areas are especially important across electric power sector supply chains:

- **Building a diverse supplier base:** As in many other sectors, supplier diversity, equity, and inclusion (DEI) is a strategic focus for the electric power sector. The share of diverse supplier[31] spending has been growing over time and is a substantial portion of the total supplier spend for many electric power companies. For example, PG&E's annual diverse supplier expenditures increased 36% over 2016–2020, constituting about 39% of its total supplier spend.[32] For some companies, supplier diversity is a corporate-level goal tied to executive compensation, and management reviews monthly diverse spend reports to monitor performance against established annual organizational unit goals.[33] Further, some companies support their prime suppliers in developing a stronger supplier diversity program for their own suppliers/subcontractors. One utility executive mentioned that they are seeking to better understand and influence subsupplier qualifications and the selection process.

- **Ensuring adoption of ethical labor practices across the supplier base:** Unethical labor practices, especially for clean energy technologies, have been a contentious issue impacting the sector's growth. Examples include allegations of unethical labor practices in the mining and processing of raw materials for solar panels and poor human rights and environmental practices in cobalt mines.[34] Some electric power companies have begun to ask manufacturers to demonstrate that their products do not contain materials from areas using forced or involuntary labor.

While many companies have set a code of conduct for their suppliers that requires them to adhere to environmental standards, ensure DEI in their supply chains, safeguard employee health and safety, and maintain ethical labor practices, compliance is not universal. Creating meaningful ESG progress within the supply chain requires an engagement journey that moves from setting aggressive emissions reduction goals, to implementing initiatives to help suppliers meet goals, and creating additional value-added opportunities for suppliers. Figure 8 illustrates five steps that can help electric power and renewable energy companies build a strategic relationship with their suppliers to boost ESG engagement.

FIGURE 8

A five-step process can help power and renewable energy companies boost their supplier ESG engagement

1 Onboard supplier
- Use ESG KPIs/metrics to evaluate and select suppliers
- Share supplier code of conduct

2 Understand supplier behavior
- Collect supplier data on their ESG practices through request for proposals (RFPs) and annual sustainability assessments

3 Increase supplier awareness
- Share industry best practices
- Create training programs for suppliers to amend their ESG practices

4 Modify supplier behavior
- Develop tools to help suppliers monitor and adhere to ESG targets
- Help benchmark supplier practices with industry

5 Create supplier opportunities
- Identify product and service strategies to improve ESG profile
- Develop additional value creation activities with strategic suppliers

Source: Deloitte analysis.

A circular economy can boost supply chain security, sustainability, and resilience

THE LINEAR NATURE of most electric power industry supply chains makes them highly susceptible to disruption. While traditionally associated primarily with recycling waste, applying circular economy (CE) initiatives across all phases of product and service life cycles can help power and renewable energy companies develop more secure, sustainable, and resilient supply chains. Embedding these initiatives into their business models can help companies reduce costs, optimize resources, and create added value through new products and services.

Companies in this sector can also play a significant role in developing circular economies in related industries, such as automotive and manufacturing, helping advance their energy transitions.

Deloitte's CE framework (figure 9) for the electric power sector shows how products and materials move through the supply chain. It consists of three dimensions related to product/service flow that integrate circular strategies. It also involves cross-sector collaboration between public and private stakeholders. These dimensions/strategies give rise to new business models that enable multiple benefits for supply chains.

- **Strategic dimensions:** The circular supply chain's primary focus is on keeping resources in the product life cycle at their highest value for as long as possible, which can be achieved by including any or all three dimensions:[35]

1. *Circular design:* Reducing resource and material intensity requirements during production, use, or disposal.
   Strategies: Rethink, reduce, and redesign

