Demand growth could widen the gap between climate goals and critical material supplies

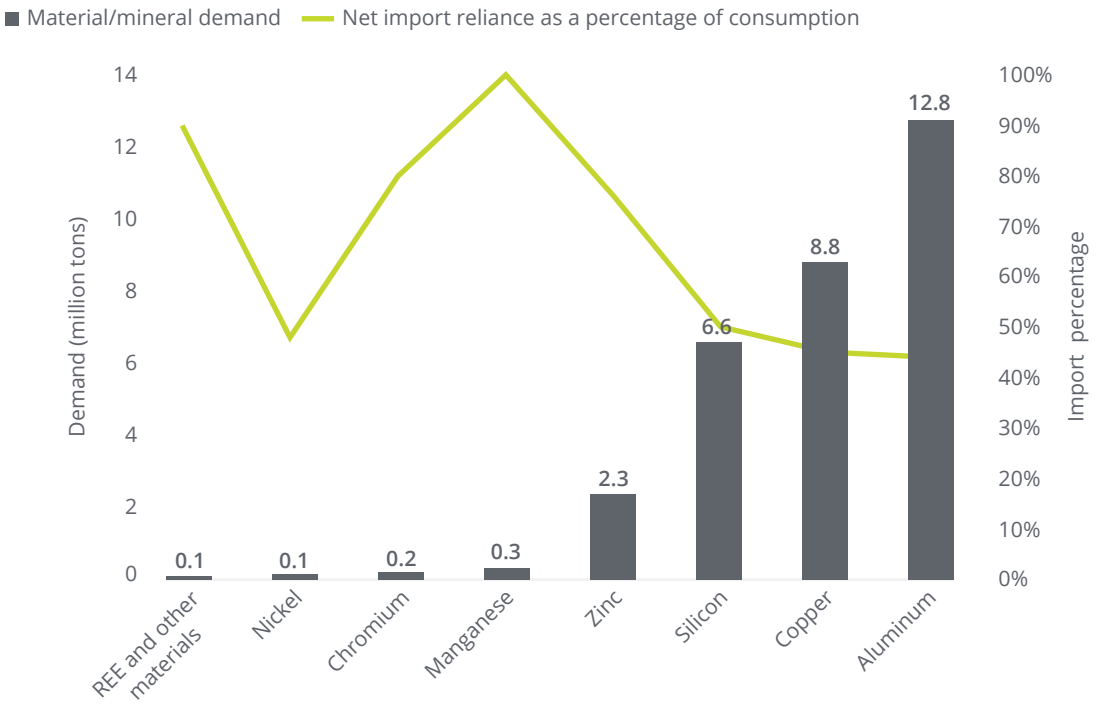
MEETING A 100% clean electricity standard in the United States between 2035 and 2050 is expected to require tripling or quadrupling each year the 25 GW of wind and solar capacity added in 2021.[9] Renewable developers currently have 282 GW of wind and solar in project pipelines in the United States through 2025.[10] In addition, grid storage deployments would need to increase from an average of 1.6–11 GWh per year in the 2020s to 40–250 GWh per year in the 2040s.[11]

As electric power companies continue to announce decarbonization goals, many will seek to build new renewable energy projects to fulfill them. And demand for renewables could increase even more rapidly with enactment of the Inflation Reduction Act and the incentives it provides.[12] But building clean energy technologies such as solar and wind generally requires more minerals, including rare earth elements, than traditional fossil-fuel technologies.[13] Our analysis shows that about 31 million tons of key minerals/materials are required to support solar and wind demand in the United States by 2050 (figure 4). With high reliance on imports for most of these materials—and competing demand from other industries for the same minerals—there's an imminent mismatch between US climate goals and the availability of critical minerals essential to meet them.

