CLIMATE ADVISERS

Risks to Sustaining Climate Action

WHY SECURING CLEAN ENERGY SUPPLY CHAINS REQUIRES A GLOBAL PERSPECTIVE

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Executive Summary

The world is embracing clean energy. A limited set of technologies (such as wind turbines and solar panels) along with select critical minerals (e.g., lithium and cobalt) are vital to this transformation of the global energy and manufacturing economy.

Securing the supply chains for these essential technologies and minerals means achieving what we term "clean energy security." A growing bipartisan majority in Washington, DC, believes that clean energy security must become a national priority, and both President Biden and Congress have taken several important steps towards this goal within the past year alone.

Achieving clean energy security will not be easy. Numerous geopolitical, military, economic, and social factors threaten vital clean energy supply chains, as do climatic and other natural disasters. At present, moreover, a significant portion of critical mining, mineral processing, and manufacturing for the clean energy economy occurs in undemocratic nations whose lack of alignment with U.S. interests and values compounds the risks.

This report is not the first to look at these threats. Some have considered how to ensure that U.S. companies and workers play a central role in today's clean energy supply chains.[1] Others have looked at how to structure these supply chains to safeguard U.S. national defense.[2] Still others explore how to navigate the changing geopolitical landscape the clean energy transition creates.[3] These perspectives are important and deserve attention, but they capture only part of the picture. This report considers a neglected aspect of the clean energy supply chain problem, taking a purely environmental perspective and scrutinizing the strategies needed to minimize supply chain disruptions that could undercut or hinder climate action.

Adopting this perspective reveals major gaps in U.S. policymaking to date. Most recent action has had a domestic focus. Both Congress and the Executive Branch, for example, have taken laudable steps recently to increase domestic mining of key minerals and manufacturing of important technologies, as well as to implement a variety of other measures intended to shore up U.S. supply chains. By comparison, the United States has done less to promote clean energy security at the global level. International cooperation in this area remains nascent. No international institutions exist for this purpose. Without a more ambitious global dimension to

[1] See, for instance, David Livingston, "Secure American energy supply chains — before China does," *The Hill*, May 13, 2019, https://thehill.com/opinion/energy-environment/443463-secure-american-energy-supply-chains-before-china-does; SAFE, *Stoking an Industrial Renaissance: Opportunities for U.S. Decision-Makers*, December 2021, https://secureenergy.org/SecureSupplies/; and BlueGreen Alliance, *Solidarity for Climate Action*, https://www.bluegreenalliance.org/work-issue/solidarity-for-climate-action/.

[2] See Jeremy Dasilva, "Securing the Critical Mineral Supply Chain is Vital to the Future of the U.S. Military," American Security Project, October 20, 2021, https://www.americansecurityproject.org/securing-the-critical-mineral-supply-chain-is-vital-to-the-future-of-the-us-military/ and SAFE, *The Commanding Heights of Global Transportation*, September 2020, https://2uj256fs8px404p3p2l7nvkd-wpengine.netdna-ssl.com/wp-content/uploads/2020/09/The-Commanding-Heights-of-Global-Transportation.pdf.

[3] Nikos Tsafos, Jane Nakano, Sarah Ladislaw, and Lachlan Carey, "Reshore, Reroute, Rebalance: A U.S. Strategy for Clean Energy Supply Chains," (Washington, DC: Center for Strategic and International Studies, May 2021), https://www.csis.org/analysis/reshore-reroute-rebalance-us-strategy-clean-energy-supply-chains.

U.S. clean energy security policies, the United States may fail to adequately manage the risk posed by other nations not having the necessary materials and technologies to decarbonize in time to meet U.S. and global climate goals. Since the United States accounts for less than 14% of global greenhouse gas emissions, our clean energy security depends not only on what we do, but also on whether other nations have affordable and reliable clean energy supply chains.[4]

To fill the foreign policy gaps in its clean energy security policies, the United States should adopt a broader, more comprehensive approach—one that elevates the importance of international cooperation in managing global clean energy supply chains. In the near term, the United States should work with its closest allies (including Canada, Europe, and Japan) to stand up new international clean energy supply chain initiatives. These should include the creation of "climate alliances" and the leveraging of traditional trade policy. Both would create resilient interdependent supply chains across this group of reliable, dependable, and like-minded nations. In addition, the United States should work with these allies to strengthen relevant international institutions to help manage clean supply chain issues globally.

[4] For US emissions, see "Annual Share of Global CO2 Emissions," Our World in Data, https://ourworldindata.org/grapher/annual-share-of-co2-emissions?tab=chart&country=~USA.

Introduction

Climate hawks have spent decades urging the world's governments to adopt stronger climate policies. It is important that they continue to do so, as climate action remains insufficiently ambitious and the threat of unmanageable climate impacts grows larger by the day. Nevertheless, these advocates' focus on the urgent need to enact more ambitious policies has distracted from a necessary consideration of the strategies required to sustain climate progress once it is underway. One consequence is that climate advocates themselves have missed an important part of the climate challenge. In addition, their absence from conversations about securing supply chains for key materials and technologies has allowed a crucial perspective to go missing in the thinking of policymakers as well as the experts focused on addressing climate change, a perspective that will be essential to achieving global climate goals. In brief, the key point is this: real leadership in the fight against climate change means not only enacting ambitious policies but working to ensure that all actors in the climate fight have reliable access to the materials and technologies they need to implement them. This report introduces a range of new U.S. clean energy supply chain policies that climate champions should promote to ensure that the implementation of ambitious global climate policies is not hobbled by supply chain issues.

Not all threats to sustaining climate action are alike. Some mega threats—such as armed conflict over Taiwan, the fraying of American democracy, or the discovery of a planet-killing asteroid on course for Earth—could divert political attention away from climate change. In addition, interruptions in supplies of fossil fuels—whether due to armed conflict or something else—could lead to price increases and raise concerns about energy independence. As we have seen in the United States since Russia invaded Ukraine, both developments have the potential to weaken or delay support among voters and elected officials for climate action. These mega threats are too big for the climate community to address alone, and many solutions extend far beyond climate policy.

Other threats to sustaining climate progress, however, emanate directly from climate impacts or responses. These threats are internal to climate policy itself. One such threat is the risk that climate policies, once implemented, will prove more socially disruptive or unfair than people can tolerate. For example, climate policies might not provide a just transition for fossil fuel-dependent communities, they might make energy unaffordable to the poor, or they might not do enough to combat pre-existing social inequities. Fortunately, a growing number of climate champions, including in the Biden administration, are prioritizing climate justice to ensure that the costs and benefits of climate action are distributed equitably and that, to the extent possible, climate programs advance broader social goals. Climate justice problems have not been solved—far from it—but the climate community is fully engaged on these issues.

Another internal threat to sustaining climate progress—the one at the heart of this report—is the risk that the supply of the technologies and raw materials necessary to decarbonize the economy will prove too scarce and unexpectedly expensive. The transition to zero emission

vehicles, for example, might not occur quickly enough if automobile manufacturers cannot source advanced batteries and silicon microchips. A trade war with China might disrupt the supply of much-needed solar panels or wind turbines. Plans to displace fossil fuels by "electrifying everything" might go astray if certain critical minerals or manufacturing inputs for heat pumps, smart appliances, and electricity grids become scarce. These setbacks, were they to materialize, could make ambitious climate goals unachievable or unaffordable even if policy makers and the public would otherwise be on board. If green goods are not available or if prices spike because of supply restrictions, green technologies could be delayed or public support for climate policies could unravel. Either way, greenhouse gas emissions could fail to decline as sharply as necessary. In the end, the world could face a far higher risk of catastrophic, potentially uncontrollable, climate change.

Supply chain risks, of course, are a red-hot topic among conservatives and liberals alike. The national security community has made the case that, when it comes to clean energy, the United States must become less dependent on potential foreign adversaries and more resilient to foreign shocks.[5] Others have emphasized the need to invest in key industries to maintain U.S. competitiveness and reap the economic benefits of the clean energy transition.[6] Labor advocates have underscored the potential benefits for U.S. workers.[7] On the right and left, a consensus appears to exist that the United States needs to own the commanding heights of the global energy economy of the future.

Congress and especially the Biden administration have taken note of the growing importance various interest groups attach to addressing supply chain risks. Congress has passed an important bipartisan infrastructure bill and is on the verge of passing additional legislation, and President Biden has signed a slew of executive orders that greatly expand and augment efforts begun under previous administrations. These new policies promise to reduce today's risks, but most experts agree much more needs to be done.

Despite the importance of securing clean energy supply chains to sustaining climate progress, however, traditional climate advocates have been largely absent from recent policy debates on the subject. No mainstream environmental NGOs appear to have devoted substantial resources to advocacy in this area. Nor do any environmental think tanks appear to have published major reports on the topic. In fact, only two think tank reports—one from the Wilson Center, and one from the IEA—focus on supply chain disruptions as a threat to climate ambition specifically, and both of these are narrowly focused on mineral supply chains.[8] Finally, with the notable exception of veteran climate hawk David Roberts, environmental and climate commentators

[5] See Dasilva, "Securing the Critical Mineral Supply Chain is Vital to the Future of the U.S. Military" and SAFE, *The Commanding Heights of Global Transportation*.
[6] Livingston, "Secure American energy supply chains — before China does" and SAFE, *Stoking and Industrial Rennaissance: Opportunities for U.S. Decision-Makers*.
[7] BlueGreen Alliance, *Solidarity for Climate Action*, https://www.bluegreenalliance.org/work-issue/solidarity-for-climate-action/
[8] Duncan Wood, Alexandra Helfgott, Mary D'Amico, and Erik Romanin, *The Mosaic Approach: a Multidimensional Strategy for Strengthening America's Critical Minerals Supply Chain*, The Woodrow Wilson International Center for Scholars, https://www.wilsoncenter.org/publication/mosaic-approach-multidimensional-strategy-strengthening-americas-critical-minerals and IEA, *The Role of Critical Minerals in Clean Energy Transitions*, (IEA: Paris, 2021), https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions.

have devoted very little attention to this issue.[9] This means that clean energy security proposals are currently being evaluated by U.S. policymakers primarily from national security, economic, or labor perspectives. The environmental lens has been diffuse. This report aims to sharpen the focus of clean energy security from an environmental perspective.

The hope is that adopting this perspective will yield new insights and result in useful new policy recommendations for the Biden administration and Congress to consider. In the recent past, both Congress and the Executive Branch have taken laudable steps to shore up clean energy supply chains, in particular by supporting increased domestic mining of key minerals and manufacturing of important technologies as well as by taking a number of other steps to shore up U.S. supply chains. Even so, little is being done to promote clean energy security at the global level. No international institutions exist for this purpose. Nor have countries committed to climate action made any significant, less formal efforts to do so. Until this gap is filled, global decarbonization efforts will be unnecessarily vulnerable to supply chain disruptions. As a result, warming could exceed safe levels, not for lack of ambition, but for lack of foresight and proper planning.

This report has the following structure. Section 1 introduces how supply chain disruptions are a threat to climate progress. Section 2 summarizes leading U.S. policy recommendations for enhancing U.S. clean energy security, which come from mainstream think tanks and leading scholars. Section 3 summarizes action underway in the federal government to improve U.S. clean energy security. Section 4 identifies gaps in existing actions and policy recommendations from an environmental perspective and offers several new solutions the U.S. government should adopt.

1. Clean Supply Chain Risks

A relatively small number of key technologies are poised to play an outsized role in decarbonizing our economy in the immediate future. In most industrialized nations the two largest sources of climate pollution are electricity production and transportation. Most experts agree that, to decarbonize these sectors over the next couple of decades, the world needs an abundant and affordable supply of wind turbines, solar panels, and electric vehicles (EVs) as well as advanced batteries for storing clean electricity and updated power transmission infrastructure systems to get clean electricity where it is needed. Where renewable energy is not viable, carbon capture technologies could play a role. To fully decarbonize industry and other sectors that do not readily admit of electrification, such as shipping, there is an emerging consensus on the need to also ramp up supplies of green liquid fuels, such as hydrogen and ammonia. Other renewable energy technologies at earlier stages of development, such as geothermal, tidal, and wave energy, could also play a vital role, as could fuel cells. Disruptions

[9] Relevant publications by David Roberts include “Minerals and the clean-energy transition: the basics,” Volts, January 21, 2022, https://www.volts.wtf/p/minerals-and-the-clean-energy-transition and “The minerals used by clean-energy technologies,” Volts, February 7, 2022, https://www.volts.wtf/p/the-minerals-used-by-clean-energy.

in the supply chains for any of these key technologies could interfere with countries' emissions mitigation efforts.

These supply chain disruptions could take a variety of forms and stem from several different sources. The remainder of this section provides an overview of the three that pose the greatest threat to decarbonization: inadequate supply of minerals, high geographical concentration of mining and manufacturing operations, and the many environmental and social harms associated with clean energy supply chains.

