



## Role of Digital Power Transformers in the Modern Energy Landscape

by Shaista Naz, Junior Analyst– at PTR Inc.

- The development of digital power transformers has ushered in a new era of efficiency and grid optimization in the energy sector, simultaneously providing revenue to the power transformer company.
- Digital power transformers provide multiple benefits with remote monitoring, management of demand response initiatives, and integration of renewable energy resources in the grid.
- Although digital power transformers provide multiple benefits, there are a few challenges with implementing digital infrastructure, including threats of cybersecurity and large-scale deployment of digital networks.

Power transformers are a crucial component of the power transmission and distribution infrastructure. These devices serve a significant role in supporting industrial operations, commercial activities, and everyday life by facilitating voltage transformation and ensuring a stable power supply. However, due to the widespread deployment of renewable energy and electric vehicles, conventional transformers can't provide the required efficiency, flexibility, and optimized power management. This is the reason why the industry is moving from conventional power transformers to digital power transformers.

This article explores the current market landscape of the power transformers market and the benefits provided by digital power transformers in the electrical system. This article also examines the challenges faced in the implementation of digital transformers and how digital transformers are the inevitable future of the power industry.

## Current Market Landscape

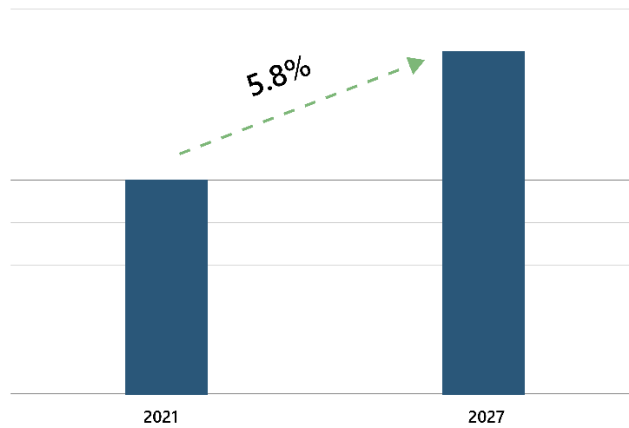


Figure 1: Power transformer market projected to have a CAGR of 5.8% from 2021 to 2027

Source: PTR Inc

According to PTR, the power transformer market is experiencing significant growth, projected to have a Compound Annual Growth Rate (CAGR) of 5.8% from 2021 to 2027. The key players of the power transformers market are tapping into the sales of digital transformers because of their numerous benefits. The increase in efficiency of the power systems due to the shift to digital transformers provides these key players with enormous growth and profits. The key players in the power transformer industry include [Hitachi Energy](#), Siemens Energy, GE, Hyusung, and China (Figure 2).

### Key Players in the Power Transformer Market

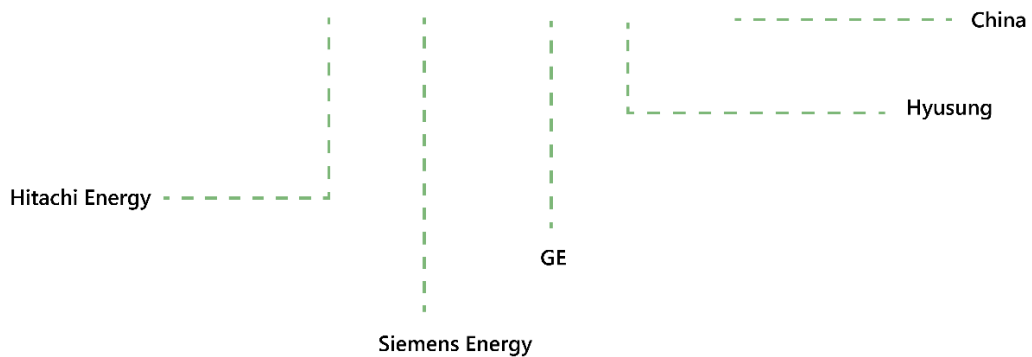


Figure 2: Key Players in the Power Transformer Market.

