Switching to sustainability: A comprehensive market analysis of sustainable practices in the switchgear industry

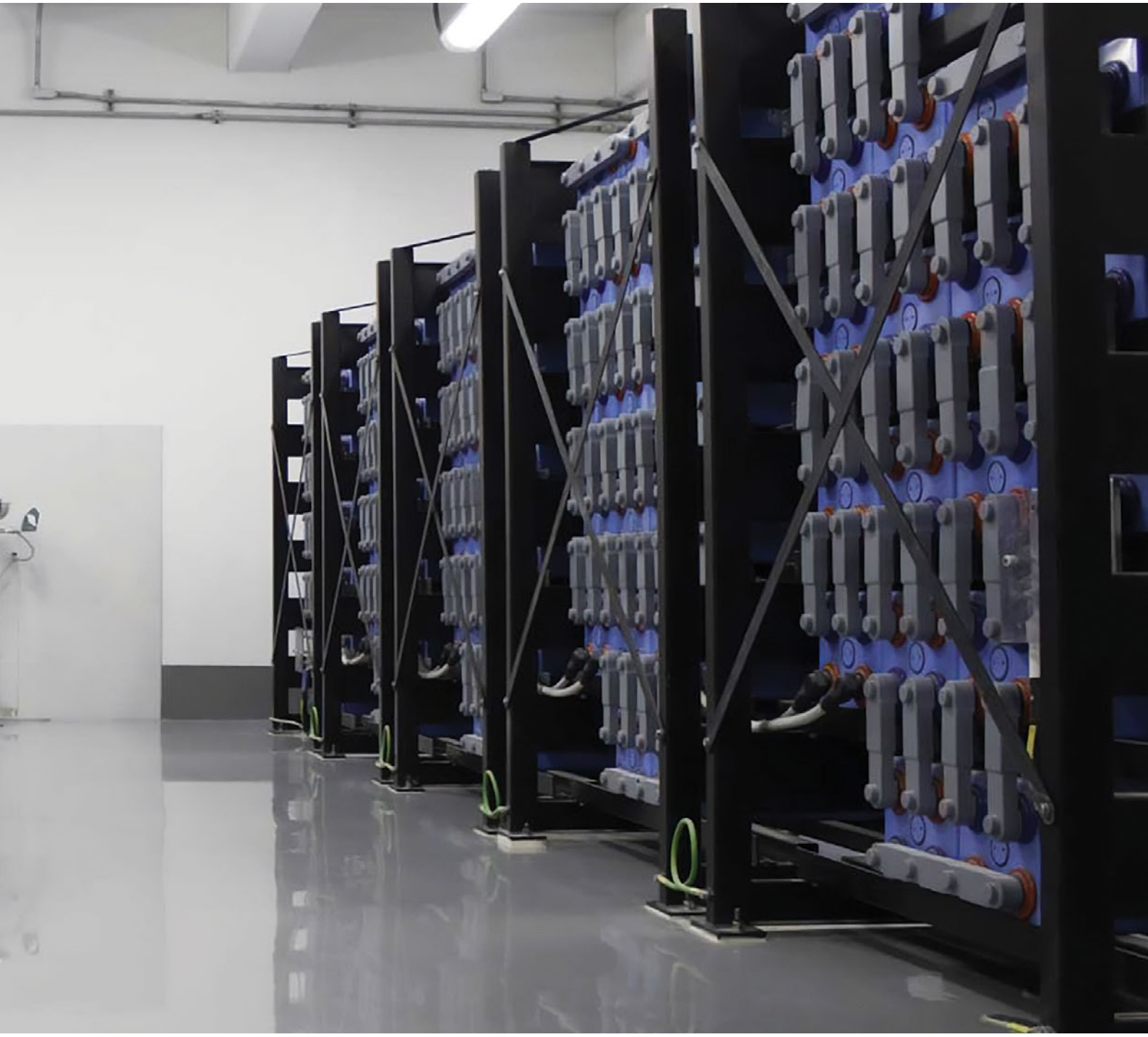
ABSTRACT

A surge in the demand for electricity over the years has made the role of switchgear in the power sector highly crucial. Conventional switchgear technology is detrimental to the environment, so there is a need to shift to adopt sustainable practices in the switchgear industry. Several bottlenecks in the way to sustainability for the switchgear industry need to be dealt with, including high initial costs and the complexity of switchgear installations. Despite the constraints, the adoption of sustainable industry practices will shape the future of the switchgear industry.