1.1. Inadequate Supply of Critical Minerals

Though some require more than others, all the most important decarbonization technologies require significant quantities of critical minerals. See Figure 1 below.

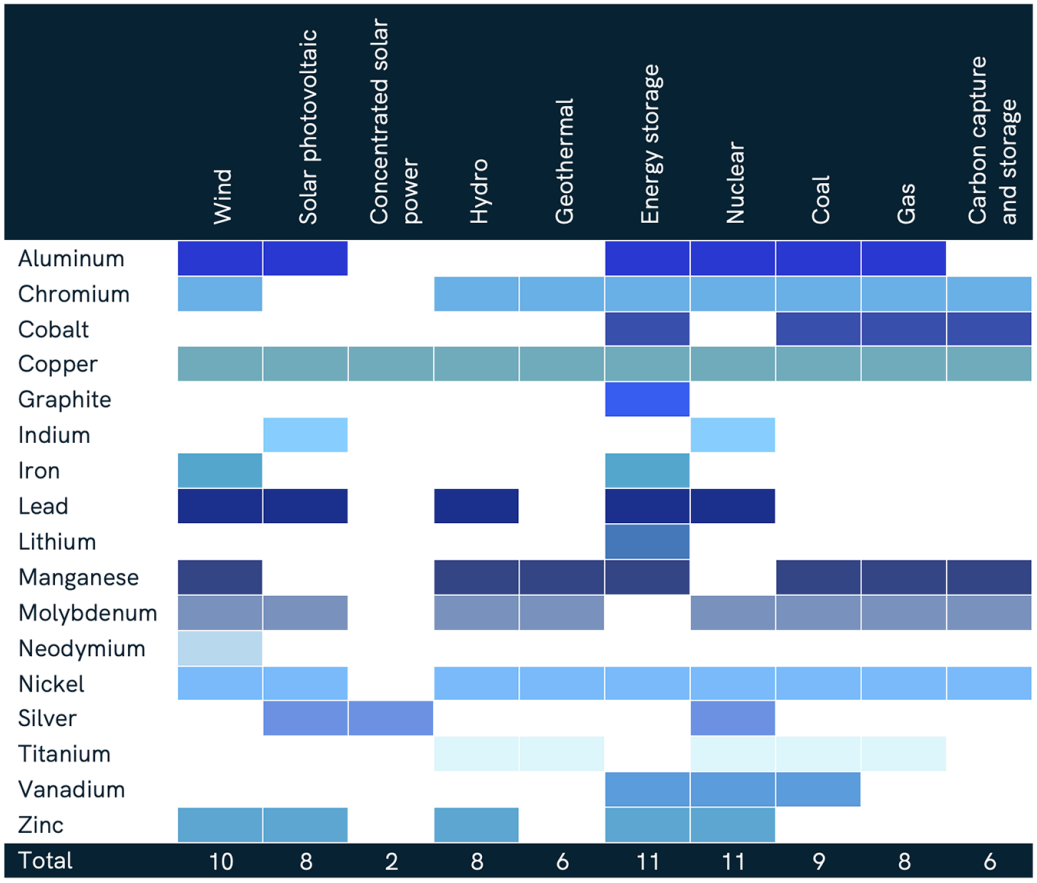

Figure 1. The Minerals Used by Clean Energy Technologies. Note that colors indicate mineral type. Source: David Roberts, "The minerals used by clean-energy technologies."

As the graphics from the International Energy Agency (IEA) below make clear, several of these technologies—notably including EVs, wind turbines, and solar panels—require far greater quantities of some minerals than the technologies they will replace. Figure 2 compares EVs and internal combustion engine vehicles while Figure 3 compares renewables and nuclear to coal and natural gas.

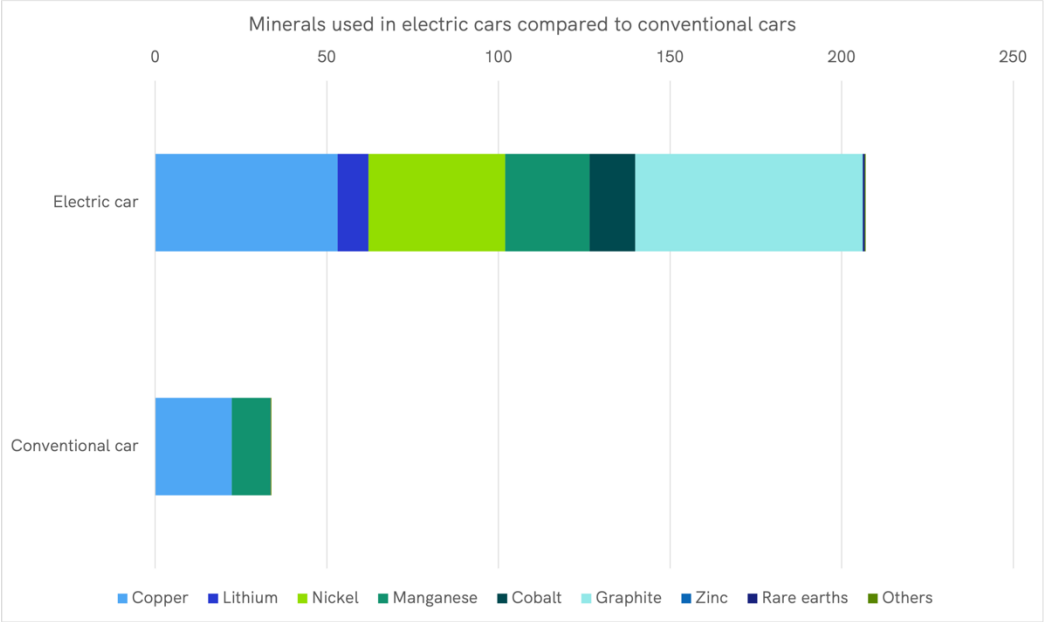

Figure 2. Minerals used in electric cars compared to conventional cars in kg/vehicle. Source : https ://www.iea.org/data-and-statistics/charts/minerals-used-in-electric-cars-compared-to-conventional-cars

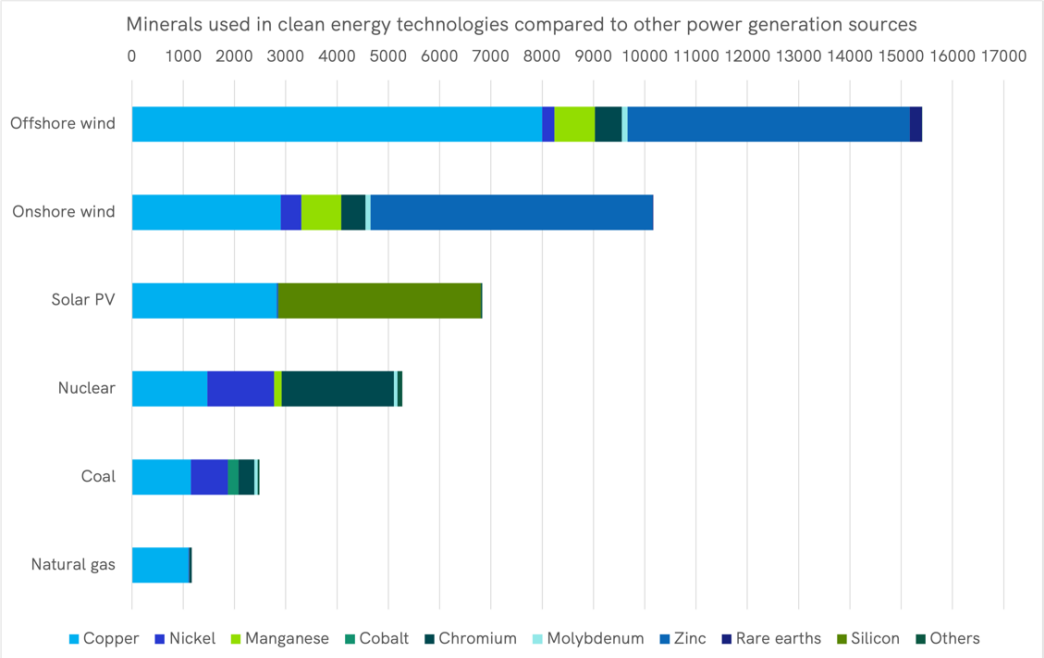

Figure 3. Minerals used in clean energy technologies compared to other power generation sources in kg/Mw. Source : https ://www.iea.org/data-and-statistics/charts/minerals-used-in-clean-energy-technologies-compared-to-other-power-generation-sources.

Consequently, demand for these minerals is projected to increase significantly as countries seek to deploy these technologies at the scales required to meet their climate targets.[10] Fortunately, there do not appear to be any signs of a shortage of economically viable reserves; in fact, according to the IEA, "economically viable reserves have been growing despite continued production growth."[11] At present, however, the IEA finds that "mineral supply and investment plans fall short of what is needed to transform the energy sector."[12] Unless supply ramps up quickly to meet projected demand, the energy transition may be too slow or too expensive to meet climate goals.

1.2. Geographical Concentration of Mining, Mineral Processing, and Manufacturing Capacity

Similarly, compared with oil and gas, extraction and processing capacity for many key raw materials is more geographically concentrated to a significant degree. Figure 4 shows the share of total extraction of selected minerals and fossil fuels of the top three producing countries, and Figure 5 shows the share of the top three processing countries. As the graphs make clear, command of mineral extraction is distributed across a handful of countries, including the DRC, China, Australia, Indonesia, and Chile. When it comes to processing, by contrast, China stands head and shoulders above all others.

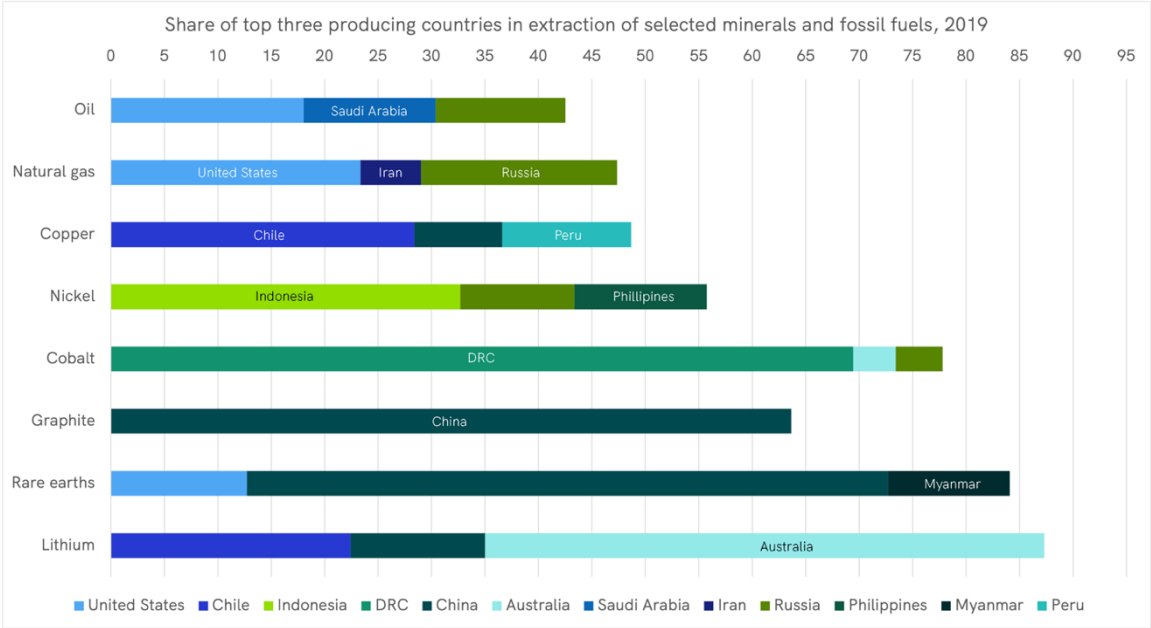

Figure 4. Share of top three producing countries in extraction of selected minerals and fossil fuels by percentage of total extraction, 2019. Source : https ://www.iea.org/data-and-statistics/charts/share-of-top-three-producing-countries-in-extraction-of-selected-minerals-and-fossil-fuels-2019.

[10] IEA, *The Role of Critical Minerals in Clean Energy Transitions*, pp. 50-51.
[11] Ibid., p. 123.
[12] Ibid., p. 11.