Source: PTR Inc

## Benefits of Digital Power Transformers

Conventional transformers have been dependable workhorses in power transmission and distribution for quite some time because of their well-established design and electromagnetic induction principles. However, they lack the advanced functions that digital transformers have. Digital transformers bring a new degree of intelligence and control because of the digital transformation of the power industry. To actively monitor and manage many facets of power transmission and distribution, digital transformers make use of power electronics, digital control systems, and communication technologies. There are a range of benefits of installing digital transformers, including asset management through remote monitoring, management of demand response initiatives and integration of renewable energy and improvement of Volt/ VAR.

### Asset management by remote monitoring

Modern transformers provide remote monitoring and control by incorporating sensors and devices. These devices are equipped with communication capabilities and provide feedback based on real-time data to plan preventive measures and avoid any unwanted failures in the equipment. Asset managers can prevent unplanned outages, schedule repairs more effectively, and address emerging concerns in advance by implementing a predictive maintenance strategy.

### Management of demand response initiatives

Digital transformers can assist demand response initiatives, which involve changing power consumption patterns in response to grid circumstances or price signals. Utilities can monitor transformer loadings and spot potential overload issues utilizing real-time data from digital transformers. Utility companies can adopt load-shedding or load-shifting strategies to ensure grid stability during times of peak demand or emergencies by integrating this data with demand response systems. Grid operators can manage power flow, control voltage, and ensure grid stability with the use of data from digital transformers, improving system flexibility and facilitating the increasing adoption of renewable energy sources.

### Integration of renewable energy and improvement of Volt/VAR

Due to its irregular and fluctuating character, integrating [renewable energy](#) sources such as solar and wind poses difficulties. Digital transformers, which offer real-time data on the state and performance of transformers, are essential for overcoming these difficulties. This knowledge is crucial for the grid to successfully incorporate renewable energy sources. Digital transformers offer accurate control of voltage and reactive power flow, contributing to volt/VAR optimization (VVO), by monitoring variables like voltage, current, and power factor.

## Challenges in the Digitalization of the Grid

Although there are numerous benefits of implementing digital power transformers into electrical systems, it is important to note that there are certain problems associated with using digital technologies. Electrical systems are susceptible to cybersecurity threats with the digitalization of the grid. Moreover, these transmission systems are spread over vast areas, and it is a financial constraint to digitalize every segment of the electrical system.

### Cybersecurity threats

With increasing digitalization in multiple stages of the power industry, there are rising concerns about sensitive information being leaked and countries facing disadvantage with loss of confidential information. China is posing threats to US electrical grid by repeated cybersecurity attacks through emerging artificial intelligence technologies. The digitalization of the power sector often involves collaborations with third-party vendors and service providers. These external entities may have access to critical systems, networks, or data, making them potential targets for cyber-attacks. If proper security measures are not implemented throughout the supply chain, vulnerabilities in third-party systems can be leveraged by hackers to compromise the power industry infrastructure. The loss in the electricity supply will result in a loss in revenue for utilities and subsequent industries dependent on electricity. Cyber-security attacks on electric system of a city or a country wide scale can lead to loss equivalent to billions of dollars.

### The scale of deployment

Transmission System Operators (TSOs) often manage and maintain power transmission networks that span vast areas of land. Adopting digital systems across huge networks requires a massive deployment effort. Deploying digital technologies, such as smart sensors, monitoring systems, data analytics platforms, and communication infrastructure, is expensive, as power transmission networks are made up of several substations. These substations are critical for transforming and regulating electricity, and replacing digital systems with existing equipment in all the substations is expensive and time-consuming. Moreover, digital systems in one segment of the transmission network will simultaneously require digitalizing other segments of the transmission network to ensure compatibility of the electrical system with its components.

## Way Forward

As the power grid undergoes extensive digitalization in the next decade, a substantial portion of the market revenue is expected to come from the deployment of digital transformers. This shift is driven by the rising interest of TSOs in grid digitalization that aims to enhance asset management, reduce outage durations, and lower direct maintenance costs. The key market players in the power transformer markets realize the need for this shift and are focused on generating revenue through the sales of digital power transformers.

**Contact:**

[sales@ptr.inc](mailto:sales@ptr.inc)