KEYWORDS:

switchgear industry; sustainability; circular economy

As the demand for electricity is rising across the globe, the role of switchgear in the power sector, especially in the transmission and distribution sector, has become increasingly crucial over the years



1. Introduction

As the demand for electricity is rising across the globe mainly due to industrial and population growth, improvements in the electrification rates and electrification of the transport sector, the role of switchgear in the power sector, especially in the transmission and distribution sector, has become increasingly crucial over the years. But the traditional switchgear industry practices are detrimental to the environment as they lead to resource depletion, pollution, and greenhouse gas emissions.

This has, in turn, created the need for the switchgear industry to move towards adopting sustainable industry practices with a focus on decarbonization, eco-design, high efficiency, and a sustainable supply chain. However, there are several impediments in the switchgear industry striving to adopt sustainable industry practices, including high initial costs and the complexity of switchgear installations. But at the same time, significant opportunities for innovation and development for switchgear OEMs exist along the way.

2. Current landscape of the switchgear market

Currently, the switchgear market is growing owing to several factors, including increasing demand for electricity, the integration of renewable energy sources and planned investments into mega infrastructure projects. As a consequence of the increasing demand for electricity and integration of renewables with the grid, the need to modernize and expand the existing electricity grid infrastructure (transmission and distribution grids)

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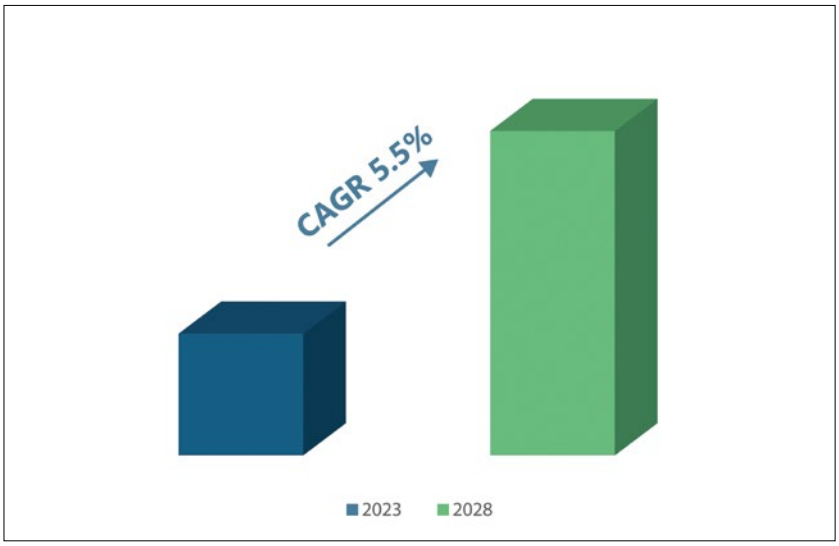

Figure 1. MV (medium voltage) switchgear CAGR 2021-2026 (Source: PTR Inc.)

is being increasingly felt. On the other hand, planned investments into mega infrastructure projects across the globe have also emerged as a key driver for the switchgear market, specifically the medium voltage switchgear market.

According to the estimates of Power Technology Research, the global switchgear market is projected to grow at a healthy pace with a CAGR of 5.5 % from 2023-2028 (Fig. 1). As far as the demand centers are concerned, switchgear demand is highest in the Asia Pacific (APAC) region, followed by EMEA (Europe, Middle East, and Africa) and the Americas. Demand in the APAC region is mainly due to industrialization and urbanization in China and India and increasing government investments in the energy sector. Key players in the global switchgear market include established names such as ABB, Siemens, Schneider Electric, and Eaton Corporation.

3. Sustainability and circular economy in the switchgear market

Sustainability is r eferred to as meeting the requirements of the present generation without compromising the ability of upcoming generations to meet their own needs. A circular economy, on the other hand, is an economic model whose focus is to produce goods and services in a manner which is sustainable in nature. It is significant to note that sustainability is a broader term that focuses on people, the planet, and the economy, whereas circularity deals with resource cycles.