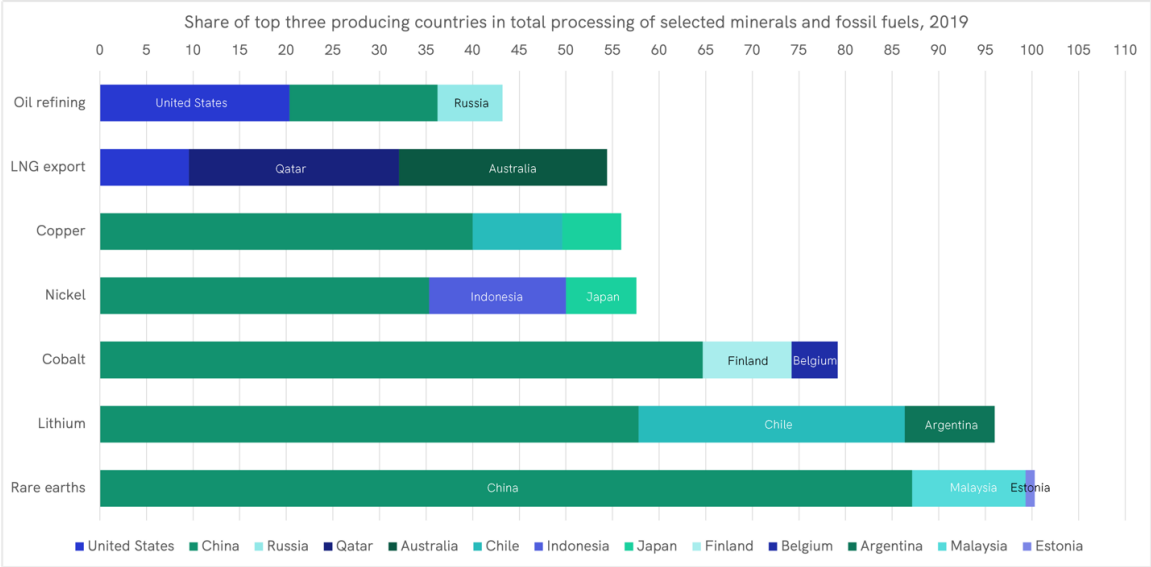

Figure 5. Share of top three producing countries in total processing of selected minerals and fossil fuels, 2019. Source : https ://www.iea.org/data-and-statistics/charts/share-of-top-three-producing-countries-in-total-processing-of-selected-minerals-and-fossil-fuels-2019

The situation is comparable when it comes to manufacturing capacity for key technologies, particularly batteries and solar PV. China is the largest manufacturer of every component of batteries, from electrolytes, anodes, cathodes, and separators to cells and packs.[13] As Figure 6 below shows, about 78% of the world's cell manufacturing capacity is in China.[14]

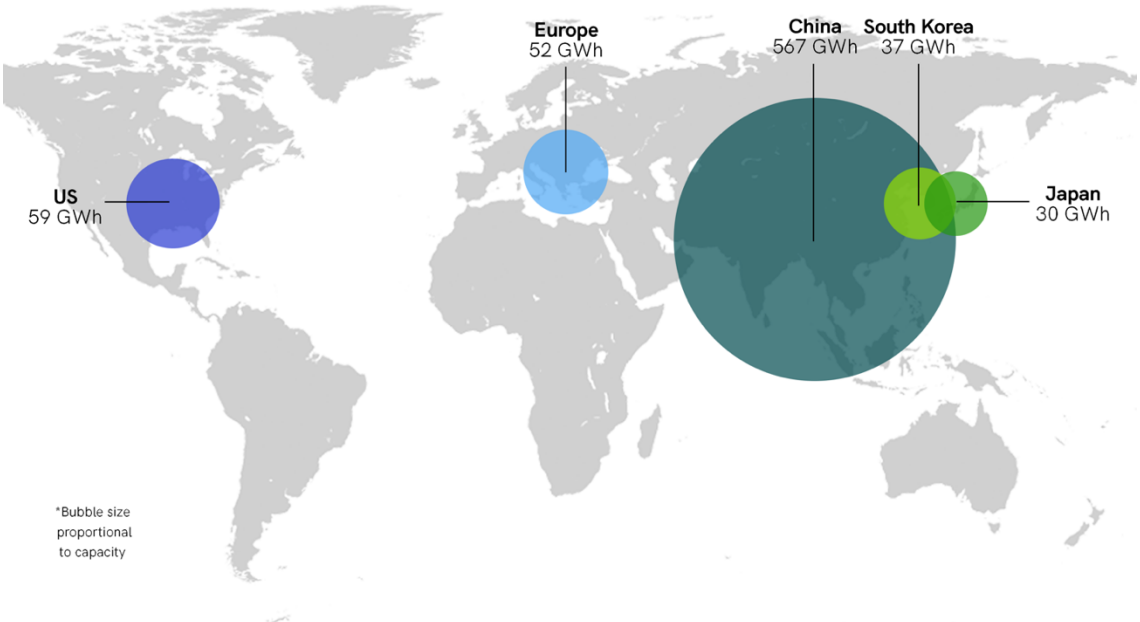

Figure 6. Cell manufacturing capacity by country or region. Source: National Blueprint for Lithium Batteries.

[13] "Energy Storage Trade and Manufacturing: A Deep Dive," BloombergNEF, February 2021, https://csis-website-prod.s3.amazonaws.com/s3fs-public/Energy%20Storage%20Case%20Study%20-%20BloombergNEF.pdf?KCOqvXlE3LM6AlBS.lyXF9LnQ7GTk5oc, p. 4 (Table 1).

[14] Ladislaw, et al., *Industrial Policy, Trade, and Clean Energy Supply Chains*, (Washington, D.C. and New York: Center for Strategic International Studies and BloombergNEF, February 2021), p. 10.

Similarly for solar PV. There are five main components of the solar PV manufacturing value chain: polysilicon, ingots, wafers, cells, and modules. China dominates in three of the five. Chinese firms own two-thirds of the world's polysilicon manufacturing capacity and about 72% of the world's module manufacturing capacity, and more than 90% of the world's wafer capacity is located in China.[15]

The high degree of concentration in clean energy supply chains makes them exceptionally vulnerable to natural disasters, the effects of climate change, and unrest or armed conflict in producer countries. As the IEA has noted, mining assets are particularly exposed to growing climate risks:

> Copper and lithium are particularly vulnerable to water stress given their high water requirements. Over 50% of today's lithium and copper production is concentrated in areas with high water stress levels. Several major producing regions such as Australia, China, and Africa are also subject to extreme heat or flooding, which pose greater challenges in ensuring reliable and sustainable supplies.[16]

Of course, clean energy supply chains are not unique in this regard: in principle, these sorts of disruptions could affect the supply chains for any product. The point, though, is that, given how concentrated they are, supply chains for critical minerals and key decarbonization technologies are particularly susceptible to these sorts of disruptions, especially by comparison with fossil fuels.

Concentration also makes clean energy supply chains liable to disruption by geopolitical tensions. For instance, given its dominant position in so many parts of clean energy supply chains, China could seek to shape global politics in its favor and punish adversaries in the same way Russia has used its role as Europe's main supplier of natural gas.[17] With that said, however, it is important to understand that the nature of the risk here differs considerably from analogous risks for oil and gas supply chains. If Russia refuses to export gas to Europe in the winter, people may not be able to heat their homes, but no such prospect looms should China decide to stop exporting battery components, for instance. Since batteries do not require fuel the way furnaces do, any batteries already in operation will continue to function regardless of whether China is willing to supply the parts necessary to build new ones, at least until they need repairing. Therefore, rather than existing clean energy technologies becoming inoperable in the short term like a gas plant without fuel, the threat is that future deployment of renewable energy, electric vehicles, other technologies would halt.

Of course, some degree of geographical concentration is inevitable, at least for mineral production, since some countries have larger reserves of some minerals than do others.[18] To a

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[15] Ibid., pp. 10-11.
[16] IEA, *The Role of Critical Minerals in Clean Energy Transitions*.
[17] Cf. Jason Bordoff and Meghan L. O'Sullivan, "Green Upheaval: The New Geopolitics of Energy," *Foreign Affairs*, January/February 2022, https://www.foreignaffairs.com/articles/world/2021-11-30/geopolitics-energy-green-upheaval.
[18] For details on country reserves for all critical minerals, see U.S. Geological Survey, *Mineral commodity summaries 2022*, (Reston, VA: U.S. Geological Survey, 2022), https://doi.org/10.3133/mcs2022.

large extent, however, the current situation is simply the result of prioritization by some countries and neglect by others. For instance, while the United States has significant reserves of some critical minerals, the country currently produces less than it could because it has been decades since concerted effort was put toward developing domestic mining and mineral processing capacity. In China, by contrast, increased solar panel and battery manufacturing and mineral processing capacity have been explicit policy goals for several years; as a result, China is dominant in these areas.[19] If other countries were to follow China's lead in this respect, supply would presumably increase and could become less geographically concentrated.

1.3. Environmental Harms, Labor Abuses, and Governance Issues with Mining and Manufacturing

Regrettably, clean energy supply chains are connected to a host of environmental and social harms. Corruption is endemic in some mineral-rich countries, meaning that the benefits of extraction tend not to benefit most residents. Mining, including for critical minerals, has often been linked to deforestation, which accounts for 16-19% of annual global greenhouse gas emissions, erodes biodiversity, and often threatens forest-dependent peoples' ways of life.[20] Even when it does not drive deforestation, moreover, both surface and seabed mining for critical minerals could have significant impacts on natural ecosystems and biodiversity.[21] In addition, reports suggest that cobalt mines in the Democratic Republic of Congo are often unsafe and employ child labor, and many solar panels are produced by Chinese companies that rely on forced labor by Muslims detained in China's Xinjiang region.[22]

If not properly addressed, these issues could prove to be a real obstacle to socially responsible production of critical minerals in sufficient quantities or at affordable prices.[23] For instance, the need to bribe local officials in countries with poor resource governance could lead to higher prices, and if investors are reluctant to finance mining projects on account of the reputational risks associated with deforestation, labor or human rights abuses, or corruption, mineral-rich countries' resources are less likely to be developed. In addition, if residents of mining countries or regions do not feel they will benefit from mining projects, whether because of corruption or

[19] For some details about how China has done this, see Ladislaw, et al., *Industrial Policy, Trade, and Clean Energy Supply Chains*, pp. 8-14.
[20] One recent example is discussed in Karol Ilagan, Andrew W. Lehren, Anna Schecter, and Rich Schapiro, "How the rise of electric cars endangers the 'last frontier' of the Philippines," *NBC News*, December 7, 2021, https://www.nbcnews.com/specials/rise-of-electric-cars-endangers-last-frontier-philippines/index.html. For the contribution of deforestation to global emissions, see Seymour and Busch, *Why Forests? Why Now?* (Washington, D.C.: Center for Global Development, 2016), p. 40.
[21] See James Marshall, "Conservation summit calls for deep-sea mining ban," *E&E News*, September 10, 2021, https://subscriber.politicopro.com/article/eenews/2021/09/10/conservation-summit-calls-for-deep-sea-mining-ban-280462 and Jael Holzman, "Lithium miner rips its own research in ESA fight," *E&E News*, December 17, 2021, https://subscriber.politicopro.com/article/eenews/2021/12/17/lithium-miner-rips-its-own-research-in-esa-fight-284358.
[22] Dionne Searcey and Eric Lipton, "Hunt for the 'Blood Diamond of Batteries' Impedes Green Energy Push," *New York Times*, November 29, 2021, https://www.nytimes.com/2021/11/29/world/congo-cobalt-albert-yuma-mulimbi.html; Ana Swanson and Chris Buckley, "Chinese Solar Companies Tied to Use of Forced Labor," *New York Times*, January 8, 2021, https://www.nytimes.com/2021/01/08/business/economy/china-solar-companies-forced-labor-xinjiang.html.
[23] IEA, *The Role of Critical Minerals in Clean Energy Transitions*, p. 192.

due to environmental damages, they may oppose development. For instance, opposition to lithium extraction is mounting in Chile, and concern about the Biden administration's push to boost domestic mining of critical minerals is already growing in the United States, where, according to one estimate, the majority of U.S. reserves of cobalt, copper, lithium, and nickel are located within 35 miles of Native American reservations.[24] Finally, any of these issues could lead to import restrictions on the part of countries that do not want to be seen as supporting corruption, environmental degradation, human rights abuses, etc. In fact, the Uyghur Forced Labor Prevention Act, signed by President Biden in December 2021, has already constricted the supply of solar panels.

2. Sensible Ideas from Experts

Think Tanks and commentators have offered a wide range of recommendations to make the United States less vulnerable to supply chain disruptions in the clean economy. In the first half of 2021, the Center for Strategic and International Studies (CSIS) published a pair of far-reaching reports on securing supply chains for clean energy technologies, and later in the year, both the IEA and the Wilson Center published complementary reports.[25] During the same period, the Center for American Progress (CAP) published a report on ways to revitalize American manufacturing.[26]

Section 4 below offers a number of novel recommendations to enhance U.S. clean energy security. First, though, this section summarizes the many sensible recommendations others have put forward, beginning with those policies that could be implemented domestically. The new recommendations offered in Section 4 build on these.

2.1. Domestic Actions

Recommendations for action at the domestic level fall into two categories, those relating to mining and minerals and those relating to manufacturing.