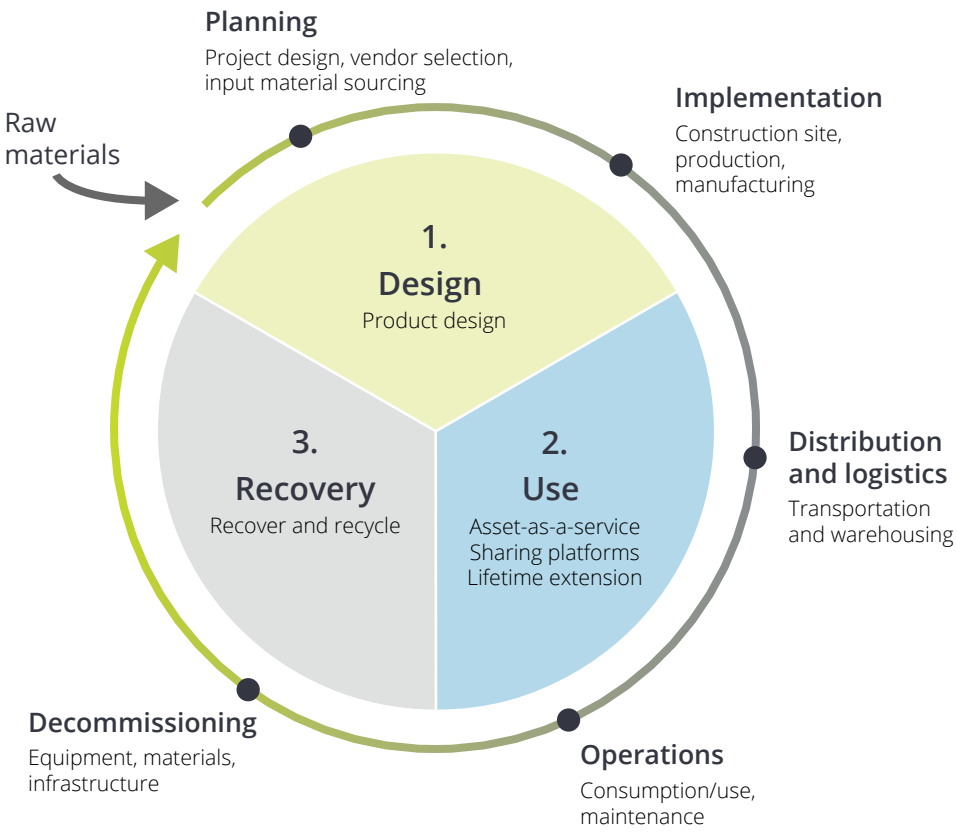
2. *Circular use:* Extending and optimizing product life and slowing the resource transition to waste or resource recapture.
   Strategies: Repurpose, reuse, refurbish, and repair

3. *Circular recovery:* Reintegrating waste or production byproducts back into the manufacture of new products.
   Strategies: Recover and recycle

- **Circular business models:** Several business models emerge around the three dimensions that use circular strategies and support moving to circular supply chains. They generally coexist and coevolve to create a circular supply chain, providing multiple benefits to the stakeholders in the ecosystem. These business models include:

FIGURE 9

Circular supply chains can benefit the electric power sector and create new opportunities



Stakeholders in an electric power supply chain

Raw materials suppliers	Component suppliers	Asset manufacturers
Electric power companies	Developers/installers	Other industries

Source: Deloitte analysis.

- *Product/process design:* Design an asset, product, or service using less, recycled, or sustainable/renewable inputs and modular/recyclable designs.

- *Asset-as-a-service:* The customer purchases a service for a limited time, while the manufacturer maintains the ownership.

- *Sharing platforms:* Employ common management among multiple users of products.

- *Lifetime extension:* Repair, upgrade, reuse, or recondition to extend product life.

- *Recover and recycle:* Recover embedded materials, energy, and resources from products at the end of use.

- **The stakeholder ecosystem:** CE supply chains require collaboration across the value chain and cross-sectoral partnerships to create joint value and deliver impact at scale. This can foster innovation and overcome challenges such as lack of capital, knowledge, and tools for efficient operations.

Figure 10 provides examples of circular business models the electric power sector is implementing across the three dimensions.

FIGURE 10

Examples of circular business models

Dimension	Enabling business model	Benefits	Examples
Circular design	Product/process design	• Efficiency gains • Optimization	• In 2021, Siemens Gamesa launched the RecyclableBlade, a wind turbine blade that can be recycled at the end of its life cycle.[a]
Circular use	Sharing platforms	• Cost and risk reduction	• Microgrids, virtual power plants, community solar, and energy market platforms enable sharing of clean energy technologies.
	Asset-as-a-service		• Energy storage-as-a-service can provide power during outages, ensure consistent power quality, and help industrial and other large electricity customers reduce demand charges. Fotowatio Renewable Ventures, in collaboration with Energy Toolbase and Ecopulse, launched "energy storage-as-a-service" for industrial customers who will not pay upfront for the battery installation, but will share their electricity savings with the project partners.[b]
	Lifetime extension		• In 2022, EDP Renewables North America LLC completed a wind turbine repowering project in the United States at the Blue Canyon II Wind Farm, increasing the capacity from 151 MW to 162 MW, thereby extending wind farm life.[c] Several additional repowering projects are underway or being planned, including work on wind farms that are only about a decade old.[d] In 2020, 33 projects were partially repowered, involving 1,827 turbines that totaled 3,087 MW prior to repowering.[e] • In 2021, Duke Energy diverted 87,700 tons of solid waste through recycling and beneficial reuse. It also remanufactured and repaired 22% of its scrap transformers, significantly reducing the need to purchase new equipment.[f]
Circular recovery	Recover and recycle	• New revenue • Minimize emissions	In 2021, Southern Company repurposed and recycled its former coal sites in Alabama and Mississippi to recover 2.4 million pounds of copper, 2.85 million pounds of aluminum, and 137 million pounds of ferrous metals.[g] In 2020, GE Renewable Energy signed an agreement with Veolia to recycle onshore wind turbine blades in the United States and turn them into a raw material for use in cement manufacturing.[h] Used transformer oil (UTO) can be processed to "as new" quality for reuse as insulating fluid.[i]