FIGURE 4

As the push to meet US climate goals increases, demand for the critical minerals necessary to generate more renewable energy is also expected to rise

Estimated US demand and import dependence for key clean energy minerals and materials through 2050



Notes/assumptions: Demand estimates represent the cumulative material demand required for solar and wind technology from 2022 to 2050 based on Wood Mackenzie's *Energy Transition Outlook 2021* projections. Mineral intensity has been considered constant over the period. "REE and other materials" refers to rare earth elements such as molybdenum, neodymium, dysprosium, praseodymium, and terbium. Mineral requirements for solar modules are projected for modules made with crystalline silicon (c-Si) technology, since they constitute 84% of modules used in the United States. These include aluminum, copper, and silicon. For wind, the minerals considered include aluminum, copper, chromium, manganese, nickel, zinc, and rare earth elements.

Sources: US Energy Information Administration; Wood Mackenzie; European Union Joint Research Center; US Geological Survey; and Deloitte analysis.

Further, the clean energy transition will require a significant expansion of transmission and distribution infrastructure, both new and end-of-life line replacements, including power transformers and high-voltage direct current (HVDC) systems, as well as digital equipment such as digital relays, smart meters, and smart inverters.[14] And the raw materials for many of these are highly dependent on a small number of countries, making them vulnerable to disruption.[15]

The electric power sector is pursuing strategies to overcome these immediate challenges—but are they sufficient?

Electric power and renewable energy companies are taking steps to resolve these supply chain pressures, including using emergency stocks of components such as transformers to address short-term demand, reviewing and planning all

scheduled work, substituting available materials when possible, improving communication with suppliers on the timing and delivery of materials, and digitalizing processes to boost efficiency. Figure 5 highlights the top three strategies our survey respondents are pursuing to overcome supply chain challenges.

Other solutions that companies, end users, and governments are implementing—particularly in the clean energy sector—include developing more domestic component manufacturing, boosting mining and production of critical minerals and materials, and committing to future demand to incentivize global investment. In June 2022, a group of independent power producers formed the US Solar Buyer Consortium to support expansion of the domestic solar supply chain.[16]

However, to mitigate far-reaching impacts, the electric power sector will likely need to adopt new, holistic approaches. Developing resilient supply chains that are also secure and sustainable will require a cohesive supply chain management strategy.

FIGURE 5

Power and renewable energy companies surveyed are adopting a number of strategies to overcome supply chain challenges

Percentage of survey respondents who selected each strategy

Source: Deloitte Electric Power Sector Supply Chain Survey.

STAKEHOLDERS COME TOGETHER TO BUILD US OFFSHORE WIND INDUSTRY SUPPLY CHAINS

Achieving the US national offshore wind (OFW) energy target of 30 GW by 2030 is expected to require a significant ramp-up in domestic manufacturing, infrastructure, and workforce. Industry stakeholders are tackling this goal on three fronts:

- **Shipping and port infrastructure:** Offshore wind logistics require specialized infrastructure, particularly ports and installation vessels, which does not currently exist. The industry is bringing wind component manufacturing facilities to ports, supporting redevelopment of existing ports, and building domestic ships to comply with US trade policies. Recently, OFW vessels were designated as "national interest," making them eligible for financial support through a federal ship financing program.[17]

- **Wind turbine production:** The industry is creating opportunities to establish an OFW Tier 1 (nacelle, towers, blades) supply chain and manufacturers plan to begin production at US facilities in the coming years. Siemens Gamesa Renewable Energy announced that it will invest in a new blade production facility for OFW turbines in Virginia.[18] Additionally, US companies are partnering with European companies both to procure manufactured components and develop those capabilities domestically.[19]

- **Workforce training:** Approximately 10,500–42,500 domestic full-time equivalent jobs will likely be needed over the next 10 years to support the OFW industry. Companies are including workforce training and outreach as part of their project development plans and using new technologies to train professionals. A partnership between Siemens Gamesa Renewable Energy and VinciVR uses virtual reality programs to train and certify OFW professionals.[20]

Securing the electric power supply chain is increasingly critical

FOR ELECTRIC POWER companies, the number of suppliers and contracted laborers providing expertise and skills has expanded over the years to meet a wide range of industry needs.[21] For example, from 2015 to 2020, Exelon's supplier pool had grown by 18%, to 8,000 suppliers, and its spending rose by 13% to US$9.5 billion.[22] In the case of clean energy technologies, concerns about supply chain security affect not only manufactured components but also go deeper into the key materials and critical minerals needed to build those components (see *Renewable transition: Separating perception from reality*). To manufacture a solar panel, about 40 components must get to the factory, including rare earth elements,[23] making analyzing not just Tier 1, but also Tier 2 and Tier 3 suppliers increasingly important to diversify supply risk.

