

# Research Report on Energy Transition Equipment & Power Technologies Industry

August 26, 2024

## Table of Contents

<b>1. Economy Outlook .....</b>	<b>7</b>
1.1 Global Economy.....	7
1.2 Indian Economic Outlook.....	9
1.2.1 GDP Growth and Outlook.....	9
1.2.2 Gross Value Added (GVA) .....	10
1.2.3 Investment Trend in Infrastructure.....	12
1.2.4 Industrial Growth .....	13
1.2.5 Consumer Price Index.....	14
1.2.6 Overview on Key Demographic Parameters .....	16
1.2.7 Concluding Remarks.....	20
<b>2. Overview of Energy Transition Equipment &amp; Power Technologies Industry .....</b>	<b>21</b>
<b>3. Overview of the Global and Indian Electricity Transmission Sector .....</b>	<b>22</b>
2.1 Global Electricity Transmission Sector .....	22
2.2 Future Market Trends and Key Investment Drivers.....	23
2.3 Transmission Network in India .....	23
2.4 Overview of Global Renewable Energy .....	25
2.4.1 Global Power Sector .....	25
2.4.2 Global Renewable Installed Capacity .....	26
2.5 Renewable Energy in India .....	26
<b>4. Global HVDC and FACTS Market.....</b>	<b>28</b>
4.1 Overview.....	28
4.2 Global Market Split by Regions .....	30
4.3 Global Market Split by Products .....	35
4.4 Competitive Landscape.....	40
4.5 Key Factors Driving the Growth of the Global HVDC and FACTS Market .....	41
3.5.1 Projected Additions in Transmission.....	41
3.5.2 Projected Investments in the Indian Electricity Transmission Sector.....	42
4.6 Market Challenges.....	45
4.7 Growth Forecast .....	46
<b>5. STATCOM.....</b>	<b>47</b>
5.1 Overview.....	47
5.2 Global STATCOM Market Size .....	48
5.3 Indian STATCOM Market Size.....	49
<b>6. Global High Voltage Products .....</b>	<b>51</b>
6.1 Overview.....	51
6.2 Global High Voltage Market Split by Region .....	53
6.2.1 USA High Voltage Product Market.....	53
6.2.2 Middle East High Voltage Product Market .....	54
6.2.3 Africa High Voltage Product Market.....	55

6.2.4 Indian High-Voltage Products Market .....	56
6.3 Global High Voltage Products Type .....	58
6.3.1 Global High Voltage Special Power Transformers .....	58
6.3.2 Global High Voltage Reactors .....	59
6.3.3 Global High Voltage Breaker Products .....	60
<b>7. Global Power Quality Products Market .....</b>	<b>62</b>
7.1 Overview.....	62
7.2 Global Power Quality Products Market Split by Region .....	63
7.2.1 APAC (Excluding India).....	63
7.2.2 Middle East.....	64
7.3 Indian Power Quality Products Market .....	65
7.4 Global Power Quality Products Type .....	67
7.4.1 Global Harmonic Filters.....	67
7.4.2 Global Capacity Banks .....	68
7.4.3 Global Static Var Compensator (SVC).....	69
7.5 Growth Drivers .....	70
7.6 Key Challenges .....	73
<b>8. Competitive Landscape .....</b>	<b>75</b>
8.1 Benchmarking Based on Profitability Parameters.....	75
8.2 Benchmarking Based on Profitability Parameters.....	76
8.3 About Quality Power Electrical Equipments Ltd .....	84
8.4 Threats and Challenges to Quality Power .....	85

## List of Charts

Chart 1: Global Growth Outlook Projections (Real GDP, Y-o-Y change in %)	7
Chart 2: Gross Fixed Capital Formation (GFCF) as % of GDP (At constant prices):	13
Chart 3: Y-o-Y growth in IIP (in %)	14
Chart 4: Retail Price Inflation in terms of index and Y-o-Y Growth in % (Base: 2011-12=100)	15
Chart 5: RBI historical Repo Rate	16
Chart 6: Trend of India Population vis-à-vis dependency ratio	17
Chart 7: Age-Wise Break Up of Indian population	17
Chart 8: Yearly Trend - Young Population as % of Total Population	17
Chart 9: Urbanization Trend in India	18
Chart 10: Trend of Per Capita Gross National Disposable Income (Current Price)	19
Chart 11: Trend of Per Capita Private Final Consumption Expenditure (Current Price)	19
Chart 12: Global Electricity Transmission Sector	22
Chart 13: Global Electricity Transmission Sector Market Forecast	23
Chart 14: Transmission Line Network (220 kV & Above)	24
Chart 15: Transformation Capacity (220 kV & Above)	25
Chart 16: Global Power Sector Installed Capacity	25
Chart 17: Forecasted Net Renewable Electricity Capacity Additions by Technology	26
Chart 18: Renewable Energy - Trend in Installed Capacity	27
Chart 19: Global HVDC and FACTS market	29
Chart 20: HVDC and FACTS Market in India	30
Chart 21: HVDC and FACTS Market Forecast in India	31
Chart 22: HVDC and FACTS Market in the USA	32
Chart 23: HVDC and FACTS Market Forecast in USA	32
Chart 24: HVDC and FACTS Market in the Middle East	33
Chart 25: HVDC and FACTS Market Forecast in Middle East	33
Chart 26: HVDC and FACTS Market in Others	34
Chart 27: HVDC and FACTS Market Forecast in other countries	35
Chart 28: Market of Reactor	36
Chart 29: Market of Reactor Forecast	36
Chart 30: Market of Capacitor	37
Chart 31: Market of Capacitor Forecast	37
Chart 32: Market of Instrument Transformers	38
Chart 33: Market of Instrument Transformers Forecast	38
Chart 34: Market of Other Instruments	39
Chart 35: Market of Other Instruments	39

Chart 36: Global HVDC and FACTS Market Forecast	46
Chart 37: Global STATCOM Market Size	48
Chart 38: Global STATCOM Market Size Forecast	49
Chart 39: Indian STATCOM Market Size	49
Chart 40: Indian STATCOM Market Size Forecast	50
Chart 41: Global High Voltage Products	52
Chart 42: Global High Voltage Products Forecast	53
Chart 43: USA High Voltage Market	53
Chart 44: USA High Voltage Market Forecast	54
Chart 45: Middle East High Voltage Market	54
Chart 46: Middle East High Voltage Market Forecast	55
Chart 47: Africa High Voltage Market	55
Chart 48: Africa High Voltage Market Forecast	56
Chart 49: Indian High Voltage Products	56
Chart 50: Indian High Voltage Products Forecast	57
Chart 51: Global High Voltage Special Power Transformers	58
Chart 52: Global High Voltage Special Power Transformers Forecast	59
Chart 53: Global High Voltage Reactors	59
Chart 54: Global High Voltage Reactors Forecast	60
Chart 55: Global High Voltage Breaker Products	61
Chart 56: Global High Voltage Breaker Products Forecast	61
Chart 57: Global Power Quality Products Market	62
Chart 58: Global Power Quality Products Market Forecast	63
Chart 59: APAC (excluding India) Power Quality Products Market	63
Chart 60: APAC (Excluding India) Power Quality Products Market Forecast	64
Chart 61: Middle East Power Quality Products Market	64
Chart 62: Middle East Power Quality Products Market Forecast	65
Chart 63: Indian Power Quality Products Market	65
Chart 64: Indian Power Quality Products Market Forecast	66
Chart 65: Global Harmonic Filters Value	67
Chart 66: Global Harmonic Filters Value Forecast	68
Chart 67: Global Capacity Bank	68
Chart 68: Global Capacity Bank Forecast	69
Chart 69: Global Static Var Compensator Value	70
Chart 70: Global Static Var Compensator Forecast	70
Chart 71: RPO Trajectory from FY23 to FY30	72

Chart 72: EBITDA Margin (%)	77
Chart 73: Profit After Tax Margin (%)	78
Chart 74: Debt to Equity Ratio (x)	79
Chart 75: Return on Equity (%)	80
Chart 76: Return on Capital Employed (%)	81
Chart 77: Current Ratio (x)	82
Chart 78: Asset Turnover Ratio	83

### List of Tables

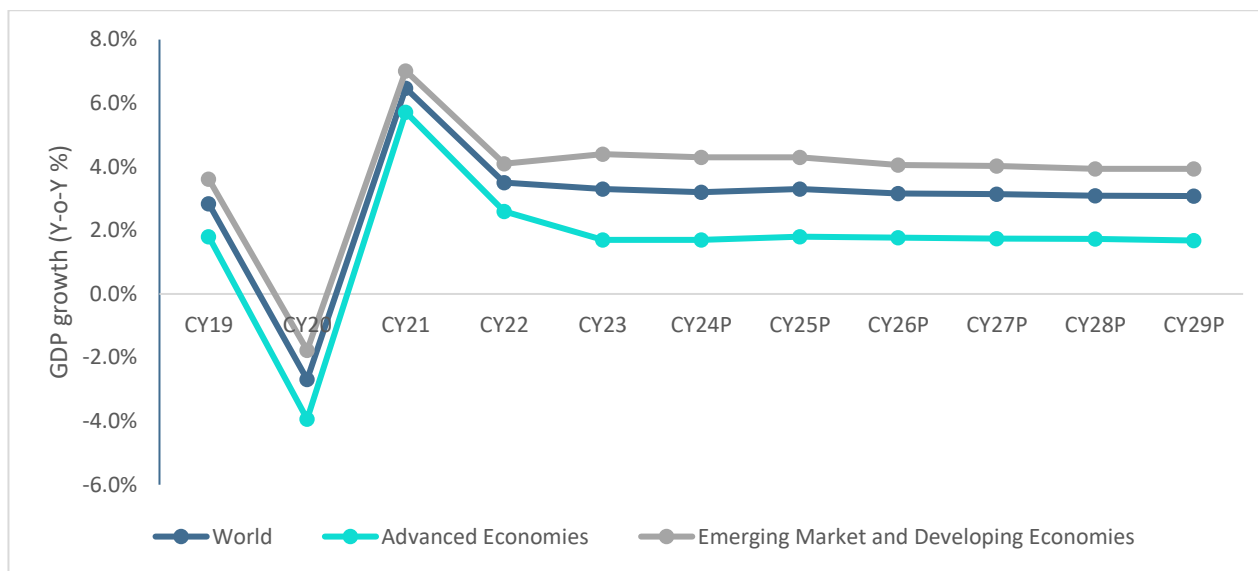
Table 1: GDP growth trend comparison - India v/s Other Economies (Real GDP, Y-o-Y change in %)	7
Table 2: RBI's GDP Growth Outlook (Y-o-Y %)	10
Table 3: Sectoral Growth (Y-o-Y % Growth) - at Constant Prices	12
Table 4: Distribution of Voltage Lines	23
Table 5: Global Market Evaluation	35
Table 6: Under Construction Transmission Line (ckm)	41
Table 7: Under Construction Transformation Capacity (MVA)	41
Table 8: Transmission Line Investments (In Cr)	42
Table 9: Different Types of High Voltage Products	51
Table 10: Indian High Voltage Products Value Segment by Type	57
Table 11: Indian High Voltage Products Value Segment by Type (2024-2028F)	57
Table 12: Indian Power Quality Products Market Segment by Type	66
Table 13: Indian Power Quality Products Market Segment by Type Forecast	66
Table 14: Revenue of Peer Companies	77
Table 15: Number of Operating Facilities Unit	83
Table 16: Exports as % of Revenue	83

## 1. Economy Outlook

### 1.1 Global Economy

Global growth, which stood at 3.3% in CY23, is anticipated to fall to 3.2% in CY24 and then bounce back again to 3.3% in CY25. The CY24 forecast has remained same compared to the April 2024 World Economic Outlook (WEO) Update, and increased by 0.1 percentage point compared to the January 2024 WEO. Despite this, the expansion remains historically low, attributed to factors including sustained high borrowing costs, inflation woes, reduced fiscal support, lingering effects of Russia’s Ukraine invasion, Iran–Israel Cold War, sluggish productivity growth, and heightened geo-economic fragmentation.

**Chart 1: Global Growth Outlook Projections (Real GDP, Y-o-Y change in %)**



Notes: P-Projection; Source: IMF – World Economic Outlook, July 2024

**Table 1: GDP growth trend comparison - India v/s Other Economies (Real GDP, Y-o-Y change in %)**

	Real GDP (Y-o-Y change in %)									
	CY20	CY21	CY22	CY23	CY24P	CY25P	CY26P	CY27P	CY28P	CY29P
India	-5.8	9.7	7.0	8.2	7.0	6.5	6.5	6.5	6.5	6.5
China	2.2	8.5	3.0	5.2	5.0	4.5	3.8	3.6	3.4	3.3
Indonesia	-2.1	3.7	5.3	5.0	5.0	5.1	5.1	5.1	5.1	5.1
Saudi Arabia	-3.6	5.1	7.5	-0.8	1.7	4.7	4.0	3.5	3.0	3.5
Brazil	-3.3	4.8	3.0	2.9	2.1	2.4	2.1	2.0	2.0	2.0
Euro Area	-6.1	5.9	3.4	0.5	0.9	1.5	1.4	1.3	1.3	1.2
United States	-2.2	5.8	1.9	2.5	2.6	1.9	2.0	2.1	2.1	2.1

P- Projections; Source: IMF- World Economic Outlook Database (July 2024)

## Advanced Economies Group

Advanced economies are expected to experience a gradual increase in growth, remaining same at 1.7% in CY23 and CY24 and increasing to 1.8% in CY25. The projection for CY24 and CY25 remains unchanged compared to the April 2024 WEO Update.

The **United States** is expected to see growth rise to 2.6% in CY24, followed by a slight slowdown to 1.9% in CY25. This deceleration is attributed to gradual fiscal tightening and labor market softening, which dampen aggregate demand. The CY24 projection has been revised downward by 0.1 percentage points since the April CY24 WEO Update. This revision primarily reflects carryover effects from stronger-than-expected growth in the fourth quarter of CY23, with some of this momentum expected to continue into CY24.

The **Euro Area's** growth is anticipated to rebound from its sluggish rate of 0.5% in CY23, mainly influenced by significant exposure to the conflict in Ukraine. Projections indicate an increase to 0.9% in CY24 and further to 1.5% in CY25. This recovery is driven by stronger household consumption, as the impact of elevated energy prices diminishes and declining inflation bolsters real income growth. Additionally, strong momentum in services, higher than expected net exports, and higher investments have further driven this growth. But, countries like Germany are expected to have a sluggish recovery on account of weak manufacturing growth.

## Emerging Market and Developing Economies Group

Emerging market and developing economies are forecasted to maintain stable growth at 4.3% in both CY24 and CY25. This forecast has been revised upwards by 0.1 percentage point as compared to the April 2024 WEO update on account of stronger activity in Asia, particularly China and India. Growth prospects in economies across the Middle East and Central Asia continue to be weighed down by oil production and regional conflicts. Growth forecast of sub-Saharan Africa has also been revised downward on account of weak economic activity. Low-income developing countries are anticipated to experience a gradual growth uptick, starting at 3.9% in CY23 and climbing to 4.4% in CY24 and 5.3% in CY25, as certain constraints on near-term growth begin to ease.

The economic forecast for emerging and developing Asia reveals a modest deceleration in growth, with projections indicating a decline from 5.7% in CY23 to 5.4% in CY24 and 5.1% in CY25. **China's** trajectory reflects a slowdown, transitioning from 5.2% in CY23 to 5.0% in CY24 and 4.5% in CY25 due to fading post-pandemic stimuli and ongoing property sector challenges. In contrast, **India's** growth remains robust, with anticipated rates of 7.0% in CY24 and 6.5% in CY25, bolstered by resilient domestic demand and a burgeoning working-age populace.

The **Indonesian** economy is expected to register growth of 5.0% in CY24 and 5.1% in CY25 with a strong domestic demand, a healthy export performance, policy measures, and normalization in commodity prices. **Saudi Arabia's** growth slowed at -0.8% in CY23 attributed to lower oil production. CY24 is predicted to see a revamp in the growth rates to 1.7% on account of Vision 2030 reforms that helped advance the country's economic diversification agenda, including through reduced reliance on oil. The forecast for CY24 has been revised downward as compared to the April 2024 WEO update on account of extension of oil production cuts. Going forward, GDP is expected to grow at 4.7% and 4.0% in CY25 and CY26, respectively. On the other hand, **Brazil's** growth is projected to ease to 2.1% in CY24, driven by fiscal consolidation, the lingering impact of tight monetary policies, and reduced contributions from the agricultural sector. There has been a downward revision in forecast for CY24 compared to April 2024 WEO update on account of the near-term impact of flooding. Going forward, GDP is expected to grow at 2.4% in CY25 on account of reconstruction following the floods and supportive structural factors.

Despite the turmoil in the last 2-3 years, India bears good tidings to become a USD 5 trillion economy by CY27. According to the IMF dataset on Gross Domestic Product (GDP) at current prices, the nominal GDP has been at USD 3.6 trillion for CY23 and is projected to reach USD 5.3 trillion by CY27 and USD 6.4 trillion by CY29. India's expected GDP growth rate for coming years is almost double compared to the world economy.



Besides, India stands out as the fastest-growing economy among the major economies. The country is expected to grow at more than 6.5% in the period of CY24-CY29, outshining China's growth rate. By CY27, the Indian economy is estimated to emerge as the third-largest economy globally, hopping over Japan and Germany. Currently, it is the third-largest economy globally in terms of Purchasing Power Parity (PPP) with a ~7.6% share in the global economy, with China [~18.7%] on the top followed by the United States [~15.6%]. Purchasing Power Parity is an economic performance indicator denoting the relative price of an average basket of goods and services that a household needs for livelihood in each country.

Despite Covid-19's impact, high inflationary environment and interest rates globally, and the geopolitical tensions in Europe, India has been a major contributor to world economic growth. India is increasingly becoming an open economy as well through growing foreign trade. Despite the global inflation and uncertainties, Indian economy continues to show resilience. This resilience is mainly supported by stable financial sector backed by well-capitalized banks and export of services in trade balance. With this, the growth of Indian economy is expected to fare better than other economies majorly on account of strong investment activity bolstered by the government's capex push and buoyant private consumption, particularly among higher income earners.

## 1.2 Indian Economic Outlook

### 1.2.1 GDP Growth and Outlook

#### Resilience to External Shocks remains Critical for Near-Term Outlook

India's real GDP grew by 7.0% in FY23 and stood at ~Rs. 161 trillion, as per the First Revised Estimate, despite the pandemic in previous years and geopolitical Russia-Ukraine spillovers. In Q1FY24, the economic growth accelerated to 8.2%. The manufacturing sector maintained an encouraging pace of growth, given the favorable demand conditions and lower input prices. The growth was supplemented by a supportive base alongside robust services and construction activities. This momentum remained in the range in the Q2FY24 with GDP growth at 8.1%, mainly supported by acceleration in investments. However, private consumption growth was muted due to weak rural demand and some moderation in urban demand amid elevated inflationary pressures in Q2FY24. The GDP growth number improved for Q3FY24 at 8.6%.

India's GDP at constant prices surged to Rs. 47.24 trillion in Q4FY24 from Rs. 43.84 trillion in Q4FY23, marking a 7.8% growth rate. This upswing was fueled by robust performances in construction, mining & quarrying, utility services, and manufacturing sectors and investment drove the GDP growth, while both private and government consumption remained subdued.

Real GDP in the year FY24 is estimated to grow at 8.2% at Rs. 173.82 trillion as per provisional estimate of the Ministry of Statistics and Programme Implementation. It is expected that domestic demand, especially investment, to be the main driver of growth in India, amid sustained levels of business and consumer confidence.

#### GDP Growth Outlook

- Driven by fixed investment and improving global environment, domestic economic activity continues to expand. The provisional estimates (PE) placed real GDP growth at 8.2% for FY24.

- Industrial activity led by manufacturing continues its momentum on the back of strengthening domestic demand. Moreover, the services sector maintained buoyancy as could be observed by growth in high frequency indicators such as E-way bills, GST revenues, toll collections, aggregate, and a healthy growth in domestic air cargo and port cargo. The purchasing managers’ index for both manufacturing and services continues to exhibit a sustained and healthy expansion.
- Domestic economic activity remains strong. On the supply side, the south-west monsoon is progressing well, with higher cumulative kharif sowing and improving reservoir levels, which bodes well for kharif output. The potential development of La Niña conditions in the latter half of the monsoon season could impact agricultural production in 2024-25. On the demand side, household consumption is bolstered by a recovery in rural demand and consistent discretionary spending in urban areas. Fixed investment activity is robust, supported by the government’s ongoing focus on capital expenditure, healthy balance sheets of banks and corporates, and other policy measures. Private corporate investment is picking up, driven by an increase in bank credit. Merchandise exports grew in June, albeit at a slower rate, while the growth in non-oil-non-gold imports accelerated, indicating resilience of domestic demand. Services exports saw double-digit growth in May 2024 before slowing down in June 2024.
- Improved agricultural activity would improve rural consumption, while urban consumption would be supported by buoyancy in services activity. Additionally, improvement in global trade prospects are expected to support external demand.

Persistent geopolitical tensions and volatility in international financial markets and geo-economic fragmentation do pose risk to this outlook. Based on these considerations, the RBI, in its August 2024 monetary policy, has projected real GDP growth at 7.2% y-o-y for FY25.

**Table 2: RBI's GDP Growth Outlook (Y-o-Y %)**

FY25P (complete year)	Q1FY25P	Q2FY25P	Q3FY25P	Q4FY25P	Q1FY26P
7.2%	7.1%	7.2%	7.3%	7.2%	7.2%

Note: P-Projected; Source: Reserve Bank of India

**1.2.2 Gross Value Added (GVA)**

Gross Value Added (GVA) is the measure of the value of goods and services produced in an economy. GVA gives a picture of the supply side whereas GDP represents consumption.

**Industry and Services sector leading the recovery charge**

- The gap between GDP and GVA growth turned positive in FY22 (after a gap of two years) due to robust tax collections. Of the three major sector heads, the service sector has been the fastest-growing sector in the last 5 years.
- The **agriculture sector** was holding growth momentum till FY18. In FY19, the acreage for the rabi crop was marginally lower than the previous year which affected the agricultural performance. Whereas FY20 witnessed growth on account of improved production. During the pandemic-impacted period of FY21, the agriculture sector was largely insulated as timely and proactive exemptions from COVID-induced lockdowns to the sector facilitated uninterrupted harvesting of rabi crops and sowing of kharif crops. However, supply chain disruptions impacted the flow of agricultural goods leading to high food inflation and adverse initial impact on some major agricultural exports. However, performance remained steady in FY22.

In FY23, the agriculture sector performed well despite weather-related disruptions, such as uneven monsoon and unseasonal rainfall, impacting yields of some major crops and clocked a growth of 4% y-o-y, garnering Rs. 22.3 trillion.

In Q1FY24, this sector expanded at a slower pace of 3.7% y-o-y growth compared to y-o-y growth a quarter ago. This further stumbled to 1.7% in Q2FY24. Further, it experienced y-o-y growth of 0.4% in Q3 and 0.6% in Q4. Leading to expectations of a modest 1.4% rise for the full year, contrasting sharply with the 4.7% growth recorded in FY23. In the Budget 2024-25, the government plans to boost private and public investment in post-harvest activities and expand the application of Nano-DAP across agro-climatic zones. Strategies for self-reliance in oilseeds and dairy development are to be formulated, alongside ramping up the Pradhan Mantri Matsya Sampada Yojana and establishing Integrated Aquaparks. Allocation for PM-Formalisation of Micro Food Processing Enterprises scheme has increased from Rs. 639 in FY24 to Rs. 880 crores in FY25.

Going forward, rising bank credit to the sector and increased exports will be the drivers for the agriculture sector. However, a deficient rainfall may have impact on the reservoir level, weighing on prospects of Kharif sowing. Considering these factors, the agriculture sector is estimated to attain Rs. 23.7 trillion and mark 1.4% y-o-y growth for complete FY24.

- From March 2020 onwards, the nationwide lockdown due to the pandemic significantly impacted the **industrial sector**. In FY20 and FY21, this sector felt turbulence due to the pandemic and recorded a decline of 1.4% and 0.9%, respectively, on a y-o-y basis. With the opening up of the economy and resumption of industrial activities, it registered 11.6% y-o-y growth in FY22, albeit on a lower base.

The industrial output in FY23 grew by only 2.1% with estimated value Rs. 44.74 trillion owing to decline in manufacturing activities.

The industrial sector grew by 6.0% in Q1FY24, while Q2FY24 growth was up by 13.6% owing to positive business optimism and strong growth in new orders supported manufacturing output. The industrial growth was mainly supported by sustained momentum in the manufacturing and construction sectors. Within manufacturing, industries such as pharma, motor vehicles, metals, petroleum and pharma witnessed higher production growth during the quarter. The construction sector (13.6% growth in Q2FY24) benefited from poor rainfall during August and September and higher implementation of infrastructure projects. This was reflected in robust cement and steel production and power demand in Q2FY24. Overall, H1FY24 picked up by 9.3% with manufacturing and construction activities witnessing significant acceleration. In Q3FY24, growth rate slowed down to 10.5%. It further fell down to 8.4% in Q4FY24.

India's industrial sector is experiencing strong growth, driven by significant expansion in manufacturing, mining, and construction. This growth is supported by positive business sentiment, declining commodity prices, beneficial government policies like production-linked incentive schemes, and efforts to boost infrastructure development. These factors collectively contribute to the sustained buoyancy in industrial growth due to which the industrial growth is estimated at 9.5% on y-o-y basis registering the value of Rs. 48.9 trillion in FY24.

- The **Services sector** was the hardest hit by the pandemic and registered an 8.2% y-o-y decline in FY21. The easing of restrictions aided a fast rebound in this sector, with 8.8% y-o-y growth witnessed in FY22.

Overall, in FY23, benefitting from the pent-up demand, the service sector was valued at Rs. 80.6 trillion and registered growth of 10.0% y-o-y.

In Q1FY24, the services sector growth jumped to 10.7%. Within services, there was a broad-based improvement in growth across different sub-sectors. However, the sharpest jump was seen in financial, real estate, and professional services. Trade, hotels, and transport sub-sectors expanded at a healthy pace gaining from strength in discretionary demand. The service sector growth in Q2FY24 moderated to 6.0% partly due to the normalization of base effect and some possible dilution in discretionary demand. Considering these factors, service sector marked 8.3% growth in H1FY24. In Q3FY24 growth increased to 7.1% compared to 7.2% last year in the same quarter. In Q4FY24, growth declined to 6.7% compared to 7.2% last year in the same quarter.

With this performance, steady growth in various service sector indicators like air passenger traffic, port cargo traffic, GST collections, and retail credit are expected to support the services sector. With this, the growth of service sector is estimated at Rs. 86.7 trillion registering 7.6% growth in FY24 overall.

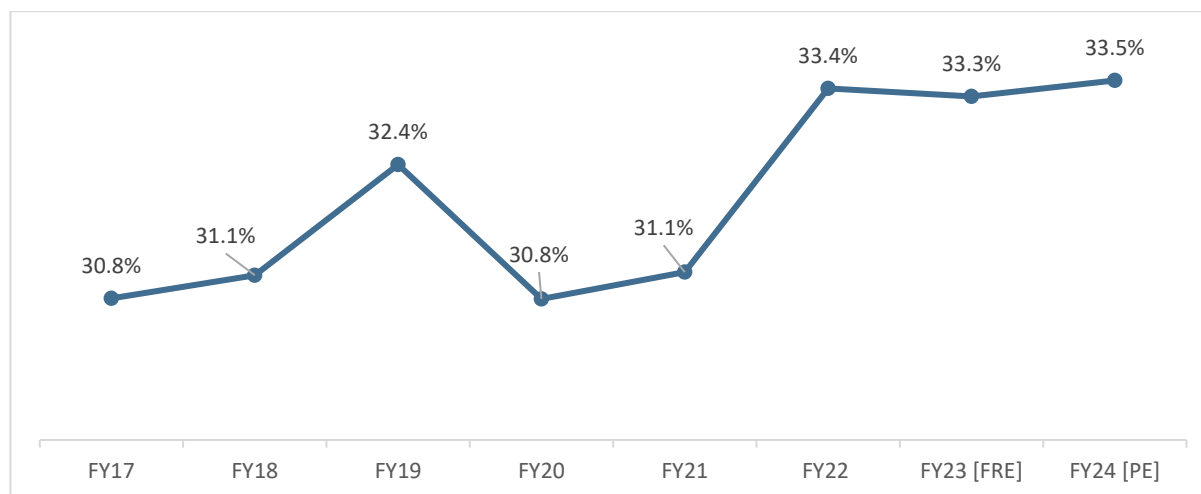
**Table 3: Sectoral Growth (Y-o-Y % Growth) - at Constant Prices**

At constant Prices	FY19	FY20	FY21	FY22	FY23 (FRE)	FY24 (PE)
<b>Agriculture, Forestry &amp; Fishing</b>	<b>2.1</b>	<b>6.2</b>	<b>4.1</b>	<b>3.5</b>	<b>4.7</b>	<b>1.4</b>
<b>Industry</b>	<b>5.3</b>	<b>-1.4</b>	<b>-0.9</b>	<b>11.6</b>	<b>2.1</b>	<b>9.5</b>
Mining & Quarrying	-0.9	-3.0	-8.6	7.1	1.9	7.1
Manufacturing	5.4	-3.0	2.9	11.1	-2.2	9.9
Electricity, Gas, Water Supply & Other Utility Services	7.9	2.3	-4.3	9.9	9.4	7.5
Construction	6.5	1.6	-5.7	14.8	9.4	9.9
<b>Services</b>	<b>7.2</b>	<b>6.4</b>	<b>-8.2</b>	<b>8.8</b>	<b>10.0</b>	<b>7.6</b>
Trade, Hotels, Transport, Communication & Broadcasting	7.2	6.0	-19.7	13.8	12.0	6.4
Financial, Real Estate & Professional Services	7.0	6.8	2.1	4.7	9.1	8.4
Public Administration, Defence and Other Services	7.5	6.6	-7.6	9.7	8.9	7.8
<b>GVA at Basic Price</b>	<b>5.8</b>	<b>3.9</b>	<b>-4.2</b>	<b>8.8</b>	<b>6.7</b>	<b>7.2</b>

Note: FRE – First Revised Estimates, PE – Provisional Estimate; Source: MOSPI

### 1.2.3 Investment Trend in Infrastructure

Gross Fixed Capital Formation (GFCF), which is a measure of the net increase in physical assets, witnessed an improvement in FY22. As a proportion of GDP, it is estimated to be at 33.4%, which is the highest level in 5 years (since FY17). In FY23, the ratio of investment (GFCF) to GDP remained flat at 33.3%. Continuing in its growth trend, this ratio has reached 33.5% in FY24.

**Chart 2: Gross Fixed Capital Formation (GFCF) as % of GDP (At constant prices):**


Note: 3RE – Third Revised Estimate, 2RE – Second Revised Estimates, 1RE – First Revised Estimates, PE – Provisional Estimate, FAE-First Advance Estimate; Source: MOSPI

Overall, the support of public investment in infrastructure is likely to gain traction due to initiatives such as Atmanirbhar Bharat, Make in India, and Production-linked Incentive (PLI) scheme announced across various sectors.

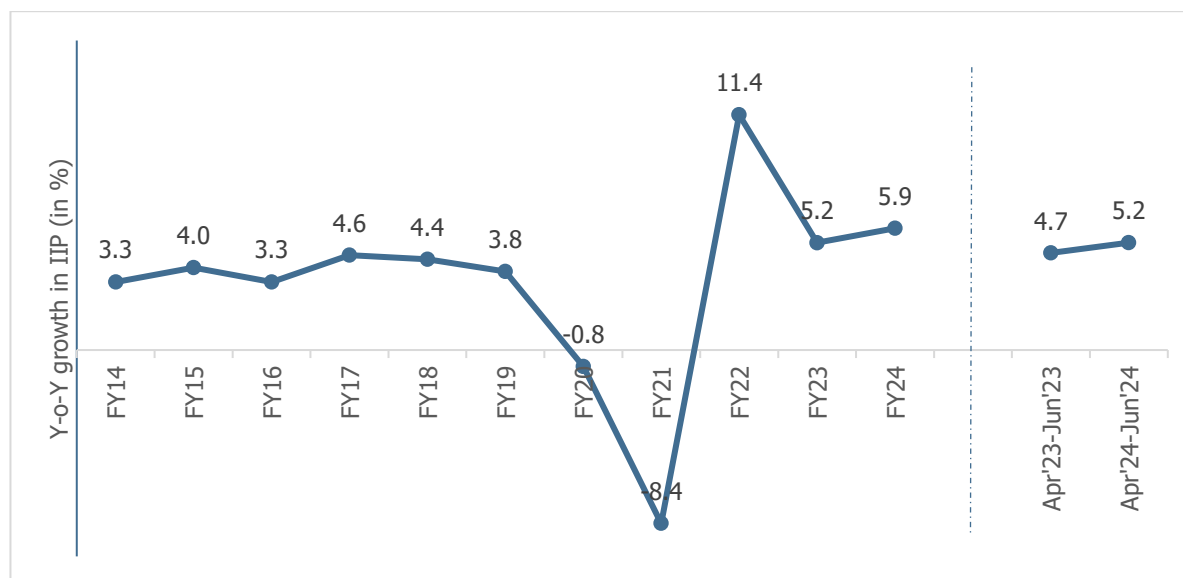
## 1.2.4 Industrial Growth

### Improved Core and Capital Goods Sectors helped IIP Growth Momentum

The Index of Industrial Production (IIP) is an index to track manufacturing activity in an economy. On a cumulative basis, IIP grew by 11.4% y-o-y in FY22 post declining by 0.8% y-o-y and 8.4% y-o-y, respectively, in FY20 and FY21. This high growth was mainly backed by a low base of FY21. FY22 IIP was higher when compared with the pre-pandemic level of FY20, indicating that while economic recovery was underway. During FY23, the industrial output recorded a growth of 5.2% y-o-y supported by a favorable base and a rebound in economic activities.

During FY24, the industrial output recorded a growth of 5.9% y-o-y supported by growth in manufacturing and power generation sectors. The period April 2024 – June 2024, industrial output grew by 5.2% compared to the 4.7% growth in the corresponding period last year. For the month of June 2024, the IIP growth increased to 4.2% compared to the last year's 4.0%, on account of growth in mining. The manufacturing sector showed a decline in June 2024 from 3.5% in June 2023 to 2.6% in June 2024. Within the growth in manufacturing, the top three positive contributors were Manufacture of basic metals, Manufacture of electrical equipment, and Manufacture of motor vehicles, trailers, and semi-trailers.

So far in the current fiscal, the government's spending on infrastructure has been strong, and there are visible signs of pick up in private investment. Consumer durables production increased due to favorable conditions, while non-durables saw a slight decline. Urban demand is driving consumption, while rural demand is recovering. Good monsoon forecasts are positive, but high unemployment and food inflation pose challenges. Infrastructure/construction output is growing well due to government spending. Private investment and manufacturing capacity utilization are increasing, supporting hopes for private sector growth. Good monsoon could boost rural demand, but food inflation remains a concern. Overall, sustained improvements in consumption and private investment are crucial for industrial performance.

**Chart 3: Y-o-Y growth in IIP (in %)**

Source: MOSPI

### 1.2.5 Consumer Price Index

India's consumer price index (CPI), which tracks retail price inflation, stood at an average of 5.5% in FY22 which was within RBI's targeted tolerance band of 6%. However, consumer inflation started to upswing from October 2021 onwards and reached a tolerance level of 6% in January 2022. Following this, CPI reached 6.9% in March 2022.