Sources: [a]Siemens Gamesa, "Siemens Gamesa pioneers wind circularity," press release, September 07, 2021.
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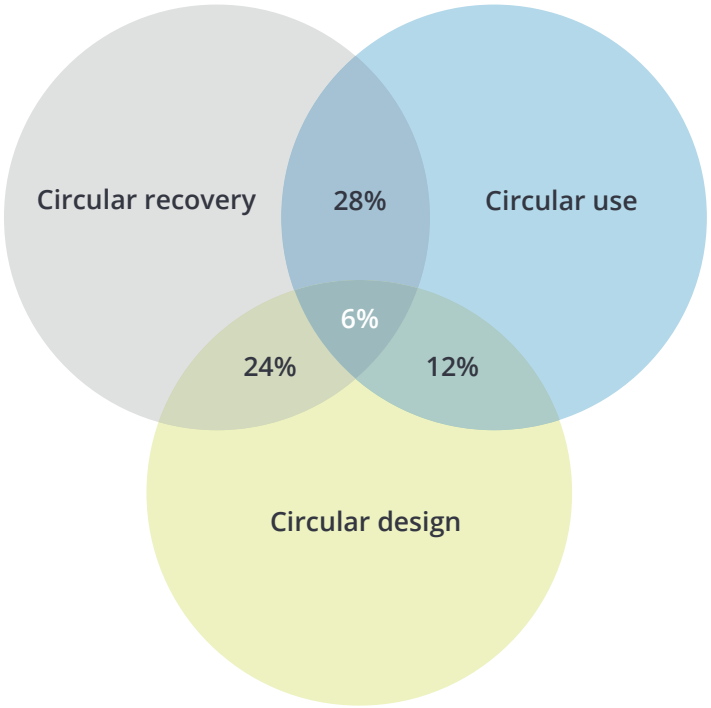
Although many electric power companies are undertaking circular supply chain initiatives for more than one dimension, very few are taking comprehensive action across all three dimensions.

According to our survey, only 6% of respondents are implementing CE activities across all three dimensions (figure 11).

FIGURE 11

Few electric power companies are implementing circular economy activities across all three dimensions



Source: Deloitte Electric Power Sector Supply Chain Survey.

Creating robust electric power supply chains: The road ahead

COMPANIES IN THE electric power and renewable energy sectors should consider committing to circular economy principles and developing a longer-term vision for security, sustainability, and resilience. Below are some considerations for companies looking to realize this vision:

- **Digitalize to increase 360-degree supply chain visibility.** Digitalization can enable complete visibility throughout the supply chain and improve the transparency and traceability of materials and products. Blockchain technology can enable authenticated data communication between supply chain stakeholders, thus increasing supply chain transparency. Digital twin and advanced analytics can help improve decision-making by ordering and tracking inventory, collecting, and storing performance data more efficiently, and proactively addressing maintenance issues before a failure occurs.

- **Advance procurement departments' role from enabling savings to creating value.** Sourcing in a circular supply chain requires greater planning and coordination that may supersede organizational boundaries. Therefore, procurement's role as an interface to stakeholders in the upstream supply network should become more strategic. Procurement departments can improve their understanding of materials, affect the circularity of the final product, and become trusted advisors, especially on supplier knowledge.[36] Instead of just chasing savings, the environmental and social footprint criteria become increasingly important in sourcing decisions.

- **Standardize for effective collaboration with stakeholders.** Standardization of products, processes, or procedures ensures all stakeholders in a supply chain are on the same page. It can enable lower production and procurement costs through economies of scale, easier and less expensive repair and replacement, as well as recycling. For example, in the case of solar, it would mean a more consistent method of designing products and assembling photovoltaic panels to make end-of-life recycling simpler and safer.

Supply chain disruptions will likely continue to occur, possibly with higher frequency. It is therefore increasingly important for the electric power sector to build resilient supply chains that are secure and sustainable, and can not only withstand such disruptions, but also emerge stronger.

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