACKGROUND

On April 22, 2021, the Biden Administration announced that the United States would aim to reduce its greenhouse gas (GHG) pollution 50 percent below 2005 levels by 2030, putting the country on the path to net-zero GHG pollution by no later than 2050.[1] To meet that target, the Administration set goals of generating 100 percent clean electricity by 2035 and reaching 50 percent electric vehicle (EV) sales by 2030.[2]

Achieving these goals will require a significant rise in clean energy deployment.[3] In the power sector, for instance, installed wind and solar capacity will need to grow fourfold by 2030,[4] while high-voltage transmission capacity must increase by 60 percent to deliver a growing

[1] The White House, *FACT SHEET: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing U.S. Leadership on Clean Energy Technologies* (Apr. 22, 2021).

[2] The White House, *FACT SHEET: President Biden Announces Steps to Drive American Leadership Forward on Clean Cars and Trucks* (Aug. 5, 2021).

[3] The National Academies of Sciences, Engineering, and Medicine, *Accelerating Decarbonization in the United States* (Feb. 2021).

[4] Princeton University, *Net-Zero America: Potential Pathways, Infrastructure, and Impacts* (Oct. 29, 2021).

portion of electricity from wind and solar to load centers.[5] Meeting these and other energy demands will require dramatic expansion of clean energy supply chains – from the production of raw materials to the manufacture of end-use products and technologies.[6] In February 2021, the Biden Administration issued Executive Order (EO) 14017 on America's Supply Chains.[7] The EO called for a review of the supply chains on which the United States relies, including a Department of Energy (DOE) review of energy storage supply chains. The Administration published results and policy recommendations in June 2021,[8] along with a National Blueprint for Lithium Batteries.[9]

Most clean energy supply chains are either nascent or geographically concentrated in other countries.[10] In some cases, the United States is almost entirely dependent on countries, like China, that have developed supply chain strongholds.[11] Developing or relocating parts of these supply chains to the United States could reduce reliance on other countries, including those with deficient human rights protections or environmental standards.[12] In particular, onshoring clean supply chains could alleviate dependence on countries that use forced labor to extract raw materials. Shifting these supply chains to the United States also presents an opportunity to revitalize domestic manufacturing and invest in American workers.[13]

---

[5] *See* notes 3 and 4.

[6] Center for American Progress, *Creating a Domestic U.S. Supply Chain for Clean Energy Technology* (Oct. 4, 2021).

[7] Exec. Order No. 14017, 86 Fed. Reg. 11849 (Mar. 1, 2021).

[8] The White House, *Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth* (Jun. 2021).

[9] U.S. Department of Energy, *National Blueprint for Lithium Batteries: 2021–2030* (Jun. 2021) (DOE/EE-2348).

[10] International Energy Agency, *Net Zero by 2050: A Roadmap for the Global Energy Sector* (May 17, 2021).

[11] Center for Strategic & International Studies, *The Geopolitics of Critical Minerals Supply Chains* (Mar. 2021).

[12] *See*, *e.g.,* Council on Foreign Relations, *Why Cobalt Mining in the DRC Needs Urgent Attention* (Oct. 29, 2020) (on.cfr.org/2ZUXGmK) and *U.S. Bans Imports of Some Chinese Solar Materials Tied to Forced Labor*, The New York Times (Jun. 24, 2021).

[13] *See* note 6.

II. CLEAN ENERGY SUPPLY CHAINS

A. Onshore Wind

In 2020, the United States generated 338 billion kilowatt-hours of electricity from onshore wind, accounting for 8.4 percent of total generation.[14] The onshore wind industry employed 116,800 full-time workers in 2020, spread across 535 turbine component manufacturing, assembly, and other supply chain facilities.[15] According to DOE, "domestic manufacturing capability…has been reasonably well balanced against historical market demand, though record wind additions in 2020 ensured that demand for blades and towers outstripped domestic manufacturing capability last year." As a result, the industry has increasingly relied on imports of key wind equipment and manufacturing inputs (namely blades, hubs, and generating sets). Nevertheless, domestic content accounts for nearly 60 percent of the components in a typical onshore wind project (by dollar value).