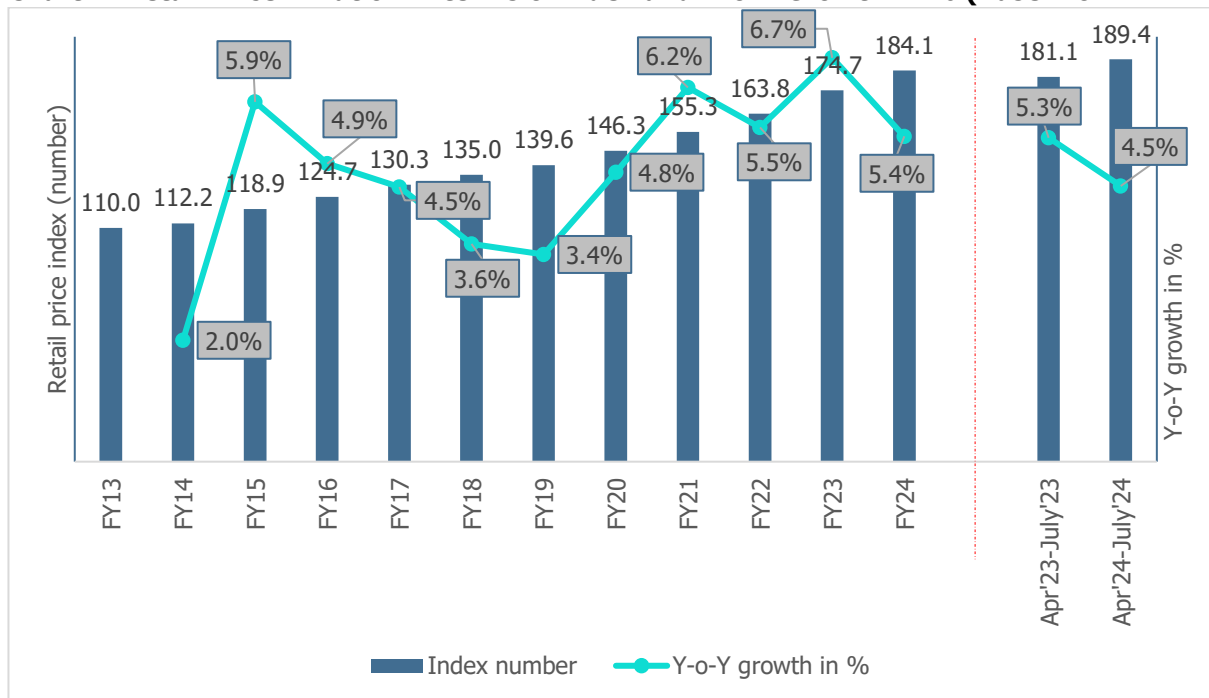
CPI remained elevated at an average of 6.7% in FY23, above the RBI's tolerance level. However, there was some respite toward the end of the fiscal wherein the retail inflation stood at 5.7% in March 2023, tracing back to the RBI's tolerance band. Apart from a favorable base effect, the relief in retail inflation came from a moderation in food inflation.

In FY24, the CPI moderated for two consecutive months to 4.7% in April 2023 and 4.3% in May 2023. This trend snapped in June 2023 with CPI rising to 4.9%. In July 2023, the CPI had reached its highest point at 7.4%, this was largely due to increase in food prices. The notable surge in vegetable prices and in other food categories such as cereals, pulses, spices, and milk have driven this increase. In August 2023, the food inflation witnessed some moderation owing to government's active intervention. This was further moderated for second consecutive month in September 2023 to 5%, led by a sharp correction in vegetables prices and lower LPG prices. Helped by deflation in the fuel and light category, the retail inflation in October 2023 softened at 4.9%. This trend reversed in November 2023 due to spike in certain vegetable prices as well as sticky inflation in non-perishable food items such as cereals, pulses and spices and the CPI rose to 5.6%. In the month of December 2023, elevated food prices and an unfavourable base drove headline inflation to a four-month peak of 5.7%. However in the month of January and February, food prices softened and the inflation was reported at 5.1% for both the months. March witnessed further softening of prices registering 4.9% growth. For FY24 inflation moderated to 5.4% which are within the boundaries set of 2% to 6% by the RBI.

High inflation in specific food items poses inflation risk, even though an improvement in south-west monsoon and progress in sowing are improving the food inflation outlook. This makes it crucial to monitor monsoon distribution. Additionally, global food prices also show some softening in July, post increases in March 2024. While government initiatives are expected to mitigate upward price pressure, external risks from geopolitical tensions may affect supply chains and commodity prices. The numbers for April 2024-July 2024 show a decline in inflation growth y-o-y to 4.5%

as compared to inflation growth y-o-y of 5.3% in April 2023-July 2023 period. For July 2024, CPI inflation stood at 3.5% which has been the lowest retail inflation in the last 5 years. There was a decline in inflation among all groups with significant decline in vegetables, spices, and fruits subgroup. Additionally, food inflation was also at the lowest in this month since June 2023.

**Chart 4: Retail Price Inflation in terms of index and Y-o-Y Growth in % (Base: 2011-12=100)**

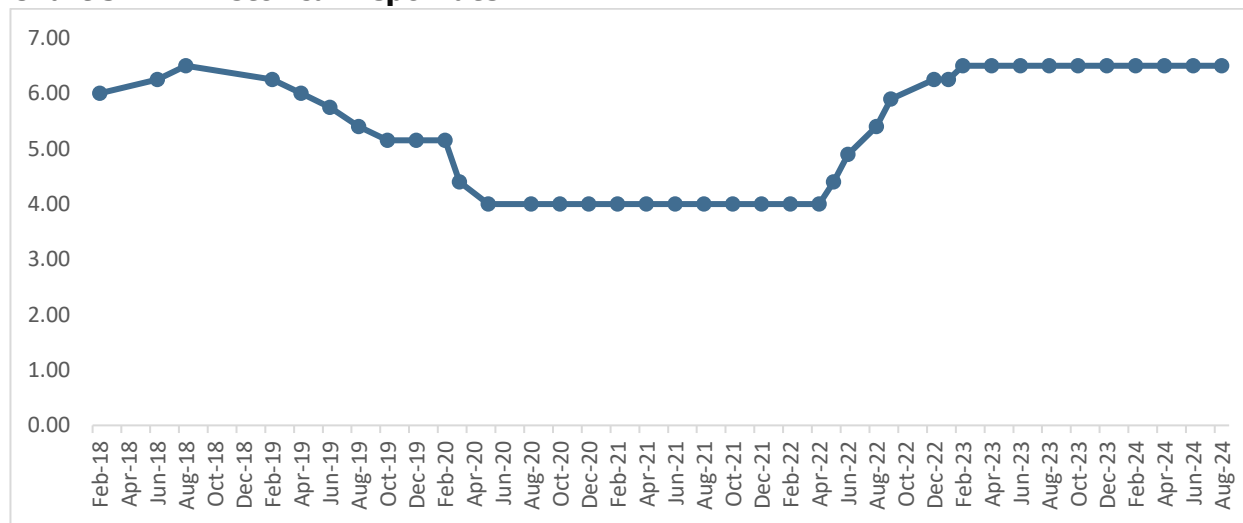


Source: MOSPI

The CPI is primarily factored in by RBI while preparing their bi-monthly monetary policy. At the bi-monthly meeting held in August 2024, RBI projected inflation at 4.5% for FY25 with inflation during Q2FY25 at 4.4%, Q3FY25 at 4.7%, Q4FY25 at 4.3%, and Q1FY26 at 4.4%.

Considering the current inflation situation, RBI has kept the repo rate unchanged at 6.5% again in the August 2024 meeting of the Monetary Policy Committee.

**Chart 5: RBI historical Repo Rate**



Source: RBI

In a meeting held in August 2024, RBI also maintained the liquidity adjustment facility (LAF) corridor by adjusting the standing deposit facility (SDF) rate of 6.25% as the floor and the marginal standing facility (MSF) at the upper end of the band at 6.75%.

Further, the central bank continued to remain focused on the withdrawal of its accommodative stance. While headline inflation has started easing due to softening in core component and economic activity has been resilient supported by domestic and investment demand, volatility in food prices due to adverse weather conditions pose a risk to the path of disinflation. Given the uncertainties in food prices that might derail the path to bring down inflation, the Central Bank has decided to be vigilant and maintain an active disinflationary stance to ensure complete transmission of past rate cuts and anchoring of inflation expectations until a better alignment of the headline CPI inflation with the target is achieved, while supporting growth.

**1.2.6 Overview on Key Demographic Parameters**

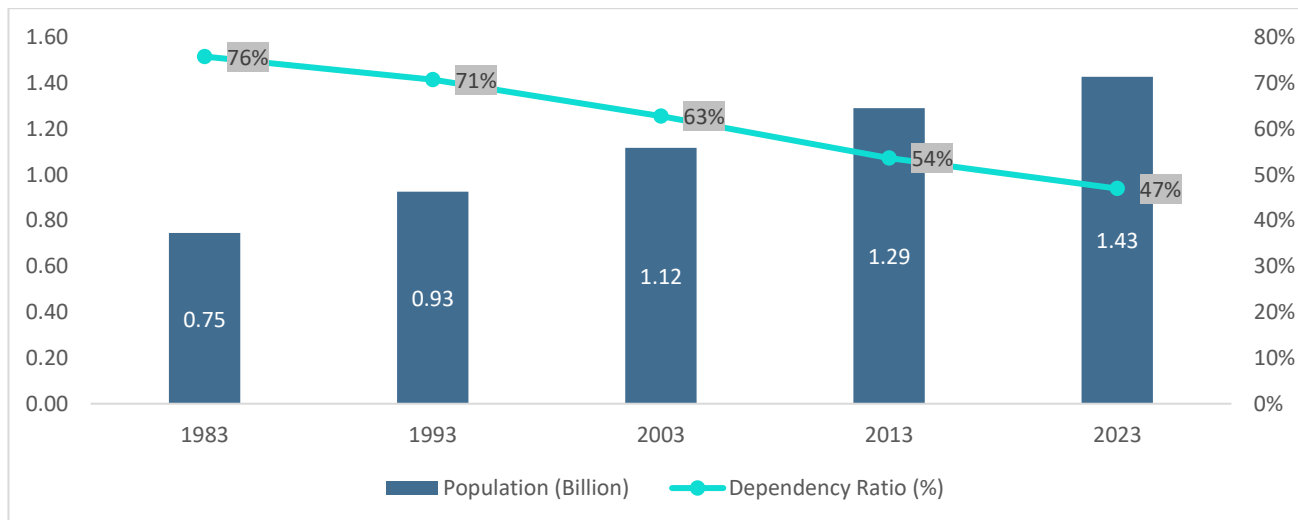
- Population growth and Urbanization**

The trajectory of economic growth of India and private consumption is driven by socio-economic factors such as demographics and urbanization. According to the world bank, India’s population in 2022 surpassed 1.42 billion slightly higher than China’s population 1.41 billion and became the most populous country in the world.

Age Dependency Ratio is the ratio of dependents to the working age population, i.e., 15 to 64 years, wherein dependents are population younger than 15 and older than 64. This ratio has been on a declining trend. It was as high as 76% in 1983, which has reduced to 47% in 2023. Declining dependency means the country has an improving share of working-age population generating income, which is a good sign for the economy.



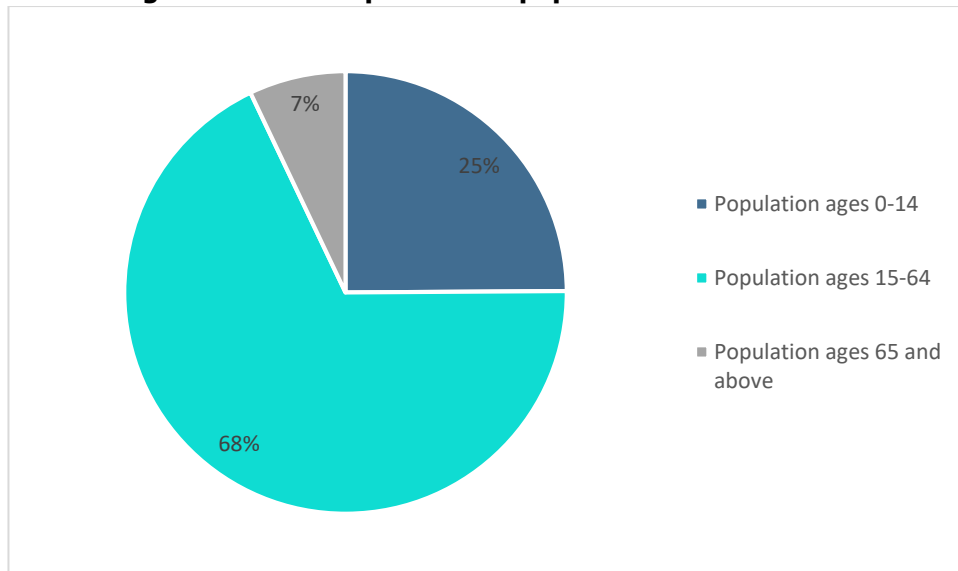
**Chart 6: Trend of India Population vis-à-vis dependency ratio**



Source: World Bank Database

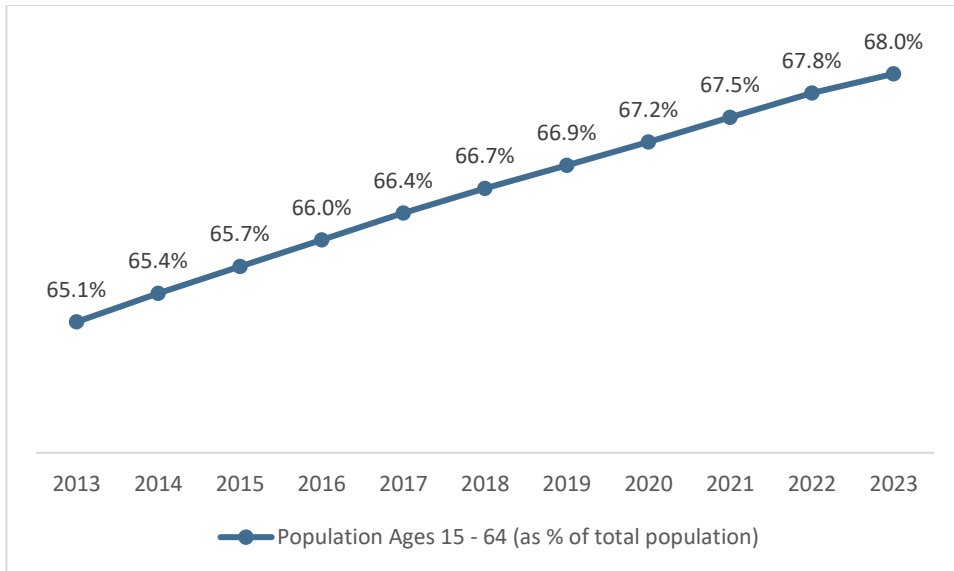
With an average age of 29, India has one of the youngest populations globally. With vast resources of young citizens entering the workforce every year, it is expected to create a 'demographic dividend'. India is home to a fifth of the world's youth demographic and this population advantage will play a critical role in economic growth.

**Chart 7: Age-Wise Break Up of Indian population**



Source: World Bank Database

**Chart 8: Yearly Trend - Young Population as % of Total Population**

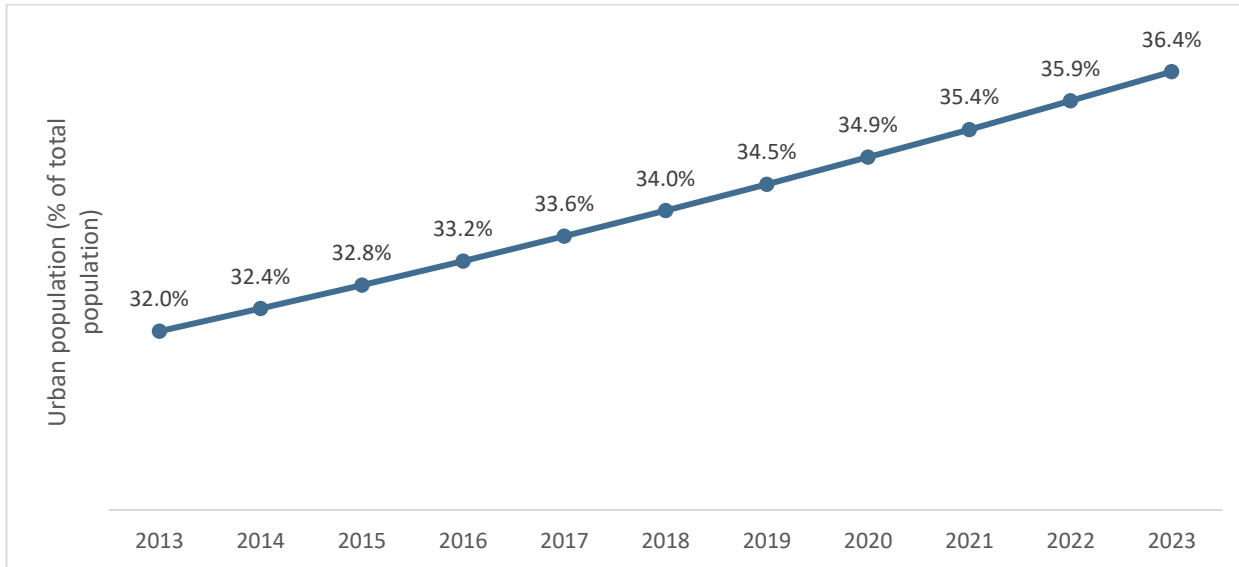


Source: World Bank database

- Urbanization**

The urban population is significantly growing in India. The urban population in India is estimated to have increased from 413 million (32% of total population) in 2013 to 519.5 million (36.4% of total population) in the year 2023. People living in Tier-2 and Tier-3 cities have greater purchasing power.

**Chart 9: Urbanization Trend in India**



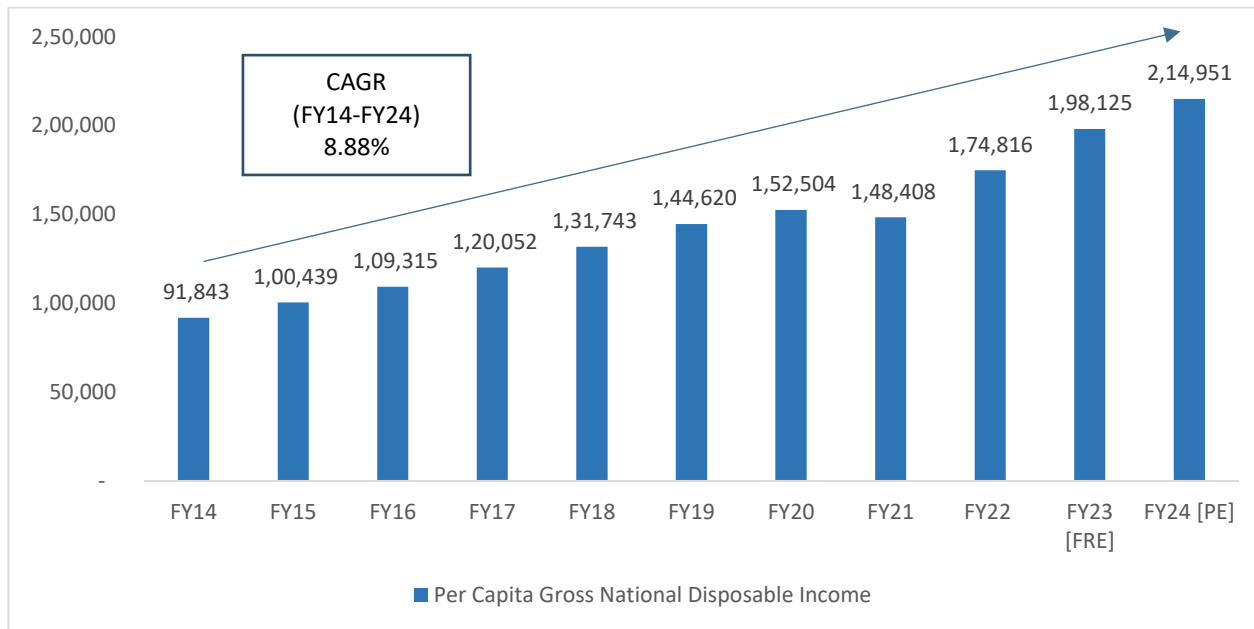
Source: World Bank Database

- Increasing Per Capita Disposable Income**

Gross National Disposable Income (GNDI) is a measure of the income available to the nation for final consumption and gross savings. Between the period FY14 to FY24, per capita GNDI at current prices registered a CAGR of 8.88%. More disposable income drives more consumption, thereby driving economic growth.

The chart below depicts the trend of per capita GNDI in the past decade:

**Chart 10: Trend of Per Capita Gross National Disposable Income (Current Price)**

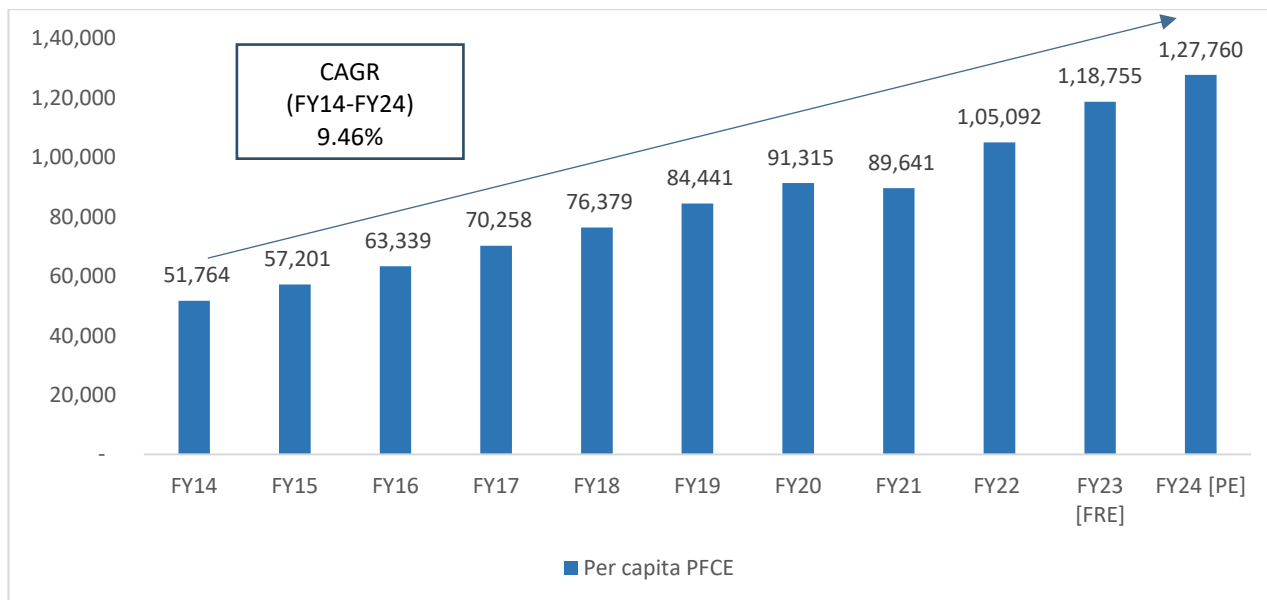


Note: 3RE – Third Revised Estimate, 2RE – Second Revised Estimates, 1RE – First Revised Estimates, PE – Provisional Estimate; Source: MOSPI

• **Increase in Consumer Spending**

With increase in disposable income, there has been a gradual change in consumer spending behaviour as well. Private Final Consumption Expenditure (PFCE) which is measure of consumer spending has also showcased significant growth in the past decade at a CAGR of 9.46%. Following chart depicts the trend of per capita PFCE at current prices:

**Chart 11: Trend of Per Capita Private Final Consumption Expenditure (Current Price)**



Source: MOSPI

### 1.2.7 Concluding Remarks

The major headwinds to global economic growth are escalating geopolitical tensions, volatile global commodity prices, high interest rates, inflation woes, volatility in international financial markets, climate change, rising public debt, and new technologies. Despite the global economic growth uncertainties, the Indian economy is relatively better placed in terms of GDP growth compared to other emerging economies. According to IMF's forecast, it is expected to be 7% in CY24 compared to the world GDP growth projection of 3.2%. The bright spots for the economy are continued healthy domestic demand, support from the government towards capital expenditure, moderating inflation, investments in technology and improving business confidence.

Likewise, several high-frequency growth indicators including the purchasing managers index, E-way bills, bank credit, toll collections and GST collections have shown improvement in FY24. Moreover, normalizing the employment situation after the opening up of the economy is expected to improve and provide support to consumption expenditure.

The India Meteorological Department (IMD) has made a significant forecast, predicting "above normal" rainfall for the upcoming monsoon season, marking the first time in a decade that such an optimistic outlook has been declared at the initial stage. This forecast, coupled with an anticipated eight-year-high rainfall, offers promising prospects for the agrarian economy and inflation. The expected development of La Nina conditions in the second half of the year (August-September) further adds to the positive outlook. La Nina is a climate pattern that tends to enhance rainfall activity. IMD's more optimistic prediction is expected to bolster agricultural growth and incomes, while also potentially alleviating stubborn food inflation pressures.

At the same time, public investment is expected to exhibit healthy growth as the government has allocated a strong capital expenditure of about Rs. 11.11 lakh crores for FY25. The private sector's intent to invest is also showing improvement as per the data announced on new project investments and resilience shown by the import of capital goods. Additionally, improvement in rural demand owing to healthy sowing, improving reservoir levels, and progress in south-west monsoon along with government's thrust on capex and other policy support will aid the investment cycle in gaining further traction.

## 2. Overview of Energy Transition Equipment & Power Technologies Industry

The global energy landscape is undergoing a significant transformation, often referred to as the Energy Transition & Power Technologies industry. This Energy Transition & Power Technologies marks a shift from traditional, carbon-intensive energy sources like coal, oil, and natural gas to cleaner, more sustainable energy sources such as solar, wind, and hydrogen. At the core of this transition is the adoption of energy transition equipment & power technologies, which encompasses a broad range of novel methods, advanced equipment, innovative technologies and devices designed to facilitate the generation, storage, distribution, and efficient use of renewable energy.

The Energy Transition & Power Technologies market is growing rapidly, driven by the global need to combat climate change, reduce greenhouse gas emissions, and increase energy efficiency. Countries around the world are implementing policies to promote the adoption of clean energy technologies, including renewable energy targets, carbon pricing mechanisms, and subsidies for green technology. These policies, combined with the declining cost of renewable energy technologies, are creating a favorable environment for the energy transition equipment market to expand.

AC (Alternating Current) and DC (Direct Current) technologies each serve crucial roles in modern energy systems. AC is the dominant form of power distribution globally, favored for its ease of voltage transformation and extensive infrastructure, making it ideal for household, industrial, and grid-level applications. On the other hand, DC, especially in the form of HVDC (High Voltage Direct Current), is essential for long-distance transmission and renewable energy integration, offering higher efficiency with fewer losses. Both AC and DC technologies are vital for the energy transition, working together to support reliable, efficient, and renewable power distribution.

Energy transition equipment encompasses various technologies aimed at advancing renewable energy and reducing reliance on fossil fuels. Solar panels, wind turbines, hydropower systems, and geothermal or biomass systems generate clean electricity for residential, commercial, and utility-scale applications. Energy storage systems, such as lithium-ion batteries and hydrogen fuel cells, balance supply and demand by storing excess renewable energy. Grid modernization, including smart grids and high-voltage transmission, enhances efficiency and facilitates renewable integration, while microgrids improve energy resilience by enabling localized generation. Electric vehicle (EV) infrastructure, including charging stations and vehicle-to-grid (V2G) technology, supports the shift to electric transportation. Energy-efficient appliances further reduce energy consumption, contributing to overall sustainability.

High Voltage Direct Current (HVDC) and Flexible Alternating Current Transmission Systems (FACTS) are integral part of high voltage electrical equipment and solutions for electrical grid connectivity and energy transition system as they play a critical role in the integration and transmission of renewable energy. Both HVDC and FACTS fall under the broader category of energy grid modernization equipment, which is essential for ensuring that high voltage renewable energy can be efficiently transmitted, distributed, and stabilized within the grid. These technologies help overcome challenges related to long-distance power transmission, grid stability, and the variable nature of renewable energy sources like solar and wind.

Some of the key product lines in the critical energy transition equipments and power technologies industry are high voltage electrical equipment and solutions such as reactors, transformers, line traps, Edison composites, line tuners, instrument transformers, capacitor banks, converters, harmonic filters, reactive power compensation systems, thyristor-controlled series capacitors ("TCSC"), unified power flow controllers ("UPFC"), HVDC, FACTS, etc. and grid interconnection solutions feature technologies such as static synchronous compensators ("STATCOM") and static var compensator systems (SVC). More details of these product lines and their market trends have been described later in this report.

The global push towards carbon neutrality, with countries like the EU aiming for net-zero emissions by 2050 and China by 2060, is driving significant investments in renewable energy and infrastructure. Falling costs of renewable technologies like solar and wind, coupled with technological advancements, have made renewable energy increasingly competitive, further fuelling the energy transition equipments and power technologies market. Additionally, the shift

towards decentralized energy systems and local renewable generation enhances energy security by reducing dependence on fossil fuel imports. Technological innovations, such as smart grids, AI, and better energy storage systems, are optimizing energy management and integration of renewables. Investments in modernizing grid infrastructure, such as high-voltage transmission systems, are crucial to accommodating renewable energy and ensuring the long-term success of the global energy transition.

The energy transition equipment and power technologies market is poised for significant growth in the coming decades. As governments and businesses around the world intensify their efforts to decarbonize the energy sector, the market for energy transition equipment will continue to expand, driven by technological advancements, supportive policies, and increasing public awareness of the need for climate action.

Emerging markets such as India, China, and Southeast Asia are expected to be major growth areas for energy transition equipment, as these regions are rapidly scaling up their renewable energy capacity and investing in grid modernization. Additionally, the electrification of transportation and the rise of green hydrogen as a clean energy carrier will open new opportunities for equipment manufacturers and technology providers.

The energy transition equipment market is a cornerstone of the global shift towards a sustainable energy future. By providing the tools and technologies needed to generate, store, distribute, and efficiently use clean energy, this market is essential for achieving global climate goals, enhancing energy security, and promoting economic growth in a low-carbon world.

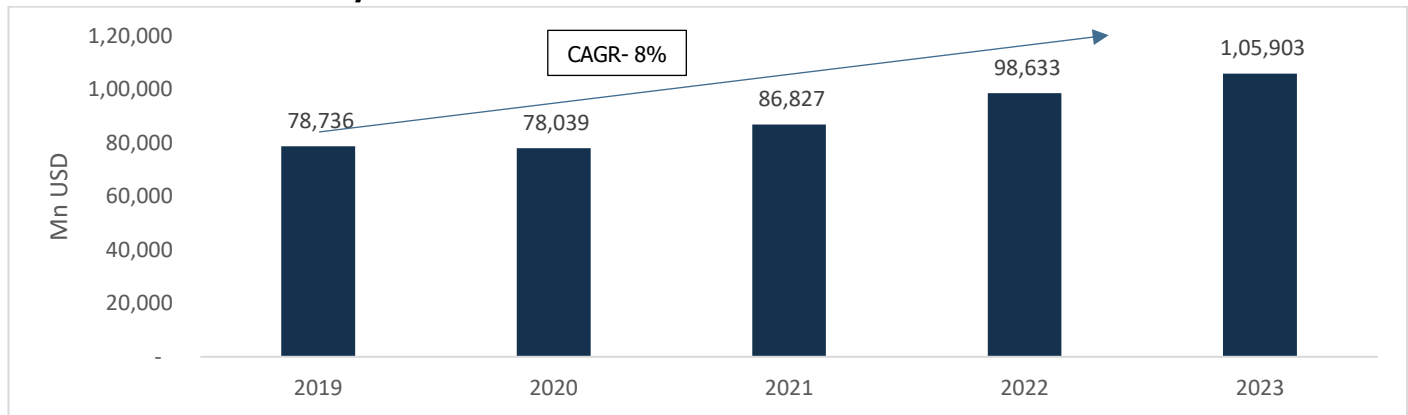
### 3. Overview of the Global and Indian Electricity Transmission Sector

#### 2.1 Global Electricity Transmission Sector

The electricity demand is expected to grow globally majorly driven by the thriving wind, solar, natural gas-fired generation, and nuclear sectors. The demand is also expected to come from residential, commercial, and industrial activities and the rising electric vehicle growth.

Transmission lines are high-voltage power lines that distribute electricity over a long distance from big power plants to smaller power distribution lines for use at the local level. The increasing electricity demand in the world, especially the need to integrate renewable energy into the main grid line is projected to drive the energy transition and power technologies sector globally. The transmission sector has grown at a CAGR of 8% in CY19 at Mn 78,736 USD to Mn 1,05,903 USD in CY23.

**Chart 12: Global Electricity Transmission Sector**



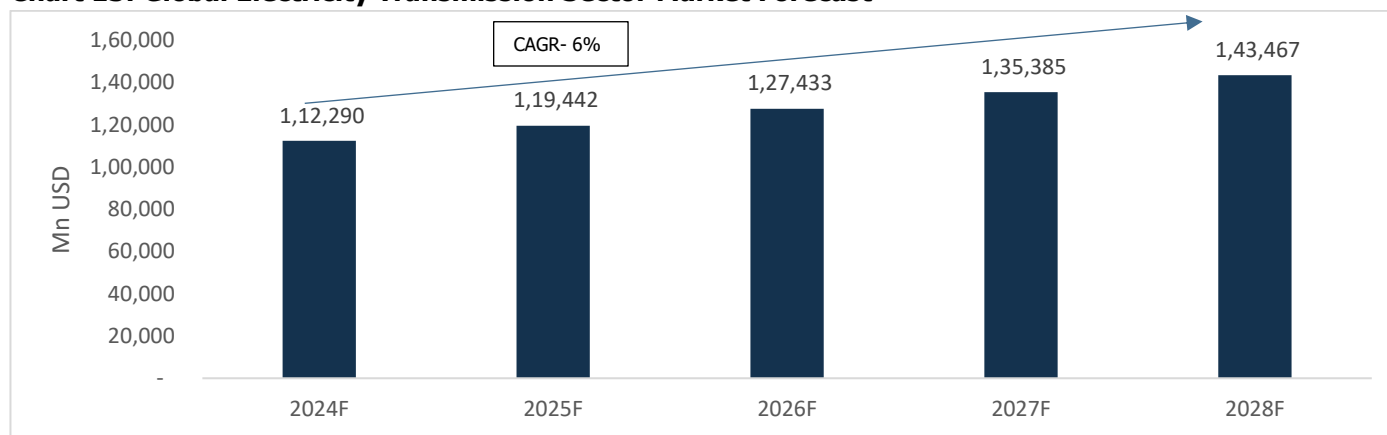
Source: Maia Research, CareEdge Research

## 2.2 Future Market Trends and Key Investment Drivers

The global transmission line market is poised for a transformative shift as the energy transition and power technologies sector is moving towards more sustainable and energy-efficient energy sources. The cross-border transmission lines and multilateral power trade around the world especially in ASEAN countries are expected to attract investments in the energy transition and power technologies sector.

The market size consists of the entire supply chain of the power transmission sector is expected to grow at a CAGR of 6% from Mn 1,12,290 USD in CY24 to Mn 1,43,467 USD in CY28.

**Chart 13: Global Electricity Transmission Sector Market Forecast**



Source: Maia Research, CareEdge Research

The energy transition and power technologies market is currently undergoing a major change with countries in pursuit of better efficiencies and more suitability for integrating renewable energy. Several countries are upgrading their energy transition and power technologies lines to higher voltages to reduce transmission losses. Whereas technological changes and upgrades are being made to make the energy transition and power technologies systems more stable against the intermittent nature of renewable energy sources.

Besides, the increased renewable power capacity has raised the need for countries to interconnect their energy transition and power technologies systems in order to balance generation and demand through the export and import of electricity. This has pushed the construction of higher-capacity interconnection lines.

Further, China and the US are the top two countries in terms of transmission length. Energy transition and power technologies lines are upgraded with advanced technologies in developed countries, given their universal access to electricity, contributing to the energy transition and power technologies sector growth. Whereas in developing countries, the growth is brought about by the expansion of grids to provide electricity to all parts.

## 2.3 Transmission Network in India

The transmission network in India operates at different voltages to cater to different needs in the industry. The different voltage levels include Extra High Voltage (EHV), High Voltage, Medium Voltage, and Low Voltage.