Circularity in the switchgear industry can be achieved by curtailing the consumption and wastage of resources, including raw materials, water and energy, followed by a reduction in the production of waste. This would require institutional interventions at both the national and international levels, along with incentives to compensate for the cost of transforming the business model from linear to circular.

3.1 Circular economy

Major components of the circular economy include decarbonization, eco-design, high efficiency, and a sustainable supply chain.

Decarbonization

Decarbonization, a crucial component of a circular economy, involves reducing greenhouse gas emissions. So, to make switchgear manufacturing more sustainable, OEMs need to decarbonize manufacturing using renewable energy sources, energy-efficient equipment and processes, sustainable materials and waste reduction.

Eco-design

Eco-design largely involves designing products and solutions that have a minimal environmental impact throughout their lifecycle, including end-of-life disposal as well. The environmental impact of the switchgear industry can be reduced by using SF6-free switchgear and solid insulation switchgear. The usage of SF6-free switchgear and solid insulation switchgear will reduce carbon dioxide emissions. Such a shift to SF6 free switchgear is in line with regulations in advanced economies, for instance, EU's F-gas Regulations 2022.

High efficiency

The high-efficiency component of the circular economy concerns reducing energy consumption, operating costs and improving overall system performance. Switchgear manufacturers can achieve high efficiency through vacuum switching, using improved insulation materials, optimized cooling systems, and moving towards digitalization and automation.

Sustainable supply chain

The sustainable supply chain component of the circular economy deals with the adoption of sustainable practices throughout the supply chain of the product. The switchgear industry can also push to adopt sustainable practices throughout the supply chain which are aimed at reducing environmental and social impacts along with value creation for stakeholders in the industry.

To build a sustainable supply chain, the switchgear industry can take key initiatives. For instance, OEMs can carry out lifecycle assessments of switchgear and adopt responsible raw material sourcing practices. On the other hand, collaboration with the suppliers and customers aimed at identifying opportunities to reduce the environmental impact and improving efficiency is also very crucial to establish a sustainable supply chain.

The circular vision presented by World Economic Forum for the electronics industry has the potential to serve as a template for the switchgear industry (Fig. 2).

4. Current landscape of switchgear OEMs

Electric switchgear manufacturers across the globe are beginning to realize the significance of the circular economy, especially after the Paris Agreement. While some of the electric switchgear companies are far ahead in adopting the practices of circular economy, some manufacturers continue to lag behind in this regard.

Furthermore, the OEMs have prioritized different aspects of the circular economy. For instance, some switchgear OEMs prioritize product design for recycling, while others focus on take-back programs for end-of-life equipment. It is expected that as the regulations become stricter and the advantages of the circular economy become more evident, more OEMs will move towards adopting circular economy practices, which in turn would contribute to sustainability.

ABB, Siemens, Schneider Electric and Eaton are some of the leading OEMs that have adopted practices of the circular economy.

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4.1 ABB

ABB has committed to reducing carbon dioxide emissions by 100 megatons by 2030 and achieving carbon neutrality in the operations of the organization with the help of renewable energy, improvements in energy efficiency and electrification of the vehicle fleet. ABB is also working with the suppliers to reduce emissions from the entire supply chain of the switchgear business significantly by 2030.

The company stresses a lot on sustainability in product design and has been pushing to maximize the use of sustainable materials while reducing waste. For example, it is noteworthy that no rare earth materials were used in the manufacturing of ABB's highest-efficiency motors. ABB is also planning to eliminate waste in its operations and offers take-back services for product and component refurbishment, reuse, or recycling [1].

4.2 Siemens

Siemens is also moving to adopt sustainable industry practices through investments in its portfolio and implementing their latest technologies internally. It has set a target to reduce carbon emissions by 55 % by 2025, compared to 2019 levels, and also aims to reduce emissions by 90 % by 2030. For smart grid products, systems and solutions, Siemens provides eco-transparency and has implemented environmental and energy management systems at several locations. At 164 Siemens locations, an environmental management system certified under ISO 14001 has been implemented [2]. An