Mining and Minerals. Expert recommendations on mining and minerals include the following:

[24] See Somini Sengupta, "Chile Writes a New Constitution, Confronting Climate Change Head On," *New York Times*, January 6, 2022, https://www.nytimes.com/2021/12/28/climate/chile-constitution-climate-change.html and Jael Holzman and Emma Dumain, "Will Biden use the Defense Production Act to boost mining?" *E&E News*, March 25, 2022, https://subscriber.politicopro.com/article/eenews/2022/03/25/will-biden-use-the-defense-production-act-to-boost-mining-00020487.

[25] The CSIS reports are Ladislaw, et al., *Industrial Policy, Trade, and Clean Energy Supply Chains* and Tsafos, et al., *Reshore, Reroute, Rebalance*. The IEA report is *The Role of Critical Minerals in Clean Energy Transitions*, and the Wilson Center Report is Wood, et al., *The Mosaic Approach*.

[26] Marc Jarsulic, "Building U.S. Manufacturing Competitiveness and Capacity," Center for American Progress, March 11, 2021, https://www.americanprogress.org/article/building-u-s-manufacturing-competitiveness-capacity/.

- Increase domestic production of minerals. There is broad agreement among think tank experts that the United States should devote energy and resources to developing its own domestic mineral resources and building out domestic processing facilities.[27]
- Consider stockpiling minerals. Experts are also united in recommending that the United States should consider stockpiling critical minerals, though they typically note that, in the case of oil, this strategy has had mixed results.[28]
- Reduce, reuse, recycle. In addition, the IEA report recommends scaling up critical minerals recycling and funding research both on ways to decrease mineral intensity in products and on substitute materials.[29] The IEA rightly views these strategies as ways to make supply chains more resilient against disruptions, including those stemming from natural disasters, conflict, or geopolitical developments affecting producing countries.
- Make mining easier and less risky, and build the workforce. Finally, the Wilson Center report adds that the United States should take steps to lower the risk profile of mining for investors to facilitate investment in the industry, streamline the permitting process for opening new mines, and invest in human capital through universities, community colleges, and lifelong learning approaches.[30]

Manufacturing. Think tank scholars generally agree that the United States should take steps to boost domestic manufacturing capacity in key green technologies. However, they do not recommend that the United States strive to produce all relevant materials and technologies domestically, or in other words, to achieve what we might call clean energy independence.[31] Two considerations support this stance. First, complete independence from other countries, including China, is very likely impossible in the near term since the United States lacks the capacity to rapidly scale up production of the relevant minerals. In part this is because of the way we govern minerals extraction, but it also has to do with the very long lead times for minerals projects and the fact that, to some extent, we have allowed our mining industry to languish.[32] Second, given the increased costs likely associated with producing all relevant materials and technologies domestically, independence is probably not even desirable.[33] Rather than aiming for clean energy independence, the CSIS report suggests that the United States should prioritize areas where we are likely to have a natural competitive advantage, such as CCUS, hydrogen, offshore wind, geothermal, biofuels, battery storage, and advanced nuclear.[34]

The most detailed recommendations to revitalize American manufacturing come from the CAP report. These include:

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[27] See, e.g., Wood, et al., *The Mosaic Approach*, pp. 18-20 and SAFE, "To Meet EV and Solar Targets, Break Dependency on China, the United States Must Get Serious about Minerals," September 14, 2021, https://secureenergy.org/to-meet-ev-and-solar-targets-break-dependency-on-china-the-united-states-must-get-serious-about-minerals/.
[28] Wood, et al., *The Mosaic Approach*, p. 20; Bordoff and O'Sullivan, "Green Upheaval"; Tsafos, et al., "Reshore, Reroute, Rebalance," p. 33; IEA, *The Role of Critical Minerals in Clean Energy Transitions*, p. 18.
[29] IEA, *The Role of Critical Mineral in Clean Energy Transitions*, pp. 169ff.
[30] Wood, et al., *The Mosaic Approach*, pp. 18-22.
[31] Tsafos, et al., *Reshore, Reroute, Rebalance*, p. 26; Bordoff and Meghan L. O'Sullivan, "Green Upheaval."
[32] Wood, et al., *The Mosaic Approach*, pp. 11-13, 19-20.
[33] On the costs of independence, see Tsafos, et al., *Reshore, Reroute, Rebalance,* p. 11-12.
[34] Tsafos, et al., *Reshore, Reroute, Rebalance,* pp. 29-30.

- Reconfigure and expand existing programs. Reforms should aim at helping firms translate scientific discoveries into new manufactured products and manufacturing processes, ensuring that early-stage scientific research suitable for use in manufacturing production is sited in the United States, and developing the production processes that are specifically geared to address climate change.[35]
- Help workers adapt to new processes. Mandate that the U.S. Department of Labor develop workforce training for firms participating in these programs.
- Use federal procurement to support good jobs and encourage innovation. Require the federal government to buy manufactured goods from high-performing U.S. firms with high productivity, high wages, and robust workforce training.

2.2. Foreign Policy Recommendations

Commentators have also put forward several recommendations for action at the international level to be implemented through changes to U.S. foreign policy. Many of these focus on mining and minerals, but others are broader in scope.

Mining and minerals. Given the high degree of geographical concentration in critical mineral production and processing, U.S. experts generally agree that the United States could make the supply chains for these key raw materials more secure by increasing the diversity of suppliers.[36] Commentators also agree that the United States should do so, in part, by working with international allies and partners.[37] More specifically, the CSIS report recommends using the Development Finance Corporation and the Export-Import Bank to develop mining capacity abroad, and the Wilson Center suggests leveraging the United States-Mexico-Canada Agreement (USMCA) and strong mining industries within North America to boost production.[38]

Think tank experts have also put forward several recommendations for dealing with the many environmental, social, and governance issues that have sometimes plagued mining operations. These include working with international partners to create a global regime for critical minerals that emphasizes minimum environmental, social, and governance standards, including using the United States' power as a major market to establish standards for products that end up in installations or equipment in the United States.[39] Other policy levers mentioned in this connection include import restrictions and sanctions, both of which could shape the behavior of international suppliers and help responsible producers of minerals compete.[40] In a similar vein, the IEA recommends that countries "promote knowledge transfer and capacity building

[35] Specifically, CAP recommends reconfiguring and expanding the existing Manufacturing Extension Partnership and the Manufacturing USA program.
[36] See IEA, *The Role of Critical Minerals in Clean Energy Transitions*, pp. 14, 18, and 129 and Wood, et al., *The Mosaic Approach*, pp. 22-23.
[37] Wood, et al., *The Mosaic Approach*, pp. 22-23;
[38] Tsafos, et al., *Reshore, Reroute, Rebalance*, p. 31.
[39] Tsafos, et al., *Reshore, Reroute, Rebalance*, p. 33; Wood, et al., *The Mosaic Approach*, pp. 22-23; IEA, *The Role of Critical Minerals in Clean Energy Transitions*, pp. 239-245.
[40] Ibid.

to spread sustainable and responsible development practice."[41] Finally, the Wilson Center's report recommends that the United States complement its efforts to promote better minerals governance abroad under the State Department's Energy Resource Governance Initiative by working to harmonize its achievements with those of the Extractive Industries Transparency Initiative, a global standard for governance of oil, gas, and mineral resources, as well as by looking for ways to ensure compliance.[42]

Cross-cutting recommendations. Commentators have also offered several cross-cutting recommendations that would enhance U.S. clean energy security relating to both minerals and manufacturing for the clean economy. These recommendations include nurturing ties with suppliers that carry little or no geopolitical baggage, repurposing existing international institutions such as IEA, EITI, the Energy Charter Treaty, and the Atomic Energy Agency to manage insecurity, and, in cases where relying on imports is unavoidable and where those imports come from suppliers that raise a number of strategic, economic, human rights, or environmental concerns, creating strategic interdependence with suppliers. [43] Such interdependence could take the form of business ties or, alternatively, an explicit quid pro quo; "for example," the authors of the CSIS report say,

> the United States could tie the export of critical technologies and products that the United States exports to China to critical technologies that the United States wants from China. Or the United States could more explicitly ringfence certain products from trade disputes, ensuring that critical minerals, rare-earth metals, and key technologies are insulated from broader trade tensions.[44]

Finally, as a last resort, some commentators have suggested that it may be necessary to use the threat of military force ("deterrence") to keep supply chains secure, beginning by making clear what actions the United States will and will not tolerate.[45]

3. The Past, Present, and Future of U.S. Clean Energy Security Policy

The United States is already taking action to enhance U.S. clean energy security. Though both the Obama and Trump administrations took steps to increase supply of critical minerals and shore up critical mineral supply chains, until very recently, the country mostly dealt with the issue indirectly, through a variety of tax credits that helped to stimulate domestic demand. Now, however, the federal government is taking steps to confront clean energy security head

[41] IEA, *The Role of Critical Minerals in Clean Energy Transitions*, p. 18.
[42] Wood, et al., *The Mosaic Approach*, p. 23.
[43] Tsafos, et al., *Reshore, Reroute, Rebalance*, p. 32.
[44] Ibid.
[45] Ibid., p. 34.

on. A great deal of this effort is being led by the Executive Branch. In addition, Congress may soon pass legislation with a multitude of complementary measures. This section provides an overview of all these measures. As this overview will make clear, current policy, as well as live policy discussions on Capitol Hill, reflect many of the recommendations from think tank experts discussed in the last section.

3.1. Past Efforts

The United States has long used tax credits to stimulate demand for climate-friendly electricity generation and vehicles. Relevant measures include investment tax credits for solar panels and wind turbines, production tax credits for electricity generated using renewables, rebates for electric vehicles, fuel efficiency standards, and the so-called "45Q" tax credit for carbon capture and storage. Several of these policies, while modified or extended during the Obama and Trump administrations, actually originated decades ago. Because these measures send a clear market signal to investors, manufacturers, and miners that their products will find buyers, they can help to increase the supply of key raw materials and technologies as well as manufacturing capacity, thereby helping indirectly to enhance U.S. clean energy security. However, these "demand-side" measures, as they are known, do little to directly and specifically increase domestic manufacturing capacity or mineral production. International companies may prove more adept at meeting rising U.S. demand than their domestic counterparts. Additionally, demand-side measures do not help to diversify the supply of critical minerals, nor, finally, do these demand measures directly ensure that supply chains are resilient to geopolitical risks and global disasters. For those reasons, such measures leave critical gaps in U.S. clean energy security policy.

Much the same is true of the Department of Energy's Loan Programs Office (LPO), which provides loans and loan guarantees to help bring innovative energy technologies to market and support manufacture of light-duty vehicles and components. Under President Obama and now again under President Biden, this program has been a tremendous boon from a climate action perspective, accelerating cost reductions and deployment of wind turbines, utility-scale solar power infrastructure, and other renewable energy technologies; however, since it has not historically been focused on increasing U.S. manufacturing capacity, this aspect of the LPO's work has improved U.S. clean energy security only indirectly, namely by making these technologies competitive with fossil fuels and, as a result, increasing demand for them. By contrast, while the LPO's support for vehicle manufacturing has not been directed exclusively at EVs, it has offered some support to EV manufacturers, including a sizable loan to Tesla at a crucial point in that company's history.[46] That aspect of its work straightforwardly contributed to increased U.S. clean energy security.

A pair of targeted efforts by the past two administrations, both focused on securing critical mineral supply chains, impact U.S. clean energy security more directly. First, in 2010, the

[46] "Tesla gets loan approval from US Department of Energy," Tesla, April 20, 2010, https://www.tesla.com/blog/tesla-gets-loan-approval-us-department-energy.

Obama administration released a report on the role of rare earth metals and other materials in the clean energy economy and chartered the new National Science and Technology Council Subcommittee on Critical and Strategic Minerals Supply Chains.[47] This subcommittee then went on to take steps to secure U.S. critical mineral supply chains, including the following:

- Forming a Critical Materials Institute," which researches ways to diversify supply, develop substitute materials, and improve reuse and recycling, as well as other topics related to reducing supply shocks and price fluctuations
- Revising the classification system used to monitor U.S. trade activity and collect duties and taxes (the Harmonized Tariff Schedule) to increase the level of detail of rare-earth trade data
- Providing analytic support that contributed to the success of a World Trade Organization case, filed by the U.S. Trade Representative, Japan, and the European Union, to address critical mineral export restrictions and market manipulation by China
- Publishing a report that develops a methodology for identifying which materials are critical for U.S. interests and security and monitoring changes in criticality[48]

Later, in 2019, under the Trump administration, the United States founded the Energy Resource Governance Initiative (ERGI) in coordination with the governments of Australia, Botswana, Canada, and Peru, with the goal of countering China's dominance in critical mineral supply chains.[49] Housed in the State Department's Bureau of Energy Resources, ERGI aims to share best practices for resource governance with mineral-rich countries; support the growth of diverse, resilient mineral supply chains; and increase the supply of the minerals needed for clean energy technologies.[50] ERGI has made available an online toolkit for mining countries to advance these goals.[51]

3.2. Actions by the Biden Administration

The Biden administration has aggressively built on and expanded these earlier efforts in several ways, beginning with a review of vulnerabilities in the nation's mineral and material supply chains the administration undertaken during the first 100 days after President Biden was inaugurated.