The following table shows the distribution of the voltage lines:

**Table 4: Distribution of Voltage Lines**

<b>Extra High Voltage</b>	765 kV, 400 kV and 220 kV
<b>High Voltage</b>	132 kV and 66 kV
<b>Medium Voltage</b>	33 kV, 11 kV, 6.6 kV and 3.3 kV

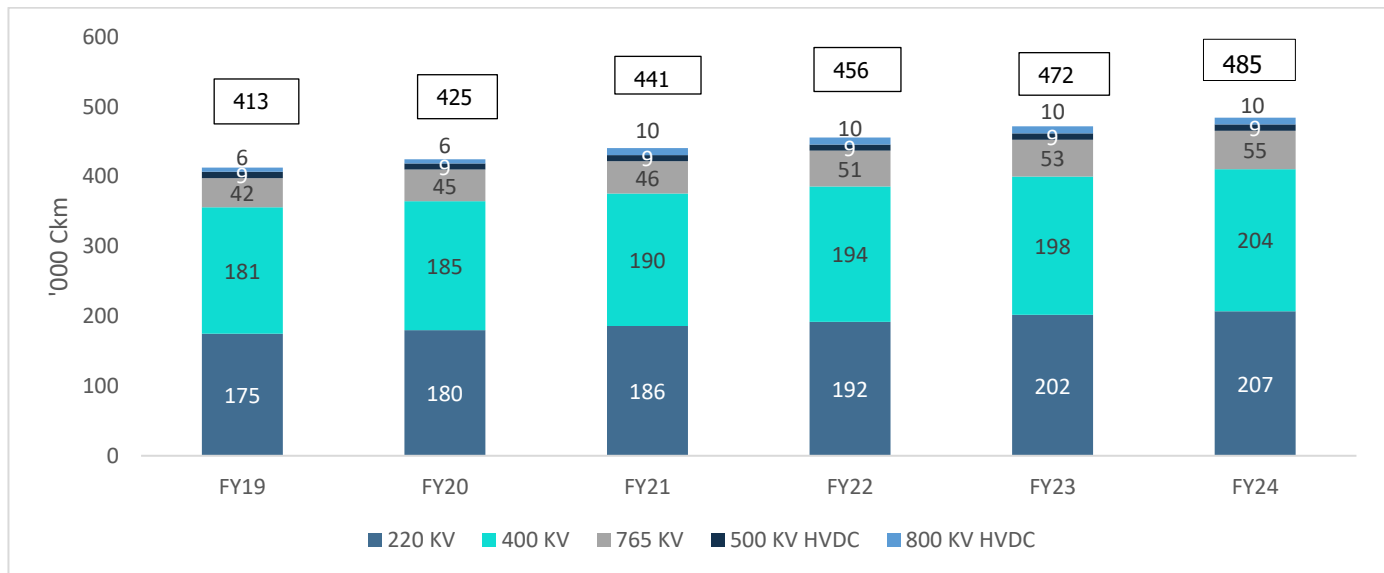
**Low Voltage**

1.1kV, 220 kV and below

Further, India’s energy transition and power technologies system has expanded at a significant pace driven by growing demand, the government’s focus on providing electricity in rural areas, and the need for connecting the generation stations including integration of RE sources from the RE-rich states. In addition, with the implementation of two Central Sector Schemes namely, the North Eastern Regional Power System Improvement Project (NERPSIP) and Comprehensive Scheme of Transmission & Distribution System in Arunachal Pradesh & Sikkim, the transmission and distribution infrastructure of North Eastern states are being strengthened.

Moreover, the transmission line network grew at a CAGR of approximately 3% to 4,85,544 CKm as of March 2024 from 4,13,407 CKm as of March 2019. During FY24, 14,203 CKm of transmission lines were added to the total network. The transmission line network stood at 4,87,587 CKm as of July 2024. Whereas the transformation line capacity is at 12,65,700 MVA as of July 2024.

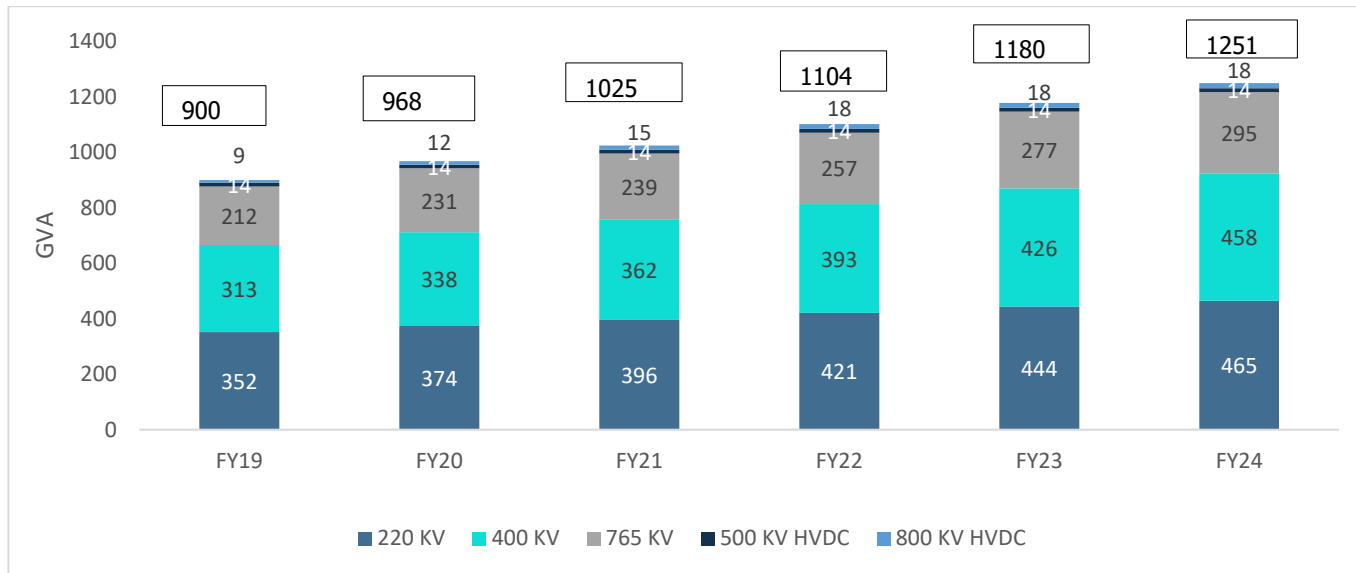
**Chart 14: Transmission Line Network (220 kV & Above)**



Source: Central Electricity Authority, CareEdge Research



**Chart 15: Transformation Capacity (220 kV & Above)**



Source: Central Electricity Authority, CareEdge Research

As of July 2024, there are 54 transmission projects have been constructed and 53 projects are under construction. These include various projects of energy transition and power technologies systems associated with renewable projects and conventional projects in Rajasthan, Karnataka, Maharashtra, etc. These projects are being executed mainly by PGCIL along with private players like Sterlite Power Transmission Limited, Adani Transmission Limited, ReNew Transmission Ventures Private Limited, etc.

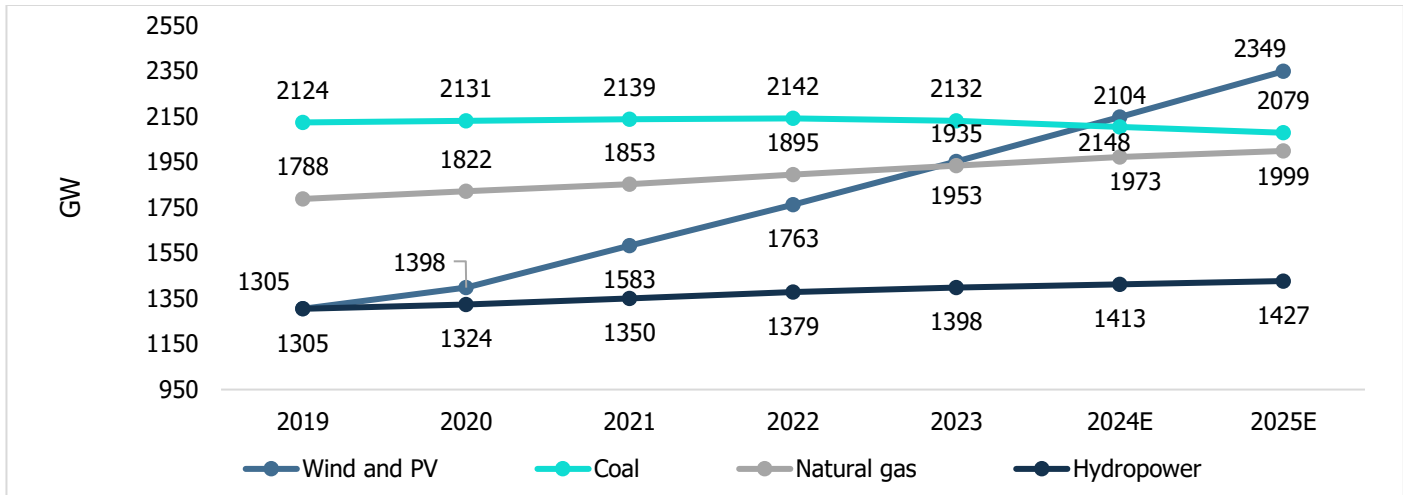
Furthermore, the substation line network grew at a CAGR of approximately 7% to 1.25 million MVA as of March 2024 from 0.8 million MVA as of March 2019. During FY24, the substation line network grew to 1.25 million MVA.

**2.4 Overview of Global Renewable Energy**

**2.4.1 Global Power Sector**

According to IEA, Renewable electricity capacity additions achieved an estimated 507 GW in 2023, marking an increase of nearly 50% compared to the previous year, 2022. The substantial growth is attributed to ongoing policy support in over 130 countries, prompting a significant shift in the global growth trend. The global acceleration in 2023 was primarily fuelled by the year-on-year expansion of China's thriving market for solar PV (+116%) and wind (+66%). The trend of increasing renewable power capacity additions is expected to persist over the next five years, with solar PV and wind collectively representing a record 96% of the total. This dominance is due to their lower generation costs compared to both fossil and non-fossil alternatives in most countries, coupled with sustained policy backing.

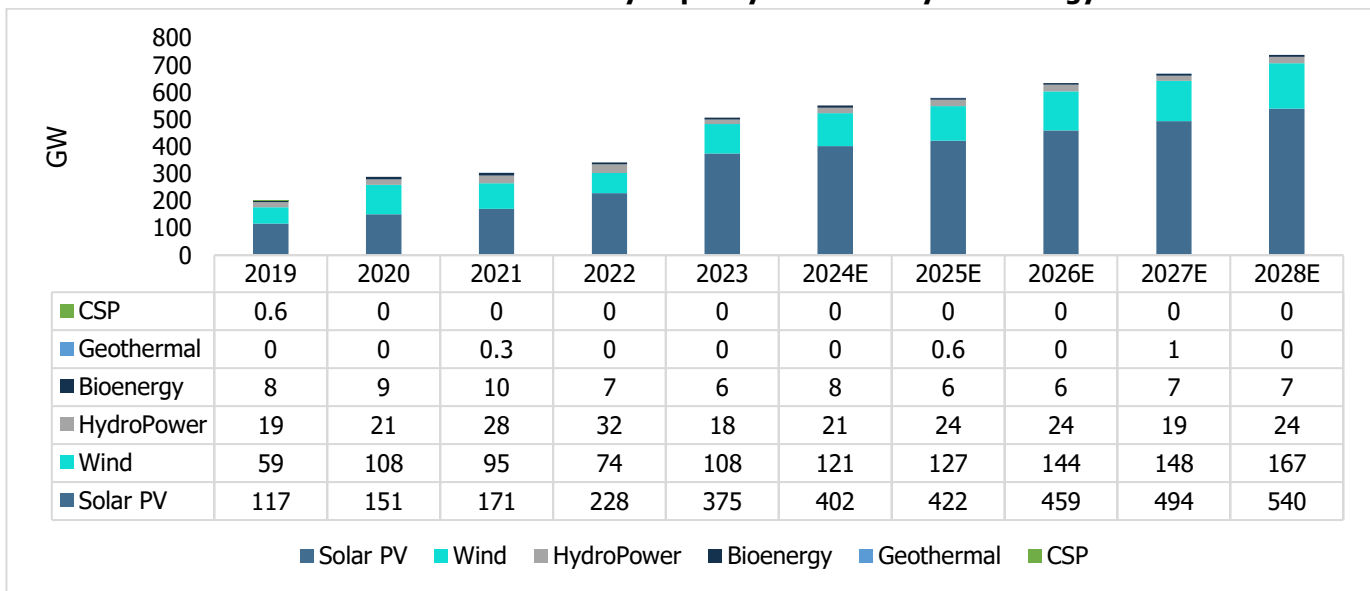
**Chart 16: Global Power Sector Installed Capacity**



Source: IEA

### 2.4.2 Global Renewable Installed Capacity

**Chart 17: Forecasted Net Renewable Electricity Capacity Additions by Technology**



Source: IEA

Solar PV capacity, encompassing both large utility-scale and small distributed systems, constitutes two-thirds of the anticipated growth in global renewable capacity for the current year. Solar PV and wind installed capacity constitute to more than 90% of the total renewable energy installed capacity. The installed capacity of renewable energy is expected to reach 11,000 GW by 2030 under COP28 targets.

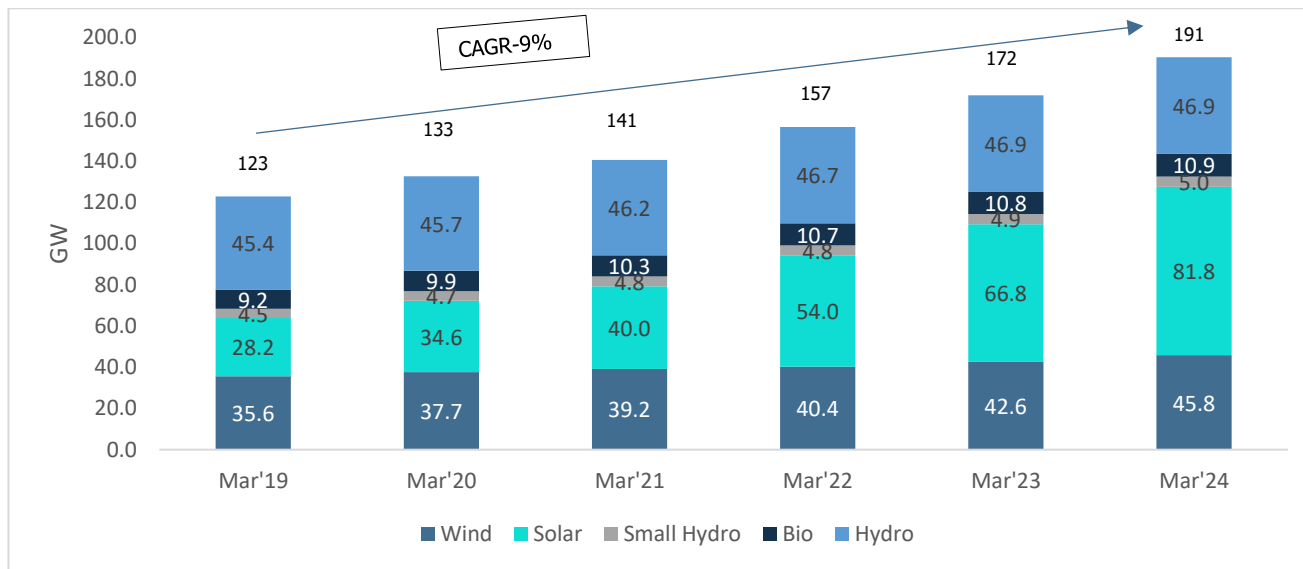
### 2.5 Renewable Energy in India

#### Overview

There has been a significant shift globally in the generation capacity mix due to the growing concerns towards the environment and climate change. India is an active participant and has taken initiatives towards sustainable development and cleaner environment including significant additions of renewable energy generation capacity.

As per REN21 Renewables 2022 Global Status Report, India currently ranks 4<sup>th</sup> globally in total renewable energy installed capacity, wind power capacity and solar power capacity with generation from non-fossil fuel sources being 43% of the total installed generation capacity in 2024. The total potential of renewable power in India is estimated to be 1,639 GW as compared to installed capacity of 191 GW as on March 2024. The installed capacity of renewable energy has grown by 123 GW over FY19-FY24, implying a CAGR of around 9%.

**Chart 18: Renewable Energy - Trend in Installed Capacity**



Note: Small Hydro denotes projects up to 25 MW, Hydro Power Plants denotes projects more than 25 MW

Source: CEA, CareEdge Research

## 4. Global HVDC and FACTS Market

### 4.1 Overview

High Voltage Direct Current (HVDC) and Flexible AC Transmission Systems (FACTS) are both critical energy transition systems and methods for optimizing transmission performance. HVDC uses direct current for the energy transition of bulk power over long distances. HVDC lines are less expensive and provide less loss of DC energy through long distances as compared to AC transmission. It interconnects the networks with different frequencies and characteristics. HVDC lines increase the efficiency of transition lines due to which power is rapidly transferred. They are majorly used in the energy transition of renewable energy.

#### **Advantages of HVDC Transmission:**

- Fewer conductors and insulators are required, reducing the system cost
- Requires less phase-to-phase and ground-to-ground clearance
- Lesser corona loss as compared to HVAC transmission lines of similar power
- Power loss is reduced with DC because fewer numbers of lines are required for power transmission
- Due to the absence of frequency in the HVDC line, losses like skin effect and proximity effect do not occur in the system

FACTS are used to control the energy transition line power flow, voltage control, transient stability improvement, and oscillation damping. They are divided into three types, shunt compensation devices, series compensation devices, and combined series and shunt compensation devices.

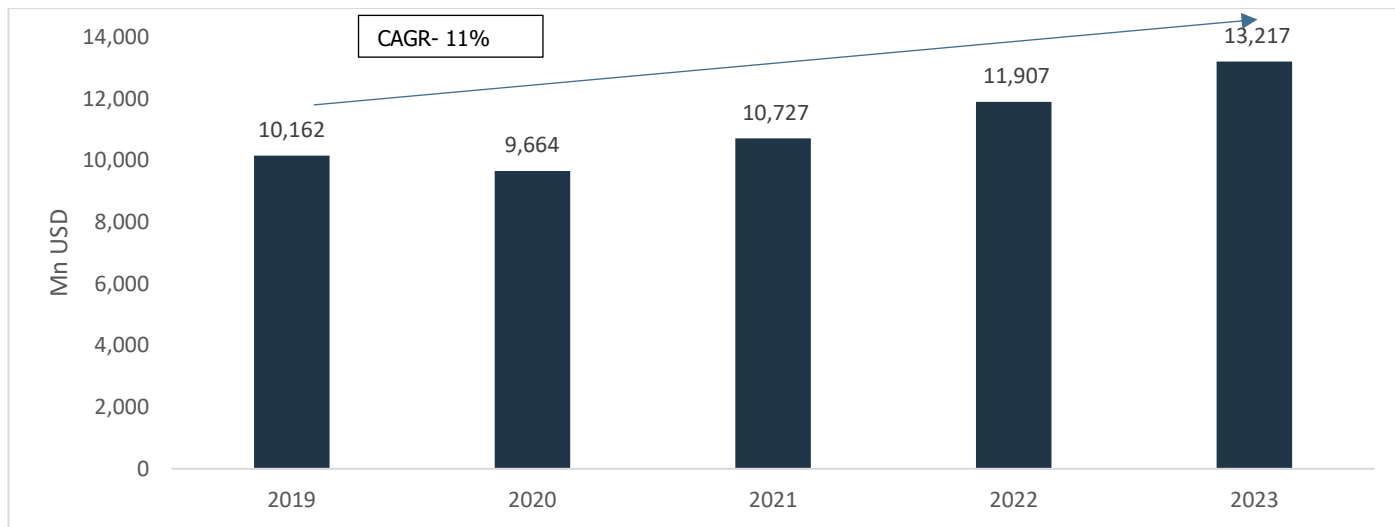
Further, FACTS are static power-electronic devices installed in AC transmission networks to increase energy transfer capability. Also, these devices are employed for congestion management and loss optimization.

The increasing number of decentralized renewables power feeds makes it difficult to ensure reliable & stable grid operation. Therefore, FACTS are used to increase the reliability of AC grids, ensuring stability, and boosting energy transition efficiency. With the help of these high voltage fluctuations, power failures can be prevented, network assets can be optimally utilized, and load-induced disturbances can be mitigated.

The installation of HVDC and FACTS systems is increasing at a rapid pace around the world, including in Europe, North and South America, and China. Another factor attributed to this accelerating trend, alongside the increasing renewable energy capacity, the thriving cross-regional electricity trading, and the rising demand for a more reliable electricity supply, is the economic feasibility of using HVDC to strengthen grid connections. The market also expects to witness 52% of the HVDC transmission capacity originating from Asia.

The global market for HVDC and FACTS has grown at a CAGR OF 11% from Mn 10,162 USD in FY19 to Mn 13,217 USD in FY23.

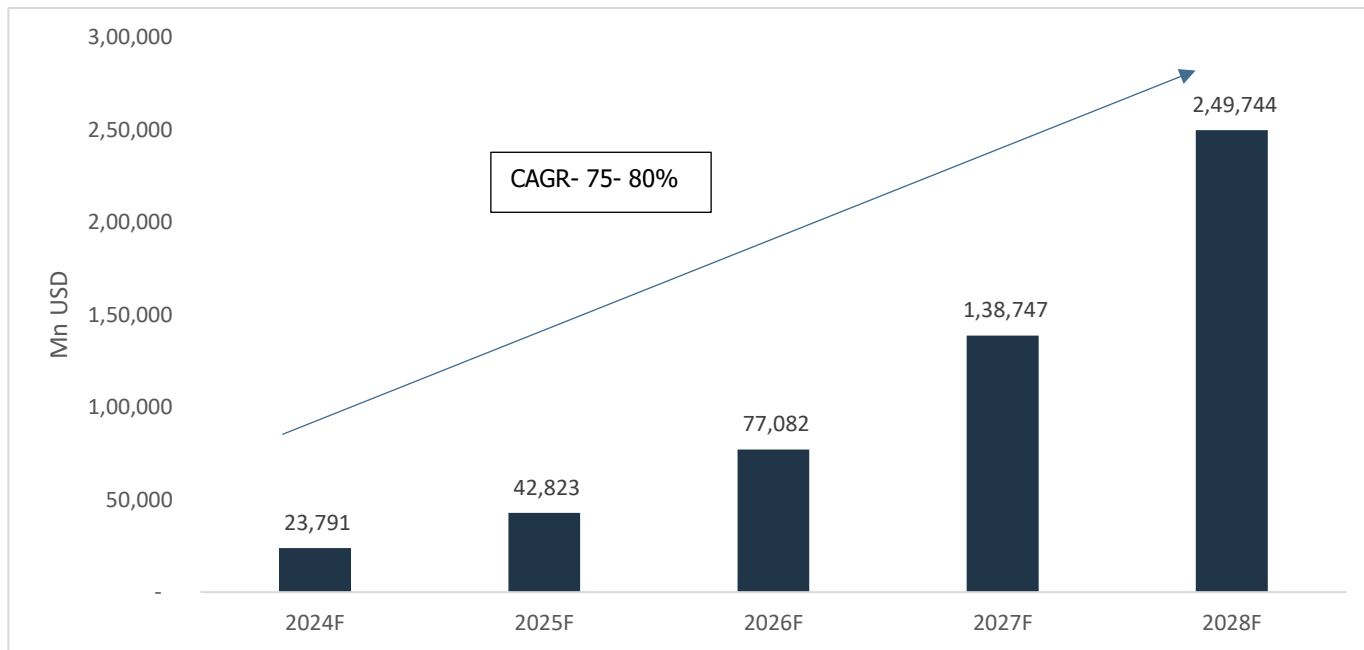
**Chart 19: Global HVDC and FACTS market**



Source: Maia Research, CareEdge Research, Industry Sources

Owing to increase in global adoption of renewable energy, the HVDC and FACTS market globally is expected to grow at a CAGR of 75-80% by CY28. This large growth is expected on the basis of projects approved all over the world and the back log in the supply of HVDC and FACTs globally.

**Chart 14: Global HVDC and FACTS Market Forecast**



Source: Maia Research, CareEdge Research, Industry Sources

## 4.2 Global Market Split by Regions

- **India**

High Voltage Direct Current (HVDC) Transmission has revolutionized the existing power system. The biggest advantage is the ease of long-distance and bulk power transmission, it has facilitated the transmission of electricity from power-rich states to power-deficit states, which coincidentally happen to be economically poor and economically rich respectively. There are currently five operational HVDC links in India namely Rihand-Dadri, Ballia-Bhiwadi, Chandrapur-Padge, Talcher-Kolar, and Mundra-Mohindergarh. Furthermore, the Biswanath-Agra link is commissioned.

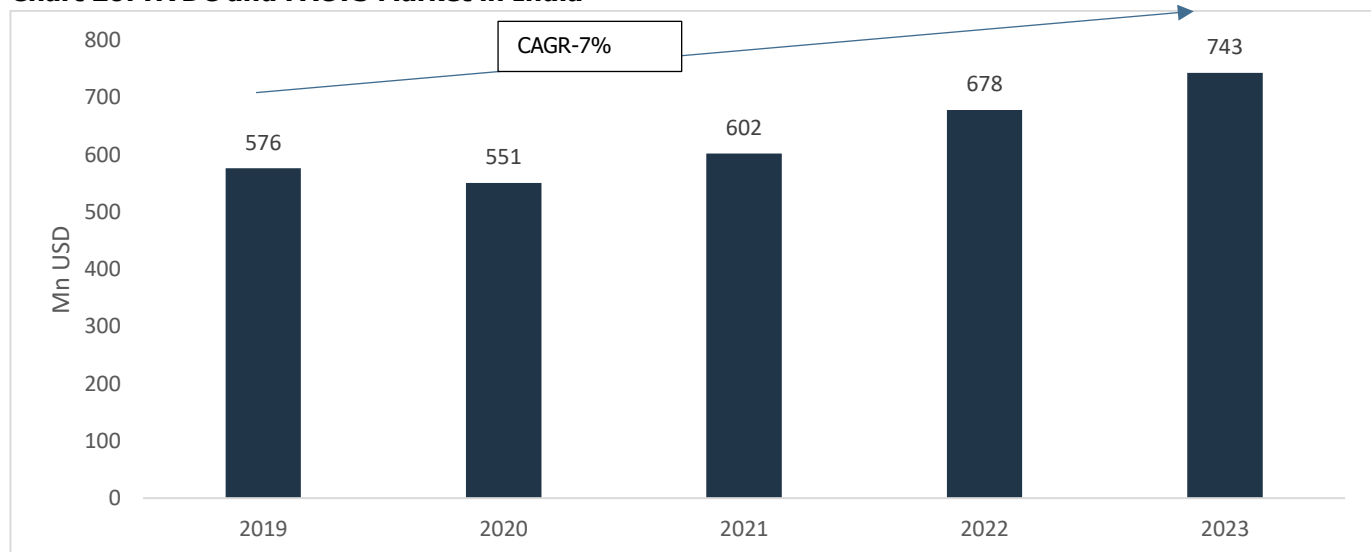
In India, the first FACTS device installed in India is Thyristor Controlled Series Capacitor (TCSC) with Fixed Series Compensation (FSC) at 400 kV transmission line between Kanpur (U.P) and Ballabgarh (Haryana) in the Northern Grid.

Some more existing FACTS projects working successfully in India are:

- Ranchi-Sipat 400 kV D/C, 376 Km transmission line with 40% FSC at Ranchi end
- Raipur-Rourkela 400 kV, D/C, 412 Km transmission line with FSC-TCSC installed at Raipur end
- FSC-TCSC installed at Kalpakam-Khammam 400 kV, D/C, 364 Km transmission line in Andhra Pradesh

The HVDC and FACTS market in India has grown at a CAGR of 7% from 576 Mn USD in CY19 to 743 Mn USD in CY23.

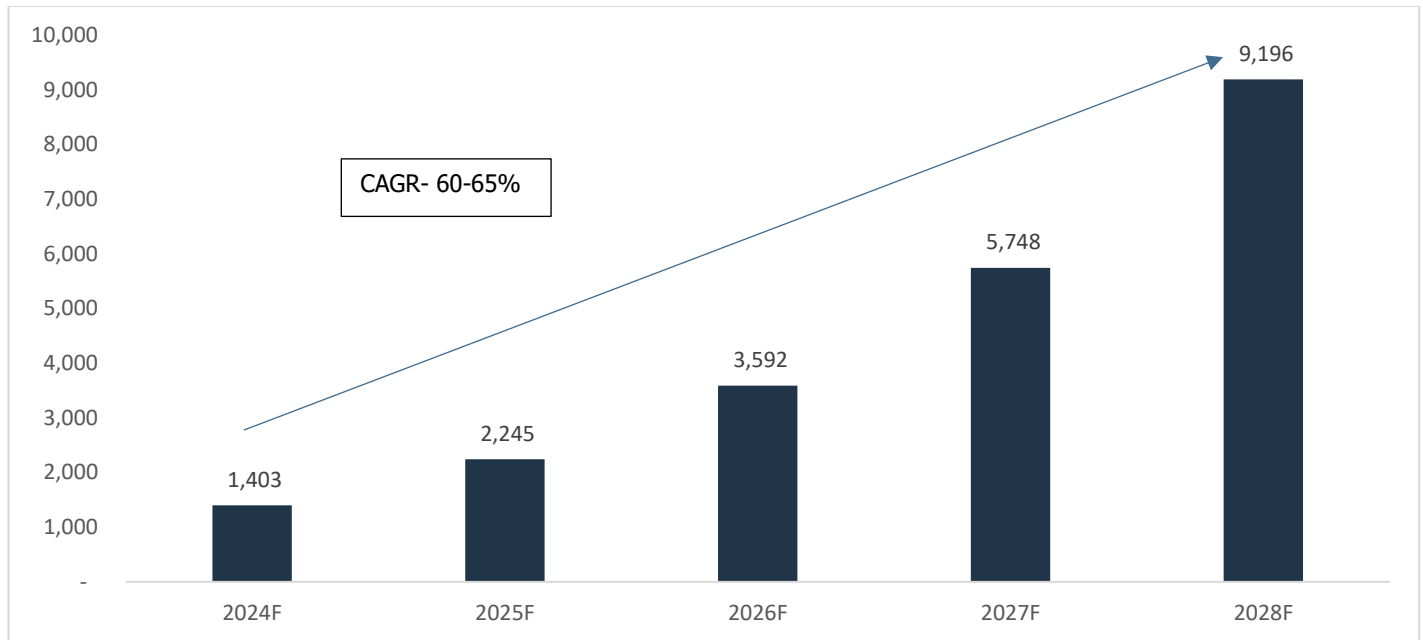
**Chart 20: HVDC and FACTS Market in India**



Source: Maia Research, CareEdge Research

The HVDC and FACTS Market in India is expected to grow at a CAGR of 60-65% from USD 1,403 Mn in CY24 to USD 9,196 Mn in CY28 due to the increased focus on the addition of renewable energy in the main stream electricity supply of the country.

**Chart 21: HVDC and FACTS Market Forecast in India**



Source: Maia Research, CareEdge Research, Industry Sources

**Note-** The quantum of the HVDC transmission projects announced far exceeds the forecasted trajectory. India has planned HVDC projects with a current investment of Rs 76,000 cr. With the tendered orders an additional of Rs 30,000 to 40,000 cr. Is estimated to being added in the next 4 to 5 years. The estimated projects awarded in the market is sizeable and if executed and operationalised will result in addition to the market size of the industry in the medium to long term.

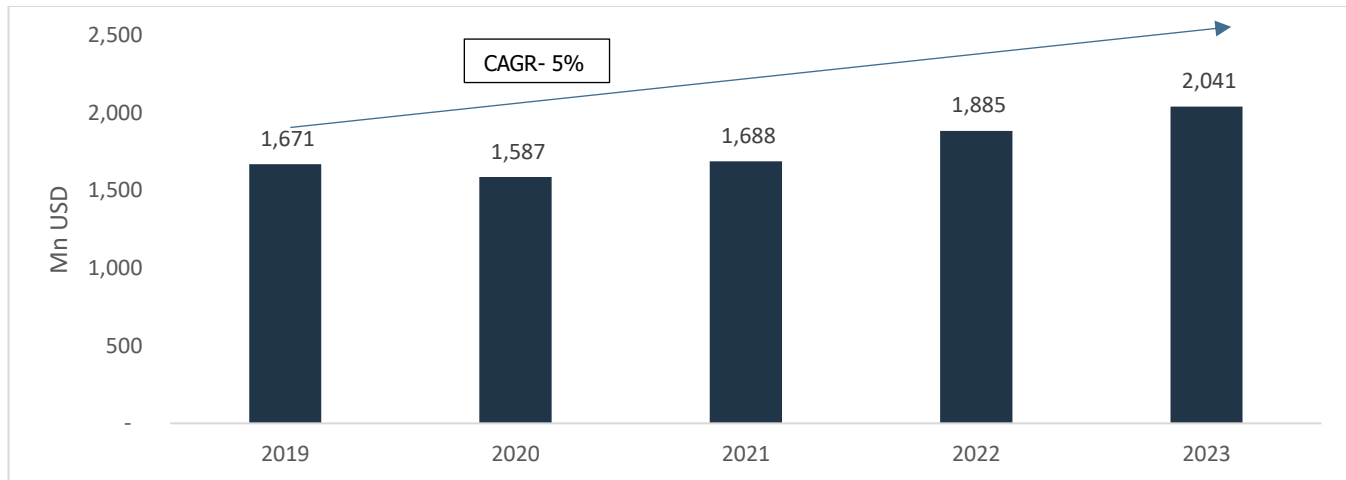
- **USA**

The increasing integration of renewable energy sources, such as wind and solar, into the U.S. grid has driven interest in HVDC transmission systems. HVDC can efficiently transport power from remote renewable energy sites to demand centres, overcoming energy transition challenges associated with long distances.

The need to modernize and increase the capacity of the U.S. power grid is increasing due to the growing population, ageing infrastructure, grid resilience requirements, operational flexibility needs, and a growing portfolio of renewable energy.

The United States has a goal to deploy 30 GW of offshore wind by 2030 and 86 GW by 2050 (Department of Energy, 2021; Wind Energy Technologies Office, 2017). Given that HVDC is a major transmission technology for integrating offshore wind farms into an onshore grid, at least ten offshore HVDC transmission systems and associated converter stations with 3 GW each or equivalent could be needed by 2030. The market of HVDC and FACTS has grown at a CAGR of 5% from Mn 1,671 USD in CY19 to Mn 2,041 USD in CY23.

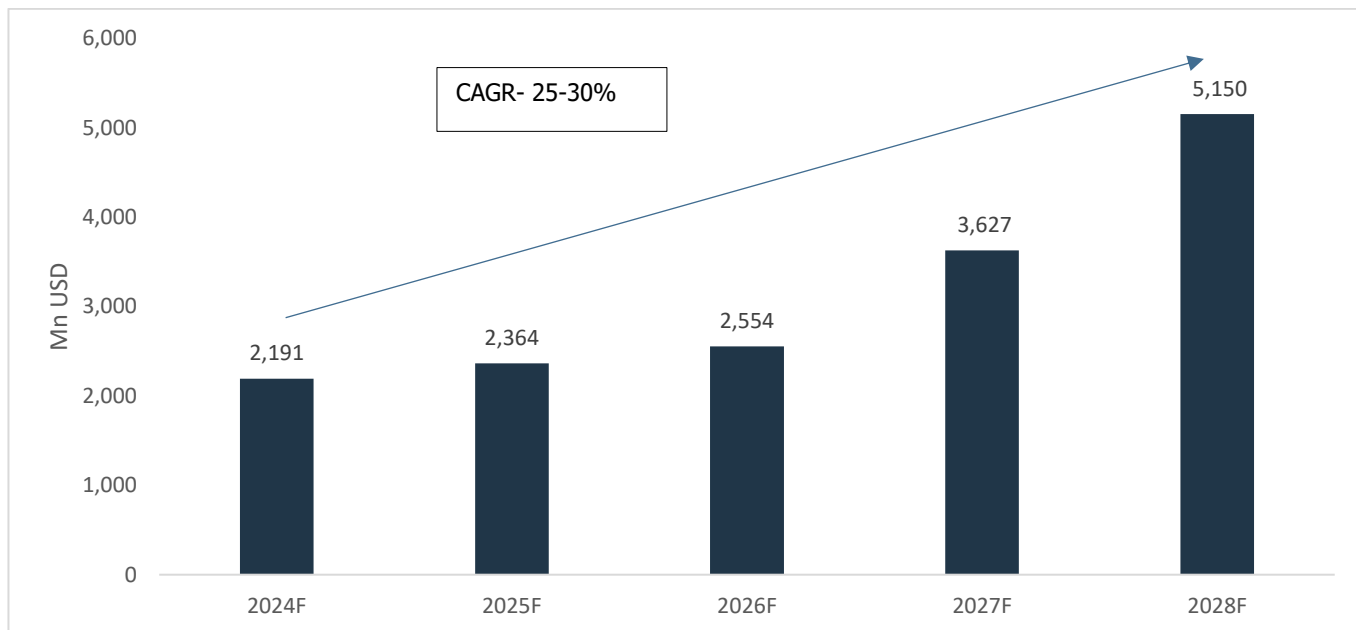
**Chart 22: HVDC and FACTS Market in the USA**



Source: Maia Research, CareEdge Research

The HVDC and FACTS market in USD is expected to grow at a CAGR of 25-30% from USD 2,191 Mn in CY24 to USD 5,150 Mn in CY28.