B. Offshore Wind

In March 2021, the Biden Administration set a goal of installing 30 gigawatts (GW) of offshore wind capacity by 2030, which is projected to create more than 44,000 direct jobs and another 33,000 supporting jobs.[16] According to DOE, however, underdevelopment of domestic supply chains means "the initial phase of offshore wind energy installed on the Atlantic Coast is expected to rely heavily on international supply chains for major components, installation vessels, and engineering design work."[17] Still, recent project announcements signal the industry's interest in developing a domestic offshore wind supply chain. The potential economic benefits of this buildout are substantial; by one estimate, meeting the Administration's 30 GW goal would generate $109 billion across the supply chain by 2030.[18]

C. Solar

In 2020, approximately 140 GW of solar photovoltaic (PV) modules shipped globally, only three percent of which were produced in the United States.[19] The vast majority of PV manufacturing capacity, including almost all equipment throughout the PV supply chain, is in

---

[14] U.S. Energy Information Administration, *What is U.S. electricity generation by energy source?* (www.eia.gov/tools/faqs/faq.php?id=427&t=3) (updated Nov. 2, 2021).

[15] U.S. Department of Energy, *Land-Based Wind Market Report: 2021 Edition* (Aug. 2021) (DOE/GO-102021-5611).

[16] The White House, *FACT SHEET: Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs* (Mar. 29, 2021).

[17] U.S. Department of Energy, *Offshore Wind Market Report: 2021 Edition* (Aug. 2021) (DOE/GO-102021-5614).

[18] The Special Initiative on Offshore Wind, *Supply Chain Contracting Forecast for U.S. Offshore Wind Power: The Updated and Expanded 2021 Edition* (Oct. 2021).

[19] U.S. Department of Energy, *Solar Futures Study* (Sept. 2021) (GO-102021-5621).

Asia. China controls 63 percent of polysilicon production, more than 95 percent of ingot and wafer manufacturing, 79 percent of cell manufacturing, and 71 percent of module assembly.[20] Although the United States produces some polysilicon, it lacks any capacity to process it. As a result, domestically-sourced polysilicon must be exported to China in order to produce ingots and wafers.[21] However, several U.S. companies remain involved in PV cell production and module assembly (i.e., the later segments of the solar supply chain). Recent Biden Administration policies barring the importation of solar components made with forced labor could lead to greater investment in domestic solar manufacturing capacity.[22]

Global PV manufacturing capacity is expected to grow significantly in the coming years, primarily in China.[23] This trend largely stems from China's longstanding industrial policies, including subsidizing manufacturing costs.[24] According to DOE, a crystalline silicon PV module with all components manufactured in the United States would cost $0.10 more per watt than a module with all components manufactured in China.[25] Despite this, the United States may be able to onshore certain segments of the solar supply chain by providing supply- and demand-side support for solar components and technologies, as well as by working with trade partners to rebalance global supply chains.[26]

D. **Batteries**

EVs and stationary storage are key demand drivers for lithium-ion batteries. BloombergNEF (BNEF) projects 66 million passenger EV sales worldwide in 2040 (about 15 percent of which will be sold in the United States)[27] and 1,095 gigawatts of stationary storage deployed worldwide by 2040.[28] The United States currently has about 59 gigawatt-hours (GWh)

---

[20] Bernreuter Research, *Solar Value Chain* (Jun. 29, 2020) (www.bernreuter.com/solar-industry/value-chain/).

[21] Center for Strategic & International Studies, *The United States Needs a Solar Manufacturing Strategy* (Aug. 12, 2021) (www.csis.org/analysis/united-states-needs-solar-manufacturing-strategy).

[22] The White House, *FACT SHEET: New U.S. Government Actions on Forced Labor in Xinjiang* (Jun. 24, 2021).

[23] *See* note 17.

[24] *See* note 11.

[25] *See* note 17.