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[47] The report is available here: https://www.energy.gov/sites/default/files/piprod/documents/cms_dec_17_full_web.pdf. The subcommittee charter is available here: https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/NSTC/CSMSC%20Charter%202016-04-21%20signed.pdf.

[48] The report is available here: https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/NSTC/csmsc_assessment_of_critical_minerals_report_2016-03-16_final.pdf.

[49] HJ Mai, "US launches initiative to reduce storage, EV reliance on Chinese minerals amid trade uncertainty," *UtilityDive*, June 13, 2019, https://www.utilitydive.com/news/us-initiative-to-reduce-storage-ev-reliance-on-chinese-minerals-amid-trade/556816/.

[50] State Department Fact Sheet available here: https://www.state.gov/wp-content/uploads/2019/06/Energy-Resource-Governance-Initiative-ERGI-Fact-Sheet.pdf.

[51] Available here: https://ergi.tools/.

First, the administration has taken steps to strengthen domestic battery supply chains. Foremost among these was the publication of a report, the National Blueprint for Lithium Batteries, which details vulnerabilities in the U.S. battery supply chain and lays out a strategy for making it more secure. The administration has also taken steps to promote commercialization and deployment of key technologies, including by using government procurement, setting up a program to assist hydrogen suppliers and users in identifying opportunities to expand development, and mobilizing public and private finance to increase production. In addition, through the Bureau of Energy Resources, the State Department "promotes reliable, solvent, and competitive power sectors, and advances renewable energy (RE) solutions in order to support decarbonization, energy security, and energy access and development goals."[52]

The administration has also taken substantive action on minerals and mining. The administration has continued and expanded the work started during the Trump administration by ERGI, providing technical assistance abroad "to build capacity for managing mineral sectors soundly and transparently, working on things like environmental regulatory frameworks and how to attract responsible investment."[53] In addition, the administration has established an interagency team to identify ways to improve mining and permitting processes; released a set of principles for domestic mining reform; and is using loan guarantees, the Development Finance Corporation, and public-private partnerships to increase mineral production at home and abroad; and has worked to secure reliable supplies of critical minerals for the United States, Japan, and India through the Quadrilateral Security Dialogue (also known as "the Quad"), an informal alliance between these three countries and Australia.[54] Most recently, President Biden invoked the Defense Production Act to boost domestic production of critical minerals.[55]

For further details on actions by the Biden administration relevant to clean energy security, see Appendix 1.

3.3. Recently Enacted Legislation

While strengthening clean energy supply chains has been a consistent goal of the past few presidents, Congress too is acting. The Infrastructure Investment and Jobs Act (also known as

[52] U.S. Department of State, "Bureau of Energy Resources: Clean Energy Diplomacy on Climate," April 22, 2021, https://www.state.gov/clean-energy-diplomacy-on-climate-bureau-of-energy-resources-enr/.
[53] Ibid.
[54] Reuters Staff, "Quad nations to focus on clean-energy supply chain, says Australia PM," *Reuters*, September 25, 2021, https://www.reuters.com/article/usa-quad-australia-critical-minerals-idCAKBN2GL054. The administration also recently announced a deal to fund Australian critical minerals projects through the DFC; for details, see Matthew Cranston, "US agrees to fund Australian critical minerals projects," *Financial Review*, March 31, 2022, https://www.afr.com/world/north-america/us-agrees-to-fund-australian-critical-minerals-projects-20220331-p5a9js.
[55] The White House, "Memorandum on Presidential Determination Pursuant to Section 303 of the Defense Production Act of 1950, as amended," March 31, 2022, https://www.whitehouse.gov/briefing-room/presidential-actions/2022/03/31/memorandum-on-presidential-determination-pursuant-to-section-303-of-the-defense-production-act-of-1950-as-amended/.

the "bipartisan infrastructure bill"), negotiated by a bipartisan group of ten senators and signed by President Biden in November, includes many provisions that complement recent executive branch action.

Among these are numerous provisions to increase domestic production of minerals and strengthen critical mineral supply chains, including a mapping effort to clarify the extent and character of the country's mineral resources, research and development on processing and recycling, and loan guarantees for projects that increase the supply of domestically produced critical minerals. Complementing these provisions are measures intended to strengthen domestic battery supply chains, including a grant program intended to increase domestic processing and manufacturing capabilities and reduce U.S. reliance on foreign competitors. Finally, the bill includes several provisions for commercialization, R&D, and deployment of key technologies. These include R&D and demonstration projects for CCUS technologies, clean hydrogen, and small and modular nuclear measures, as well as funding for a national network of electric vehicle charging stations. For further details, see Appendix 2.

Another piece of recent, bipartisan legislation, the Energy Act of 2020, includes funding for R&D and commercialization programs for nuclear energy and R&D programs focused on carbon capture and critical minerals. It also includes several demand-side measures, such as extensions of existing tax credits for wind and solar.[56]

3.4. Pending Legislation

Congress also appears set to go further. Two pieces of legislation pending in Congress contain several relevant provisions. These are the Build Back Better bill, or rather its climate provisions, and the United States Innovation and Competition Act. Enactment of the former in its current form is highly unlikely; however, its climate provisions have broad support among Democrats, and enactment of some of them could come later through other bills. Congress is likely to enact a compromise version of the latter into law later this year.

Build Back Better. In November 2021, the House of Representatives passed the sweeping Build Back Better bill, which would implement a significant portion of President Biden's domestic agenda. The bill included numerous climate spending provisions, amounting to about $550 billion of climate-related investments, as well as sweeping changes to other aspects of federal policy.[57] While the broader Build Back Better bill died in the Senate, the fate of its climate provisions remains less clear. All fifty Democratic Senators have said publicly that they support large parts of the climate package. Congressional enactment of those provisions remains possible. Provisions in the bill relevant to clean energy security include funding for loans, loan guarantees, and demonstration projects to help commercialize key technologies; funding for the Department of Interior to develop better planning, permitting, and approval processes for

[56] NCSL, "Energy Act of 2020 Signed into Law," December 28, 2020, https://www.ncsl.org/Portals/1/Documents/standcomm/scnri/EnergyAct2020_Omnibus.pdf.

[57] These include measures intended to provide free childcare for children under six, provide young adults two years of free community college, expand Medicare, reduce prescription drug prices, and increase taxes on corporations and people making over $400,000 per year, among others.

mining operations; and several demand-side measures intended to accelerate deployment of key technologies.

United States Innovation and Competition Act. The United States Innovation and Competition Act passed the Senate in June 2021 with significant bipartisan support, including seven Republican and six Democratic co-sponsors.[58] Its companion in the House of Representatives, the America Creating Opportunities for Manufacturing, Pre-Eminence in Technology, and Economic Strength Act of 2022 (also known as the America COMPETES Act), passed in February 2022. The primary aim of these bills is to address a semiconductor shortage and other supply chain issues that have contributed to inflation during the pandemic and make U.S. manufacturing more competitive, especially with China. Because the version passed by the House differs significantly from the Senate version of the bill, the House and the Senate will need to agree on a compromise version before the bill goes to President Biden for signature. It is unclear at present whether the two chambers can agree, since significant differences remain. Any compromise bill is likely to pare back the climate provisions added in the more partisan House version, but those items may not be eliminated entirely.

Many provisions in the bill are relevant to clean energy security. These include measures to promote domestic manufacturing of solar panels and semiconductors, as well as provisions intended to promote supply chain resilience, including by establishing a supply chain resilience and crisis response office and developing and implementing a strategy to support the resilience, diversity, security, and strength of supply chains. The bill also includes several provisions to support commercialization, R&D, and deployment of key technologies, including a provision establishing a research, development, demonstration, and commercial application program designed to enhance U.S. energy security and several provisions intended to promote the deployment of clean energy technologies abroad. For further details, see Appendix 3.

4. Policy Recommendations

The preceding discussion reveals that the U.S. government is taking action to strengthen our clean energy security. Leading experts have advanced sensible policy recommendations, and both President Biden and Congress have adopted a range of these. The Biden administration has taken the issue very seriously, more so than not only any past administration but also Congress, which has now been sitting on the U.S. Innovation and Competition Act for almost a year. These actions are laudable, but are they enough? In particular, have they put the United States on track to neutralize the risks supply chain disruptions pose to global climate action? Answering this question requires rethinking the concept of clean energy security. This section explains that while recent U.S. actions to strengthen clean energy security have merit, climate change requires the United States to take a broader and more comprehensive approach to supply chain disruptions, an approach that starts from and keeps firmly in view the unavoidably global character of climate change and climate solutions. The discussion below explains why

[58] A list of co-sponsors is available here: https://www.congress.gov/bill/117th-congress/senate-bill/1260/cosponsors.

such an approach is necessary, identifies several critical gaps in existing U.S. policy, and offers new policy recommendations for filling those gaps.

4.1. Clean Energy Security from a Climate Perspective

Solving the climate crisis, experts often say, requires a global response. This is because greenhouse gases mix and diffuse in the atmosphere. Emissions from one country contribute to adverse climate impacts (such as droughts, floods, and severe storms) not just in that one country, but globally. In addition, no one country, not even the United States, can solve the climate problem alone. The United States has emitted more climate pollution than any other nation since the beginning of the Industrial Revolution, as shown in Figure 7 below. Today, however, U.S. emissions account for a small fraction of global emissions (approximately 13.5% of global CO_2 emissions in 2020).[59] At this time, China's emissions are larger than those from the United States. In fact, China alone produces more climate pollution than the United States and Europe combined. What's more, the U.S. share of global emissions will shrink in the years ahead. India's emissions will surpass those of the United States in the coming decades, and experts expect economic growth in Africa and other parts of the developing world to increase emissions so as to be on par with U.S. emissions in the same timeframe. To see how global responsibility for climate pollution is changing quickly, see Figure 8.

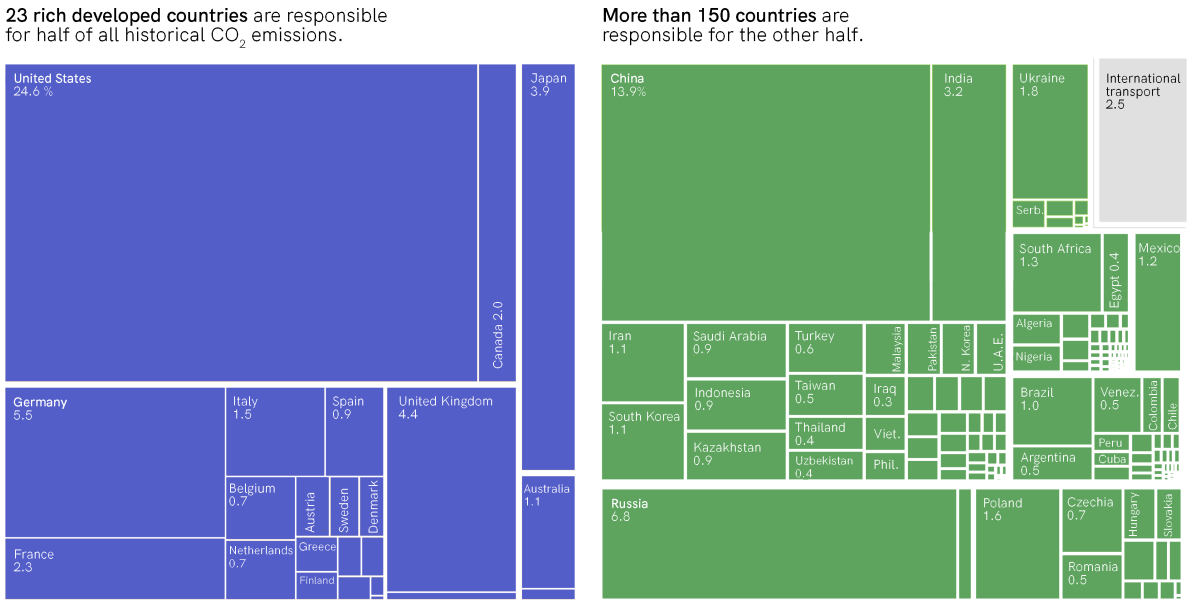

Figure 7. Source: Nadja Popovich and Brad Plumer, "Who Has The Most Historical Responsibility for Climate Change?," New York Times, November 12, 2021, https://www.nytimes.com/interactive/2021/11/12/climate/cop26-emissions-compensation.html

[59] "Annual Share of Global CO2 Emissions," Our World in Data, https://ourworldindata.org/grapher/annual-share-of-co2-emissions?tab=chart&country=~USA.