**Chart 23: HVDC and FACTS Market Forecast in USA**



Source: Maia Research, CareEdge Research

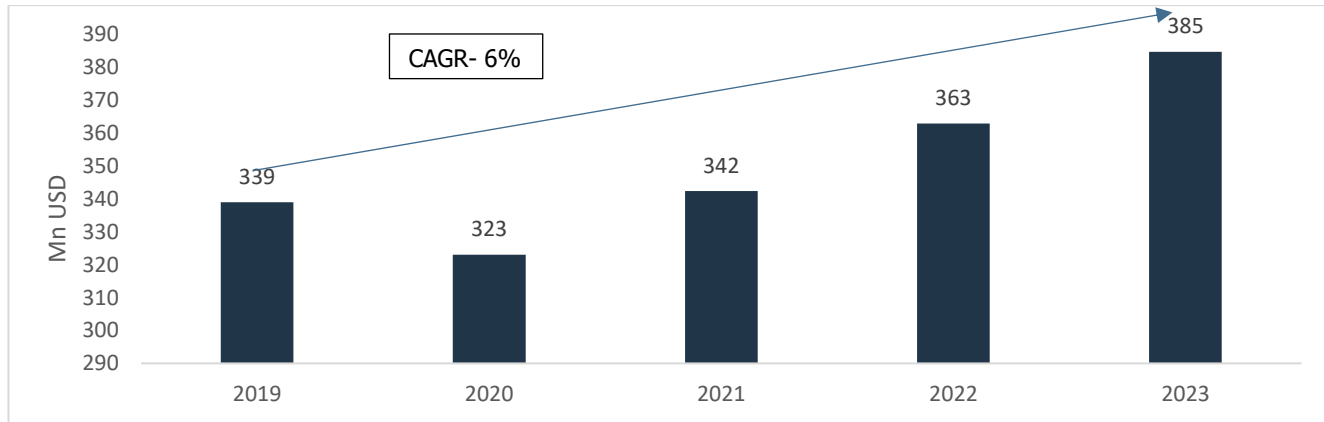
- **Middle East**

HVDC technology is employed to enhance energy security, optimize resource utilization, and enable the exchange of electricity between neighbouring nations. The Middle East has been investing in renewable energy projects, including solar and wind power. HVDC systems can be instrumental in efficiently transmitting electricity generated from renewable sources, especially from remote areas with abundant renewable resources. The growing demand for electricity in the Middle East, driven by economic development and population growth, creates a need for efficient and reliable energy transition system. HVDC and FACTS technologies can address challenges associated with transmitting large amounts of electricity across the region.



Furthermore, the Middle East is mainly the six Gulf countries, including Saudi Arabia, Kuwait, Bahrain, Qatar, the United Arab Emirates, and Oman, connecting Asia, Africa, Europe, and the three continents of the superior geographical position. The region has rich solar energy resources and wind energy resources, so the development potential is huge. HVDC transmission can facilitate the integration of renewable energy into the production of green hydrogen. The Middle East's interest in renewable hydrogen as a clean energy carrier may drive the adoption of HVDC systems. The market of HVDC and FACTS has grown at a CAGR of 4% from Mn 330 USD in CY19 to Mn 391 USD in CY23.

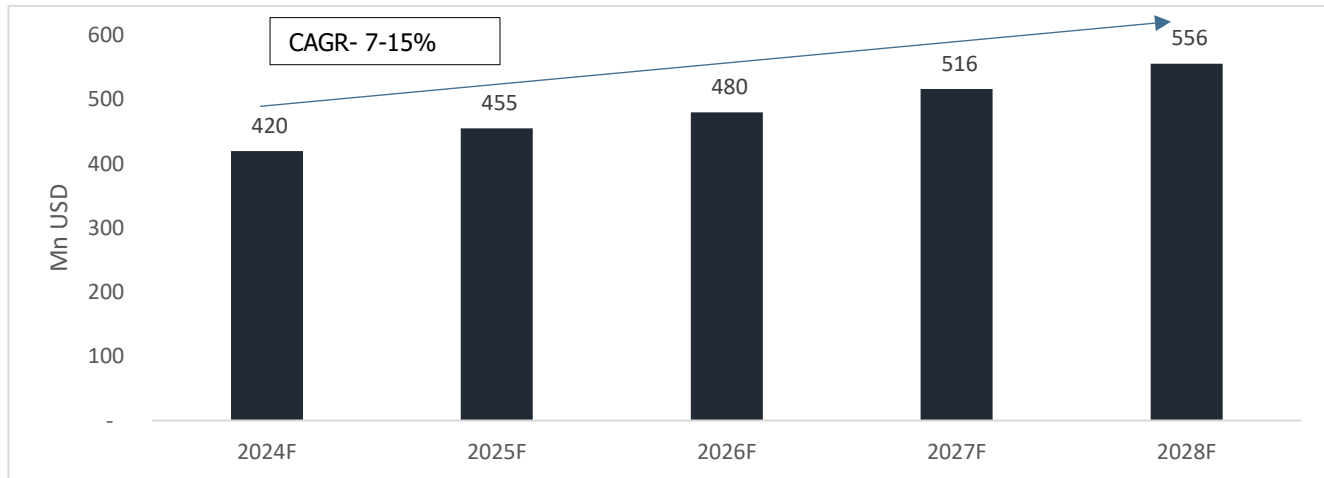
**Chart 24: HVDC and FACTS Market in the Middle East**



Source: Maia Research, CareEdge Research

The HVDC and FACTS market in Middle East is expected to grow at a CAGR of 7-15% from USD 420 Mn in CY24 to USD 556 Mn in CY28.

**Chart 25: HVDC and FACTS Market Forecast in Middle East**



Source: Maia Research, CareEdge Research, Industry Sources

- Other Countries**

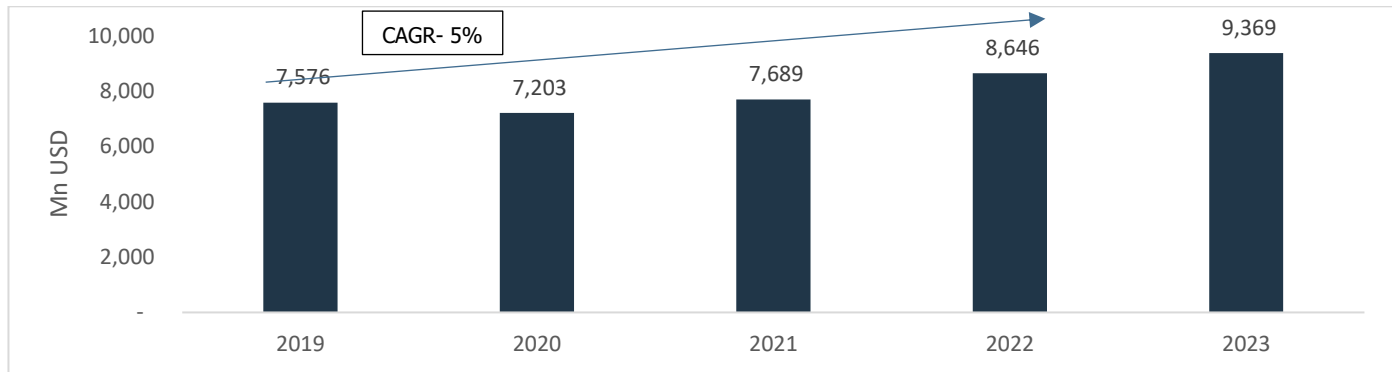
In Europe, the North Sea Wind Power Hub serves as a prominent offshore wind energy source for several European Union countries. Given the considerable distance of the North Sea wind farm from the onshore grid, HVDC transmission stands out as the optimal choice for efficient long-distance transmission to meet load demand centres in Germany, the Netherlands, the UK, Norway, Denmark, Belgium, France, and other nations.

In the summer of 2020, the German government made the decision to expand the capacity from 15 GW to 20 GW, aiming to realize the climate and energy objectives outlined in the Paris Climate Agreement cost-effectively. Through this initiative, Germany and the Netherlands aim to achieve production capacities of 20 GW and 11.6 GW, respectively, by 2030, leveraging offshore HVDC platforms and 525 kV undersea transmission cable systems. With the vast offshore wind power potential in the North Sea, the target is to generate 180 GW by 2045. Additionally, a portion of the generated electricity undergoes conversion to hydrogen, transported to shore via pipelines, while the remaining wind energy is conveyed to the shore through electrical connections. Plans include the implementation of over 40 GW of electrolyzers by 2030.

Furthermore, in China, the northwest region boasts abundant wind resources, and the western region hosts numerous hydropower plants. However, these sources are situated at a considerable distance from end-users in the southeast regions. To achieve efficient long-distance and high-power transmission, the nation operates multiple ±1,100 kV, ±800 kV, and ±500 kV HVDC systems, facilitating the delivery of over 1000 GW of electricity from rural northwest areas to economic centres in the southeast regions.

The market of HVDC and FACTS has grown at a CAGR of 5% from Mn 7,576 USD in CY19 to Mn 9,369 USD in CY23.

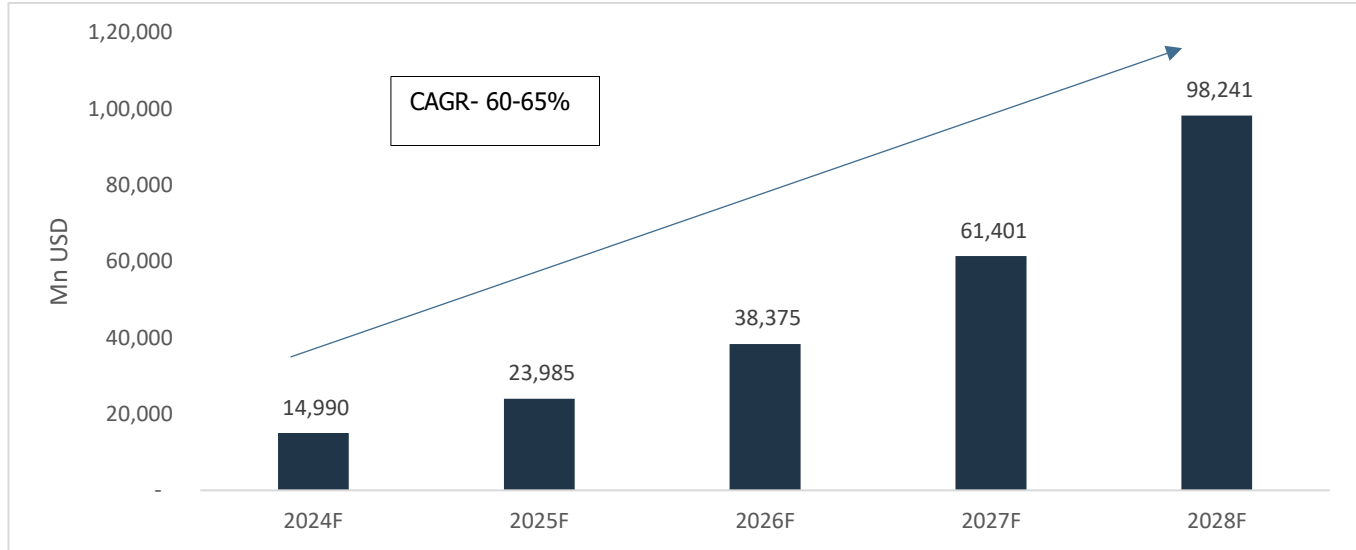
**Chart 26: HVDC and FACTS Market in Others**



Source: Maia Research, CareEdge Research

The HVDC and FACTS market in other countries is expected to grow at a CAGR of 60-65% from USD 14,990 Mn in CY24 to USD 98,241 Mn in CY28.

**Chart 27: HVDC and FACTS Market Forecast in other countries**



Source: Maia Research, CareEdge Research, Industry Sources

**4.3 Global Market Split by Products**

**Table 5: Global Market Evaluation**

	Significant Global Market	Projected Significant Global Demand
Reactor	Yes	Yes
Converter	Yes	Yes
DC Breakers	No	Yes
DC Filters	Yes	Yes
Capacitors	Yes	Yes
Inductor	Yes	Yes
Transformer	Yes	Yes

Source: Electric Grid Supply Chain Review, U.S. Department of Energy

**Reactors**

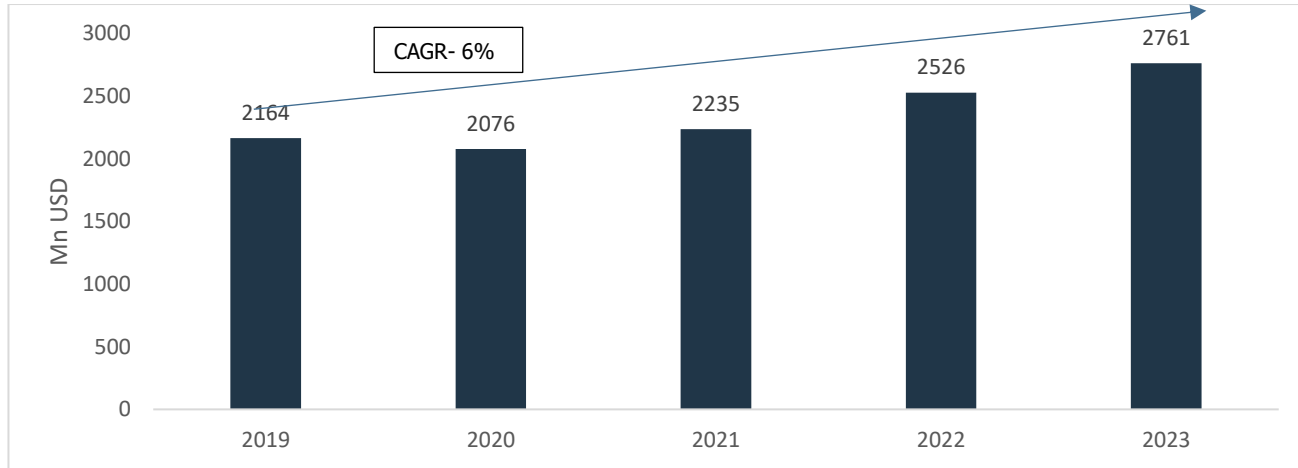
HVDC converters can generate harmonics due to the switching actions in the power electronics. Reactors are often employed as harmonic filters to mitigate these harmonics, ensuring the smooth operation of the HVDC system and reducing interference with other equipment on the AC and DC sides.

The integration of reactors with Flexible Alternating Current Transmission Systems (FACTS) devices is becoming more common. This combination provides comprehensive solutions for grid stability and voltage control.

The global push towards renewable energy sources, including solar and wind power, drives the demand for energy transition reactors and ongoing grid modernization initiatives worldwide, aimed at improving reliability and accommodating new technologies, contribute to the demand for reactors.

The market for reactors has grown at a CAGR of 6% from Mn 2,164 USD in CY19 to Mn 2,761 USD in CY23.

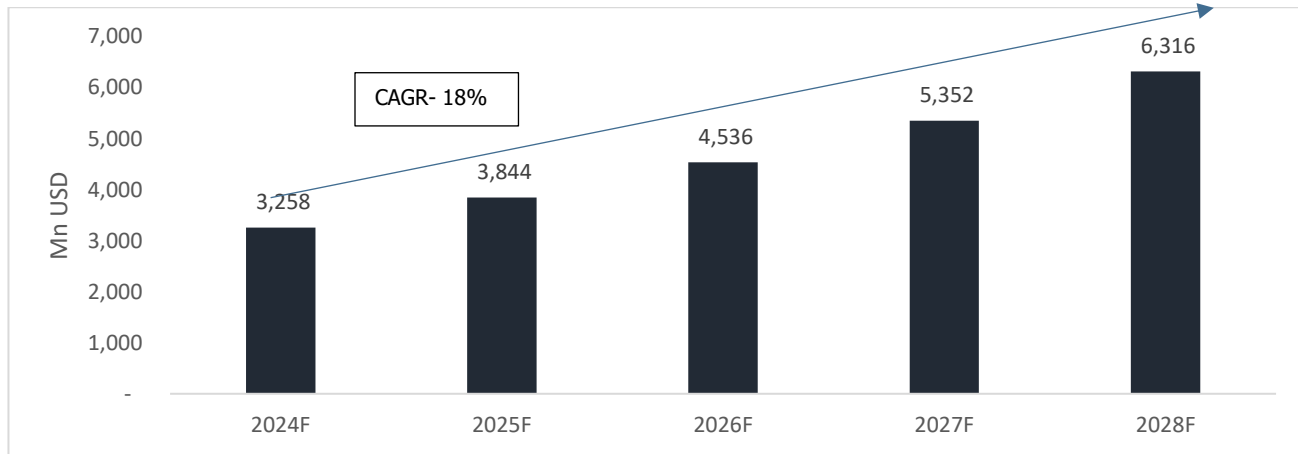
**Chart 28: Market of Reactor**



Source: Maia Research, CareEdge Research

The global reactor market is expected to grow at a CAGR of 8% from USD 3,258 Mn in 2024 to USD 6,316 Mn in 2028.

**Chart 29: Market of Reactor Forecast**



Source: Maia Research, CareEdge Research, Industry Sources

**Capacitors**

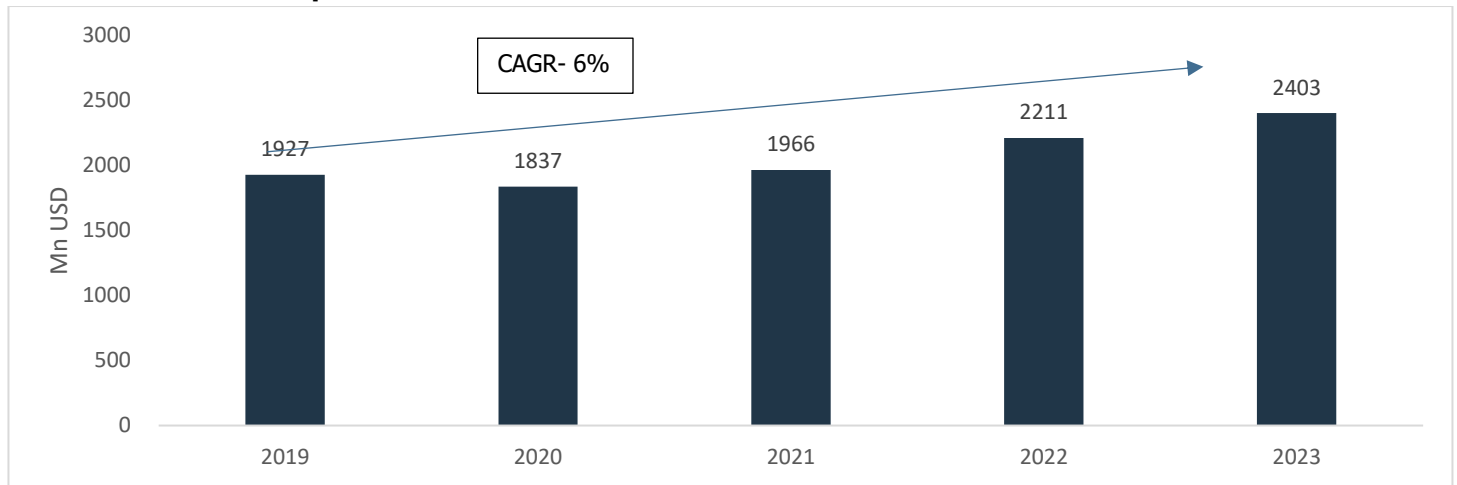
In HVDC systems, especially in voltage source converter (VSC) HVDC, smoothing capacitors are used to reduce DC voltage ripple. These capacitors help stabilize the DC voltage and improve the quality of power transmission.

Capacitors are used in static var compensators, thyristor-controlled series compensators, static synchronous compensators, unified power flow controllers, etc., These are FACTS components. Capacitors play a crucial role in controlling voltage levels in the power system, improving power factors, enhancing system stability, and maintaining voltage stability.

The global capacitor market is growing steadily driven by factors like the increasing adoption of electronic devices, industrial automation, electrical vehicles, and renewable energy systems.

The market for capacitors has grown at a CAGR of 6% from Mn 1,927 USD in CY19 to Mn 2,403 USD in CY23.

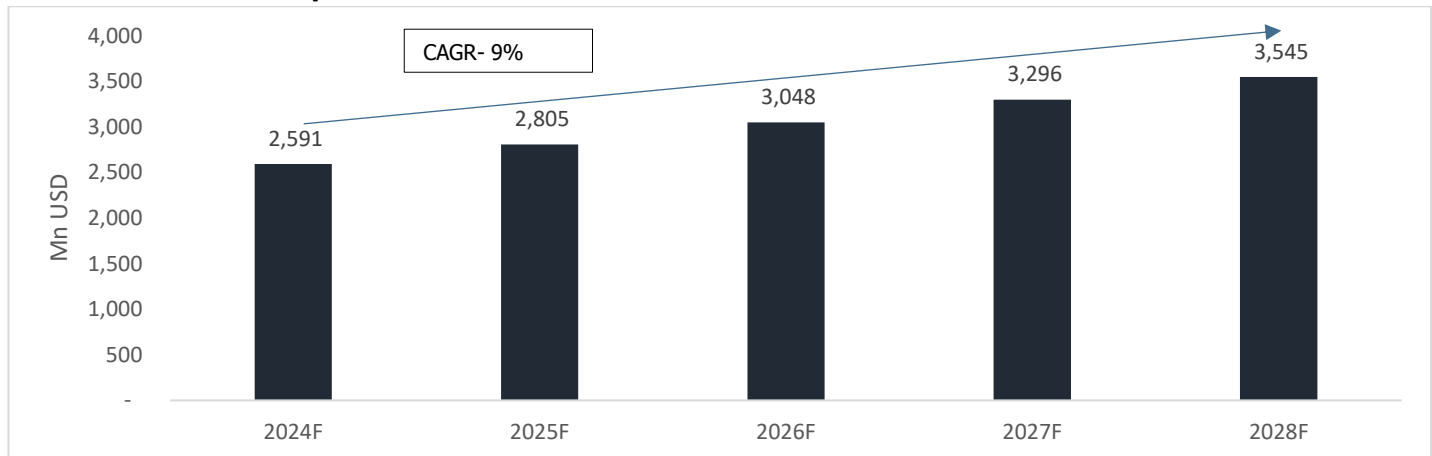
**Chart 30: Market of Capacitor**



Source: Maia Research, CareEdge Research

The global capacitor market is expected to grow at a CAGR of 8% from USD 2,591 Mn in 2024 to USD 3,545 Mn in 2028.

**Chart 31: Market of Capacitor Forecast**



Source: Maia Research, CareEdge Research

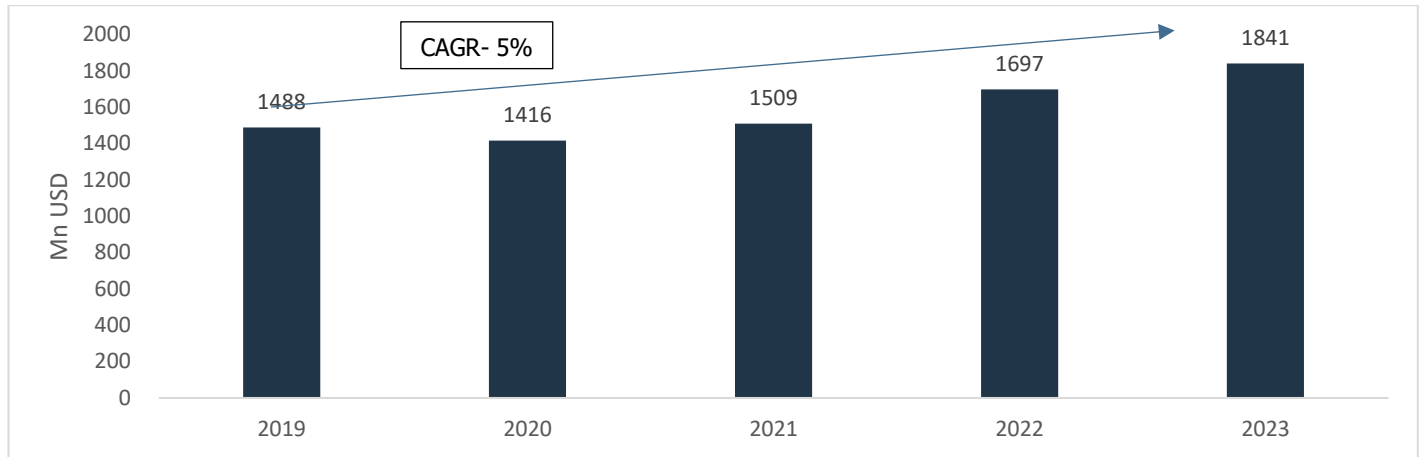
**Instrument Transformers**

Current Transformers (CTs) in HVDC systems are used to measure and monitor the current flowing through the conductors. They provide a reduced, proportional current output to instruments and relays. Voltage Transformers (VTs) in HVDC systems are utilized for voltage measurement and monitoring. They step down the high DC voltage to levels suitable for metering, relaying, and control devices. Some HVDC systems use combined instrument transformers that integrate both current and voltage measurements into a single unit. These transformers simplify the design and installation process.

Current Transformers and Voltage Transformers in FACTS devices are similar to those in HVDC systems, providing accurate current and voltage measurements for monitoring and control purposes. In FACTS devices like Static Var Compensators (SVC), shunt reactor voltage transformers are employed to monitor the voltage across the shunt reactor. The instrument transformer market is expected to continue growing as power systems evolve, with a focus on reliability, efficiency, and environmental sustainability. The shift toward digital solutions, the expansion of renewable energy, and ongoing grid modernization projects will likely drive innovations in instrument transformer technologies.

The market for capacitors has grown at a CAGR of 6% from Mn 1,927 USD in CY19 to Mn 2,403 USD in CY23.

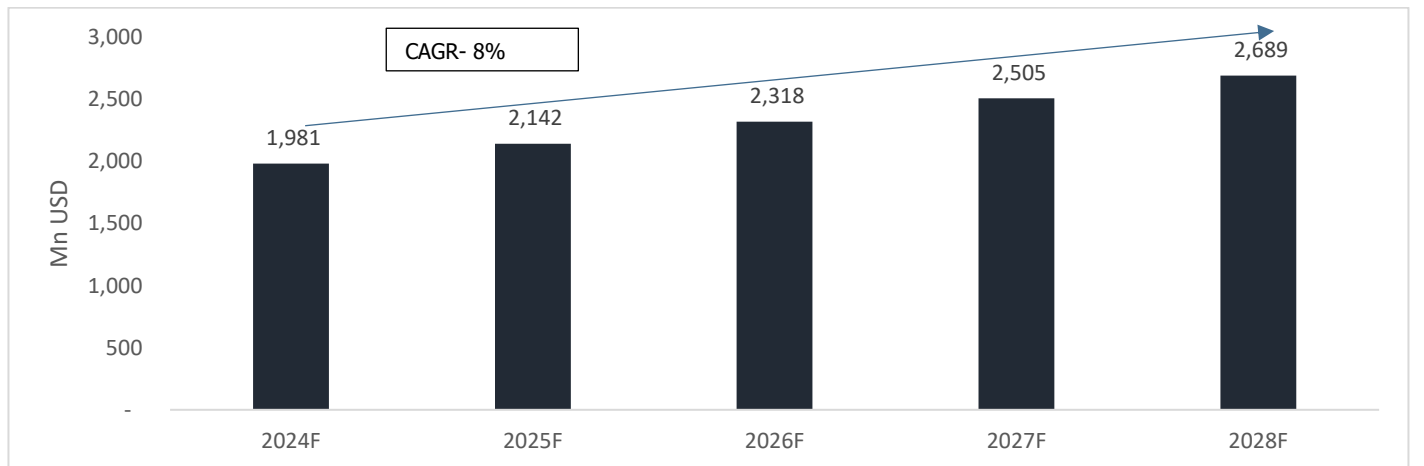
**Chart 32: Market of Instrument Transformers**



Source: Maia Research, CareEdge Research

The global instrument transformers market is expected to grow at a CAGR of 8% from USD 1,981 Mn in 2024 to USD 2,689 Mn in 2028.

**Chart 33: Market of Instrument Transformers Forecast**



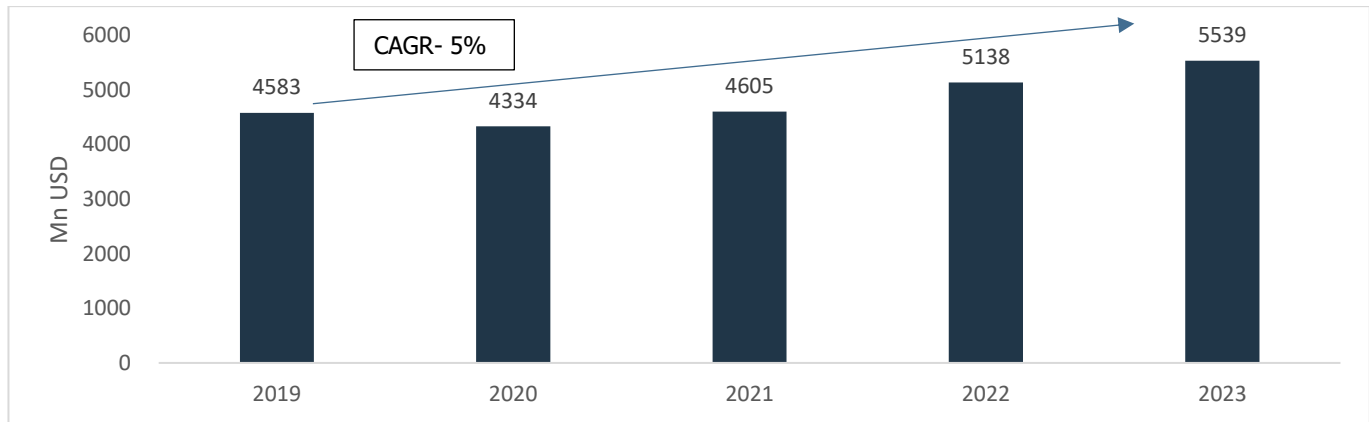
Source: Maia Research, CareEdge Research

**Others**

Other instruments like inverters, generators, AC Filters, rectifiers, converters, harmonics, filters, capacitors and diodes are used in HVDC and FACTS. The market for other instruments is expected to grow with the growing adoption of HVDC and FACTS in transmission grids.

The market of other products has grown at a CAGR of 5% from Mn 4,583 USD in CY19 to Mn 5,539 USD in CY23.

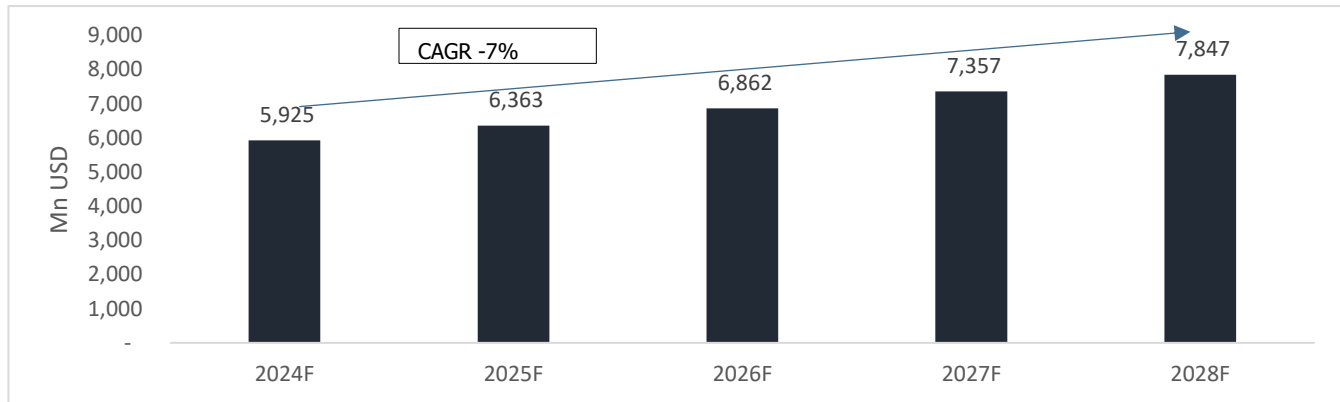
**Chart 34: Market of Other Instruments**



Source: Maia Research, CareEdge Research

The global market for other than the mentioned instruments is expected to grow at a CAGR of 7% from USD 5,925 Mn in 2024 to USD 7,847 Mn in 2028.

**Chart 35: Market of Other Instruments**



Source: Maia Research, CareEdge Research

#### 4.4 Competitive Landscape

Company	Locations	Description
Siemens AG	Germany, The United States, China, India	Siemens is a electrification solution provider, offering a comprehensive portfolio of products and solutions for power generation, distribution, and utilization. The company provides electrical infrastructure for industries, cities, and utilities, including smart grids and energy-efficient technologies.
Hyosung Group	USA, Australia, UK, Asia	Hyosung Group has capabilities and provides services in various industries including textiles, advanced materials, heavy industry, construction, trade, information and communication. Hyosung Heavy industries provides energy solutions.
General Electric	United States, Europe, Asia	GE Renewable Energy focuses on developing and providing solutions in the renewable energy sector, including wind, hydro, and solar power. GE Power is involved in the generation, transmission, and distribution of electricity. The segment offers a range of products and services for power generation and grid solutions.
Hitachi ABB Power Grids	Switzerland, Japan, India	Hitachi ABB Power Grids is a joint venture between Hitachi Ltd. and ABB Ltd., specializing in power and energy solutions. The company focuses on providing solutions and services in the power and energy sector. Its core business areas include energy transition equipments and power technologies and distribution, grid automation, and sustainable energy solutions.
Toshiba Corporation	Japan, The United States, Asia	Toshiba is known for its diversified portfolio of products and services spanning various industries, including electronics, energy, infrastructure, and healthcare. It provides energy solutions which Involves power generation, transmission, and distribution solutions.
Crompton Greaves	Majorly India	It is an Indian multinational company with a significant presence in the power transmission and distribution sector. CG Power is in power systems services, offering solutions for power generation, transmission, and distribution. Products include transformers, circuit breakers, and other electrical equipment.
Transformers & Rectifiers India Limited	Majorly India	Transformers & Rectifiers (India) Limited (TRIL), specializes in manufacturing power, distribution, and special-purpose transformers, along with



		rectifiers for industrial use. TRIL's products serve power networks, industrial applications, and railway electrification, with operations spanning India and around 25 international markets.
Arteche Group	Global Player	Arteche Group provides electrical engineering and energy solutions, specializing in protection, control, measurement, and communication equipment for the power industry. Their products include relays, instrument transformers, and power quality equipment, serving utilities, industries, and renewable energy sectors. Arteche has a global presence, exporting to roughly 175 countries.

#### 4.5 Key Factors Driving the Growth of the Global HVDC and FACTS Market

The growth of the global HVDC and FACTS market is expected to continue as the power industry evolves, and as the focus on sustainable, reliable, and interconnected energy systems increases.

- **Growing investment in Transmission Line**

##### 3.5.1 Projected Additions in Transmission

The interstate transmission lines are expected to add 13,042 CKm from FY24-FY28, according to ISTS Rolling Plan 2027-28 alongside the increasing transformation capacity of 96,905 MVA in the same period. This will attract an investment of Rs. 42,998 crores from FY24 to FY28.