[26] *See* note 19.

[27] BloombergNEF, *Electric Vehicle Outlook 2021* (Jun. 2021) (about.bnef.com/electric-vehicle-outlook/).

[28] BloombergNEF, *Energy Storage Investments Boom as Battery Costs Halve in the Next Decade* (Jul. 31, 2019) (about.bnef.com/blog/energy-storage-investments-boom-battery-costs-halve-next-decade/).

of lithium-ion cell manufacturing capacity, which is expected to reach 224 GWh by 2025.[29] Still, the United States accounts for less than 10 percent of global manufacturing capacity across all major battery components and cell fabrication.[30] China, in contrast, is home to 80 percent of all component and cell manufacturing (largely due to having the world's largest EV market).[31]

Despite anticipated growth through 2025, domestic lithium-ion battery production is unlikely to meet U.S. demand. According to DOE, "there is a real threat that U.S. companies will not be able to benefit from domestic and global market growth, potentially impacting their long-term financial viability. Our supply chains for the transportation, utility, and aviation sectors will be vulnerable and beholden to others for key technologies necessary for advancement. Without action, the United States risks long-term dependence on foreign sources of batteries and critical materials."[32]

Additional investment and stable policy support could mitigate this risk. According to BNEF, "the U.S. has many of the ingredients needed to foster a domestic lithium-ion battery value chain … Now that there is policy support in place, we are seeing a coordinated effort from companies across the supply chain to anchor more value within the country."[33] Providing incentives for battery manufacturing could spur additional private investment in the domestic battery market, especially as EVs assume a greater share of vehicle sales.[34] Investing in additional battery chemistries and battery recycling will also support domestic battery manufacturing industry growth and alleviate reliance on lithium supply chains.

III. CRITICAL MINERAL SUPPLY CHAINS

In May 2018, the Federal government identified 35 critical minerals that are vital to U.S. security,[35] and recently characterized these minerals as relying on supply chains that are "vulnerable to disruption" and serving an "essential function in the manufacturing of a product, the absence of which would have significant consequences for our economy or our national

[29] *See* note 9.

[30] *See* note 8.

[31] BloombergNEF, *U.S. Narrows Gap with China in Race to Dominate Battery Value Chain* (Oct. 7, 2021) (about.bnef.com/blog/u-s-narrows-gap-with-china-in-race-to-dominate-battery-value-chain/).

[32] *See* note 9.

[33] *See* note 29.

[34] *See* note 7.

[35] Department of the Interior, *Final List of Critical Minerals 2018*, 83 Fed. Reg. 23295 (May 18, 2018) (notice).

security."[36] The United States currently relies on 100 percent net imports for 14 of these minerals and at least 50 percent net imports for another 14 minerals.[37]

Wind turbines, solar panels, batteries, and other clean energy technologies all rely on critical minerals, making these inputs key to the clean energy transition.[38] In the coming decades, the energy sector will be the leading consumer of critical minerals like lithium, cobalt, and nickel. Global mineral demand for EVs and battery storage could grow by 30-fold through 2040, while mineral demand for power generation could triple over the same period.[39] In general, the United States imports the vast majority of critical minerals it needs for these technologies. For example, the United States relies on:

- 100 percent net imports of rare earth elements[40] (used in wind turbines and EV motors);
- 76 percent net imports of cobalt (used in EV batteries and storage); and
- 50 percent net imports of lithium (used in EV batteries and storage) and nickel (used in EV batteries, storage, and various power generation technologies).[41]

The supply chains for these minerals primarily exist in other countries. According to the International Energy Agency (IEA), the top three producing nations for lithium, cobalt, and rare earth elements control more than three-quarters of global output.[42] China, for instance, produces 60 percent of all rare earth elements, while the Democratic Republic of the Congo produces 69 percent of all cobalt. Reliance on these and other exporters not only creates supply chain dependence, but also raises grave concerns about unacceptable labor and environmental practices associated with mining in those countries.[43]

Critical minerals extraction is just the first step in the minerals supply chain. Once produced, these minerals must be refined and processed before making their way into components or end-use products. Just as China dominates the market for production of certain

[36] Exec. Order No. 13817, 82 Fed. Reg. 60835 (Dec. 26, 2017).