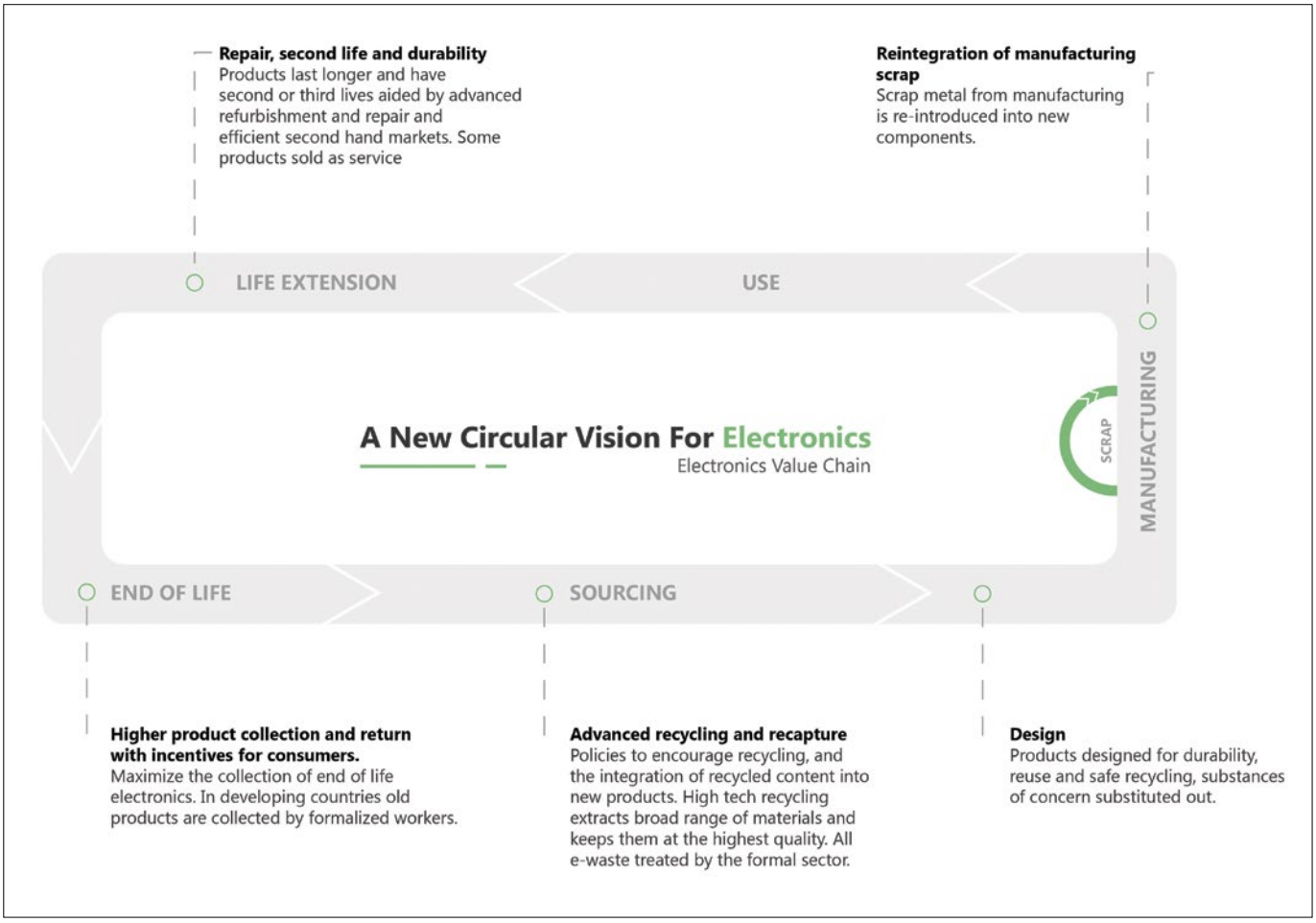

Figure 2. Circular vision for the switchgear industry (Source: WEF)