The detailed split across years is provided below:

**Table 6: Under Construction Transmission Line (ckm)**

FY	WR	SR	NR	ER	NER	Total
<b>FY24</b>	2,642	1,909	3,807	80	450	<b>8,888</b>
<b>FY25</b>	2,189	911	405	235	-	<b>3,737</b>
<b>FY26</b>	187	-	-	-	230	<b>417</b>
<b>FY27</b>	-	-	-	-	-	-
<b>FY28</b>	-	-	-	-	-	-
<b>Total</b>	<b>5,015</b>	<b>2,820</b>	<b>4,212</b>	<b>315</b>	<b>680</b>	<b>13,042</b>

Source: ISTS Rolling Plan 2027-28, CareEdge Research

**Table 7: Under Construction Transformation Capacity (MVA)**

FY	WR	SR	NR	ER	NER	Total
<b>FY24</b>	22,500	13,500	18,815	-	320	<b>55,135</b>
<b>FY25</b>	30,500	8,500	-	1,050	-	<b>40,050</b>
<b>FY26</b>	-	-	-	-	1,720	<b>1,720</b>
<b>FY27</b>	-	-	-	-	-	-
<b>FY28</b>	-	-	-	-	-	-

<b>Total</b>	<b>53,000</b>	<b>22,000</b>	<b>18,815</b>	<b>1,050</b>	<b>2,040</b>	<b>96,905</b>
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Source: ISTS Rolling Plan 2027-28, CareEdge Research

### 3.5.2 Projected Investments in the Indian Electricity Transmission Sector

**Table 8: Transmission Line Investments (In Cr)**

<b>FY</b>	<b>WR</b>	<b>SR</b>	<b>NR</b>	<b>ER</b>	<b>NER</b>	<b>Total</b>
<b>FY24</b>	7,365	6,659	10,770	285	417	<b>25,495</b>
<b>FY25</b>	11,320	3,391	1,077	594	77	<b>16,459</b>
<b>FY26</b>	614	-	-	-	430	<b>1,044</b>
<b>FY27</b>	-	-	-	-	-	-
<b>FY28</b>	-	-	-	-	-	-
<b>Total</b>	<b>19,298</b>	<b>10,050</b>	<b>11,847</b>	<b>879</b>	<b>925</b>	<b>42,998</b>

Source: ISTS Rolling Plan 2027-28, CareEdge Research

#### • Renewable Energy Integration:

**HVDC:** HVDC is particularly suitable for long-distance transmission of electricity. This is advantageous for connecting remote renewable energy generation sites, such as offshore wind farms, to population centres where electricity demand is high. The growth of renewable energy sources, such as wind and solar, requires effective integration into existing power grids. HVDC technology facilitates the long-distance transmission of power from remote renewable energy generation sites to demand centres.

**FACTS:** FACTS devices, such as Static Var Compensators (SVCs) and Static Synchronous Compensators (STATCOMs), provide dynamic control over voltage and reactive power. This is essential for stabilizing the grid when integrating intermittent renewable sources. FACTS devices enhance grid stability and power quality, supporting the integration of variable renewable energy sources. They provide dynamic control to manage voltage, reactive power, and grid conditions.

#### • Long-Distance Transmission:

**HVDC:** HVDC is highly efficient for long-distance transmission of electricity, especially across regions or countries. It reduces transmission losses, improves grid reliability, and enables power trading between distant locations. HVDC minimizes transmission losses and allows for the efficient transport of electricity over hundreds or even thousands of kilometres.

**FACTS:** FACTS, such as Static Synchronous Compensator (STATCOM), Static Var Compensators (SVCs) and Thyristor-Controlled Series Compensators (TCSC), enhance the capability of power transmission over long distances by improving the system's overall stability and control. FACTS technologies provide dynamic control over power flow within AC transmission systems. This capability is crucial for optimizing power transfer in long-distance transmission corridors and managing system congestion.

#### • Grid Modernization Initiatives:

Governments and utilities worldwide are investing in upgrading and modernizing power grids to enhance efficiency, reliability, and flexibility. HVDC and FACTS technologies play a vital role in supporting these grid modernization initiatives. Utilities are investing in digital upskilling as well as in new business processes, technologies, and structures and

increasing capacity. They are rolling out multiple initiatives to account for the rise in two-way power flow and reduce emissions.

At the same time, the grid lines are expected to be more digitally tethered grid. This will widen the attack surface and make it more vulnerable to cyber threats. In response, utilities are deploying operational technology enhancements, new security architecture, security-by-design in products and services, and updated business processes.

- **Increasing Energy Demand:**

The growing global demand for electricity, driven by population growth, industrialization, and urbanization, necessitates more efficient & advanced energy transition equipments and power technologies like HVDC and FACTS to meet the increasing load requirements. The increasing demand in residential/ commercial real estate, industrial electricity requirement, transportation across the world, etc., are leading to increased demand for power. Hence, there is a rising need for electricity generation and transfer it through distances.

- **Cross-Border Power Trading:**

HVDC facilitates cross-border power trading, allowing countries to exchange electricity more efficiently. Cross-border electricity trading (CBET) can reduce costs, improve reliability, and reduce emissions for all participating countries. Regulatory coordination is essential to making CBET successful. For example, India's expanding CBET mechanisms could increase access to Nepal's large hydroelectric potential. Interconnected grids with HVDC links enable the sharing of surplus power and contribute to energy security.

- **Grid Resilience and Stability:**

The energy generated must be equal to the energy consumed. So, 'unreliable' energy sources like renewable energy are difficult to integrate with conventional grids. For a power grid, to remain stable, it needs to respond to volatility in voltage and frequency disturbances. Due to increased loads during peak hours, the existing transmission lines face the challenge of capacities matching the inflow and outflow of power. A surge can occur when producers generate too much power without warning, and the entire system shuts down. A transmission line has its specified capacity, and if this limit gets passed, thermal loads will build up, leading to damage. HVDC and FACTS technologies enhance grid resilience and stability by providing fast and dynamic control over voltage and reactive power. This is crucial in mitigating the impact of disturbances and ensuring the reliable operation of the power system.

- **Smart Grid Integration:**

Renewable energy integration is crucial for several reasons. It helps mitigate climate change by reducing greenhouse gas emissions. Moreover, it diversifies the energy mix, enhances energy security, and promotes local economic development. However, the intermittent nature of renewable sources poses unique challenges that must be addressed for smooth grid integration. To effectively integrate renewable energy, grid management and control strategies need to be agile and adaptive. Advanced algorithms and real-time monitoring systems enable grid operators to optimize power flow, balance supply, and demand, and mitigate potential grid instabilities.

Further, demand response programs and smart grid technologies empower consumers to participate actively in load management. Grid optimization technologies, such as advanced sensors, automation, and real-time data analytics, play a significant role in integrating renewable energy sources. By monitoring and analysing grid conditions, these technologies facilitate efficient grid operations, reduce energy losses, and enhance grid stability.

Moreover, smart grid technologies enable better communication and coordination between various grid components, paving the way for seamless renewable energy integration. The integration of HVDC and FACTS technologies into smart

grid systems enhances overall grid intelligence, enabling more efficient control, monitoring, and management of power flows.

### • Upcoming Mega Transmission Projects

#### ○ **North Sea Wind Power Hub (NSWPH) - North Sea Region:**

- a) The North Sea Wind Power Hub (NSWPH) program is establishing a knowledge base to assist European countries in selecting the appropriate solution to unlock the potential of the anticipated 180GW offshore wind capacity to be deployed in the North Sea by 2050. Utilizing a transnational, integrated approach, the hub-and-spoke project represents a significant departure from existing national and fragmented offshore wind developments within the energy sectors. NSWPH will integrate offshore and onshore hydrogen production capabilities and storage with wind and power transmission systems spanning the continent. The hub's objective is to offer long-term flexibility by supplying electricity during periods when renewable energy production is insufficient.
- b) The North Sea Wind Power Hub is a visionary project aiming to create an artificial island in the North Sea as a hub for connecting offshore wind farms from neighbouring countries, including Denmark, Germany, the Netherlands, Belgium, and the United Kingdom. The project envisions a large-scale interconnection of renewable energy sources to facilitate efficient power transmission across borders.

#### ○ **Trans-Mediterranean Renewable Energy Cooperation (TREC) - North Africa to Europe:**

- a) TREC proposes the creation of a super grid to transmit solar and wind power from North Africa to Europe. The project involves the construction of high-voltage direct current (HVDC) transmission lines to connect solar and wind farms in the Sahara Desert region to European countries. This initiative aims to tap into North Africa's abundant renewable energy resources and support Europe's clean energy goals.
- b) TREC envisioned the establishment of large-scale renewable energy projects, primarily solar and wind farms, in North African countries such as Morocco, Algeria, Tunisia, and Libya. The generated renewable electricity would then be transmitted to Europe. The initiative considered the use of high-voltage direct current (HVDC) transmission lines to transport the electricity generated in North Africa across the Mediterranean Sea to Europe.

#### ○ **Asian Super Grid - East Asia:**

- a) The concept of an Asian Super Grid involves connecting the electricity networks of several East Asian countries, including China, Japan, South Korea, Mongolia, and Russia. This project envisions the transmission of renewable energy, particularly solar and wind power, across borders to meet the region's growing energy demand sustainably.
- b) The growth avenue for Asian nations involves combining a super grid with microgrid technologies, allowing them to enjoy the advantages of interconnection while minimizing the risks associated with dependence on neighboring countries. The Asia Super Grid, or ASG, represents a substantial network of interconnected electricity grids designed to facilitate the transmission of power from renewable sources such as solar, wind, and hydro throughout the continent. China, Japan, South Korea, Russia, and Mongolia have already endorsed and supported this initiative. These nations have outlined plans to construct an ocean-floor power network to link their electricity grids, paving the way for a cleaner and more efficient pan-Asian electric power system.

#### ○ **European Supergrid - Europe:**

- a) The European Super Grid serves as a collective term encompassing various projects underway in Europe and beyond. Upon completion, these initiatives would establish a power network that connects European countries internally and extends to other regions, including North Africa and the Middle East. The primary objectives of the Super Grid involve enhancing existing energy interconnectors and introducing new ones between different

European areas to elevate the capacity and quality of power transmission among nations. Although a significant portion of these projects is still in the planning stages, several have already commenced production.

b) Specifically, the interconnectedness of energy will enable European states to trade their energy surpluses with other countries and acquire excess energy during times of deficiency. This energy-sharing mechanism plays a crucial role in mitigating the variability of renewable energy as an unstable and unreliable electricity source. This dynamic becomes evident in a practical scenario; for instance, during the summer, the power generated by solar panels in Southern European Countries experiences an exponential increase, leading to the producing country accumulating an energy surplus.

- **ASEAN Power Grid - Southeast Asia:**

a) The Association of Southeast Asian Nations (ASEAN) has been working on a plan to develop an ASEAN Power Grid. This project aims to connect the electricity networks of ASEAN member countries, promoting cross-border electricity trade and facilitating the integration of renewable energy sources in the region.

b) The ASEAN Power Grid (APG) initiative aims to establish a regional power interconnection, initially on crossborder bilateral terms, with subsequent expansion to a sub-regional basis and eventual integration into a comprehensive power grid system for South East Asia. Positioned as a vital element within the Master Plan of the ASEAN Connectivity, the APG project anticipates facilitating electricity trade across borders. This is projected to yield advantages by addressing the growing demand for electricity and enhancing access to energy services throughout the region.

- **African Clean Energy Corridor - Africa:**

a) The Africa Clean Energy Corridor (ACEC) is a regional effort aimed at expediting the advancement of renewable energy capabilities and the cross-border exchange of renewable power within the Eastern Africa Power Pool (EAPP) and Southern African Power Pool (SAPP). This endeavor is grounded in the robust political dedication of African leaders to fortify regional institutions and transmission infrastructure, establishing expansive competitive markets and reducing costs across production sectors. Through the establishment of a more extensive regional electricity market, the ACEC has the potential to draw investments, fulfilling 40–50% of power requirements in the EAPP and SAPP regions by 2030.

b) The African Clean Energy Corridor seeks to create an interconnected transmission network across Eastern and Southern Africa, allowing for the efficient transmission of renewable energy. This project is particularly focused on harnessing the vast potential of solar and wind resources in the region.

## 4.6 Market Challenges

- **High Initial Costs:**

The upfront capital costs associated with HVDC and FACTS projects can be substantial. HVDC and FACTS systems involve complex engineering and sophisticated technologies. The design, manufacturing, and installation of specialized components, such as converters, transformers, and control systems, contribute to the overall complexity, driving up costs. These costs may pose a challenge for potential investors and project developers.

Further, the construction of HVDC converter stations, which house critical equipment for converting AC to DC or vice versa, involves substantial costs. These stations require specialized infrastructure, including high-power electronic devices, cooling systems, and control systems. High-voltage transmission lines, a fundamental component of HVDC projects, contribute significantly to the overall costs.

- **Technological Complexity:**

HVDC and FACTS technologies involve complex engineering and sophisticated control systems. The deployment and maintenance of such advanced technologies require specialized knowledge and skilled personnel. The design, manufacturing, and installation of specialized components, such as converters, transformers, and control systems, contribute to the overall complexity, driving up costs.

- **Grid Integration Challenges:**

Existing power grids are predominantly designed for alternating current (AC) transmission. Integrating HVDC systems requires compatibility measures to ensure the smooth interaction of HVDC with AC systems, involving transformers, converters, and control systems. Accordingly, integrating HVDC and FACTS technologies into existing power grids can be challenging due to compatibility issues, grid codes, and the need for coordinated planning and operation.

- **Financing and Funding Challenges:**

The significant upfront capital required for HVDC and FACTS projects can be a barrier to securing financing. Investors and financial institutions may perceive these projects as high-risk due to the large initial investments.

HVDC and FACTS projects typically have long payback periods. Investors may be hesitant to commit capital to projects with extended timelines for returns on investment, especially if other opportunities offer shorter payback periods. Securing financing for HVDC and FACTS projects can be challenging, especially for large-scale installations. Economic uncertainties and project risks may further deter potential investors.

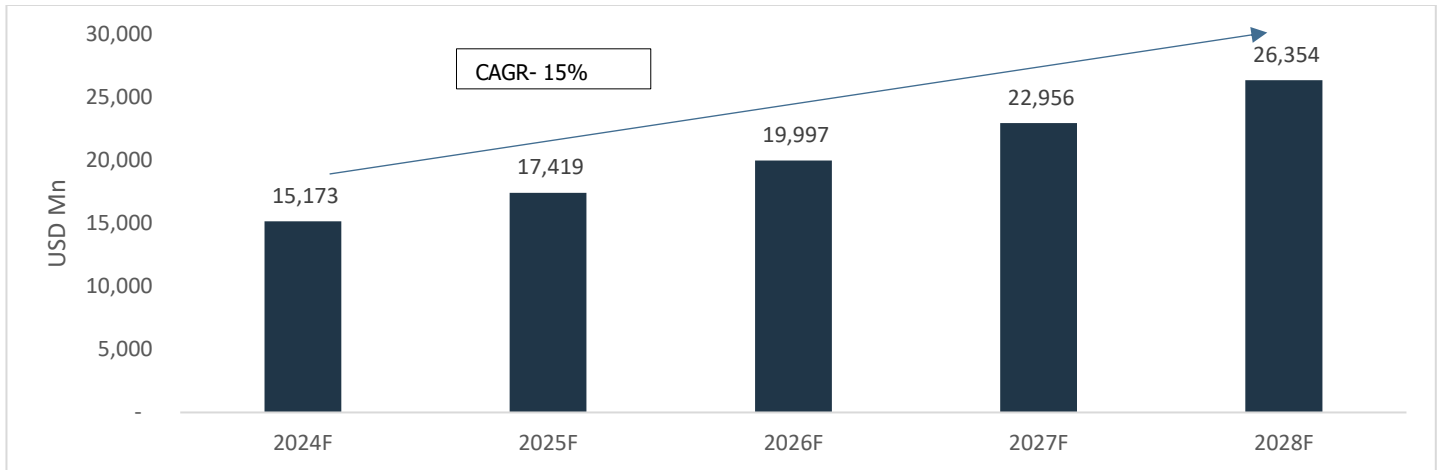
#### **4.7 Growth Forecast**

The global HVDC market witnessed significant growth in the past decade, driven by large-scale projects in regions like Europe, Asia-Pacific, and North America. The development of intercontinental HVDC links and submarine cables contributed to market expansion. Whereas the increasing share of renewable energy in power generation and the growing need for efficient transmission are expected to drive the demand for HVDC transmission lines. In addition, the need for grid resilience against disturbances and fluctuations is expected to increase the adoption of FACTS devices to stabilize voltage and improve power quality.

Furthermore, as the world is undergoing an energy transition, the demand for HVDC and FACTS solutions is expected to align with the goals of integrating renewable energy sources and improving overall grid performance. On the other hand, the incorporation of HVDC and FACTS technologies into smart grid initiatives may contribute to their continued growth, supporting the development of intelligent and efficient power systems.

The Global HVDC and FACTS market is expected to grow at a CAGR of 15% from USD 15,173 Mn in 2024 to USD 26,354 Mn in 2028.

#### **Chart 36: Global HVDC and FACTS Market Forecast**



Source: Maia Research, CareEdge Research, Industry Sources

**Note-** The quantum of the HVDC transmission projects announced far exceeds the forecasted trajectory. With tendered projects worth USD 90 to 100 billion already been allotted worldwide, the estimated projects awarded in the market is sizeable and if executed and operationalised will result in addition to the market size of the industry in the medium to long term.

## 5. STATCOM

### 5.1 Overview

STATCOM stands for Static Synchronous Compensator. It is a critical energy transition device type used in electricity grids to regulate voltage, improve power quality, and enhance grid stability. A STATCOM operates by generating or absorbing reactive power to maintain the voltage within acceptable limits, especially during transient conditions or grid fluctuations. This helps improve the overall efficiency and reliability of the electrical system.

STATCOM (Static Synchronous Compensator) finds various applications in electrical power systems to enhance grid stability, improve power quality, and support voltage regulation. Some common applications of STATCOM include:

**Voltage Regulation:** STATCOMs are used to regulate voltage levels in transmission and distribution networks. By injecting or absorbing reactive power, STATCOMs help maintain the voltage within acceptable limits, ensuring a stable operation of electrical equipment and systems.

**Power Factor Correction:** STATCOMs can be employed to correct power factor issues in industrial and commercial facilities. By supplying or absorbing reactive power as needed, STATCOMs help improve power factor, thereby optimizing the efficiency of power distribution systems.

**Grid Stability Enhancement:** STATCOMs play a crucial role in enhancing the stability of power grids, especially during transient events or disturbances. By providing rapid and precise reactive power support, STATCOMs help dampen voltage fluctuations and stabilize grid operation, preventing voltage collapses and blackouts.

**Renewable Energy Integration:** STATCOMs are increasingly used in renewable energy systems, such as wind farms and solar power plants, to mitigate voltage fluctuations and grid integration challenges. By providing reactive power support, STATCOMs facilitate a smooth integration of variable renewable energy sources into the grid.

**Industrial Applications:** STATCOMs are utilized in various industrial applications to improve power quality, stabilize voltage levels, and mitigate harmonics. They are commonly deployed in industries with sensitive equipment, such as manufacturing plants, data centres, and semiconductor facilities, to ensure reliable & stable power supply.

**Transmission Line Compensation:** STATCOMs can be installed at strategic locations along transmission lines to compensate for voltage drops, line losses, and reactive power demand. This helps optimize power transfer capacity, reduce transmission losses, and enhance overall grid efficiency.

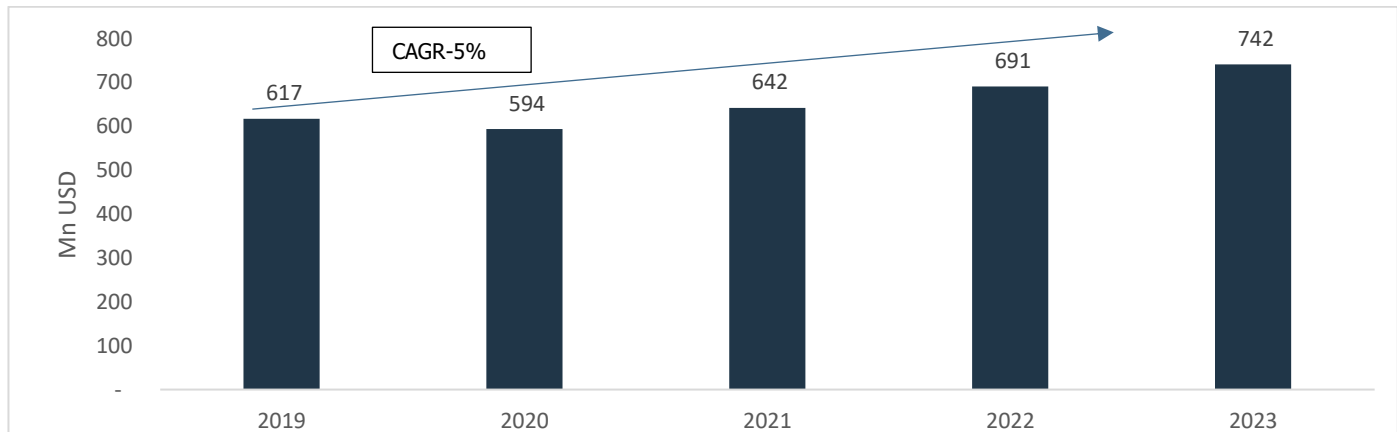
**5.2 Global STATCOM Market Size**

The integration of renewable energy sources into the power grid presents challenges related to voltage fluctuations and intermittent power generation. Also, the rising demand for electricity worldwide calls for grid stability and power quality. In this regard, STATCOM solutions help stabilize the grid and help with the seamless integration of renewable energy in the main power grid. Similarly, governments worldwide are implementing regulations and policies to promote clean energy generation and grid stability. Accordingly, the market for STATCOM technologies is expected to gain more traction in the coming years.

Furthermore, research and development efforts are ongoing to improve the ability of STATCOMs, resulting in improved efficiency, reliability, and cost-effectiveness. The market for STATCOMs is geographically segmented into regions such as North America, Europe, Asia Pacific, Latin America, and the Middle East & Africa. Asia Pacific is anticipated to dominate the global STATCOM market, owing to rapid industrialization, urbanization, and infrastructure development initiatives in countries like China, India, and South Korea.

The global STATCOM market has grown at a CAGR of 5% from 2019 to 2023 to reach Mn 742 USD from Mn 617 USD in 2019.

**Chart 37: Global STATCOM Market Size**



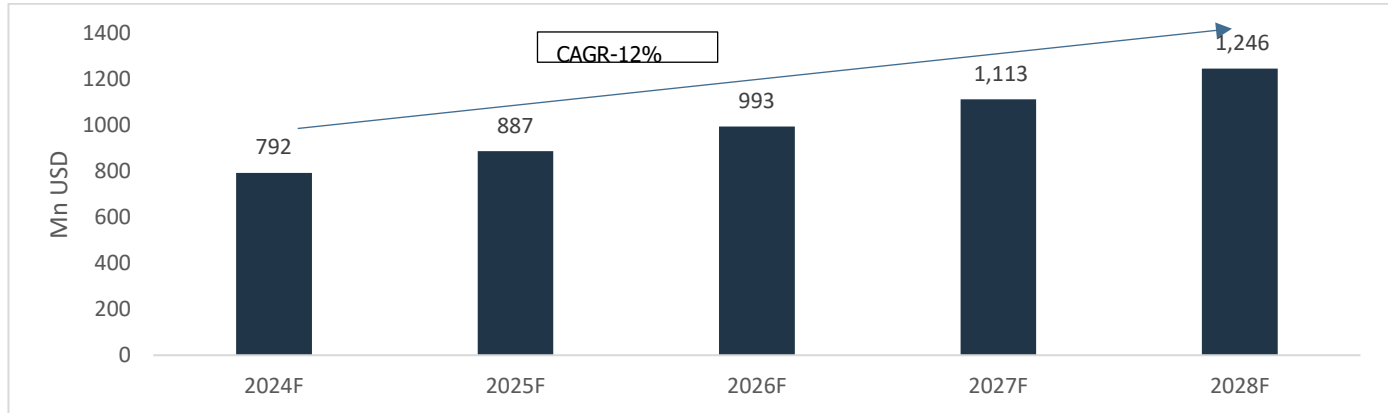
Source: Maia Research, CareEdge Research



Moreover, rapid industrialization & urbanization and a rising population are expected to substantially raise power consumption. This will further necessitate robust power transmission and distribution systems. Such factors alongside the global shift to sustainable energy sources are expected to drive the STATCOM market globally.

The global STATCOM market is expected to grow at a CAGR of 12% from Mn 792 USD in 2024 to Mn 1,246 USD in 2028.

**Chart 38: Global STATCOM Market Size Forecast**



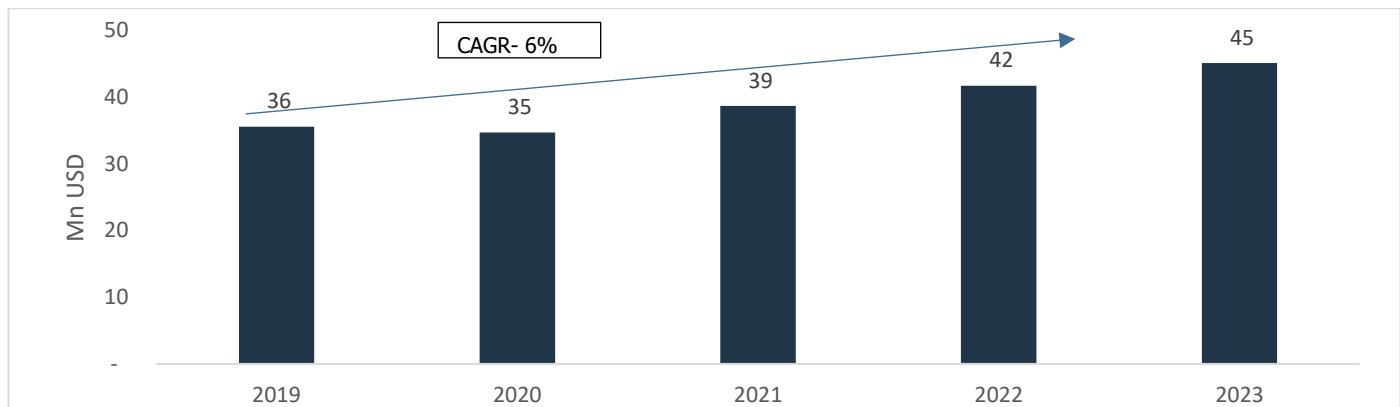
Source: Maia Research, CareEdge Research, Industry Sources

**5.3 Indian STATCOM Market Size**

The Indian STATCOM market has been witnessing steady growth, propelled by rising investments in renewable energy integration, grid modernization projects, and infrastructure development initiatives. The market for STATCOM has grown at a CAGR of 6% from Mn 36 USD in 2019 to Mn 45 USD in 2023.

The growth of the Indian STATCOM market is primarily driven by growing concerns regarding grid stability and power quality, increasing renewable energy penetration, rising demand for efficient power transmission and distribution systems, and government initiatives promoting clean energy and sustainable development. The domestic market for STATCOM and the pent-up demand from exports project about 35-40% CAGR for this product.

**Chart 39: Indian STATCOM Market Size**



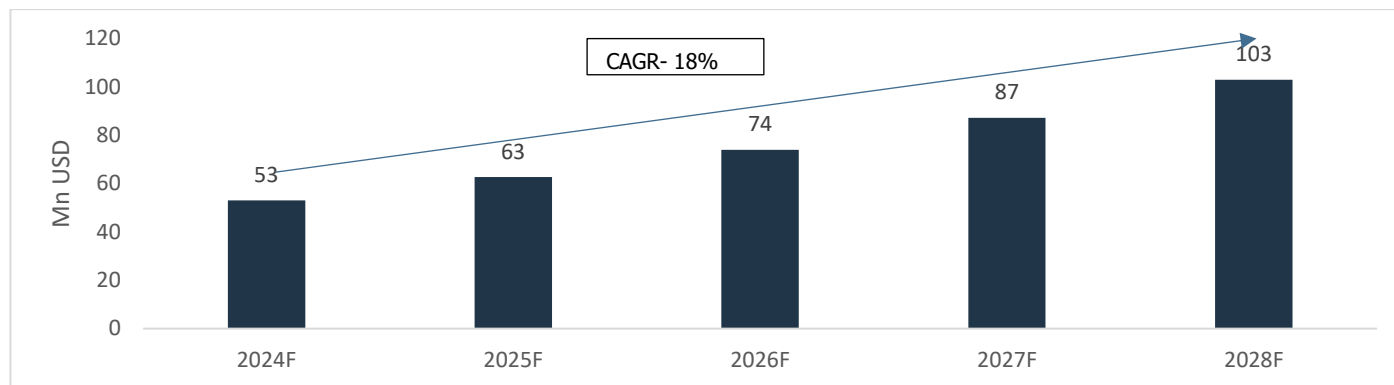
Source: Maia Research, CareEdge Research

Furthermore, the growing use of STATCOM in high voltage direct systems and its adoption in renewable energy industries for voltage stability electric utility applications are expected to drive the Indian STATCOM market. This will be supplemented by the high demand for STATCOM from the expanding industrial sector and the rising use of STATCOM in photovoltaic generation.

Moreover, the Indian government has been implementing various policies and initiatives to promote the adoption of STATCOMs and other FACTS (Flexible Alternating Current Transmission Systems) solutions in the country. For instance, initiatives such as the Green Energy Corridor project, Smart Grid Mission, and UDAY (Ujwal DISCOM Assurance Yojana) scheme aim to modernize the power sector and enhance grid reliability and stability.

The Indian STATCOM market size is expected to grow at a CAGR of about 18% from Mn 53 USD in 2024 to Mn 103 USD in 2028.

**Chart 40: Indian STATCOM Market Size Forecast**



Source: Maia Research, CareEdge Research, Industry Sources

**HVDC and STATCOM under bidding/ planned/ under Planning as per CEA**

HVDC and Statcom Projects as of now which are under bidding/ planned/ under Planning are as follows:

**1. HVDC HVDC (Under Bidding/ Planned/Under Planning):**

- (i) ±800 kV 6000 MW HVDC (LCC) from Bhadla-III to Fatehpur
- (ii) ±800 kV 6000 MW HVDC (LCC) from KPS2 to Nagpur
- (iii) ±500 kV 2500 MW HVDC (VSC) from KPS3 to South Olpad
- (iv) ±350 kV 5000 MW HVDC (VSC) from Pang (Leh) to Kaithal
- (v) ±800 kV 6000 MW HVDC (LCC) from Barmer-II to a suitable location in WR /SR
- (vi) ±800 kV 6000 MW HVDC (LCC) from Merta-II (final location being finalized)
- (vii) ±320 kV 500 MW HVDC from Angul/ Paradeep to Port Blair/ Great Nicobar
- (viii) ±320 kV 1000 MW India – Sri Lanka VSC HVDC System
- (ix) 500 MW India – Myanmar Back-to-back LCC HVDC System
- (x) 2000 MW HVDC between India and Singapore

**2. STATCOMS (Under Bidding/ Planned/Under Planning):**

S.No.	Location	Capacity
1	Bikaner-IV	± 2x300 MVAR
2	Siwani	± 2x300 MVAR
3	Barmer-I	± 2x300 MVAR

4	Sirohi	± 2x300 MVAR
5	Rishabhdeo	± 2x300 MVAR
6	Mandsaur	± 300 MVAR
7	Kurawar	± 300 MVAR
8	Bikaner-III	± 2x300 MVAR
9	Ghiror	± 2x300 MVAR
10	Merta-II	± 2x300 MVAR
11	Nizamabad-II	±300 MVAR
12	Khavda PS-I	2 x ±300 MVAR
13	Khavda PS-III	2 x ±300 MVAR
14	Boisar-II	2 x ±200 MVAR
15	Pune-III	±300 MVAR
16	Jamnagar	±400 MVAR
17	Navsari	±300 MVAR
18	Navinal (Mundra)	±300 MVAR
19	Halvad	±300 MVAR
20	Vatman	±300 MVAR

## 6. Global High Voltage Products

### 6.1 Overview

High-voltage power is AC (alternating current) power with a voltage exceeding 1000V or 1500V DC (direct current) in distribution lines (International Electrotechnical Commission standard). High-voltage electrical equipment are a series of key products that ensure safe, reliable, and efficient power transmission under high voltage, such as High Voltage Special Power Transformers, High Voltage Reactors, and others. These products play a crucial role in various industries, including power generation, transmission, distribution, and industrial applications.

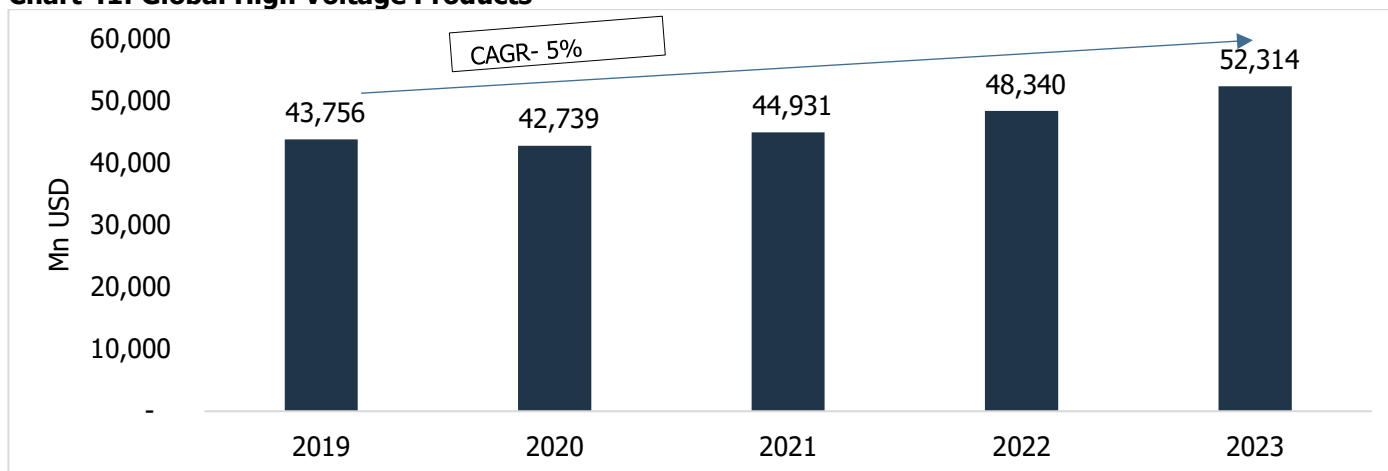
**Table 9: Different Types of High Voltage Products**

Types	Description
High-Voltage Special Power Transformers	High-voltage transformers convert voltages from one level or phase configuration to another, usually from higher to lower. They can include features for electrical isolation, power

	distribution, and control & instrumentation applications. The transformer design is based on the principle of magnetic induction between coils to convert voltage and/or current levels.
High-Voltage Reactors	A high-voltage reactor is a coil wired in series between two points in a power system to minimize inrush current, voltage notching effects, and voltage spikes. Reactors may be tapped so that the voltage across them can be changed to compensate for a change in the load that the motor is starting.
High-Voltage Breaker Products	High-voltage circuit breakers are mechanical switching devices which connect and break current circuits (operating currents and fault currents) and carry the nominal current in closed position.
Others	Other high-voltage products include capacitors, combined electrical appliances, transformers, lightning arresters, coupling capacitors, transmission lines, power cables, grounding devices, generators, condensers, electric motors, closed busbars, thyristors, etc.

The global high voltage products value grew at a CAGR of 5% in the period from 2019-2023. The industry grew from USD 43,756 million in 2019 to USD 52,314 million in 2023. In 2023, high-voltage special power transformers had the highest product market share at 33.8% followed by high-voltage switchgear, high-voltage reactors, high-voltage breakers, and others at 21.2%, 8.7%, 5.0%, and 31.3%, respectively. Whereas the utility market by application contributes the largest share at 60.1% followed by industrial, commercial, and others at 19.2%,10.8%, and 9.9%, respectively, as of 2023 the growth is determined by energy requirements and governments shift towards renewable energy which has resulted in development of transmission grids.