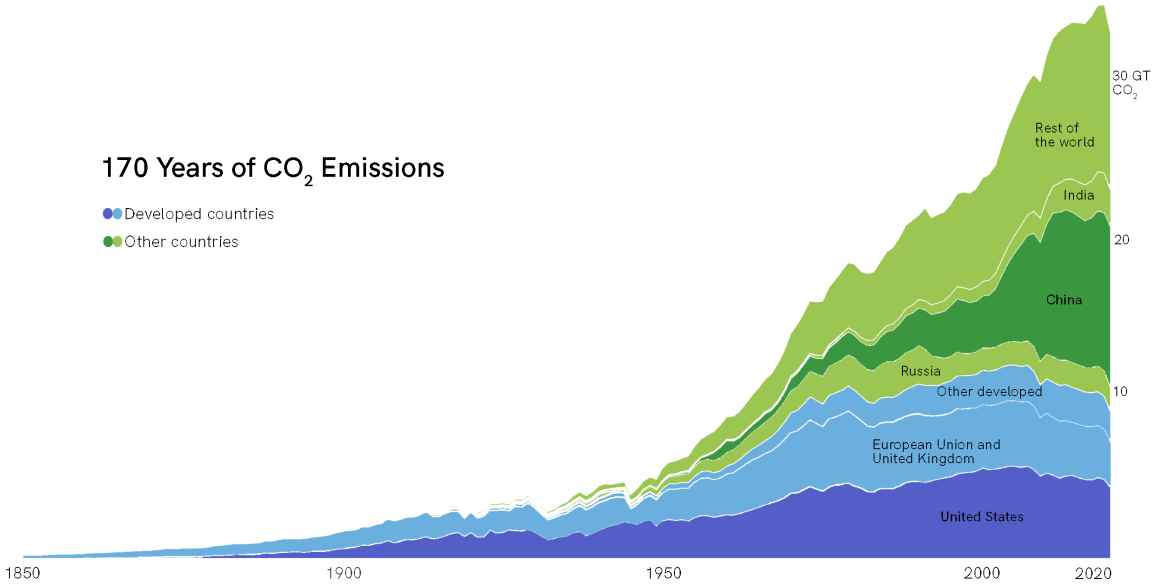

Figure 8. Source Nadja Popovich and Brad Plumer, "Who Has The Most Historical Responsibility for Climate Change?"

The wicked truth, of course, is this: success on climate change necessitates decarbonizing the global economy, not just our own. This means that, from an environmental perspective, clean energy security requires not just that the United States has reliable access to abundant and affordable critical minerals and clean technologies, but that all the world's major emitters do as well. In climate terms, it may matter little that the United States has access to all the electric vehicles, solar panels, and wind turbines it needs if India and other rapidly growing economies in Asia and Africa do not. Clean energy security policies that focus only or even primarily on making the United States immune to supply chain shocks have little potential for ensuring that the world's largest emitters are also able to decarbonize their economies in a timely manner.[60]

For this reason, U.S. climate champions need to actively promote a fuller, more expansive concept of clean energy security than the one that experts are advancing today in most policy circles in Washington, DC. U.S. companies and labor unions are advocating policies to shore up American jobs, and U.S. national security experts are promoting policies to reduce our reliance on real or potential adversaries. These are likely necessary but not sufficient to ensure the world sustains needed climate action. From this perspective, U.S. clean energy security policies so far have been both too narrowly drawn and too timid.

For instance, discussions of the need to increase manufacturing capacity have been focused on the economic, job, and security benefits to the United States of increasing domestic manufacturing capacity. Yet if global climate goals are to be achieved, all states committed to climate action will need to have secure, reliable access to key technologies. Similarly,

[60] For a similar (albeit more general) perspective, see Anne-Marie Slaughter, "It's Time to Get Honest About the Biden Doctrine," *New York Times*, November 12, 2021, https://www.nytimes.com/2021/11/12/opinion/biden-foreign-policy.html.

discussion of the need to shore up critical mineral supply chains has mostly focused on the need to ensure that the United States has reliable access to the minerals it needs. Virtually ignored is the plain fact that every nation committed to keeping warming to safe levels has an interest in ensuring that every other similarly committed nation also has access to key minerals. This is just as true of reports and remarks by think tank experts as it is of current and prospective policy measures and remarks by policymakers.[61]

These observations suggest a need for the United States to work with its trading partners and allies to make clean energy supply chains more reliable, resilient, and affordable for all nations, particularly countries where the United States and the world need to achieve ambitious emission reductions. From an environmental perspective, U.S. clean energy security depends on sustaining global action and avoiding global supply chain disruptions.

4.2. Roadmap for Efforts

While efforts to ensure clean energy security need to become more global in scope, this does not mean that U.S. policy needs to be geared at this time toward enhancing the energy security of all 200-plus countries in the world. Today, the top ten greenhouse gas emitters are responsible for about two thirds of global emissions.[62] Although the entire world will need to be climate neutral later in the century, for the next two decades, global efforts need to concentrate on rapidly reducing climate pollution in these nations first and foremost. Yet even achieving clean energy security in just these nations—which collectively account for roughly 57% of global population—is too large a task to take on immediately.[63] Rather, the United States should start by trying to enhance the clean energy security of our largest trading partners. Improving clean energy security in these countries would also enhance U.S. energy security since our supply chains are interconnected. Even among U.S. trading partners, however, not all nations are equally important. Initially, we can make rapid progress by working most closely with our closest allies: Canada, Japan, Europe, and other democracies that are members of the Organization for Economic Cooperation and Development. These are the nations whose security is most important to the preservation of U.S. prosperity and values. These are also nations with whom we are likely to find common ground and that will have the capacity to take strong actions that complement our own bold moves toward clean energy security. Thus, while global clean energy security should be a long-term U.S. objective, today's U.S. clean energy

[61] For an exception to this general trend, see Joshua Busby, "COVID-19 and Other Inflection Points: Fifth Annual Review of Solar Scale-Up in India," Council on Foreign Relations, June 22, 2020, https://www.cfr.org/blog/covid-19-and-other-inflection-points-fifth-annual-review-solar-scale-india and Joshua W. Busby, Sarang Shidore, Johannes Urpelainen, and Morgan D. Bazilian, "The case for US cooperation with India on a just transition away from coal," Brookings Institution, April 20, 2021, https://www.brookings.edu/research/the-case-for-us-cooperation-with-india-on-a-just-transition-away-from-coal/. The first piece notes that the United States could increase the reliability of both U.S. and Indian solar supply chains by using the Development Finance Corporation to increase manufacturing of solar panels in India; the second suggests that supporting increased solar manufacturing in India will help both to advance global climate goals and Indian energy independence.

[62] Johannes Friedrich, Mengpin Ge, and Andrew Pickens, "This Interactive Chart Shows Changes in the World's Top 10 Emitters," World Resources Institute, December 10, 2020, https://www.wri.org/insights/interactive-chart-shows-changes-worlds-top-10-emitters.

[63] Using population figures from Our World in Data, available here: https://ourworldindata.org/grapher/population-past-future?tab=table.

security foreign policies should prioritize policy coordination with a far smaller group of like-mind developed nations that are major U.S. trading partners. This concept of concentric circles of national importance for near-term action is illustrated in Figure 9 below.

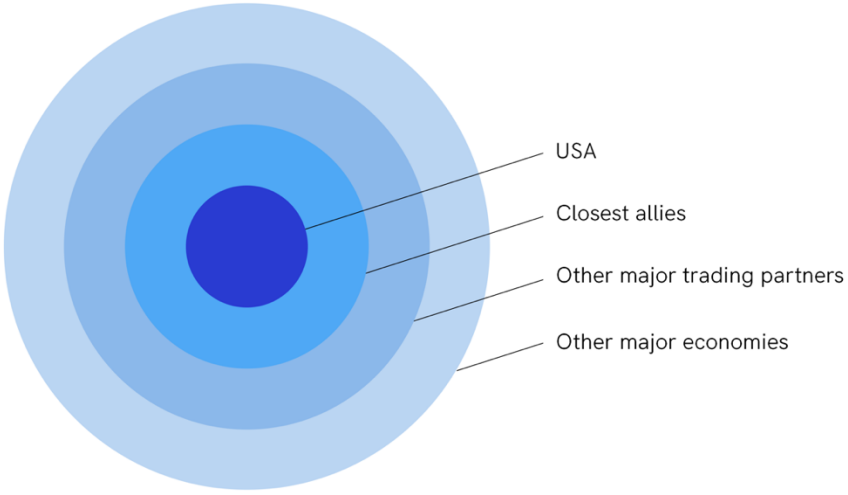

Figure 9. Sequencing of U.S. clean energy security efforts

What, specifically, should the United States seek to accomplish with its closest like-minded trading partners right now? Initially, U.S. clean energy security foreign policy should have three medium-term goals. Working in cooperation with major democratic economies, the United States should try to (i) forge new international "climate alliances", (ii) create interdependent clean energy supply chains with stable democracies, and (iii) strengthen relevant international institutions. Each of these policy recommendations is explored immediately below.

4.3. Climate Alliances

The United States should work with its closest allies to create one or more international climate alliances that would expand markets for green technologies and essential minerals, encourage the sourcing of clean goods from reliable and stable democracies, and provide a platform for adopting a full range of clean energy security policies within a like-minded group.

Among policy and legal experts, one of the most talked-about issues in international climate politics these days is how best to make the global trade system work to accelerate climate action. The World Trade Organization (WTO) oversees a rules-based system that limits trade barriers. Success on climate change requires that this system not inhibit the ability of nations to adopt strong climate policies. Climate advocates argue that subsidies for clean technologies and minimum environmental performance standards for goods (including imports) are essential to climate success. Yet governments could use trade rules—which generally require non-discrimination and tend to look only at finished goods and not the environmental harm caused while making them—to challenge growing national policy preferences for clean goods. In addition, going back more than a decade, a significant number of trade and climate experts

have called for industrialized nations to use trade policy more assertively for climate purposes.[64] The European Union is in the process of enacting a carbon border adjustment (import fee) on products from certain energy-intensive, trade-exposed industries, mainly aluminum and steel. Others have proposed tariffs or import bans on goods made in ways that produce a lot of climate pollution.

To decarbonize the industrial sector, where there are few easy solutions, German Chancellor Olaf Scholz and some scholars have proposed the creation of one or more trade-based international climate alliances.[65] As proposed, these climate alliances would be dedicated to raising climate ambition by adopting ever-improving environmental standards on negotiated timeframes. Domestic goods that failed to meet the standards would be banned or taxed, and similar imported goods would be treated in the same manner. (Some people refer to this idea as a "carbon club," but that term is used in many ways and avoided here for that reason.) Under some proposals, membership in a climate alliance would be open to all nations that agree to follow the alliance's stringent environmental standards. For fairness and to minimize geopolitical fallout, proponents say that developed nations in the climate alliance should offer significant financial assistance to developing nations wishing to join the alliance to ensure those nations continue to have access to global markets.

Although for very different reasons, the idea of climate alliances is also gaining traction among both conservatives and progressives in the United States. Conservatives note that U.S. industrial products, such as steel and aluminum, produce far less climate emissions than similar products in Russia and China, for example.[66] Some conservatives and business groups argue that the United States should do more to turn this U.S. "carbon advantage" into economic, environmental, and political gain, including by convincing other nations to buy U.S. goods rather than more polluting goods.[67] Some in the U.S. labor movement agree and see preferences for cleaner U.S. products as good for American workers and unions.[68] Members of Congress are taking note, with a variety of Senators and Representatives from both political parties calling for U.S. action.

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[64] Jennifer Hillman, "Changing Climate for Carbon Taxes: Who's Afraid of the WTO?," Climate Advisers, American Action Forum, and the German Marshall Fund of the United States, 2013, https://www.climateadvisers.com/wp-content/uploads/2017/07/2013-07-Changing-Climate-for-Carbon-Taxes.pdf.

[65] See this white paper written by then-Finance Minister Olaf Schulz for the German government from August 2021: https://www.bundesfinanzministerium.de/Content/DE/Downloads/eckpunkte-internationaler-klimaclub.pdf?__blob=publicationFile&v=5, as well as Domien Vangenechten and Johanna Lehne, "Can climate clubs accelerate industrial decarbonisation?," E3G, February 9, 2022, https://www.e3g.org/publications/can-climate-clubs-accelerate-industrial-decarbonisation/ and Oliver Sartor, Aaron Cosbey, and Aylin Shawkat, "Getting the Transition to CBAM Right: Finding Pragmatic Solutions to Key Implementation Questions," Agora Industry, January 2022, https://www.agora-energiewende.de/en/publications/getting-the-transition-to-cbam-right/. On how best to design a climate alliance, see Matthew C. Porterfield, "Climate Clubs – Key Design and WTO Compliance Issues," (Washington, D.C.: Climate Advisers, April 2022), https://www.climateadvisers.org/climate-clubs-key-design-and-wto-compliance-issues/.