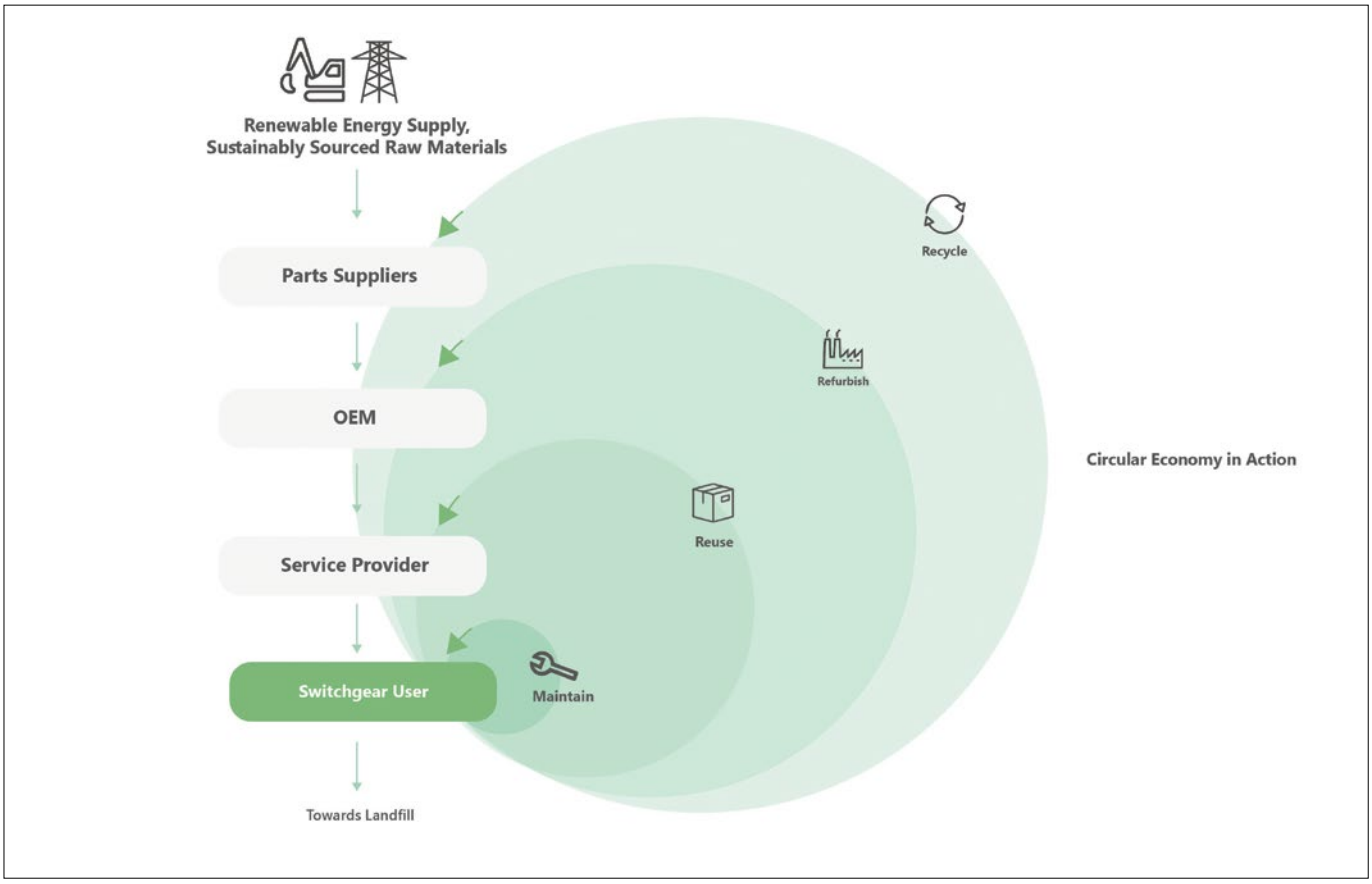

Figure 3. Graphical depiction of circular economy (Source: Ellen MacArthur Foundation)

Electric switchgear manufacturers across the globe are beginning to realize the significance of the circular economy, especially after the Paris Agreement

energy management system as per ISO 500001 has been introduced at 29 Siemens locations. On the other hand, Siemens calculates the exact carbon footprint of its products as per ISO 14040/44 [2].

4.3 Schneider Electric

Schneider Electric has been able to incorporate circularity throughout the value chain of the products and services it provides to its customers. It has taken a wide range of initiatives to support circularity, beginning with sourcing green materials and designing circular-ready products, for instance, those under the Green Premium Program. Furthermore, Schneider Electric offers lifecycle services, such as retrofitting, repair, refurbishment and recycling services and an energy management system. It is noteworthy that the company is also advocating the use of sustainable and returnable packaging.