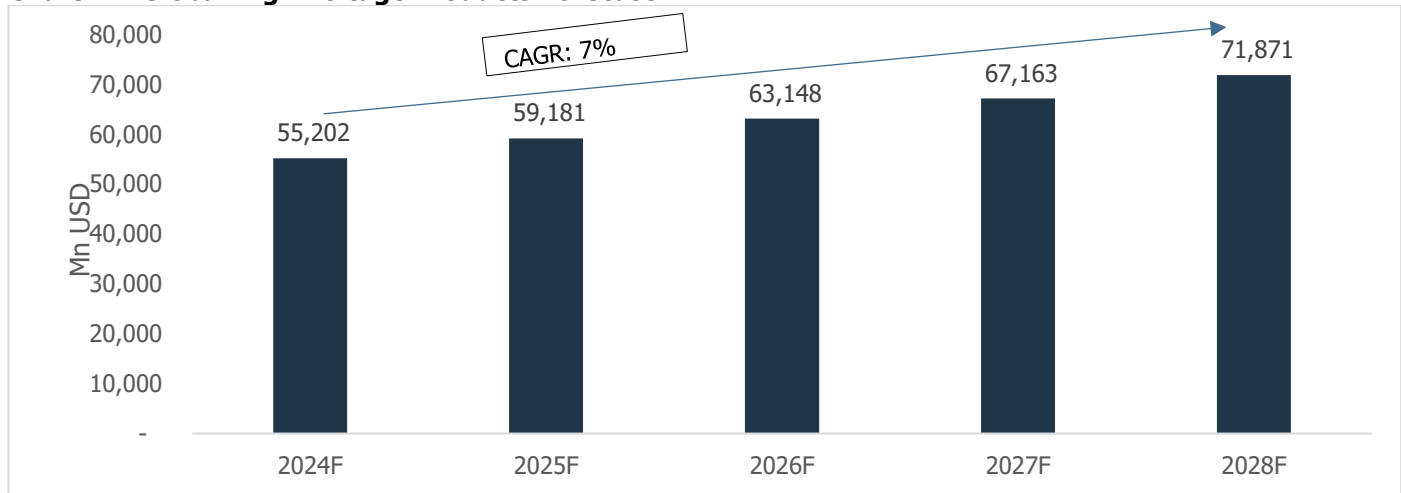
**Chart 41: Global High Voltage Products**



Source: Maia Research, CareEdge Research

The global high voltage products value is expected to grow at a CAGR of 7% in the period from 2023-2028. The industry is expected to grow from USD 52,314 million in 2023 to USD 71,871 million in 2028. In 2028, high-voltage special power transformers will contribute around 35.3% of the market share followed by high-voltage switchgear, high-voltage reactors, high-voltage breakers, and others at 21.2%, 8.2%, 4.8%, and 30.4%, respectively. Whereas the utility market by application will continue to contribute the largest share at 60.3% followed by Industrial, Commercial and Others at 18.6%,11.1% and 10.1% respectively as of 2028. The government’s stance on Net-Zero carbon has resulted in the focus from thermal energy to renewable energy which will lead to an increase in transmission grids and high voltage product requirements.

**Chart 42: Global High Voltage Products Forecast**



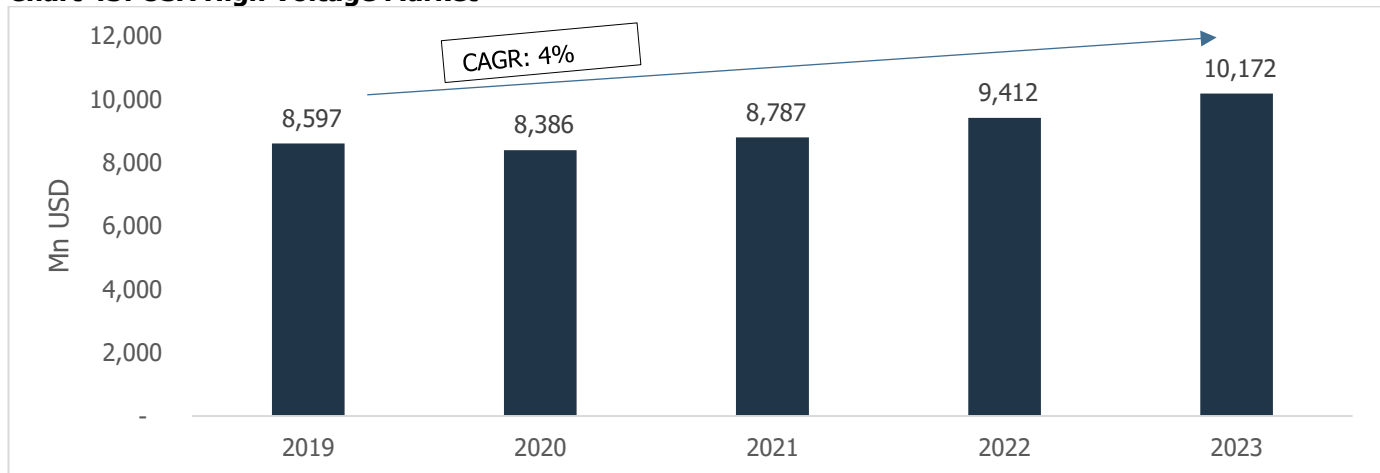
Source: Maia Research, CareEdge Research

## 6.2 Global High Voltage Market Split by Region

### 6.2.1 USA High Voltage Product Market

The USA is one of the largest markets for high-voltage products globally, driven by factors such as infrastructure development, industrial expansion, and the increasing demand for electricity. The market has been experiencing steady growth, driven by investments in grid modernization, renewable energy integration, and electrification projects. The USA accounted for the largest market share at 19.4% as of 2023. The high voltage market of the USA was valued at USD 10,172 million which grew at a CAGR of 4% from USD 8,597 million in 2019. Some of the major companies operating in the USA high-voltage products market include ABB, Siemens, General Electric, Schneider Electric, Eaton Corporation, and Mitsubishi Electric Corporation.

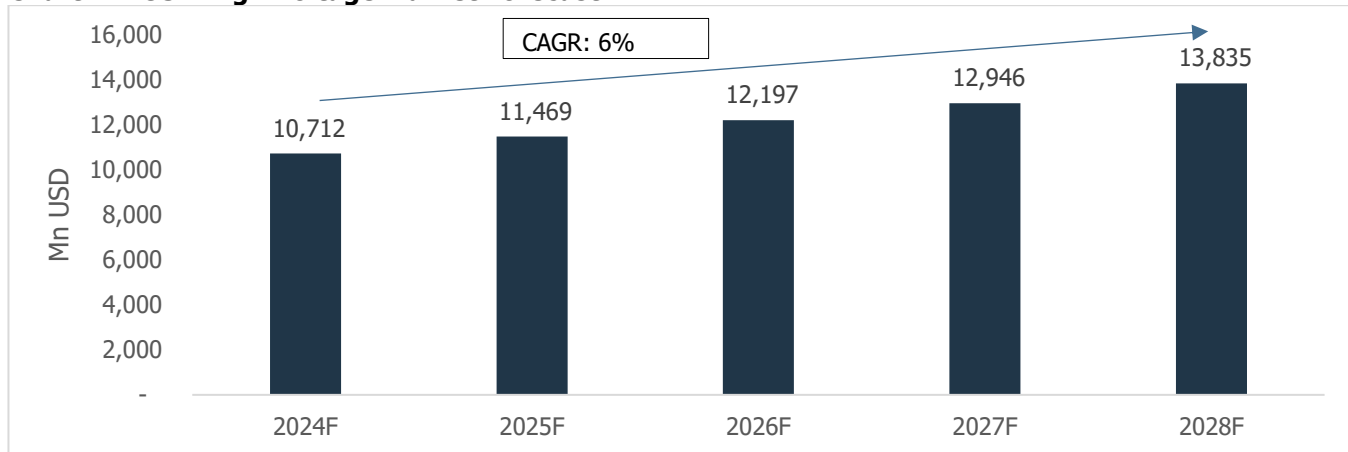
**Chart 43: USA High Voltage Market**



Source: Maia Research, CareEdge Research.

The USA will account for the largest market share at 19.3% as of 2028. The high voltage market of the USA is estimated to be valued at USD 13,835 million, growing at a CAGR of 6% from 2023 marginally lower than industry growth CAGR of 7% in the same period.

**Chart 44: USA High Voltage Market Forecast**

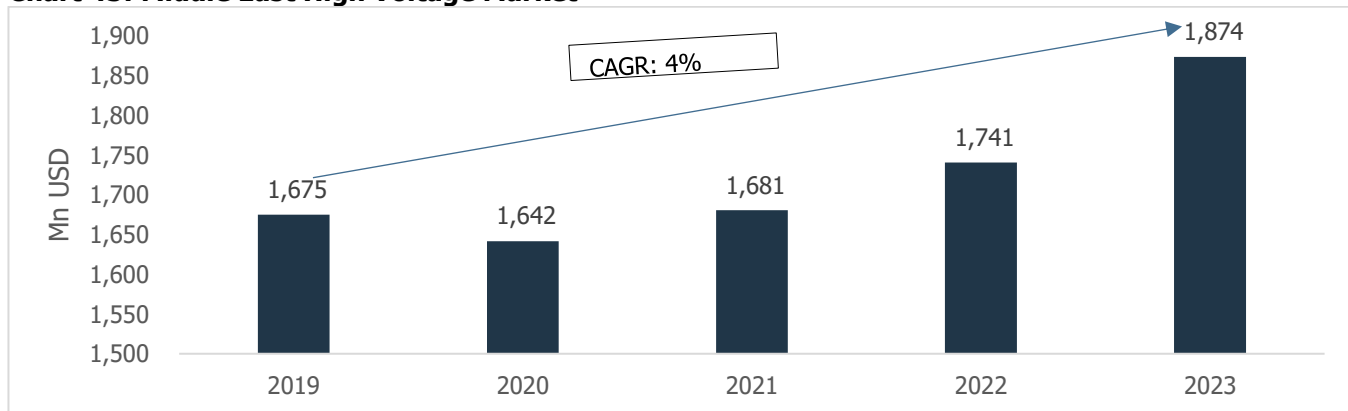


Source: Maia Research, CareEdge Research.

**6.2.2 Middle East High Voltage Product Market**

The Middle East region, with its rapidly growing economies and increasing energy demand, represents a significant market for high-voltage products. The Middle East accounts for a market share of 4% as of 2023. The high voltage market of the Middle East was valued at USD 1,873.8 million which grew at a CAGR of 3% from USD 1,675 million in 2019 whereas the industry grew by 5% in the same period. The market includes both domestic and international players, with major global companies often partnering with local firms to capitalize on market opportunities.

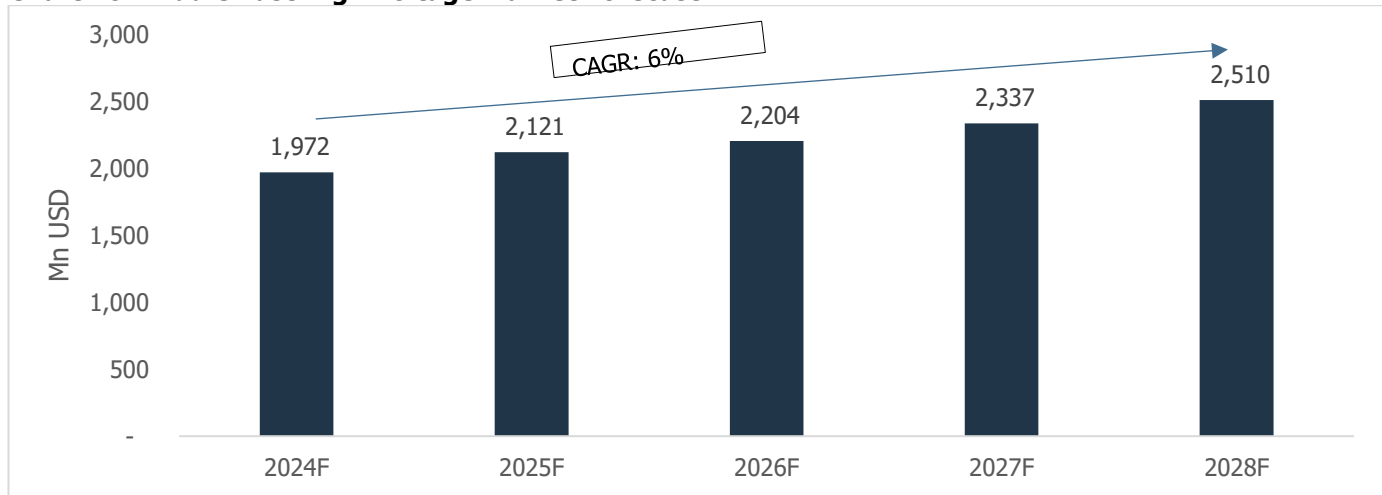
**Chart 45: Middle East High Voltage Market**



Source: Maia Research, CareEdge Research.

The Middle East will account for the market share of 6% as of 2028 lower than 2023. The high voltage market of the Middle East is estimated to be valued at USD 2,510 million, growing at a CAGR of 6.0% from 2023 marginally lower than industry growth CAGR of 6.6% in the same period.

**Chart 46: Middle East High Voltage Market Forecast**

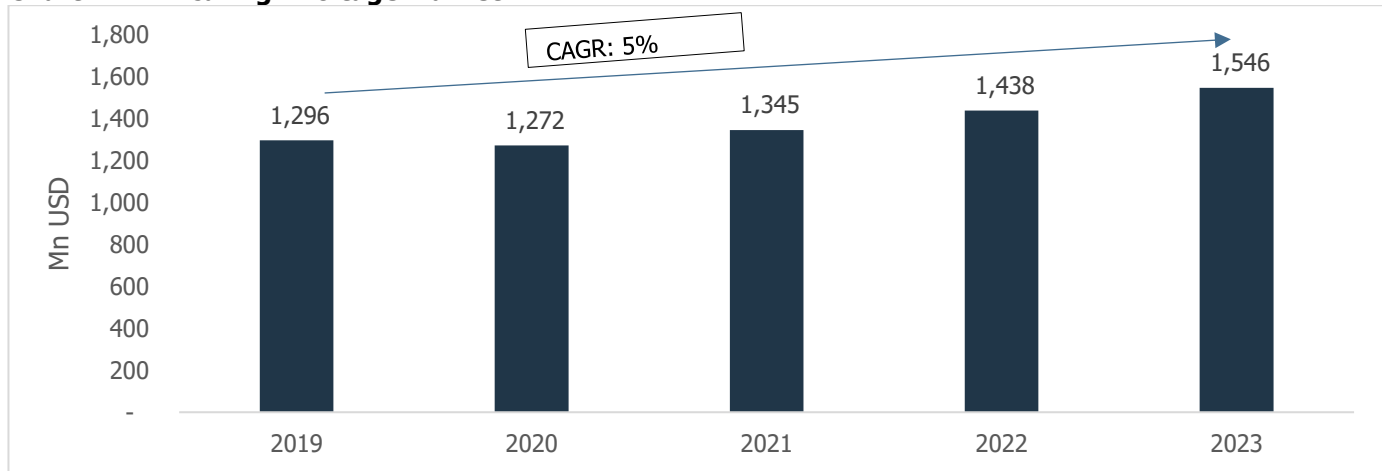


Source: Maia Research, CareEdge Research

**6.2.3 Africa High Voltage Product Market**

The African high-voltage products market is characterized by diverse levels of development across different regions and countries. Africa accounts for a market share of 3.0% as of 2023. The high voltage market of Africa was valued at USD 1,546 million which grew at a CAGR of 5% from USD 1,631 million in 2019 in line with the industry growth. Many countries in Africa are investing in infrastructure projects to address the growing demand for electricity and improve access to reliable power.

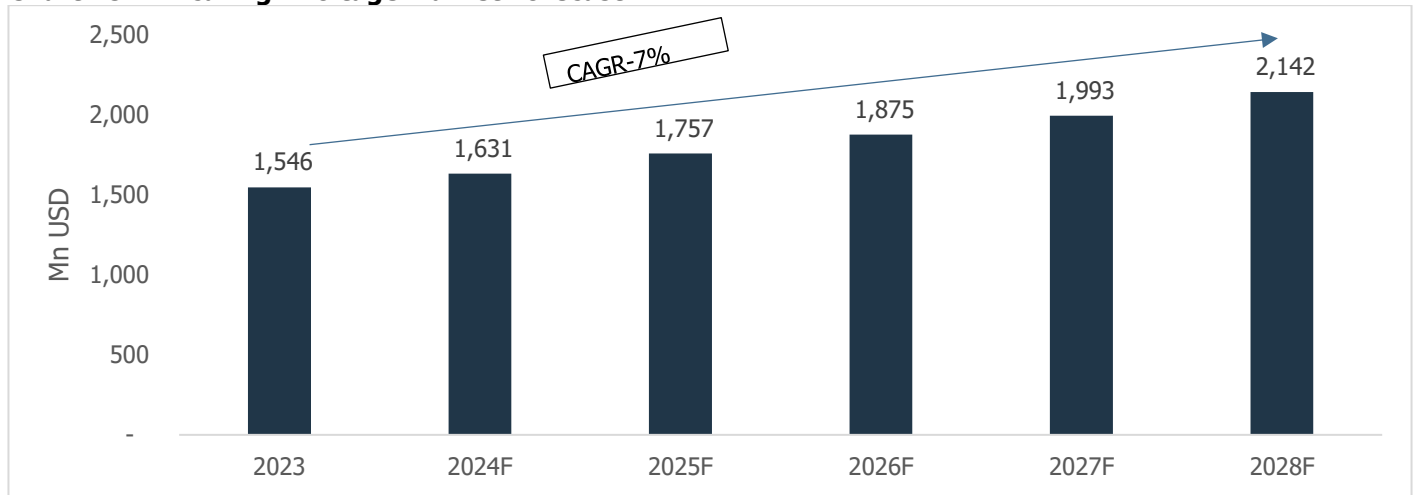
**Chart 47: Africa High Voltage Market**



Source: Maia Research, CareEdge Research

Africa will continue to account for the market share of 3% as of 2028. The high voltage market of Africa is estimated to be valued at USD 2,142 million, growing at a CAGR of 7% from 2023.

**Chart 48: Africa High Voltage Market Forecast**

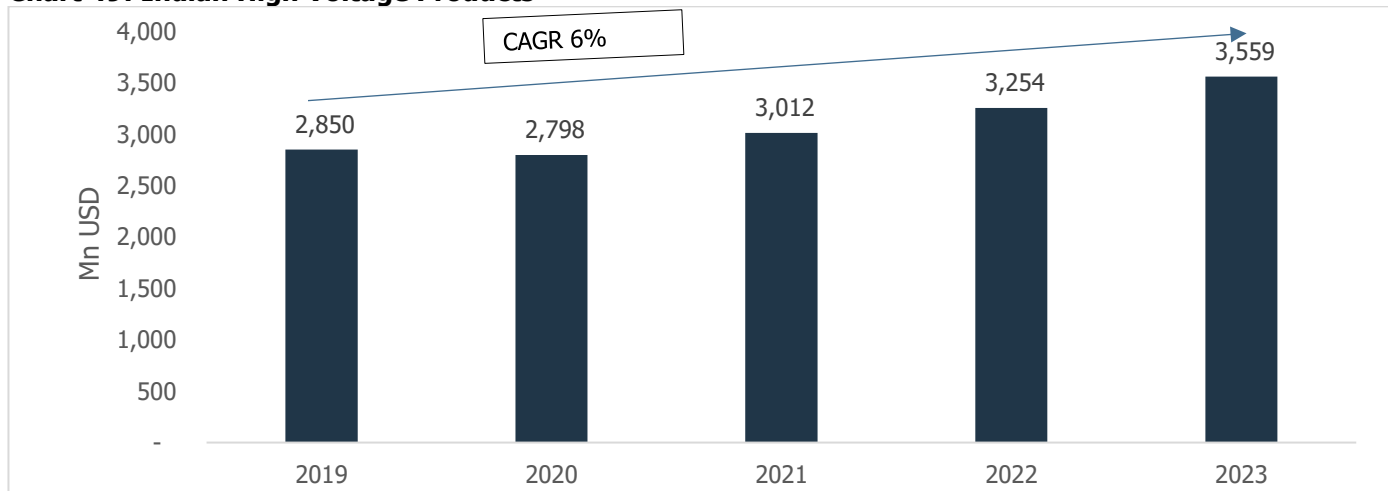


Source: Maia Research, CareEdge Research

**6.2.4 Indian High-Voltage Products Market**

The high-voltage products market in India encompasses a broad spectrum of electrical equipment designed to handle and control high levels of voltage in various applications across the country. The Indian high-voltage products value grew at a CAGR of 6% in the period from 2019-2023. The industry grew from USD 2,850 million in 2019 to USD 3,558 million in 2023. In 2023, high-voltage special power transformers had the highest product market share at 37.3% followed by high-voltage switchgear, high-voltage reactors, high-voltage breakers, and others at 25.1%, 6.9%, 4.5%, and 26.2% respectively. The utility market by application contributes the largest share at 62.9% followed by industrial, commercial, and others at 21.5%, 7.1%, and 8.5%, respectively as of 2023. India has ambitious targets for renewable energy deployment, including solar, wind, and hydroelectric power. India is investing heavily in infrastructure projects to modernize its power transmission and distribution networks, improve grid reliability, and meet the growing energy demand. Initiatives such as the Green Energy Corridors, Smart Cities Mission, and Rural Electrification Program drive the demand for high-voltage products across the country.

**Chart 49: Indian High Voltage Products**



Source: Maia Research, CareEdge Research

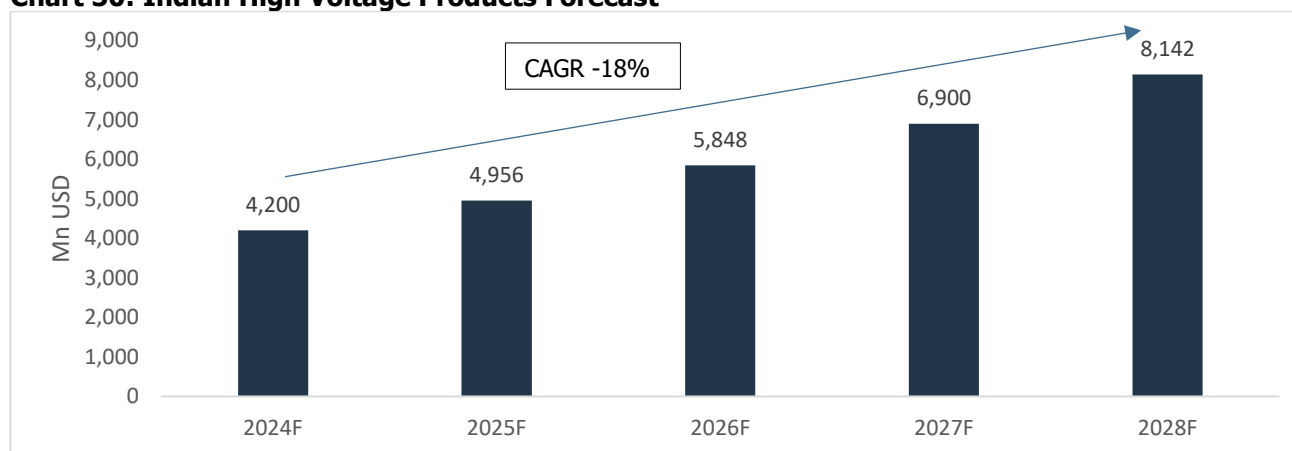


**Table 10: Indian High Voltage Products Value Segment by Type**

Million USD	2019	2020	2021	2022	2023
High Voltage Special Power Transformers	1,039	1,026	1,111	1,207	1,326
High Voltage Reactors	206	199	213	227	247
High Voltage Breaker Products	132	128	137	147	159
Others	760	744	797	858	933
Total	2,850	2,798	3,012	3,255	3,559

Source: Maia Research, CareEdge Research

The Indian high-voltage products value is expected to grow at a CAGR of 8% in the period from 2023-2028. The industry is expected to grow from USD 3,558 million in 2023 to USD 5,133 million in 2028. In 2028, high-voltage special power transformers will contribute around 38.4% of the market share followed by high-voltage switchgear, high-voltage reactors, high-voltage breakers, and others, at 25.1%, 6.6%, 4.3%, and 25.7% respectively. The utility market by application will continue to contribute the largest share at 63.0% followed by industrial, commercial, and others at 20.8%, 7.3%, and 8.9% respectively, as of 2028.

**Chart 50: Indian High Voltage Products Forecast**


Source: Maia Research, CareEdge Research

**Table 11: Indian High Voltage Products Value Segment by Type (2024-2028F)**

Million USD	2024F	2025F	2026F	2027F	2028F
High Voltage Special Power Transformers	1,565	1,846	2,179	2,571	3,034
High Voltage Reactors	291	344	406	479	565
High Voltage Breaker Products	188	221	261	308	364
Others	1,101	1,299	1,533	1,809	2,134
Total	4,200	4,956	5,848	6,900	8,142

Source: Maia Research, CareEdge Research.

### 6.3 Global High Voltage Products Type

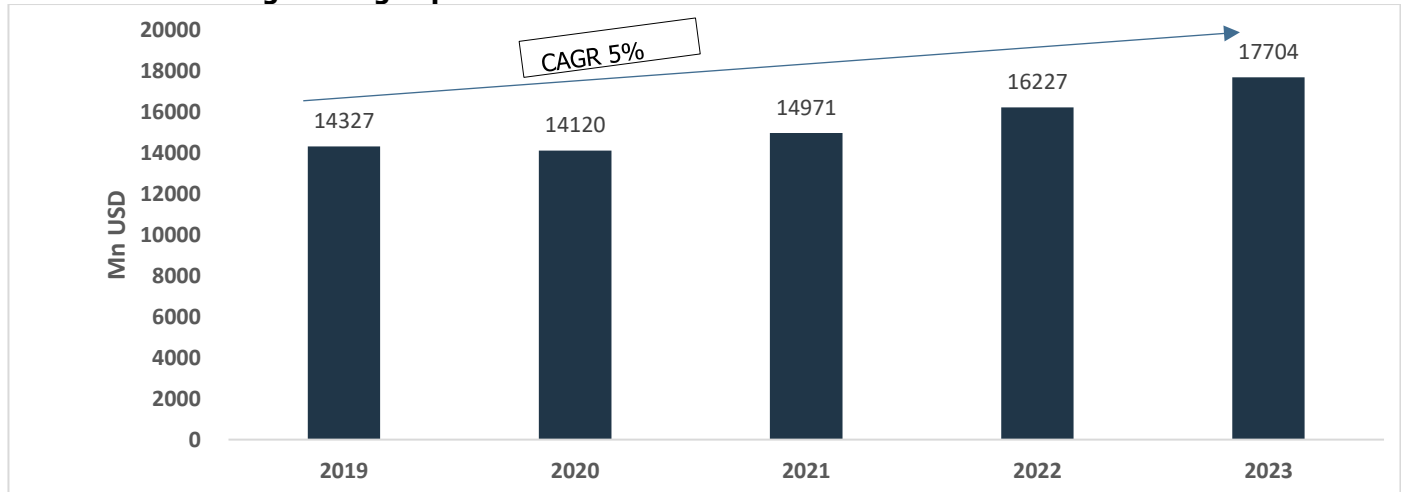
#### 6.3.1 Global High Voltage Special Power Transformers

High voltage special power transformers are transformers designed to handle exceptionally high voltage levels, typically above 69 kV (kilovolts). These transformers play a crucial role in energy transition and distribution systems, stepping up voltage levels for long-distance transmission and stepping down voltage levels for distribution to end-users.

High voltage special power transformers are often custom-designed to meet the unique needs of a particular power system. This includes considerations such as voltage levels, load characteristics, environmental conditions, and regulatory requirements.

High voltage special power transformers account for 33.8% of the market size of the high voltage products market, the market size of high voltage special power transformers was at USD 17,704 million as of 2023. It grew at a CAGR of 5% from USD 14,327 million in 2019.

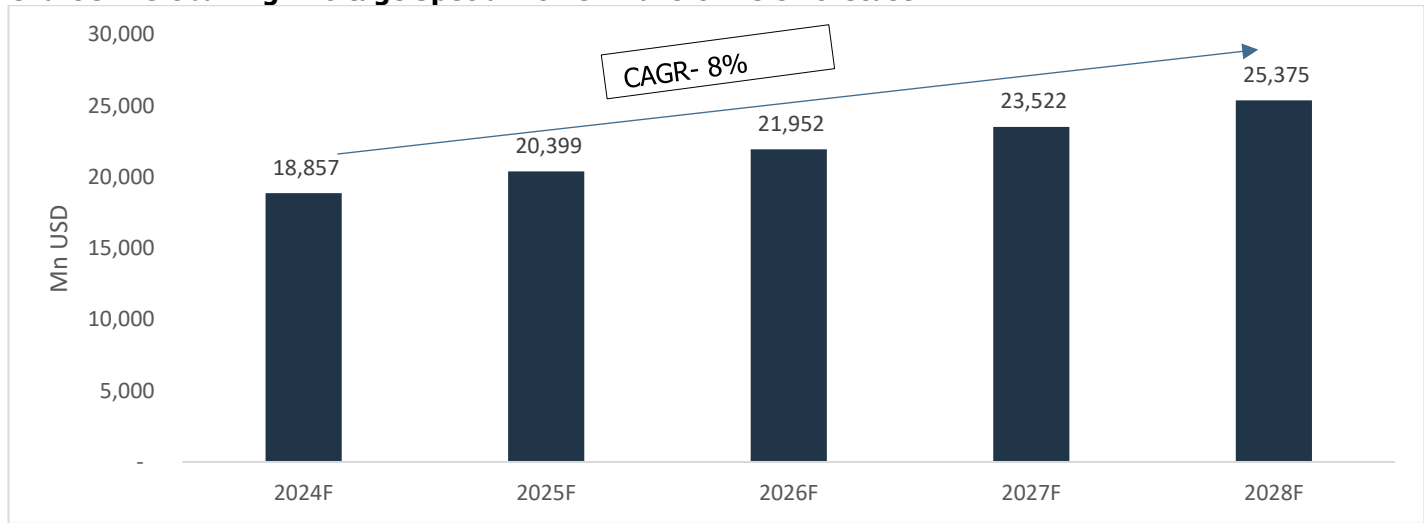
**Chart 51: Global High Voltage Special Power Transformers**



Source: Maia Research, CareEdge Research.

High voltage special power transformers will account for the largest share at 35.3% of market size of the high voltage products market, the market size of high voltage special power transformers is expected at USD 25,375 million as of 2028. It is expected to grow at a CAGR of 8% from 2024.

**Chart 52: Global High Voltage Special Power Transformers Forecast**



Source: Maia Research, CareEdge Research

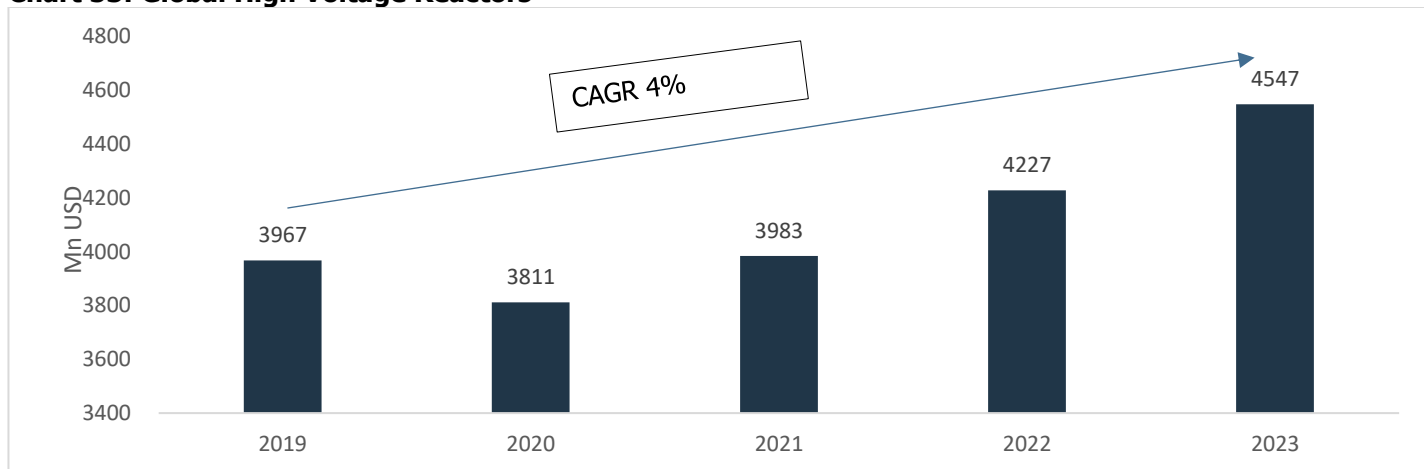
**6.3.2 Global High Voltage Reactors**

High voltage reactors are electrical devices used in critical energy transition systems to control voltage, manage reactive power, and improve system stability. High voltage reactors are primarily used to regulate voltage levels and control reactive power flow in electrical networks. They help maintain voltage stability, reduce voltage fluctuations, and improve the overall efficiency of power transmission and distribution systems.

High voltage reactors are connected in series with power lines or electrical equipment to limit the flow of reactive power and adjust voltage levels. By introducing inductive impedance into the system, they help offset the capacitive reactance of transmission lines and loads, thereby improving power factor and voltage regulation.

High voltage reactors account for 8.7% of the market size of the High voltage products market, the market size of high voltage reactors was at USD 4,547 million as of 2023. It grew at a CAGR of 4% from USD 3,967 million in 2019.

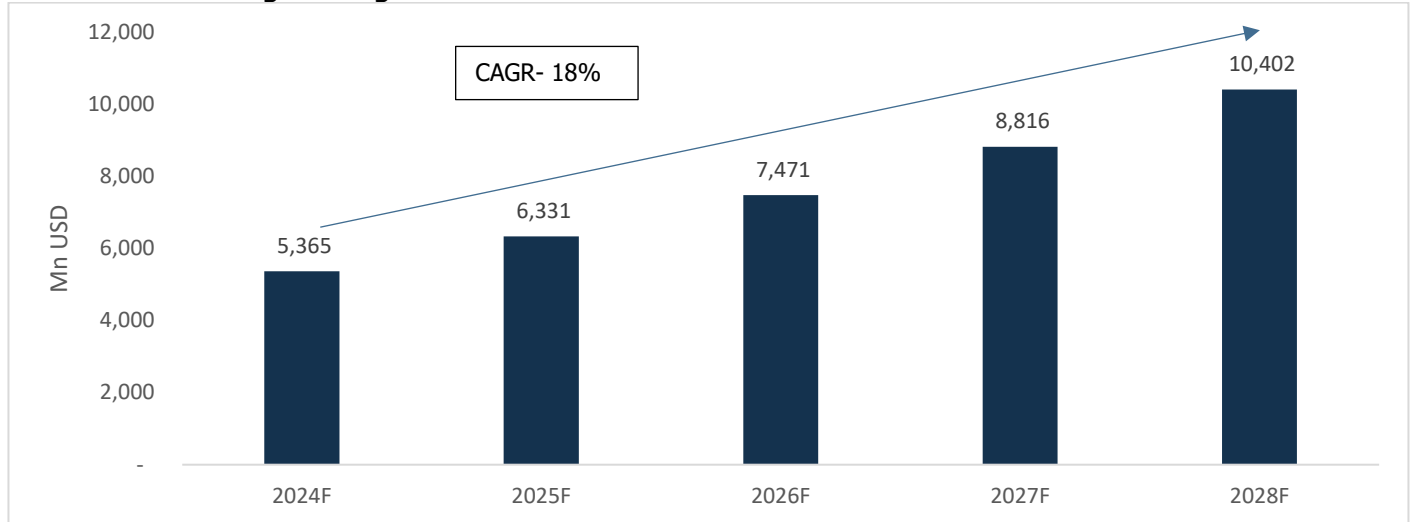
**Chart 53: Global High Voltage Reactors**



Source: Maia Research, CareEdge Research.

High voltage reactors will account for the market share at 8.2% of the market size of the high voltage products market, the market size of high voltage reactors is expected at USD 5,907.2 million as of 2028. It is expected to grow at a CAGR of 18% from 2023 below the industry growth of 6.6% in the same time period.

**Chart 54: Global High Voltage Reactors Forecast**



Source: Maia Research, CareEdge Research, Industry Sources

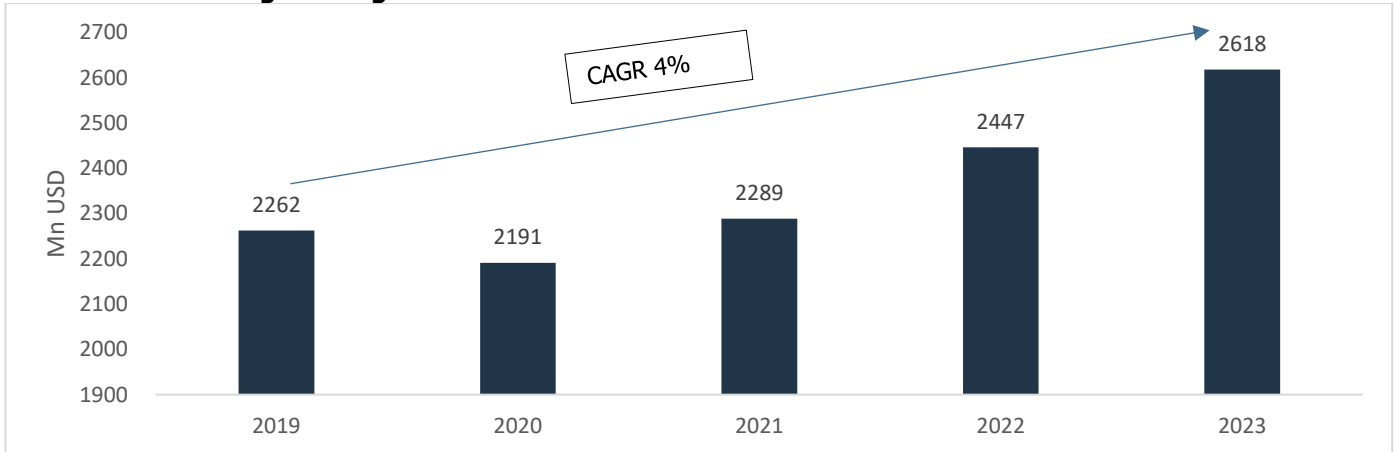
### 6.3.3 Global High Voltage Breaker Products

High voltage breaker products are essential components in critical energy transition equipment systems used to interrupt or break electrical circuits at high voltage levels. High voltage breakers are designed to interrupt the flow of electrical current under normal and fault conditions. They play a crucial role in protecting electrical equipment, ensuring personnel safety, and maintaining the reliability of power systems.