[66] Kevin Cramer and H.R. McMaster, "Use Climate and Trade Policy to Counter Putin's Playbook," *Foreign Policy*, December 23, 2021, https://foreignpolicy.com/2021/12/23/russia-energy-us-europe-carbon-tarriff-ukraine-nordstream-oil-gas/.

[67] George David Banks, "Understanding America's Carbon Advantage and Identifying Strategic Goals for a Bipartisan Approach to U.S. Climate & Trade Policy," Bipartisan Policy Center, February 9, 2022, https://bipartisanpolicy.org/explainer/understanding-americas-carbon-advantage/.

[68] See, for instance, Justin Stofferahn, "Four Questions: Cleaner Steel Here in the US," BlueGreen Alliance, April 8, 2022, https://www.bluegreenalliance.org/resources/four-questions-cleaner-steel-here-in-the-us/.

U.S. experts and law makers do not yet agree on policy specifics. Senator Coons (D-DE) has proposed that U.S. border adjustments would measure the cost imposed by all climate policies and regulations in exporting countries—a concept known as the "shadow price" of carbon.[69] This means that products from countries that have not adopted ambitious climate policies (relative to those in the United States) would have to pay fees upon arrival at the border. Others note that calculating shadow prices would be difficult, subjective, and potentially unworkable. One alternative would be to impose border adjustment charges based on the carbon produced while making a specific good—what some call the "embedded carbon content" of a product.[70] This approach has many virtues, including being more compliant with trade rules, fairer, and easier to administer. Politically and economically, such an approach would give the United States credit for producing clean goods, when that is the case, and would not penalize U.S. manufactures and workers for climate policy gridlock in Washington, DC.

A climate alliance that had as its goal increasing the share of global trade coming from clean goods, including using border measures or import bans on dirty goods, could prove highly useful for enhancing the clean energy security of the United States and its closest allies for at least four reasons. First, nations that produce green goods are likely to see eye-to-eye on the importance of maintaining resilient, stable, and affordable clean energy supply chains. These are the nations that will be moving fastest to decarbonize their economies. The climate alliance, therefore, would be an ideal forum for promoting policy alignment and action to maximize clean energy security.

Second, nations in a climate alliance would be more likely to trade with each other than with non-members, all other things being equal. Why? Trade among alliance members, by definition, would not face climate-related trade restrictions, whereas trade with non-members would face new trade restrictions (or the risk thereof). With more trade occurring among nations that prioritize climate action, clean energy security risks would decrease. Nations in a climate alliance would be unlikely to disrupt clean energy trade with other alliance members (as this would work against their common goal of increasing climate ambition). Climate alliance members, moreover, would also be more likely to have invested in climate adaptation and resilience, which might mean that supply chains with alliance members would prove less vulnerable to natural disasters.

Third, a well-designed climate alliance could include as a condition of membership a commitment not to disrupt clean energy supply chains. Members could explicitly promise each other—with commitments codified in the alliance's political charter or underlying legal agreement—that they will refrain from erecting barriers to trade in clean energy technologies and critical minerals. Spelling out such a commitment in writing would minimize the risk of supply chain disruptions. Nations would be reluctant to risk international criticism for breaking

[69] "Sen. Coons, Rep. Peters introduce legislation to support U.S. workers and international climate cooperation," July 19, 2021, https://www.coons.senate.gov/news/press-releases/sen-coons-rep-peters-introduce-legislation-to-support-us-workers-and-international-climate-cooperation.

[70] Erin Campbell and William Pizer, "Border Carbon Adjustments without Full (or Any) Carbon Pricing," Resources for the Future, July 29, 2021, https://www.rff.org/publications/working-papers/border-carbon-adjustments-without-full-or-any-carbon-pricing/.

a clear commitment. International norms and obligations tend to encourage compliance through their soft power. As legal scholars have noted, most nations honor most of their international commitments most of the time.[71] Additionally, with obligations not to disrupt clean energy supply chains embedded as a condition of membership in an alliance that offers preferential access to major global markets, this new norm would influence for the better the behavior of other nations. Nations that hope to join the alliance, for example, would be more likely to refrain from intentionally disrupting or distorting clean energy supply chains. These nations would want existing alliance members to view them as suitable candidates for membership and one way to do that would be to show a pattern of already complying with the alliance's norms and obligations.

Finally, climate alliances could help to nurture the growth of green industry and increase manufacturing capacity in states committed to climate action by insulating green technologies from competition with dirtier alternatives. As already emphasized, a key gap in clean energy security policies to date is the lack of focus on increasing manufacturing capacity globally as a way of minimizing the impact of disruptions in any single manufacturing country. The agreement on steel and aluminum that the Biden administration is currently developing with the European Union should help to address this gap for production of green steel and aluminum, especially if other countries join later.[72] By negotiating similar agreements for other key technologies, countries could help to address this gap in current policies.

For all these reasons, the United States should promote international acceptance of the climate alliance concept and should actively work with countries such as Germany that already support the idea. To repeat: the type of alliance that the United States should promote should not require that members of the alliance have certain policies in place, such as carbon pricing or certain types of regulations. Rather, alliance members should work to adopt trade rules, including border measures, that ensure the effectiveness of their climate policies, create a level playing field for manufacturers and workers, and, in so doing, increase the share of green goods in global trade.

That said, however, constructing a climate alliance would represent a major undertaking, one that would likely take years to complete. For this reason, the United States needs to simultaneously pursue other international strategies for managing risks to clean energy security, as discussed below.

4.4. Traditional Trade Policy

Just as climate alliances provide one avenue to enhance clean energy security, so do traditional trade policies. Specifically, the United States should leverage both its future trade agreements

[71] Louis Henkin, *How Nations Behave: Law and Foreign Policy*, 2nd ed, (New York: Columbia University Press, 1979), p. 47.
[72] The White House, "FACT SHEET: The United States and European Union To Negotiate World's First Carbon-Based Sectoral Arrangement on Steel and Aluminum Trade," October 31, 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/10/31/fact-sheet-the-united-states-and-european-union-to-negotiate-worlds-first-carbon-based-sectoral-arrangement-on-steel-and-aluminum-trade/.

and existing domestic trade law in service of making more durable and resilient clean energy supply chains.

Trade Agreements. The preceding discussion drew attention to the importance of building interconnected clean energy supply chains with like-minded countries that can serve as reliable sources of clean technologies and critical minerals. Some people call this "ally-shoring", in contrast to off-shoring and reshoring.[73] While a climate alliance would be one way to re-orient U.S. and global supply chains toward allies, there are additional solutions as well.

The United States should actively consider the advisability of including in future trade agreements provisions that would enhance trade in clean energy technologies and minerals among parties to those agreements. Since the United States prioritizes negotiating trade agreements with key allies and democratic governments, promoting trade in clean energy goods through these trade agreements would help preference trade with allies over trade with potential adversaries. New trade agreements could lower tariffs on clean energy technologies. Also, they could include tax incentives for U.S. companies to assist trading partners in developing their critical mineral resources and develop their technical capacities in clean energy manufacturing. More technical and legal analysis is needed to identify all the ways the United States could use trade agreements to promote greater ally-shoring.

Clean Trade Doctrine. While international cooperative approaches should take priority, the United States should also leverage existing domestic trade laws. The United States, more specifically, should publicly signal to other nations that America considers open global access to clean energy technologies and critical minerals to be of paramount importance and that it will use the leverage provided by existing domestic law to discourage nations from restricting or interfering with clean energy supply chains. International trade law already prohibits nations from imposing export restrictions on products in the absence of certain narrow exceptions, such as for national security.[74] That exception, however, is prone to abuse. The Trump administration justified a range of trade barriers on non-military products by declaring the restrictions necessary for national security. China has done the same with rare earth minerals.[75] To discourage other nations from erecting export restrictions, the United States could announce its intention to retaliate against countries that restrict clean energy supply chains, even if those restrictions do not apply to the United States. Existing law, including Section 301 of the Trade Act, provides the President with broad authority to impose retaliatory trade measures. The threatened use of this authority to minimize threats to global climate progress would be a first, arguably, and could become known as a new *Clean Trade* doctrine—as every nation should have the right to trade in the technologies and minerals needed to create a clean, prosperous

[73] See Elaine K. Dezenski and John Austin, "Re-Forge Strategic Alliances and Check China Abroad, Rebuild Economy at Home," *Newsweek*, July 12, 2020, https://www.newsweek.com/re-forge-strategic-alliances-check-china-abroad-rebuild-economy-home-opinion-1516801 and Elaine K. Dezenski and John Austin, "Rebuilding America's economy and foreign policy with 'ally-shoring'," Brookings Institution, June 8, 2021, https://www.brookings.edu/blog/the-avenue/2021/06/08/rebuilding-americas-economy-and-foreign-policy-with-ally-shoring/.

[74] See Article XXI of the General Agreement on Tariffs and Trade (GATT).

[75] Keith Bradsher, "Amid Tension, China Blocks Vital Exports to Japan," *New York Times*, September 22, 2010, https://www.nytimes.com/2010/09/23/business/global/23rare.html.

economy. This doctrine or domestic policy statement could be announced by President Biden and/or through a Congressional resolution.

4.5. International Governance

International institutions generally play important roles in helping nations solve global problems and this should be the case for the international effort to strengthen clean energy security. When it comes to clean energy supply chains, the world needs strong international institutions to facilitate action in three distinct areas.

Political Coordination. International cooperation on clean energy supply chains would be strengthened by the existence of an open-ended high-level political forum with a mandate to address clean energy security challenges. Such a forum would convene at the ministerial or cabinet level to establish international goals, develop a political framework for achieving these goals within coordinated timeframes, articulate political understandings and rules of the road when it comes to trade (working within existing international trade obligations), develop new initiatives to fill gaps in global action, and help unlock needed public and private investments. A standing secretariat, ideally within one or more international agencies such as the IEA, should support the forum.

Today, there is no global forum for political coordination on clean energy security or supply chains generally nor any ministerial-driven process for overcoming risks relating to both critical minerals and manufacturing. Some efforts have been made to promote international cooperation on minerals, such as the OECD Due Diligence Guidance, the Extractive Industries Transparency Initiative, and the Climate-Smart Mining Initiative. When it comes to manufactured goods for the clean energy economy, however, far less has been done. While dealing with these issues in a fragmented manner may have certain advantages, a forum that looked at the entire issue—with the broad understanding that true clean energy security requires all major emitters to have access to abundant and affordable critical minerals and essential green technologies—would be far more likely to result in a comprehensive, strategic international response.

Many experts agree that a political level forum is needed to strengthen international. The IEA notes that "today there are few avenues for collective action among governments."[76] It has also recommended the creation of "a high-level forum for co-ordination could be pivotal in standardizing environmental and social standards and coordinating activity on security of supply."[77] The UN Environmental Programme (UNEP), the United Nations environmental arm, has also concluded that effective collective action on clean energy security requires a high-level standing forum.[78]

[76] IEA, *The Role of Critical Minerals in Clean Energy Transitions*, p. 245.
[77] IEA, *The Role of Critical Minerals in Clean Energy Transitions*, p. 245.
[78] IRP (International Resource Panel), *Mineral Resource Governance in the 21st Century: Gearing Extractive Industries Towards Sustainable Development*, (United Nations Environment Programme, 2020), https://www.resourcepanel.org/reports/mineralresource-governance-21st-century, p.131.

Policy & Technical Cooperation. While more political coordination would prove invaluable, a great deal of the work required to forge an effective and coordinated international response is not political. Rather, it is work that must be done by experts in government departments and international agencies. Examples include the following:

- Pooling and analyzing existing data on mineral deposits, mining and manufacturing capacities, prices, and trade flows, as well as identifying and filling essential gaps in data and analysis.
- Creating financial transparency and price discovery about the cost of minerals and clean energy technologies to ensure a level playing field and promote an effective global market.
- Streamlining transnational investment rules to encourage rapid deployment of capital to increase the supply of essential minerals and clean energy goods.
- Collecting and sharing national and regional approaches to enhancing clean energy security, compiling "best practice" policies (the policies that have worked best so far) and, if resources allow, building the capacity of developing nations to put in place those policies.
- Establishing common standards (or determining how to apply existing standards) to best address the social and environmental concerns that arise in the extraction of critical minerals and production of clean technologies.
- Staffing the ministerial-level political process identified above.

Some have recommended repurposing existing international institutions and initiatives to get this work done.[79] This makes sense as a wide variety of international bodies are currently working on portions of the clean energy security problem or could be refocused toward it with stronger political guidance, such as from the G7 or G20. Yet, some gaps in capacity exist and, in some cases, multiple entities are working on the same problem. And, of course, no international agency or initiative currently staffs the needed high-level political forum, as the latter does not yet exist. The Clean Energy Ministerial (CEM) process, which brings together energy ministers from most G20 nations, has not to date made clean energy supply chains a top priority. In addition, the CEM group is politically diverse and includes several nations, such as India and China, that do not support border adjustments and other mechanisms to align trade policy with climate goals.