While having such a vast breadth and depth of suppliers can help mitigate supply constraints caused by natural disasters, pandemics, trade policies, and more, it can also open the door to more noncompliance and safety risks, especially without adequate supplier qualification and risk management controls. Understanding these multitier supplier dependencies and vulnerabilities better can help power and renewable energy companies address not only the physical but also the cybersecurity risks that the sector is increasingly facing.

Consequently, many companies are expanding their supply chain management approach and integrating it into total third-party risk management (TPRM). In fact, their third-party networks now go well beyond suppliers of goods and services to include affiliates and joint venture partners, research and development (R&D) organizations, technology incubators, retailers, distributors, and sales agents that can cause disruptions in the supply chain.

Until recently, companies in the electric power sector often addressed supply chain risk management in siloes, separating risks related to policy, technology, finance, corruption, cybersecurity, suppliers and other stakeholders, and more. And supply chain owners often had sole responsibility. But siloed approaches to TPRM can result in check-the-box exercises in which a business unit or function narrowly focuses on a single part of the business, without considering the effects on other areas of supply chain. Today, there's increasing coordination between functions in a more integrated, cross-risk approach. Executives across the organization, from chief financial officers to chief operating officers, are increasingly involved, and some companies are combining supply chain with TPRM. These programs are continuously monitored to enable proactive management of emerging risks. A senior supply official at a Midwestern utility noted that they recently integrated supplier relationship management into their supplier quality team and aligned it with the supply chain function.

Companies can manage these risks by improving supply chain visibility—illuminating each tier of the supply chain from primary supplier (Tier 1) through their supplier's supply chain (Tier 2 and beyond). With greater visibility, they can better understand the potential risks involved with each supply chain partner, across all tiers. For example, a company might think it is diversifying risk by procuring solar panels from four to five suppliers, but if those suppliers were all purchasing a critical element for producing solar panels, such as polysilicon, from the same supplier, the risk may be insufficiently managed. Most of our survey respondents reported limited visibility into their supplier network beyond Tier 1 or Tier 2 (figure 6).

Managing cybersecurity risk in electric power supply chains

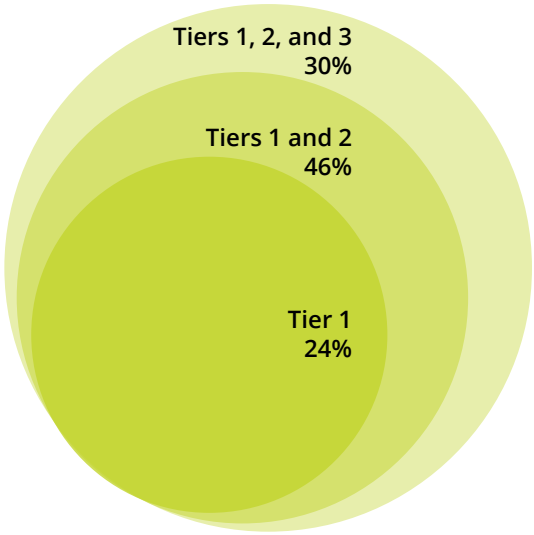
Cyberattacks targeting energy systems have increased over the last five years,[24] and power sector vulnerability may be rising as renewable and distributed energy resources (DERs) are added and systems become more complex, digitalized, and decentralized. What's more, these attacks are more frequently targeting operational technology (OT) and industrial control systems (ICS), and the software used to connect information technology (IT) and OT.[25] These cyber criminals often see ICS as attractive targets for ransomware thinking operators might pay up to avoid downtime.