High voltage breakers are typically housed within robust enclosures made of metal or composite materials to withstand the stresses of high voltage operation. They consist of stationary and moving contacts that make and break the electrical connection. The contacts are designed to handle high currents and withstand arcing during interruption. Breakers may also include mechanisms for arc quenching, such as magnetic blowout coils, puffer chambers, or arc chutes, to extinguish the arc quickly and safely.

High voltage breaker products account for 5% of market size of the high voltage products market, the market size of high voltage breaker products was at USD 2,620 million as of 2023. It grew at a CAGR of 4% from USD 2,262 million in 2019.

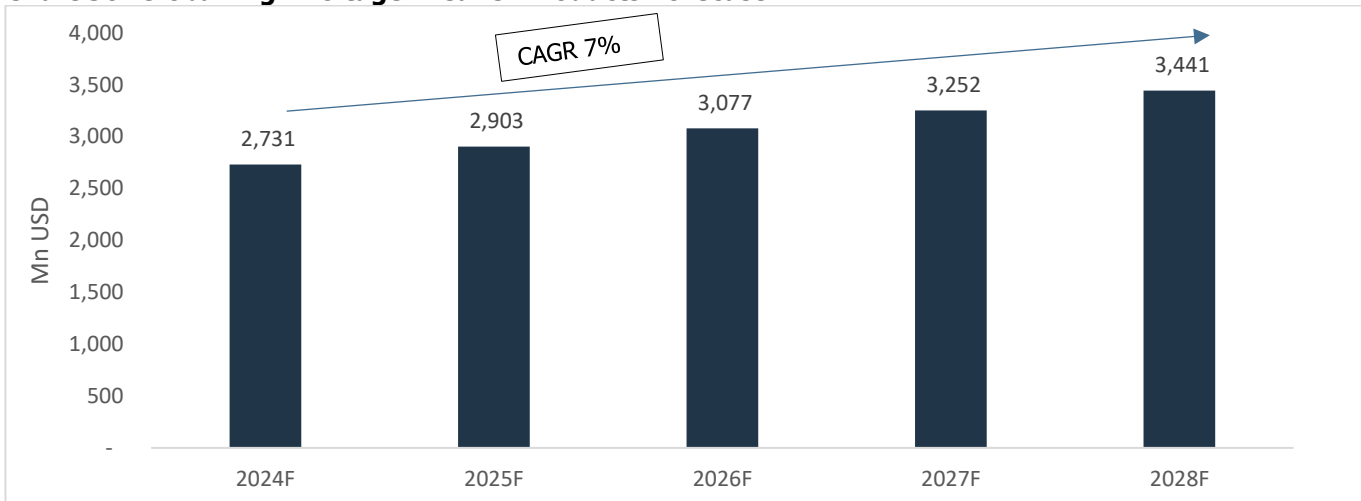
**Chart 55: Global High Voltage Breaker Products**



Source: Maia Research, CareEdge Research

High voltage breaker products will account for the market share at 4.8% of market size of the high voltage products market, the market size of high voltage breaker products is expected at USD 3,441 million as of 2028. It is expected to grow at a CAGR of 6% from 2023 below the industry growth of 7%.

**Chart 56: Global High Voltage Breaker Products Forecast**



Source: Maia Research, CareEdge Research

## 7. Global Power Quality Products Market

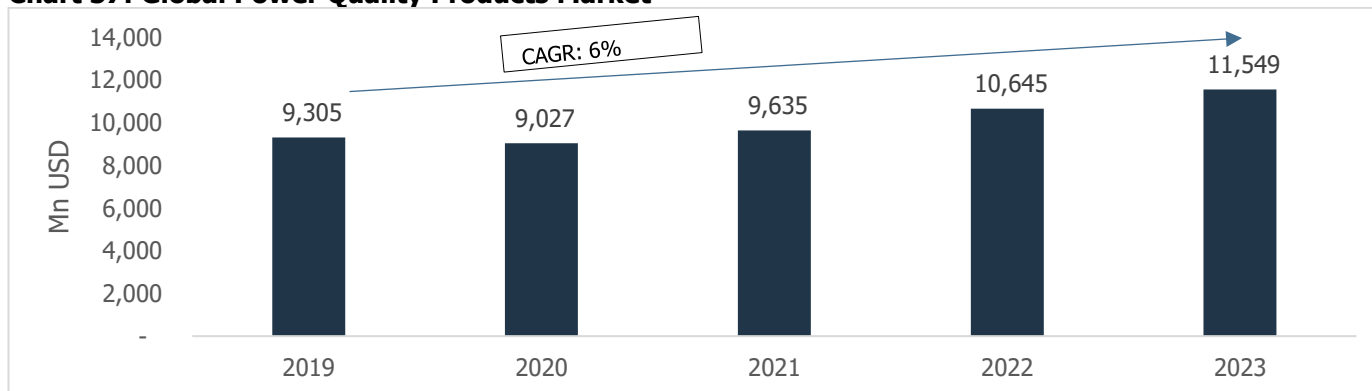
### 7.1 Overview

Power quality is the quality of electric energy in the energy transition system. The main indicators to measure power quality are voltage, frequency, and waveform. Deviations in voltage, current, or frequency that cause electrical equipment to malfunction or not work properly are defined as power quality problems. Power quality products are used to eliminate power quality problems and extend the operating life of electrical systems.

Types	Description
Harmonic Filters	Harmonic filters are series or parallel resonant circuits designed to shunt or block harmonic currents. They reduce the harmonic currents flowing in the power system from the source, and thereby, reduce the harmonic voltage distortion in the system.
Static Var Compensator (SVC)	A static VAR compensator (SVC) is a set of electrical devices for providing fast-acting reactive power on high-voltage energy transition networks. SVCs can regulate voltage, power factor, and harmonics and stabilize the system.
Static Synchronous Compensator (STATCOM)	A Static synchronous Compensator (STATCOM) is a fast-acting device capable of providing or absorbing reactive current, thereby regulating the voltage at the point of connection to a power grid. It is categorized under Flexible AC transmission system (FACTS) devices. The technology is based on VSCs with semi-conductor valves in a modular multi-level configuration.
Others	Other Power Quality Products include output filters and LCL filters and so on. An output filter helps approximate the ideal waveform by blocking undesirable ripple voltages and currents from reaching the load. LCL filter is a type of filter used in power electronics to reduce harmonic distortion and improve the performance of power converters. The acronym LCL stands for the inductance (L), capacitance (C), and inductance (L) components that make up the filter.

The global power quality products market grew at a CAGR of 6% in the period from 2019-2023. The industry grew from USD 9,305 million in 2019 to USD 11,549 million in 2023. In 2023, capacitor banks had the highest product market share at 31.5% followed by static var compensator (SVC), harmonic filters, static synchronous (STATCOM), and others at 16.9%, 11.9%, 6.4%, and 33.3%, respectively. Whereas the public utility market by application contributes the largest share at 46.5% followed by industrial and others at 28.1% and 25.4%, respectively, as of 2023. The power quality products market experienced significant growth due to the increasing importance of maintaining a stable, reliable, and high-quality electrical power supply.

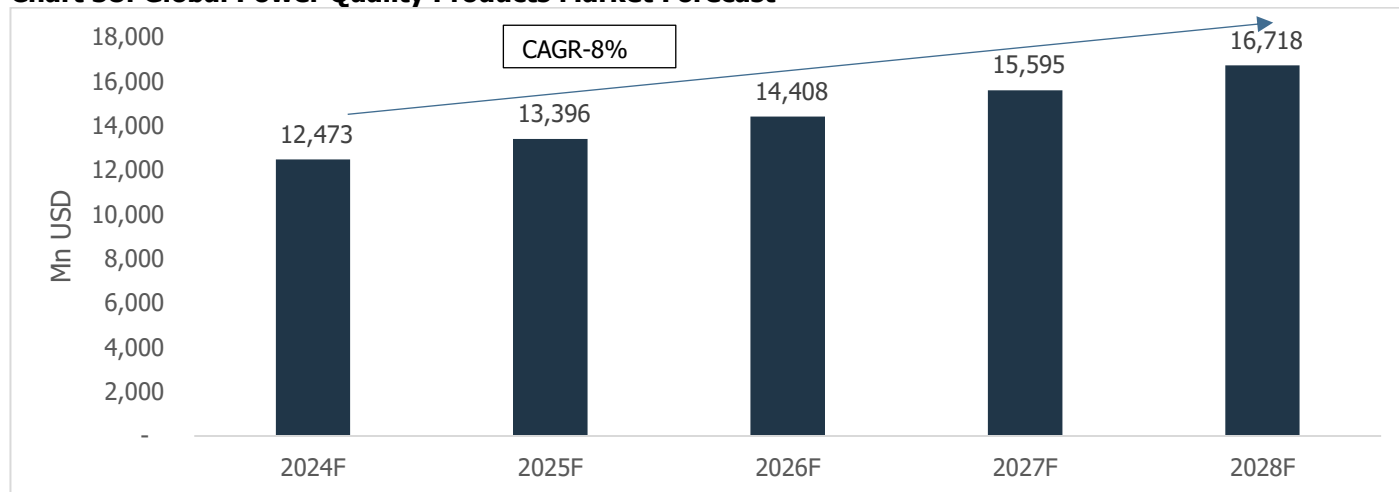
**Chart 57: Global Power Quality Products Market**



Source: Maia Research, CareEdge Research

The global power quality products market is expected to grow at a CAGR of 8% in the period from 2023-2028. The industry is expected to grow from USD 11,549 million in 2023 to USD 16,718 million in 2028. In 2028, capacitor banks will contribute around 31.5% of the market share followed by static var compensator (SVC), harmonic filters, static synchronous (STATCOM), and others at 17.0%, 12.5%, 6.1%, and 32.8%, respectively. Whereas the public utility market by application will continue to contribute the largest share at 46.7% followed by industrial and others at 27.4% and 25.9%, respectively, as of 2028 driven by several factors, including the increasing reliance on sensitive electronic equipment, the growing awareness of the importance of power quality, and the expansion of renewable energy integration and electrification initiatives.

**Chart 58: Global Power Quality Products Market Forecast**



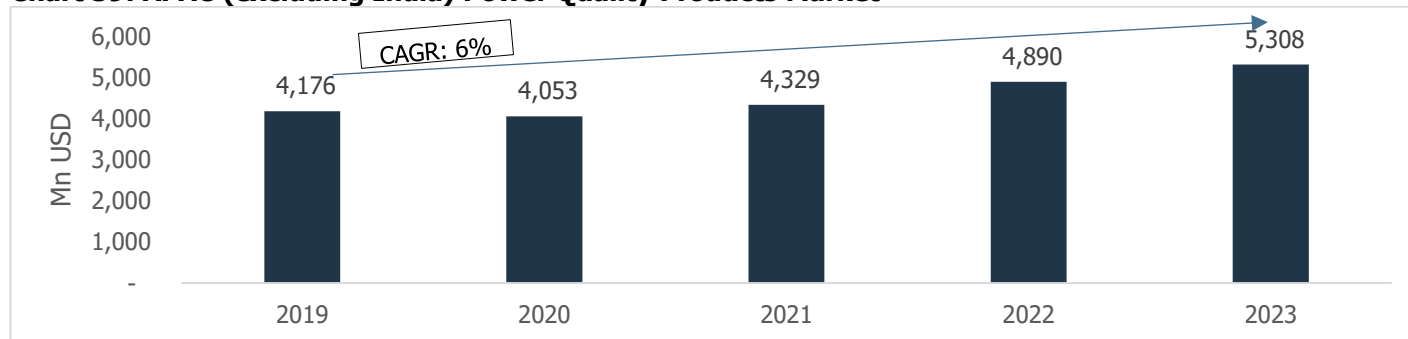
Source: Maia Research, CareEdge Research

## 7.2 Global Power Quality Products Market Split by Region

### 7.2.1 APAC (Excluding India)

The historical growth of the power quality products market in the APAC region can be attributed to experiencing rapid economic growth over the past few decades, driven by industrialization, urbanization, and infrastructure development. APAC (excluding India) accounts for the largest market share at 46.0% as of 2023. The global power quality products market of APAC (excluding India) is valued at USD 5,307.6 million growing at a CAGR of 6% from 2019. The APAC region is a leader in renewable energy deployment, with countries like China, Japan, and Australia investing heavily in solar, wind, and hydroelectric power.

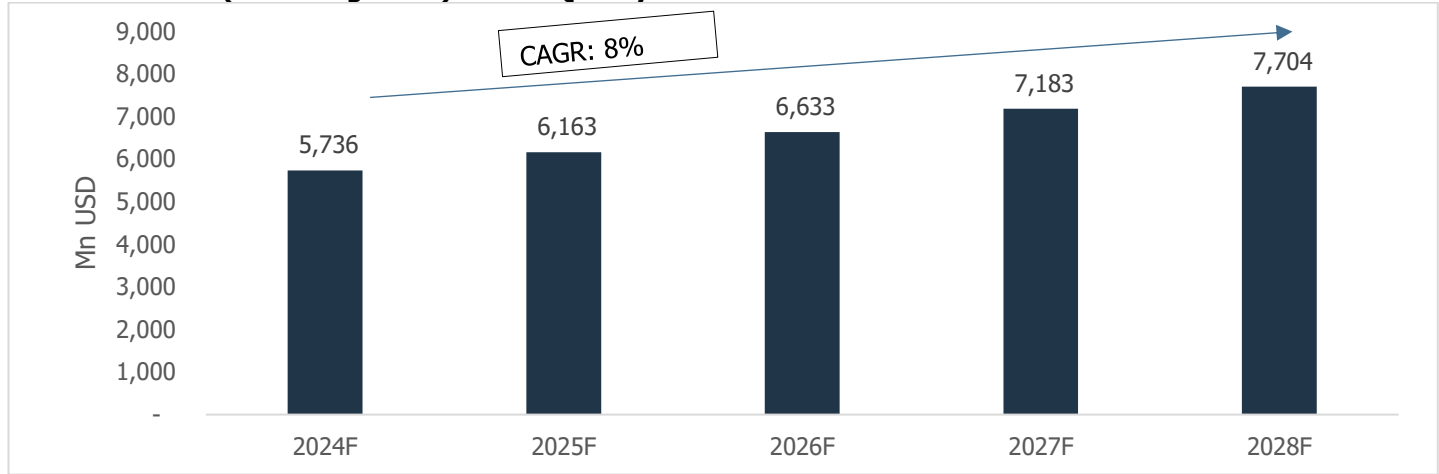
**Chart 59: APAC (excluding India) Power Quality Products Market**



Source: Maia Research, CareEdge Research

APAC (excluding India) will account for the largest market share at 46.1% as of 2028. The power quality products market of APAC (excluding India) is estimated to be valued at USD 7,703.6 million, growing at a CAGR of 7.7% from 2023 in line with the industry growth CAGR of 8% in the same period.

**Chart 60: APAC (Excluding India) Power Quality Products Market Forecast**

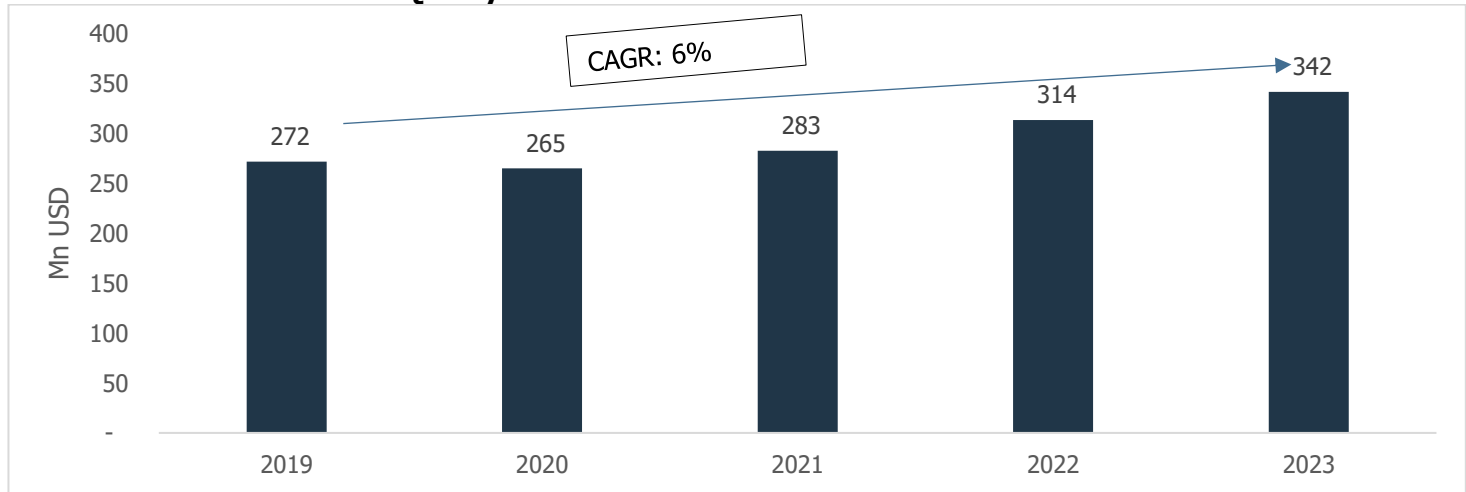


Source: Maia Research, CareEdge Research

**7.2.2 Middle East**

The Middle East accounts for the market share at 2.9% as of 2023. The global power quality products market of the Middle East is valued at USD 242 million growing at a CAGR of 6% from 2019 majorly due to growth in Urbanization and industrialization with industries heavily relying on power quality products that are vulnerable to power disturbances.

**Chart 61: Middle East Power Quality Products Market**

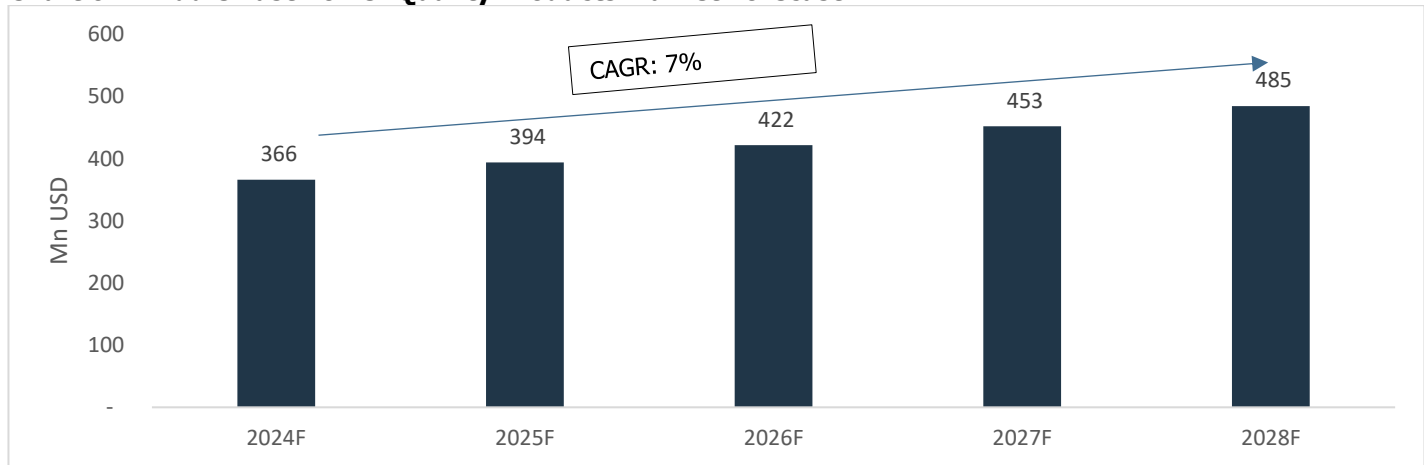


Source: Maia Research, CareEdge Research

The Middle East will account for a market share of 2.9% as of 2028. The power quality products market of the Middle East is estimated to be valued at USD 485 million, growing at a CAGR of 7% from 2023 comparatively below the industry growth CAGR of 8% in the same period.



**Chart 62: Middle East Power Quality Products Market Forecast**

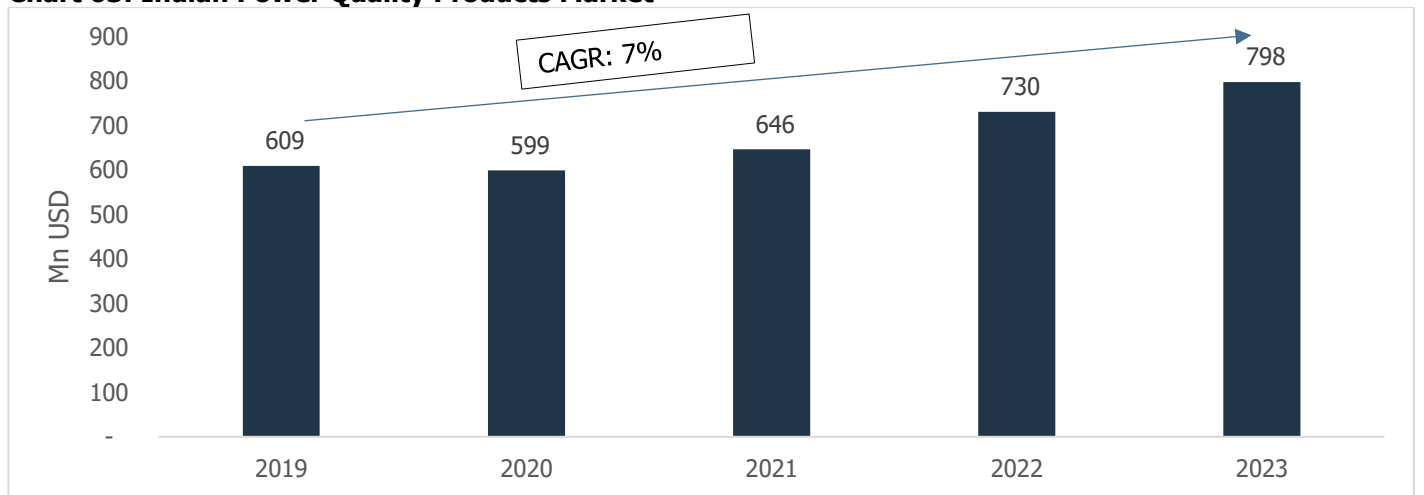


Source: Maia Research, CareEdge Research

**7.3 Indian Power Quality Products Market**

The power quality products market in India has witnessed significant growth in recent years, driven by ambitious targets for renewable energy deployment, including solar, wind, and hydroelectric power. The Indian power quality products market grew at a CAGR of 7% in the period from 2019-2023. The industry grew from USD 609 million in 2019 to USD 798 million in 2023. In 2023, capacitor banks had the highest product market share at 28.6% followed by harmonic filters, static var compensator (SVC), static synchronous (STATCOM), and others at 18.5%, 13.3%, 5.7%, and 33.9%, respectively. Whereas the public utility market by application contributes the largest share at 46.1% followed by industrial and others at 31.3% and 22.7%, respectively, as of 2023.

**Chart 63: Indian Power Quality Products Market**



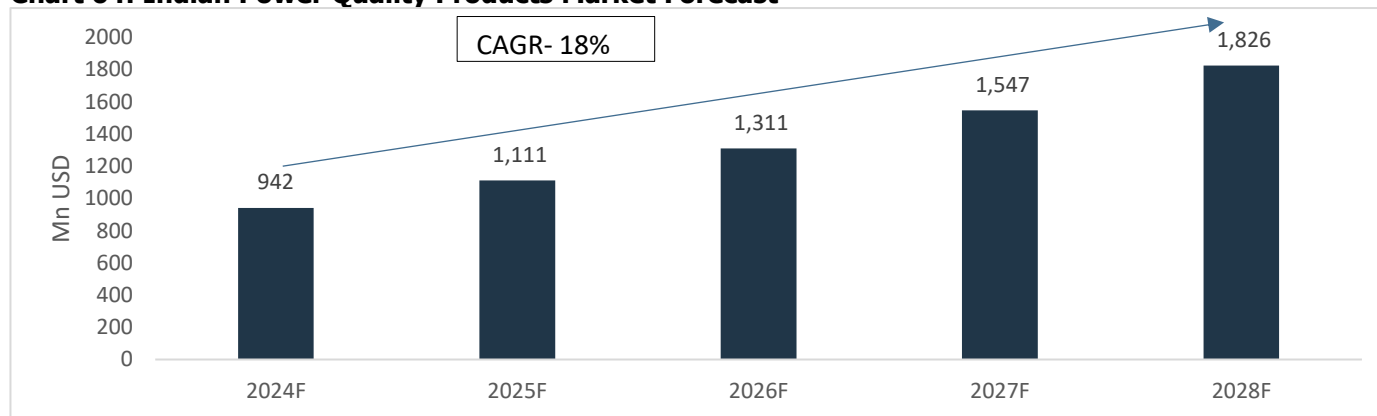
Source: Maia Research, CareEdge Research

**Table 12: Indian Power Quality Products Market Segment by Type**

Million USD	2019	2020	2021	2022	2023
Harmonic Filters	110	108	120	134	147
Capacitor Banks	173	172	183	208	229
Static Var Compensator (SVC)	80	80	86	98	106
Static Synchronous (STATCOM)	36	35	39	42	45
Others	211	204	219	249	271
Total	609	599	646	730	798

Source: Maia Research, CareEdge Research

The Indian power quality products market is expected to grow at a CAGR of 9% in the period from 2023-2028. The industry is expected to grow from USD 798 million in 2023 to USD 1,22 million in 2028. In 2028, capacitor banks will contribute around 28.7% of the market share followed by harmonic filters, static var compensator (SVC), static synchronous (STATCOM), and others, at 19.1%, 13.3%, 5.4%, and 33.5%, respectively. Whereas the public utility market by application will continue to contribute the largest share at 46.1% followed by industrial and others at 31.3% and 22.7%, respectively, as of 2028.

**Chart 64: Indian Power Quality Products Market Forecast**


Source: Maia Research, CareEdge Research

**Table 13: Indian Power Quality Products Market Segment by Type Forecast**

Million USD	2024F	2025F	2026F	2027F	2028F
Harmonic Filters	173	205	242	285	336
Capacitor Banks	270	319	376	444	524
Static Var Compensator (SVC)	125	148	174	206	243
Static Synchronous (STATCOM)	53	63	74	87	103
Others	320	377	445	525	620
Total	942	1,111	1,311	1,547	1,826

Source: Maia Research, CareEdge Research

## 7.4 Global Power Quality Products Type

### 7.4.1 Global Harmonic Filters

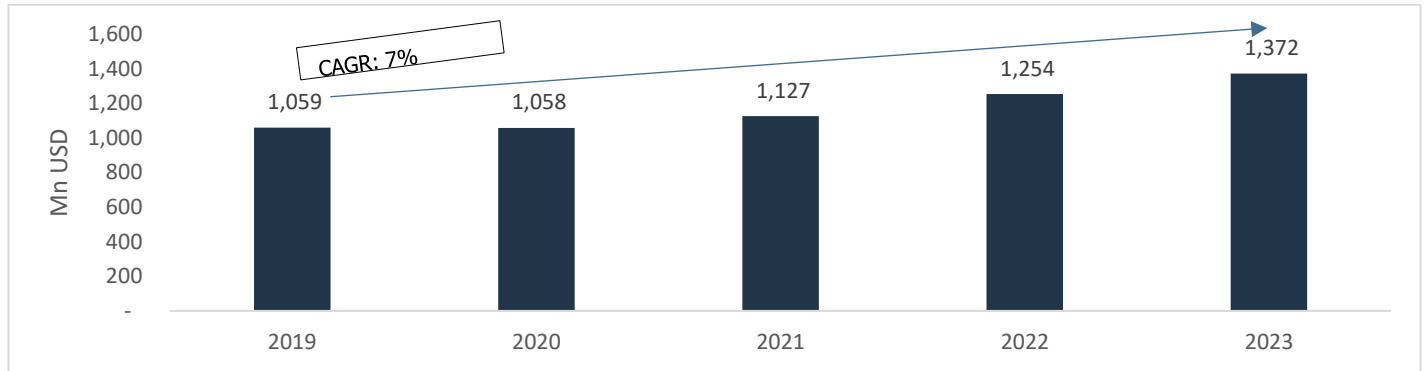
Harmonic filters are essential components in critical energy transition equipments and power technologies systems used to mitigate the adverse effects of harmonic distortion. Harmonic filters are designed to reduce harmonic distortion in electrical systems caused by nonlinear loads such as power electronic devices, variable frequency drives (VFDs), rectifiers, and other equipment. Harmonic distortion can lead to voltage and current waveform distortion, increased losses, equipment overheating, and interference with sensitive electronic equipment.

Harmonic filters work by providing a low-impedance path for harmonic currents to flow, diverting them away from the power system and preventing them from propagating to other equipment. They typically consist of passive components such as capacitors, inductors, and resistors configured in various configurations to create impedance at specific harmonic frequencies.

Harmonic filters reduce voltage and current distortion, improving power quality and reducing the risk of equipment malfunction or failure. By reducing losses associated with harmonic distortion, filters help optimize energy efficiency and reduce electricity consumption.

Harmonic filters account for 11.9% of market size of global power quality products, the market size of harmonic filters was at USD 1,371.6 million as of 2023. It grew by CAGR of 7% from USD 1,058.6 million in 2019.

**Chart 65: Global Harmonic Filters Value**

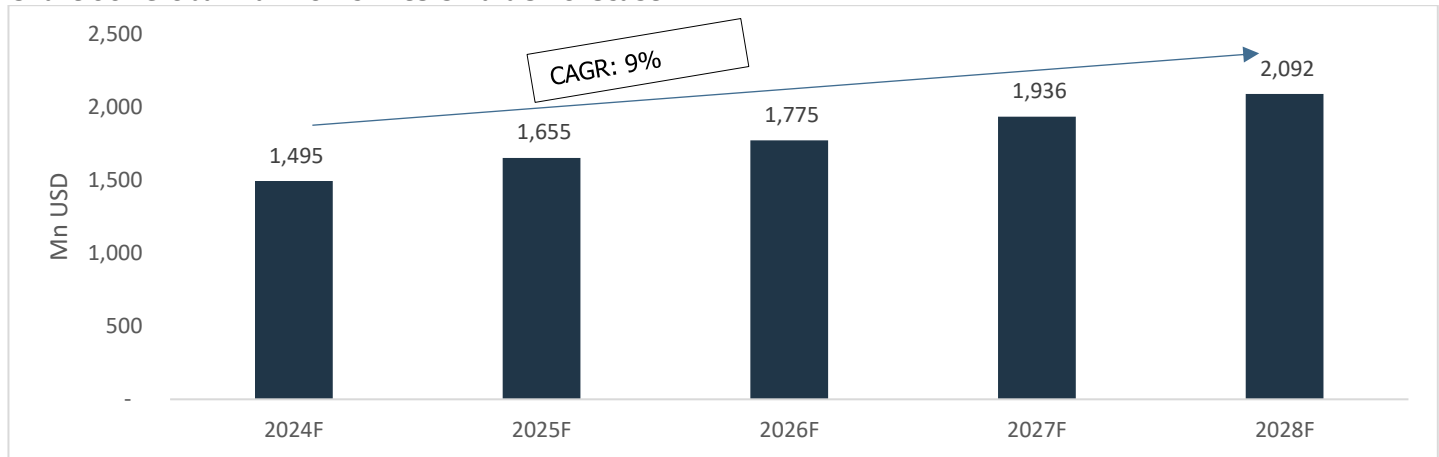


Source: Maia Research, CareEdge Research

Note: E-Estimates

Harmonic filters will account for the market share at 12.5% of market size of global power quality products, the market size of harmonic filters is expected at USD 2,092.2 million as of 2028. It is expected to grow by CAGR of 9% from 2023.

**Chart 66: Global Harmonic Filters Value Forecast**



Source: Maia Research, CareEdge Research

**7.4.2 Global Capacity Banks**

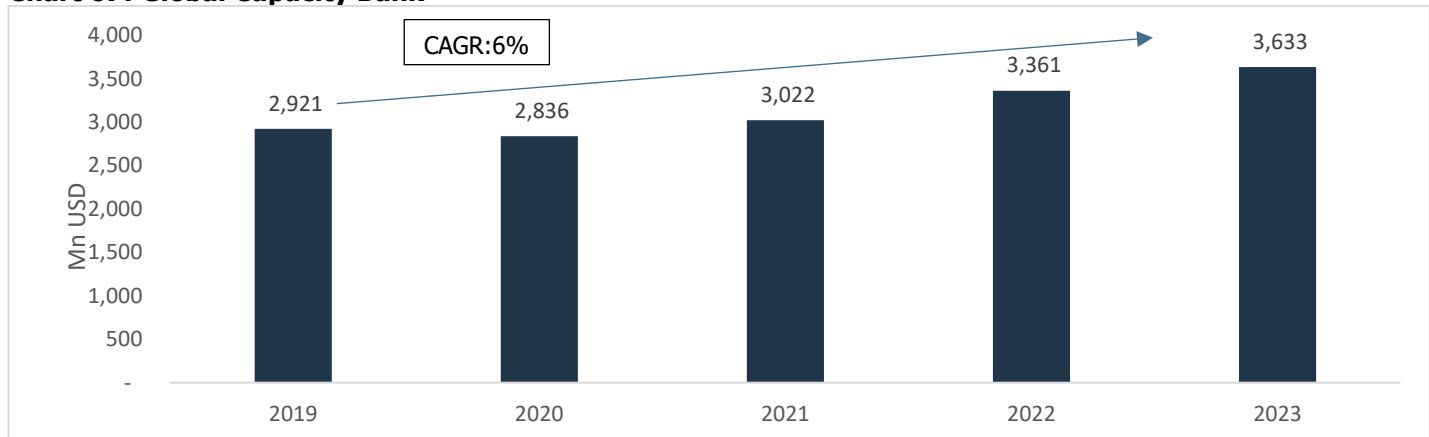
A capacity bank, also known as a capacitor bank, is a collection of capacitors connected in parallel in critical energy transition system. The primary purpose of a capacity bank is to provide reactive power compensation to improve power factor and voltage regulation in electrical networks. Capacitors store electrical energy in an electric field and release it when needed, helping to balance the reactive power demand of inductive loads such as motors, transformers, and fluorescent lighting.

Capacitor banks can also help regulate voltage levels in electrical systems by supplying or absorbing reactive power to maintain voltage within acceptable limits. During periods of high demand or voltage drops, capacitors can inject reactive power into the system to boost voltage levels and improve system stability.

Capacitor banks are controlled by automatic switching devices such as capacitor switching contactors or controllers that monitor system conditions and switch capacitors on or off as needed to maintain desired power factor and voltage levels. Advanced control systems may include reactive power controllers, power factor relays, and programmable logic controllers (PLCs) for precise and efficient operation.

Capacity banks account for 31.5% of market size of global power quality products, the market size of harmonic filters was at USD 3,633 million as of 2023. It grew by CAGR of 6% from USD 2,921 million in 2019.