Governance Blueprint Needed. The preceding discussion reveals that strong international institutions are needed to help promote international cooperation to minimize risks to clean energy security. While many international initiatives are working on portions of the problem on an *ad hoc* basis, no durable framework for international governance exists. To rectify this, the international community needs a blueprint that would streamline and, where appropriate, centralize international capacity to help nations focus and take action to address the biggest risks. The United States should work with its closest allies to commission such a blueprint as soon as possible. In 2022, Germany holds the rotating presidency of the G7. Because the G7

[79] Tsafos, et al., *Reshore, Reroute, Rebalance*, pp. 32-33.

and G20 have helped to coordinate similar efforts in the past—for instance, through the Brisbane 2014 *G20 Principles on Energy Collaboration*—the G7 might be the ideal body to send the political signal to one or more international institutions, such as the IEA, that a full analysis of the capacities and gaps in global governance on clean energy security would inform future political decisions by G7 nations that are keen to collaborate to enhance global clean energy security.[80] To be as useful as possible, the blueprint should identify concrete options and policy recommendations for G7 leaders to consider in 2023. Possible initial focus areas include coordination on strategic minerals stockpiling efforts, mine development, and buildouts of processing capacity, among many others.

Conclusion

There will be no shortage of challenges in implementing just the initial three strategies recommended above—standing up climate alliances, harnessing the power of traditional trade policy, and strengthening international governance on clean energy supply chains. What's more, as sweeping as these policies are, much more will eventually be needed to sustain climate progress by addressing risks to clean energy security. All the same, it is worth pausing to note that the fact that there is a need now to focus on *sustaining* climate ambition (rather than just getting climate action started) is itself a sign of progress. After all, there is a reason that climate advocates have not devoted as much energy and attention to this issue: inadequate as the climate ambition we see today remains, marshaling just that level of ambition has been so much work that advocates have had little bandwidth for anything else. Nevertheless, the climate community must now take on a new challenge, working to ensure that countries can achieve their existing climate goals even as we work simultaneously to further increase climate ambition.

[80] The G20 principles statement is available here: https://www.mofa.go.jp/files/000059860.pdf.

Appendix 1: Executive Actions Taken by the Biden Administration to Enhance U.S. Clean Energy Security Policy

This appendix summarizes relevant actions taken by the Biden administration to enhance U.S. clean energy security.

Strengthening Supply Chains

- The administration released a national blueprint for lithium batteries that lays out a number of steps the government can take to secure a reliable supply chain for batteries and boost domestic industry, including by working with allies to secure reliable domestic and foreign sources for critical minerals; ramping up US processing, recycling, and reuse; stimulating the US electrode, cell, and pack manufacturing sectors; and maintaining US leadership by supporting R&D, workforce development, and STEM education.[81]
- The administration has directed the Department of Energy's (DOE) Loan Programs Office to use its loan authority to support the domestic battery supply chain through the Advanced Technology Vehicles Manufacturing Loan Program (ATVM)[82]
- DOE has released a strategy for securing U.S. clean energy supply chains.[83]

Commercialization and Deployment of Key Technologies

- Through the Federal Energy Management Program (FEMP), the Department of Energy (DOE) has launched a new effort to increase deployment of energy storage projects by federal agencies.
- The administration has set a goal of reducing the cost of clean hydrogen by 80% to $1 per 1 kilogram and directed DOE to allocate funds accordingly.[84]
- Through DOE, the administration has launched the H2 Matchmaker, a program to assist hydrogen suppliers and users identify opportunities to expand development toward realizing regional hydrogen hubs.[85]

[81] Available here: https://www.energy.gov/sites/default/files/2021-06/FCAB%20National%20Blueprint%20Lithium%20Batteries%200621_0.pdf

[82] The White House, "FACT SHEET: Biden-Harris Administration Announces Supply Chain Disruptions Task Force to Address Short-Term Supply Chain Discontinuities," February 22, 2022, https://www.whitehouse.gov/briefing-room/statements-releases/2022/02/22/fact-sheet-securing-a-made-in-america-supply-chain-for-critical-minerals/.

[83] United States Department of Energy, "America's Strategy to Secure the Supply Chain for a Robust Clean Energy Transition," February 24, 2022, https://www.energy.gov/sites/default/files/2022-02/America%E2%80%99s%20Strategy%20to%20Secure%20the%20Supply%20Chain%20for%20a%20Robust%20Clean%20Energy%20Transition%20FINAL.docx_0.pdf.

[84] Details available here: https://www.energy.gov/eere/fuelcells/hydrogen-shot.

[85] Details available here: https://www.energy.gov/eere/fuelcells/h2-matchmaker.

- Through DOE and public-private partnerships including the First Movers Coalition, the administration is using public and private funds to mobilize investment in the production of clean technologies.[86]
- Through the Bureau of Energy Resources, the State Department "promotes reliable, solvent, and competitive power sectors, and advances renewable energy…solutions in order to support decarbonization, energy security, and energy access and development goals."[87]

Mining and minerals

- The administration has released a set of principles for domestic mining reform.[88]
- The administration has updated the list of critical minerals and directed agencies "to prioritize the production and processing of minerals necessary to produce key products like batteries, semiconductors, and permanent magnets"[89]
- The administration has established an interagency team composed of staff from agencies including Interior, USDA, EPA, and others with expertise in mine permitting and environmental law to identify ways to improve mining and permitting processes[90]
- Via the Department of Defense (DOD), the administration is using the Defense Production Act to deploy incentives including grants, loans, loan guarantees, and offtake agreements to support sustainably produced strategic and critical materials[91]
- DOE is providing loan guarantees for critical materials projects through its Loan Program Office (LPO)[92]
- The administration has directed the Development Finance Corporation to "expand international investments in projects that will increase production capacity for critical products, including critical minerals"[93]
- DOD has announced "an investment in the expansion of the largest rare earth element mining and processing company outside of China to provide the raw materials necessary to help combat the climate crisis."[94]

[86] The White House, "Fact Sheet: Biden-Harris Administration Advances Cleaner Industrial Sector to Reduce Emissions and Reinvigorate American Manufacturing," February 15, 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2022/02/15/fact-sheet-biden-harris-administration-advances-cleaner-industrial-sector-to-reduce-emissions-and-reinvigorate-american-manufacturing/.
[87] U.S. Department of State, "Bureau of Energy Resources: Clean Energy Diplomacy on Climate."
[88] Available here: https://www.doi.gov/sites/doi.gov/files/biden-harris-administration-fundamental-principles-for-domestic-mining-reform.pdf.
[89] The White House, "FACT SHEET: Securing a Made in America Supply Chain for Critical Minerals."
[90] The White House, "FACT SHEET: Biden-Harris Administration Announces Supply Chain Disruptions Task Force to Address Short-Term Supply Chain Discontinuities," June 8, 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/06/08/fact-sheet-biden-harris-administration-announces-supply-chain-disruptions-task-force-to-address-short-term-supply-chain-discontinuities/.
[91] Ibid.
[92] Ibid.
[93] Ibid.
[94] Ibid.

- The United States Agency for International Development (USAID) has released a report exploring ways the United States could use foreign aid to address environmental, social, and governance issues in mining countries.[95]
- DOD has awarded $35 million to a private company, MP Materials. to separate and process heavy rare earth elements at its facility in Mountain Pass, California.[96]
- Through ERGI, the Biden administration is providing technical assistance abroad "to build capacity for managing mineral sectors soundly and transparently, working on things like environmental regulatory frameworks and how to attract responsible investment."[97]
- President Biden invoked the Defense Production Act to boost domestic production of critical minerals.[98]

[95] Terah U. De Jong, Titus Sauerwein, and Ludivine Wouters, *Mining and the Green Energy Transition: Review of International Development Challenges and Opportunities*, USAID, November 2021, https://www.land-links.org/wp-content/uploads/2021/11/Green-Energy-Minerals-Report_FINAL.pdf.
[96] The White House, "FACT SHEET: Securing a Made in America Supply Chain for Critical Minerals."
[97] U.S. Department of State, "Bureau of Energy Resources: Clean Energy Diplomacy on Climate."
[98] The White House, "Memorandum on Presidential Determination Pursuant to Section 303 of the Defense Production Act of 1950, as amended," March 31, 2022, https://www.whitehouse.gov/briefing-room/presidential-actions/2022/03/31/memorandum-on-presidential-determination-pursuant-to-section-303-of-the-defense-production-act-of-1950-as-amended/.

Appendix 2: Provisions in the Infrastructure Investment and Jobs Act Relevant for U.S. Clean Energy Security

This appendix lists relevant provisions in the Infrastructure Investment and Jobs Act. The relevant sections of the bill are indicated in parentheses.

Mining and Minerals

- An effort by the United States Geological Survey (USGS) to determine the extent and character of the country's mineral resources (sec. 40201)
- A USGS energy and minerals research facility (sec. 40204)
- A "facility to demonstrate the commercial feasibility of a full-scale integrated rare earth element extraction and separation facility and refinery" (sec. 40205)
- A provision requiring the secretaries of Interior and USDA to submit a report summarizing ways to improve mineral permitting processes (sec. 40206)
- Awards to support basic research that will accelerate innovation to advance critical minerals mining, recycling, and reclamation strategies and technologies. This provision also includes a $750M grant program to enable manufacturers to build new or retrofit existing manufacturing and industrial facilities to produce or recycle advanced energy products in communities where coal mines or coal power plants have closed. Covered advanced energy products include solar panels, wind turbines, geothermal power technology, electrolyzers, batteries, electric vehicles, and carbon capture technologies (sec. 40209)
- A grant program for pilot projects on mineral and metals development, mineral processing, and mineral recycling in the United States (sec. 40210)
- Loan guarantees for projects that increase the supply of domestically produced critical minerals (sec. 40401)

Strengthening domestic battery supply chains

- A provision for a competitive grant program within DOE with the following aims:
    - to ensure that the United States has a viable battery materials processing industry to supply the North American battery supply chain;
    - to expand the capabilities of the United States in advanced battery manufacturing;
    - to enhance national security by reducing the reliance of the United States on foreign competitors for critical materials and technologies; and
    - to enhance the domestic processing capacity of minerals necessary for battery materials and advanced batteries. (sec. 40207)
- Funding for research on battery recycling and second-life applications (sec. 40208)

Commercialization, R&D, and Deployment of Key Technologies

- Provisions to boost carbon capture and utilization technologies, "clean" hydrogen, and micro and small modular nuclear reactors, including demonstration projects and R&D (Division D, Title III)
- $7.5 billion for a nation-wide network of EV charging stations (sec. 11401)
- Grants to replace existing school buses with electric and other zero-emissions models (sec. Sec. 71101)

Appendix 3: Provisions in the United States Innovation and Competition Act Relevant to U.S. Clean Energy Security

This appendix lists provisions relevant to clean energy security in the United States Innovation and Competition Act. Section numbers in parentheses correspond to those in the House version of the bill, called the America COMPETES Act.

Manufacturing

- $3 billion to fund the establishment of a domestic solar manufacturing supply chain (sec. 10623)
- A provision calling for a strategy for advanced and reliable energy infrastructure to increase U.S. exports of advanced energy technologies (sec. 30114)
- $2 billion to incentivize investment in facilities and equipment for fabricating, assembling, testing, and packaging semiconductors, as well as several measures intended to make semiconductor supply chains more resilient and secure (secs. 1002 and 2506)

Supply chain resilience

- A provision establishing a supply chain resilience and crisis response office, the aim of which is to identify and remediate vulnerabilities in the supply chains for critical industries (sec. 20201)
- A provision requiring development and implementation of a strategy taking a government-wide approach to support the resilience, diversity, security, and strength of supply chains, including plans to reduce reliance on concentrated supply chains, to "[c]ollaborate with other relevant Federal agencies to assist allies or key international partners build capacity for manufacturing critical goods," and to incentivize domestic manufacturers of critical goods to, among other things, "relocate manufacturing facilities, industrial equipment, or operations related to the production of critical goods from countries of concern to the United States or to other allies or key international partners" (sec. 20202)
- A provision establishing an interagency task force, led by the State Department, to monitor international climate change impacts on social conditions to anticipate potential national security risks to the United States (sec. 30610)

Commercialization, R&D, and Deployment of Key Technologies

- Funding for the Department of Energy to "support the coordination of relevant technology transfer programs that advance the commercial application of clean energy technologies nationally" (sec. 10625)

- A provision establishing a program to support incubators that accelerate the commercial application of clean energy technologies (sec. 10623)
- A provision establishing a research, development, demonstration, and commercial application program designed to enhance U.S. energy security and accelerate the pace of innovation of clean energy technologies (sec. 10642)
- Several provisions intended to increase clean energy technology deployment abroad (e.g. secs. 30249, 30276, 30604)

CLIMATE ADVISERS

RISKS TO SUSTAINING CLIMATE ACTION

May 2022