In 2020, an overwhelming majority of Schneider Electric's sales, accounting for 75 % fell under the Green Premium Program, which in turn allowed Schneider Electric to avoid the consumption of 157,000 metric tons of primary resources through retrofitting, recycling and take back programs [3].

4.4 Eaton

Eaton is pursuing to significantly reduce the carbon emissions from operations by 50 % from 2018 levels, lower product and supply chain emissions, achieve carbon neutrality in operations and certify all manufacturing sites as zero waste to landfill by 2030 [4].

The organization plans to invest a whopping sum of USD 3 billion in research and development of sustainable solutions by 2030 [4]. Eaton's Additive Manufacturing Centre of Excellence in Michigan promotes sustainable manufacturing and develops high-performance components, tools and fixtures through 3D printers. Furthermore, to monitor and optimize power usage, Eaton utilizes IoT. Eaton's strategy is aligned with the United Nations Sustainable Development Goals. The company follows a Design for Environment principle focused on minimizing waste and pollution along with the optimization of the use of natural resources.

5. Outlook and drivers for sustainable switchgear

As the switchgear OEMs are moving away from a linear business model to a circular business model, Power Technology Research is observing the emergence of several new technologies, for instance, solid-state switchgear and digital switchgear. These technologies have the capacity to improve the overall sustainability performance of switchgear products by reducing energy losses, enhancing reliability, and curtailing environmental impact.

Furthermore, as sustainability is becoming increasingly crucial for the stakeholders in the switchgear industry, manufac-

turers and suppliers in the future will be required to innovate and separate themselves by developing sustainable switchgear products from conventional OEMs and suppliers.

In the future, the sustainable switchgear market will be largely driven by national and regional targets to reduce emissions and the integration of renewables with the electricity grid, followed by regulatory and policy drivers.

Economies across the globe have made international and regional commitments to reduce carbon dioxide emissions. In turn, they require OEMs to move towards digitalization and reduce their emissions in line with regional and international commitments. Such requirements are creating demand for sustainable switchgear.

Furthermore, Power Technology Research is observing the widespread deployment of distributed energy resources across countries, driving the demand for sustainable switchgear. The intermittency linked with DERs complicates the job of the system operator, so in order to maintain the security and improve the reliability of the system with distributed energy resources, utilities move to install digital switchgear. Digital switchgear contributes to sustainability and has the capacity to gather information which is crucial for the system operator.

Lastly, regulations and policies, for instance, the EU's Eco-design Directive, can also drive the adoption of sustainable switchgear. The upcoming bans and directives are, in a way, incentivizing manufacturers and suppliers to invest in sustainable switchgear technologies. EU has proposed strict deadlines to ban the sale of new switchgear employing SF6 by 2031. Also, the revision of the renewable energy directive of the EU in light of the geopolitics calls for a further increase in renewable penetration, electrification, and energy efficiency, which in turn will drive the demand for sustainable switchgear.

As the switchgear OEMs are moving away from a linear business model to a circular business model, Power Technology Research is observing the emergence of several new technologies

6. Looking forward

The global switchgear market is being largely driven by increasing electricity demand, integration of renewables with the electricity grid and mega infrastructure projects. Push for the adoption of sustainable practices with a focus on components of the circular economy, including decarbonization, eco-design, high efficiency, and sustainable supply chain, is shaping the global switchgear market, especially in advanced economies. There are still several challenges that the market faces in the way of adopting sustainable practices that need to be dealt with, including high initial costs and the complexity associated with the installation of switchgear. Power Technology Research has observed that despite the bottlenecks, significant opportunities exist in the market for innovation and the development of new products.

Furthermore, it is observed that customers and the stakeholders in the switchgear industry demand environmentally friendly products and solutions, specifically in advanced economies. But as we move forward, the demand for such products and solutions will also be generated from developing economies.

Power Technology Research believes that OEMs that are able to introduce commercially viable technological solutions that are not only eco-friendly but sustainable as well will be leading the global switchgear market in the long run. OEMs are recommended to focus on sustainability and develop products that cater to the latest market trends and challenges. Additionally, for successful implementation of sustainable practices, OEMs need to collaborate with the customers and suppliers of switchgear.

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Customers and the stakeholders in the switchgear industry demand environmentally friendly products and solutions, specifically in advanced economies

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