Digitalizing resources and connecting them to operating systems can create new vulnerabilities, including supply chain risks for digital components such as software, virtual platforms and services, and data. Several cyberattacks specifically targeting the energy sector have exploited supply chain vulnerabilities in trusted third-party suppliers with less secure networks (see *Managing cyber risk in the electric power sector* for additional details).

FIGURE 6

Less than one-third of respondents have visibility beyond Tier 2 suppliers

Percentage of survey respondents who selected each level of visibility



Notes: **Tier 1** includes partners with whom companies directly conduct business, including contracted manufacturing facilities or production partners; **Tier 2** includes companies that produce and supply parts to Tier 1 from the material obtained via Tier 3; **Tier 3** includes raw material providers.
Source: Deloitte Electric Power Sector Supply Chain Survey.

The supply chain for digital components is complex, fragmented, and virtual. Software development is often sourced globally to save costs, and parts of the process may be subject to control by adversaries who could insert malicious code or otherwise interfere with software or data sets. Similarly, virtual platforms and services hosted in data centers within adversary nations are subject to the same types of collection and interference.

To prevent or limit the impact of future cyberattacks, electric power and renewable energy companies can also enhance visibility into their suppliers' cybersecurity profiles and require that they meet certain minimum standards. For example, they could require that suppliers have a formal cybersecurity program for the product or services offered or provide a "bill of materials" detailing the provenance of all product components. Figure 7 indicates how widespread selected vendor requirements currently are among our survey respondents.

Notably, some power and utility companies are applying lessons learned from compliance with the North American Electric Reliability Corporation's Critical Infrastructure Protection (NERC-CIP) standards. While NERC-CIP standards are mandated only for bulk electric system assets, some power companies are expanding their enhanced cybersecurity supply chain risk management to other parts of their businesses.

FIGURE 7

Many electric power sector survey respondents require third-party suppliers of connected products and services to ...

Source: Deloitte Electric Power Sector Supply Chain Survey.

Building sustainability into the electric power supply chain is becoming a priority

COMPANIES IN THE electric power sector are increasingly committing to putting environmental, social, and governance (ESG) considerations at the core of their decision-making process and integrating it into their strategies and operations. And supply chains are becoming an important focus area. Since supply chains are outside a company's core operations, they can create some of the highest ESG compliance exposure. The sector's vast breadth and depth of suppliers also means that ESG risks, especially for the clean energy sector, reach multiple value chain partners and sectors, including manufacturing, mining, and construction. As investors, customers, regulators, and other stakeholders begin demanding sustainable and ethical practices across the production cycle of clean energy, ESG considerations in the supply chain will likely multiply.

Electric power companies can benefit from a thorough understanding of potential ESG risk exposure across their supply chains—from raw material procurement through production and, ultimately, the entire product life cycle. They can also gain from incorporating traceability into the supply chain to track the provenance of products and components from the point of origin through delivery to the end user, providing supply chain transparency for investors and customers. For example, many solar developers adhere to the Solar Energy Industries Association's Solar Supply Chain Traceability Protocol—a set of guidelines intended to trace the origin of solar materials, especially to prove their procurement is free from unethical labor practices.[26]

The ESG agenda for electric power supply chains

In 2020, Scope 3 emissions for the global electric power sector accounted for, on average, 110% more than Scope 1 and Scope 2 emissions combined.[27] And supply chain emissions are a significant contributor to these emissions.[28] In March 2022, the US Securities and Exchange Commission (SEC) proposed requiring US-listed companies to disclose greenhouse gas emissions generated by suppliers and partners if they are material or included in any company's emission reduction targets.[29] Companies in the sector have started prioritizing environmental issues in their supply chains, and approaches include gathering information on suppliers' sustainability performance through the request for proposal (RFP) process, supplier scorecard reviews, and asking suppliers to voluntarily fill out annual sustainability surveys. However, only 13 utilities have committed to reducing some or all Scope 3 emissions.[30] According to our survey, only 36% of respondents have specific sustainability metrics in their supplier procurement process.

In the social sphere, electric power companies have often been at the forefront in developing their local communities economically—and momentum is growing for developing local supply networks. Two