[37] U.S. Department of the Interior, U.S. Geological Survey, *Mineral Commodities Summary 2021* (Jan. 29, 2021) (pubs.usgs.gov/periodicals/mcs2021/mcs2021.pdf).

[38] International Energy Agency, *The Role of Critical Minerals in Clean Energy Transitions* (May 2021).

[39] *Id*.

[40] The terms "critical minerals" and "rare earth elements" describe different but overlapping elements. The list of 35 critical minerals includes "the rare earth elements group", which is comprised of 17 elements used in metal alloys, catalysts, magnets, motors, and displays.

[41] *See* note 35.

[42] *See* notes 11 and 36.

[43] *See* note 12.

minerals, it similarly processes 87 percent of all rare earth elements, 65 percent of all cobalt, and 58 percent of all lithium.[44]

Although the United States produces limited amounts of certain critical minerals (such as lithium and rare earth elements), these minerals must be exported for processing due to lack of domestic processing capacity. According to a White House review, "the United States has an even more significant deficit [in processing] than in raw production capacity."[45] Without new processing capacity, the United States will continue to rely on other nations for various technology components, regardless of where their mineral inputs are produced. The White House review further found that, "increasing U.S. processing capacity alone would bolster the supply chain, and coupled with recycling, is the most promising pathway to securing the supply chain for minerals where the United States does not have significant reserves from which to extract."

IV. DEVELOPING DOMESTIC SUPPLY CHAINS

By investing in supply chain buildout and resilience, manufacturing capacity, and materials innovation, the United States can ensure that clean energy technologies used at home and abroad are made in America.[46] Various supply- and demand-side policies have been proposed to support this goal. These include grants and loans to expand domestic manufacturing; research, development, and demonstration of advanced technologies; tax credits for domestically-made or domestically-sourced clean energy technologies; and, in cases where it is challenging to onshore supply chains, diversifying those supply chains to avoid reliance on a limited number of suppliers.[47]

Developing U.S. supply chains does not solely mean producing new products or materials. End-of-life recycling of clean energy technologies and their components will be critical going forward. According to BNEF, battery recycling is key to reducing the costs of the energy transition: "Without it, cumulative lithium demand exceeds currently known reserves by 2050. With universal battery recycling, not only does primary lithium demand remain below known reserves, but there is also the prospect of a fully circular battery industry, with recycled lithium supply exceeding total annual demand by mid-century.[48]

---

[44] *See* note 36.

[45] *See* note 7.

[46] *See* note 6.

[47] Center for Strategic & International Studies, *Reshore, Reroute, Rebalance: A U.S. Strategy for Clean Energy Supply Chains* (May 2021).

[48] BloombergNEF, *Electric Vehicle Sales Set to Rise Faster Than Ever, but More Policy Action Needed to Get on Track for Net Zero* (Jun. 9, 2021) (about.bnef.com/blog/electric-vehicle-sales-set-to-rise-faster-than-ever-but-more-policy-action-needed-to-get-on-track-for-net-zero/).

The IEA similarly notes that recycling will reduce costs and pressure on mineral supply.[49] By 2040, recycled quantities of copper, lithium, nickel, and cobalt from spent batteries could reduce combined need for new supply of these minerals by 10 percent. IEA added that "the security benefits of recycling can be far greater for regions with wider deployment of clean energy technologies due to greater economies of scale."

V. WITNESSES

The following witnesses have been invited to testify:

Ethan Zindler
Head of Americas
BloombergNEF

Roxanne Brown
International Vice President at Large
United Steelworkers

Jackson Switzer, Ph.D.
Senior Director of Business Development
Redwood Materials

Lucian Pugliaresi
President
Energy Policy Research Foundation, Inc. (EPRINC)

---

[49] *See* note 36.