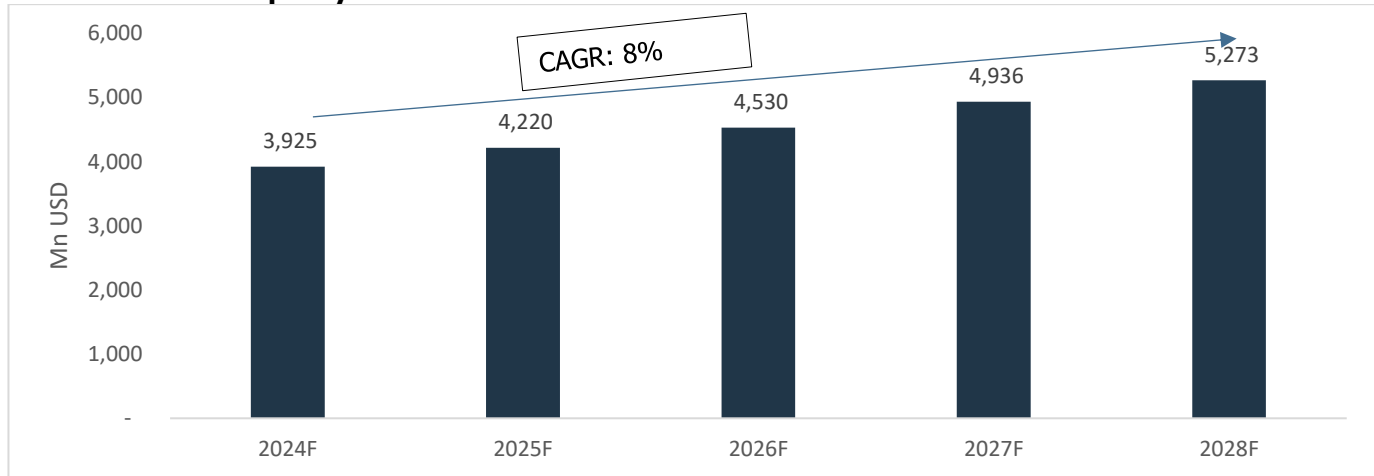
**Chart 67: Global Capacity Bank**



Source: Maia Research, CareEdge Research

Capacity Bank will account for the market share at 31.5% of market size of global power quality products, the market size of capacity bank is expected at USD 5,272.9 million as of 2028. It is expected to grow by CAGR of 8% from 2023.

**Chart 68: Global Capacity Bank Forecast**



Source: Maia Research, CareEdge Research

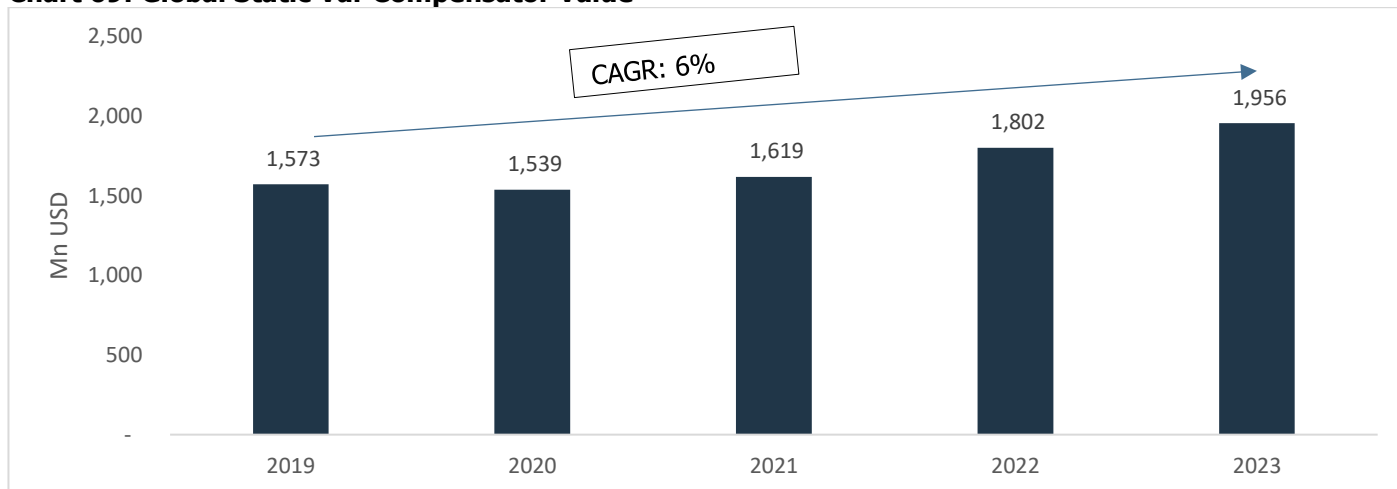
**7.4.3 Global Static Var Compensator (SVC)**

A Static Var Compensator (SVC) is a device used in critical energy transition equipment systems to regulate voltage, improve power factor, and enhance system stability by controlling reactive power flow. SVCs are deployed in power systems to compensate for reactive power fluctuations caused by varying loads, particularly those with a high percentage of inductive loads like motors and transformers. By dynamically adjusting reactive power output, SVCs help maintain voltage stability and power quality.

SVCs consist of power electronic devices such as thyristors or insulated-gate bipolar transistors (IGBTs), along with capacitors and reactors. They inject or absorb reactive power into the system as needed to regulate voltage and power factor. SVCs can respond rapidly to changes in system conditions, making them effective for dynamic voltage control and stability enhancement.

SVCs account for 16.9% of market size of global power quality products, the market size of SVCs was at USD 1,956 million as of 2023. It grew by CAGR of 6% from USD 1,573 million in 2019.

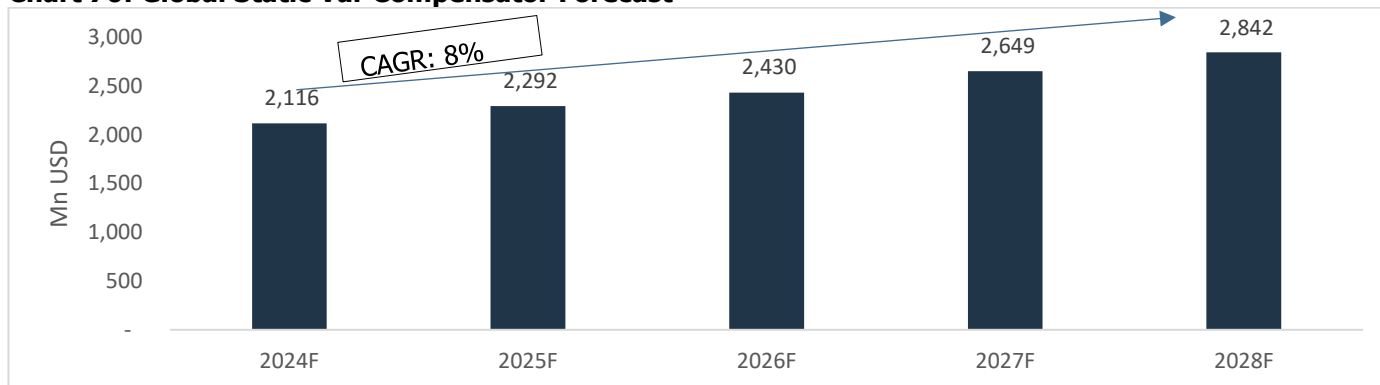
**Chart 69: Global Static Var Compensator Value**



Source: Maia Research, CareEdge Research

SVCs will account for the market share of around 17.0% of market size of global power quality products, the market size of SVCs is expected at USD 2,842 million as of 2028. It is expected to grow by CAGR of 8% from 2023.

**Chart 70: Global Static Var Compensator Forecast**



Source: Maia Research, CareEdge Research

**7.5 Growth Drivers**

Some of the key growth drivers include:

- **High Entry Barrier on account of Established Track Record of Operations with Power Utilities**

The power transmission sector, both in India and abroad, presents formidable barriers to entry, largely due to the capital-intensive nature of infrastructure development and stringent product specification frameworks. Establishing a foothold in this sector demands substantial financial resources for acquiring land, procuring equipment, and deploying skilled manpower. Moreover, the complex approval procedures imposed by customers often prolong the entry process, adding further to the barriers.

Additionally, existing players in the market often enjoy economies of scale and established networks, making it challenging for new entrants to compete effectively. Furthermore, the long gestation period associated with transmission projects and the inherent risks involved deter potential investors from venturing into the sector. Consequently, despite the potential for lucrative returns, the high entry barriers in the power transmission sector serve as a significant deterrent for new players, necessitating careful strategic planning and substantial investment to navigate successfully.

Meeting regulatory requirements and obtaining necessary certifications indeed pose significant challenges for new entrants into the power transmission sector, both domestically and internationally. These processes are often time-consuming and expensive, creating formidable barriers to entry.

Establishing a manufacturing facility for STATCOMs requires substantial upfront investment in equipment, technology, and infrastructure. Designing and manufacturing STATCOMs requires advanced technical knowledge in power electronics, control systems, and grid integration. Companies with established expertise and intellectual property in these areas have a competitive advantage, making it challenging for new entrants to compete without similar capabilities. Apart from this, utility track record of more than 5 years is required paired with raw materials constrains adds to the entry constraints.

Compliance with industry standards and regulations is essential for ensuring the safety and reliability of STATCOMs with existing grid infrastructure. Meeting regulatory requirements and obtaining necessary certifications can be time-consuming and expensive, creating barriers to entry for new players.

- **Increasing Power Demand**

As industries become more reliant on stable and high-quality power supply, there is a growing demand for solutions that can improve power factor, voltage stability, and grid reliability. STATCOMs offer dynamic reactive power compensation, voltage regulation, and fast response capabilities, making them attractive for utilities and industries seeking to enhance power quality.

- **Growing Renewable Energy Integration**

STATCOMs can mitigate the impact of fluctuations in renewable energy output by providing reactive power support and grid stabilization services, driving demand for STATCOM solutions in renewable energy integration projects.

The integration of renewable energy sources, such as solar and wind, into the power grid can induce fluctuations in power generation. Power quality products help manage the variability and ensure a smooth integration of renewable energy into the grid. India has committed to decrease the emissions intensity of its Gross Domestic Product (GDP) by 45% by 2030, compared to 2005 levels.

Furthermore, with the announcement of 500 GW RE capacity installation by 2030 and Net-Zero emissions by 2070, India has set itself on one of the most accelerated energy transition trajectories in the world. This will increase the demand for the STATCOMs as on average 100MW around 10MVar STATCOMs are required.

- **Waiver of ISTS Charges**

The Ministry of Power has issued the order for an extension to the inter-state transmission system (ISTS) charges waiver on solar and wind energy projects commissioned up to 30 June 2025. The waiver of ISTS charges shall allow for hydro-pumped storage plant and battery energy storage system projects to be commissioned up to 30th June 2025 following some conditions.

Further, ISTS waiver would be allowed for trading electricity generated and supplied from solar, wind, pumped hydro, and Battery Energy Storage Systems (BESS) in the green term ahead market (GTAM) till 30th June 2023. The arrangement would be reviewed on an annual basis depending on future developments in the power market.

Moreover, as per the notification issued by the Ministry of Power, a complete waiver of ISTS charges has been given for offshore wind power projects commissioned on or before 31st December, 2032 for 25 years from the date of commissioning of the Project.

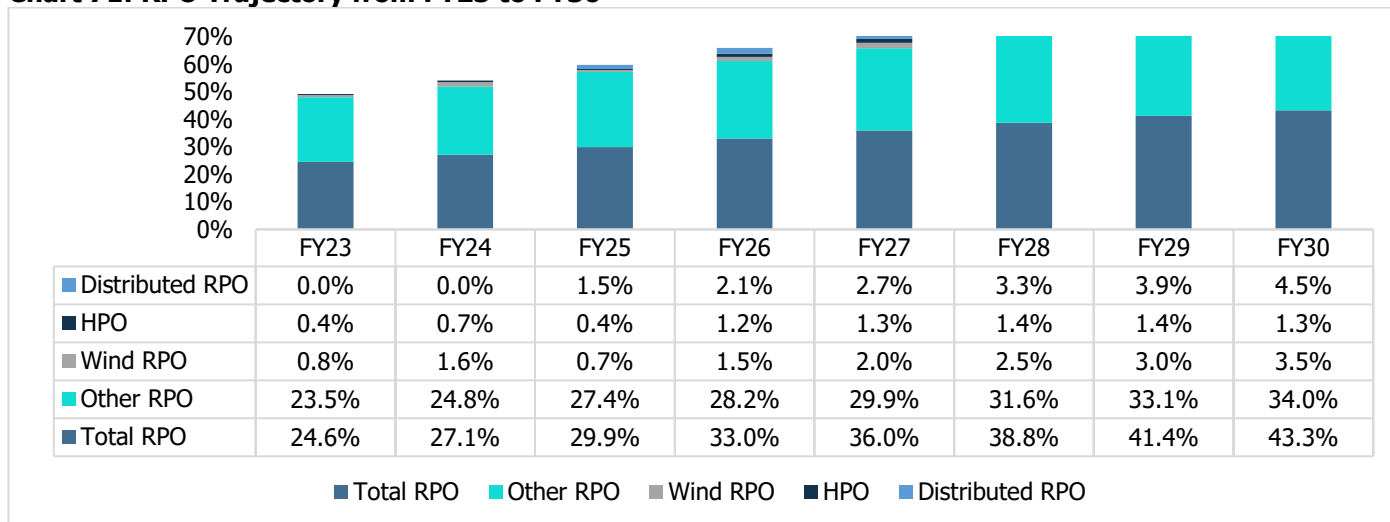
• **Renewable Purchase Obligation (RPO)**

Under Section 86(1) (e) of the Electricity Act 2003 and the National Tariff Policy 2006, Renewable Purchase Obligation (RPO) is a mechanism wherein the obligated entities are obliged to purchase a certain percentage of electricity from renewable energy sources, as a percentage of the total consumption of electricity or buy, in lieu of that, renewable energy certificates (REC) from the market.

RPOs were earlier categorised as solar and non-solar RPOs. However, as per the latest targets, RPOs are categorized as Wind RPO, Hydro RPO, Distributed RPO, and Others. Obligated entities [which include distribution companies (or DISCOMs), open access consumers, and captive power producers] are obligated to purchase a minimum share of their electricity from renewable energy sources as per RPO targets.

Furthermore, a joint committee under the co-chairmanship of the Secretary, the Ministry of Power and Secretary, and the Ministry of New and Renewable Energy was constituted on 17<sup>th</sup> December 2020 and based on the recommendations, the Ministry of Power has specified the RPO trajectory beyond FY22. As per the targets set, an RPO of 43.33% is proposed to be achieved by FY30.

**Chart 71: RPO Trajectory from FY23 to FY30**



Source: Renewable Purchase Obligation and Energy Storage Obligation Trajectory Report dated 22<sup>nd</sup> July, 2023  
Renewable Purchase Obligation and Energy Storage Obligation Trajectory

Note: Distributed RPO is not available for FY23 and FY24

• **Increasing Grid Modernization Initiatives**

Many regions are investing in grid modernization initiatives to enhance the overall efficiency and reliability of power distribution. This involves the deployment of advanced power quality products to manage and control grid dynamics. The deployment of smart grid technologies, which enable better monitoring and control of power distribution, is driving the adoption of power-quality products. These products play a crucial role in maintaining the stability and reliability of smart grids.

• **Industrialization and Urbanization**

Urbanization and industrial growth lead to increased electricity consumption. High-voltage products are essential for transmitting large amounts of power over long distances efficiently, supporting the power needs of industrial zones and urban areas. The increasing reliance on electronic devices, data centres, and critical infrastructure has driven the



demand for UPS systems. These systems are an integral part of power quality solutions, providing backup power during outages and ensuring a continuous, high-quality power supply for rural and urban areas.

- **Electrification of Transportation**

The growing trend of electric vehicles (EVs) and the electrification of transportation systems require robust high-voltage infrastructure for charging stations and grid connections. This contributes to the demand for high-voltage products. EV charging stations, particularly fast-charging stations, require high power levels to charge multiple vehicles simultaneously. This increased power demand can lead to voltage fluctuations and grid instability, necessitating the use of STATCOMs for voltage regulation and reactive power compensation. EV charging stations incorporate renewable energy sources, such as solar photovoltaic (PV) panels or wind turbines, to offset their energy consumption and reduce carbon emissions. However, renewable energy sources are inherently variable and intermittent, leading to grid instability and voltage fluctuations. STATCOMs can help address these challenges by providing dynamic reactive power support and grid stabilization, enabling seamless integration of renewable energy into EV charging infrastructure.

- **Government Regulations and Standards**

Stringent regulations and standards related to energy efficiency, environmental impact, and safety influence the development and adoption of high-voltage products. Compliance with these regulations often leads to the replacement or upgrade of existing infrastructure.

## 7.6 Key Challenges

Some of the key challenges include:

- **High Initial Investment**

Power quality products, STATCOMs, and high-voltage equipment require significant initial capital investment for procurement, installation, and commissioning. The costs associated with purchasing the equipment, site preparation, civil works, and system integration can be substantial, presenting a barrier to adoption for many organizations.

- **Complex Engineering and Design**

Power quality products, STATCOMs, and high-voltage equipment are complex systems that require careful engineering and design to ensure proper operation, reliability, and integration with the existing power grid. Design considerations include voltage and current ratings, reactive power compensation, harmonic mitigation, control strategies, and grid compatibility, which can be challenging to optimize and implement effectively.

- **Grid Compatibility and Interoperability**

Integration into existing power grids can pose compatibility and interoperability issues. Challenges may arise in synchronizing operation with grid frequency and voltage levels, ensuring seamless coordination with other grid control devices, and addressing potential interactions with grid protection systems. Power quality products, STATCOMs, and high-voltage equipment can introduce harmonics and electromagnetic interference (EMI) into the power system due to their switching operation and power electronics components. Mitigating harmonics and EMI requires careful filtering, shielding, and grounding measures to prevent adverse effects on sensitive equipment and ensure compliance with regulatory standards for power quality.

- **Grid Integration of Renewable Energy**

While the integration of renewable energy sources is a growth driver, it also poses challenges for grid operators. The intermittent nature of renewable sources like wind and solar requires advanced grid management solutions and additional investments in energy storage systems.

- **Project Approval and Permitting Delays**

Obtaining regulatory approvals and permits for new high-voltage projects can be a time-consuming process. Delays in project approval and permitting can hinder the timely implementation of infrastructure projects. The industry requires skilled labour for designing, manufacturing, and installing products. Shortages of skilled workers and a widening skills gap can lead to challenges in meeting production demands and maintaining quality standards. The complex nature of the industry coupled with the need for precision engineering, can result in extended lead times for manufacturing. Production delays may occur due to factors such as customization requirements, testing, and quality control.

- **Maintenance, Reliability, and Safety**

Ensuring the maintenance, reliability, and safety of power quality products, STATCOMs, and high-voltage equipment is essential for minimizing downtime, preventing equipment failure, and ensuring personnel safety. Challenges may arise in accessing and servicing equipment components, diagnosing and troubleshooting faults, and implementing effective maintenance and safety protocols.

## 8. Competitive Landscape

### 8.1 Benchmarking Based on Profitability Parameters

Name of the Company	Business Overview
<b>Quality Power Electrical Equipments Ltd.</b>	<p>Quality Power is a established indigenous Indian company in critical energy transition equipments and power technologies sector which provides specialised customised high voltage electrical equipment and solutions for electrical grid connectivity and energy transition to its customers. The company was established in 2001 and has operations in India and Turkey.</p> <p>Quality Power has its prominent presence in a number of products and industries in the fields of Reactors, Transformers, Line Traps, Capacitor Banks, Static VAR Compensators (SVC), STATCOM'S, Harmonic Filters, Grid Automation &amp; SCADA systems.</p> <p>Quality Power has a Global presence with a satisfied customer base in over 100 countries. Quality Power have over two decades of experience in the power transmission sector. Company has a wide range of products portfolio in Power Products and Power Quality Systems with market presence spread over India, Asia, Middle East, North America, South America, Australia and Europe. These products play a critical role in various essential processes, including power generation, energy transition, and distribution. Quality Power Electrical Equipments Ltd. has 7 operating facilities with export presence in nearly 100 countries. Export contribution in revenue stood at 73% in FY24, 71% in FY23 and 64% in FY22.</p>
<b>GE T&amp;D India Limited</b>	<p>GE T&amp;D India Limited is a key player in the Indian power transmission and distribution industry. The company is part of the global GE Grid Solutions business, which provides equipment, systems, and services to enable the reliable and efficient transmission and distribution of electricity.</p> <p>GE T&amp;D India Limited specializes in high voltage products, substation automation, distribution automation, and software solutions to enhance grid reliability and efficiency. It offers maintenance, support, and retrofit services to extend asset life and performance. The company has completed major projects for power utilities, industrial customers, and renewable energy providers, holding a significant market share in India's T&amp;D sector. The company has 5 operating facilities unit with export presence in roughly 50 countries. Export contribution in revenue stood at 31% in FY24, 30% in FY23 and 30% in FY22.</p>
<b>Transformers &amp; Rectifiers Limited (India)</b>	<p>Transformers &amp; Rectifiers (India) Limited (TRIL) was established in 1994. The company has been in operation for several decades, specializing in the manufacturing of power and distribution transformers, as well as rectifiers.</p> <p>TRIL focuses on the design, manufacturing, and supply of a wide range of transformers, including power transformers, distribution transformers, and special-purpose transformers. TRIL's transformers find applications in power transmission and distribution networks, industrial setups, and railway electrification projects. The rectifiers produced by the company are commonly used in various industrial processes.</p>

	<p>TRIL has a presence not only in India but also in international markets. The company exports its products to different countries like Canada and the United Kingdom, contributing to its global footprint. The company has 4 operating facilities unit with presence in around 25 countries contributing roughly 8% of company's revenue.</p>
<b>Hitachi Energy India Ltd.</b>	<p>Hitachi Energy India Limited (formerly known as ABB Power Products and Systems India Limited) is a leading player in the power and energy sector in India. It operates as part of the global Hitachi Energy business, which focuses on power grids, energy storage, and digital solutions for utilities, industries, and infrastructure.</p> <p>Hitachi Energy India Limited specializes in grid automation, high voltage products, grid integration, and digital solutions. It provides advanced control and protection systems, manufactures transformers and switchgear, designs substations, and offers HVDC solutions. The company also focuses on energy management, cybersecurity, renewable integration, and energy storage. Serving national utilities, industrial clients, and renewable developers. The company has 8 operating facilities. Export contribution in revenue stood at 25% in FY24, 27% in FY23 and 23% in FY22.</p>
<b>Siemens Limited</b>	<p>Siemens India Limited is a leading multinational company in the Indian technology and engineering sector, providing a wide range of products, solutions, and services across various industries. As part of the global Siemens AG, Siemens India has a significant presence in sectors like energy, healthcare, industry, infrastructure, and cities.</p> <p>Siemens Limited provides comprehensive solutions across multiple sectors. In energy, it offers conventional and renewable power generation systems and high-voltage transmission products. In healthcare, it supplies advanced imaging and diagnostic systems along with healthcare IT solutions. For industry, Siemens delivers automation and digitalization products and process industry solutions. In infrastructure and cities, it offers smart building technologies and mobility solutions, while also driving digital transformation with software and IT services. The company has 6 operating facilities with export presence in roughly 35 countries. Export contribution in revenue stood at 17% in FY22.</p>

## 8.2 Benchmarking Based on Profitability Parameters

- Indian HVDC equipment market is closely competed among five companies with Siemens Ltd., Hitachi Energy India Ltd. and Quality Power Electrical Equipments Ltd. being the most prominent players.
- CAGR (FY22-FY24) of Quality Power is best amongst peers at 25.1%. Quality Power's revenue grew led by strong export sales. They are also one of the leading manufacturers of Air core dry type reactors in India. This was followed by Siemens Limited at 22.2% in similar time frame.
- Quality Power Electrical Equipments Ltd. has seen the second highest YoY growth in % terms when compared with FY23. It grew from Rs. 2,735.6 million in FY23 to Rs. 3,314.0 million in FY24 whereas average growth amongst peers was at 13.3%. The company is one of the fastest growing amongst peers at 56.5% during FY22 to FY24.

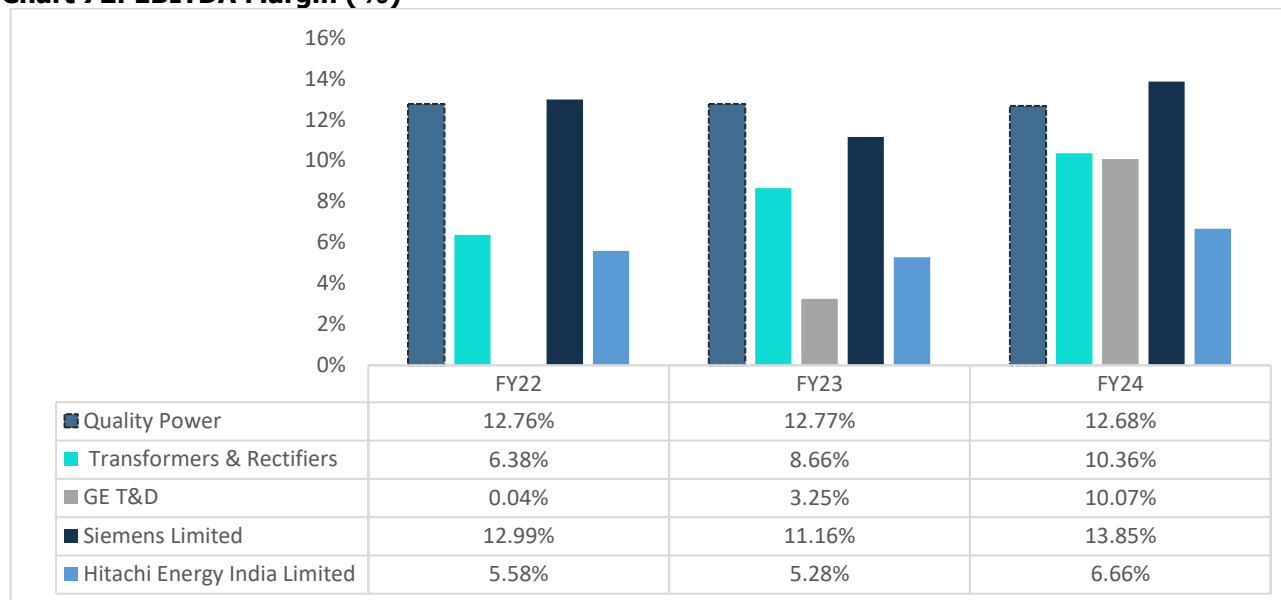
**Table 14: Revenue of Peer Companies**

Revenue (INR Million)	FY22	FY23	FY24	Y-o-Y	CAGR (FY22-FY24)
<b>Quality Power Electrical Equipments Ltd.</b>	2,117.3	2,735.6	3,314.0	21.1%	25.1%
<b>Transformers &amp; Rectifiers (India) Limited</b>	11,715.5	14,046.6	13,005.0	-7.4%	5.4%
<b>GE T&amp;D</b>	30,916.9	28,071.5	31,904.6	13.7%	1.6%
<b>Siemens Limited</b>	1,34,249.0	1,64,456.0	2,00,500.0	21.9%	22.2%
<b>Hitachi Energy India Limited</b>	39,271.3	44,836.5	52,467.8	17.0%	15.6%

Source: Annual Reports, Company Financials.

The figures are on consolidated basis.

Hitachi Energy India Limited figures are unaudited for FY22.

**Chart 72: EBITDA Margin (%)**


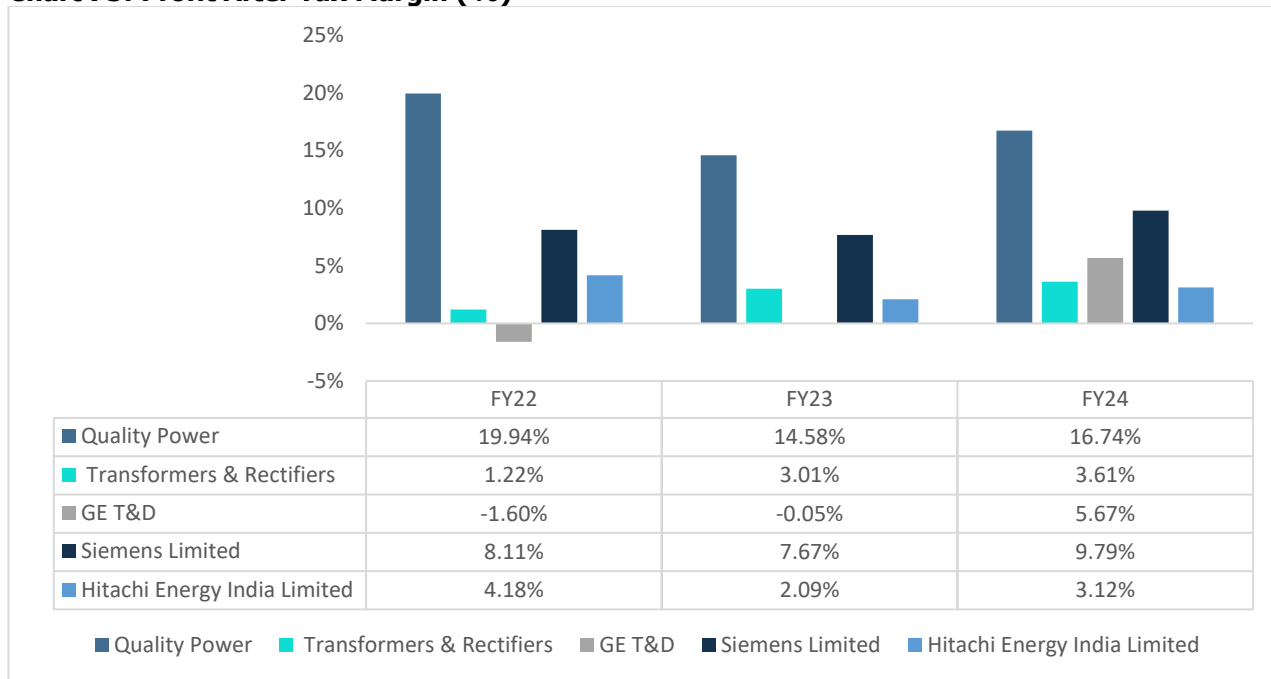
Source: Annual Reports, Company Financials.

The figures are on consolidated basis.

Hitachi Energy India Limited figures are unaudited for FY22.

- Quality Power Electrical Equipments Ltd. have EBITDA margins with above average levels of the industry due to strong revenue growth from domestic & export sales of 12.68% in FY24.
- For FY24, the EBITDA margin of the peers has been in the range of 6.66% to 13.85%.
- Quality Power Electrical Equipments Ltd. has the best EBITDA margins in FY23 at 12.77% was second best in FY22 at 12.76% respectively.

**Chart 73: Profit After Tax Margin (%)**



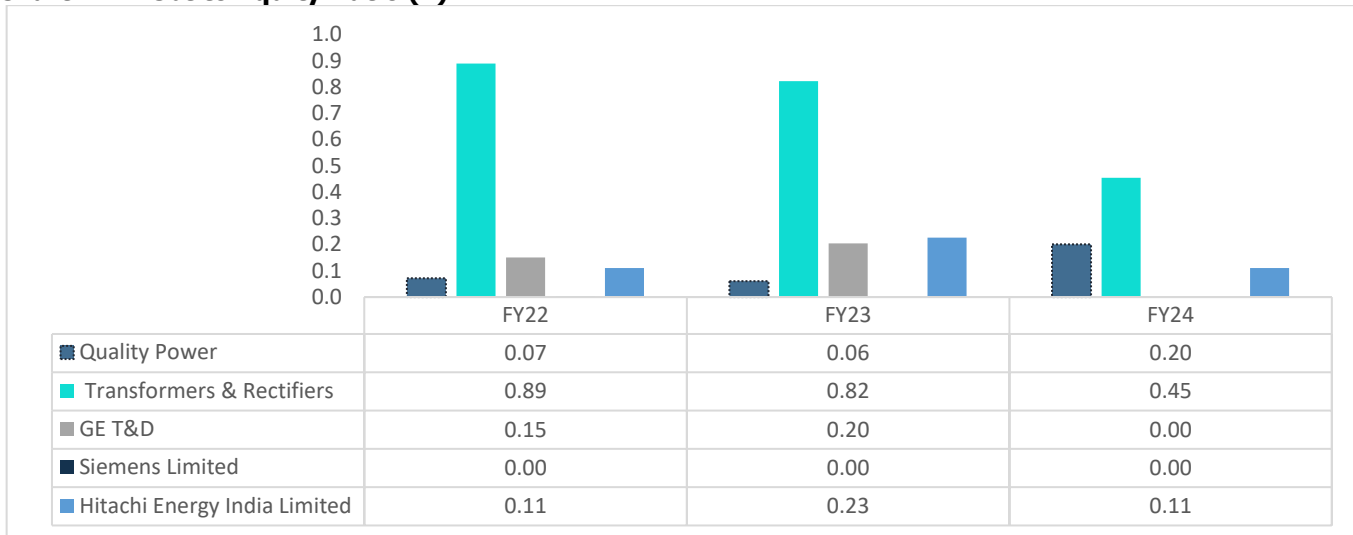
Source: Annual Reports, Company Financials.

The figures are on consolidated basis.

Hitachi Energy India Limited figures are unaudited for FY22.

- In FY24, Quality Power Electrical Equipments Ltd. Profit after tax margin was the highest among its peers at 16.74% supported by increase in revenue from operations along with decrease in interest & depreciation expenses. The company had consistently best ratio amongst FY22, FY23 and FY24.
- Quality Power Electrical Equipments Ltd. ratio was above average of 7.35% in FY24 which was followed by Siemens Limited as second-best ratio of 9.79%. Hitachi Energy India Limited has the lowest ratio in FY24 at 3.12% and GE T&D ratio has improved from -1.60% in FY22 to 5.67% in FY24.

**Chart 74: Debt to Equity Ratio (x)**



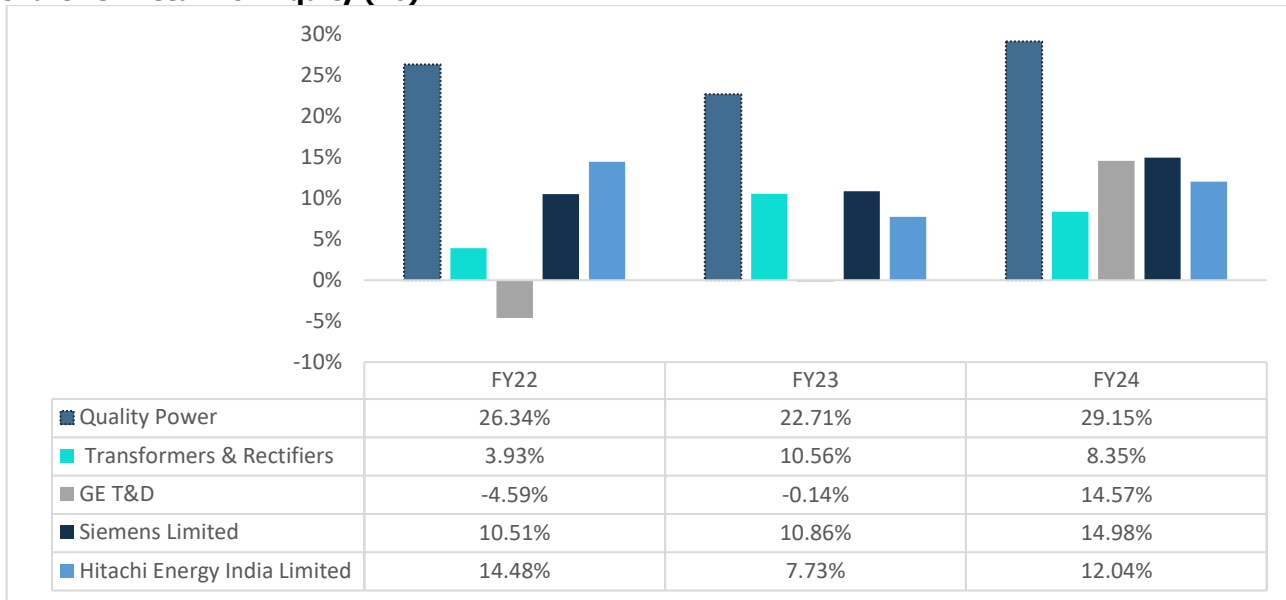
Source: Annual Reports, Company Financials.

The figures are on consolidated basis.

Hitachi Energy India Limited figures are unaudited for FY22.

- Quality Power Electrical Equipments Ltd. debt has increased from Rs. 106.08 million in FY23 to Rs. 382.79 million in FY24 where equity was at Rs. 1,756.57 million in FY23 and increased to Rs. 1,903.26 million in FY24.
- The average debt-to-equity ratio of peers was at 0.24x, 0.26x & 0.15x from FY22-FY24 respectively. Transformers & Rectifiers has the highest ratio whereas Quality Power Electrical Equipments Ltd. ratio was at 0.20x in FY24.
- GE T&D and Siemens Limited has the best ratio where company has reduced it's debt from FY23 to FY24.

**Chart 75: Return on Equity (%)**

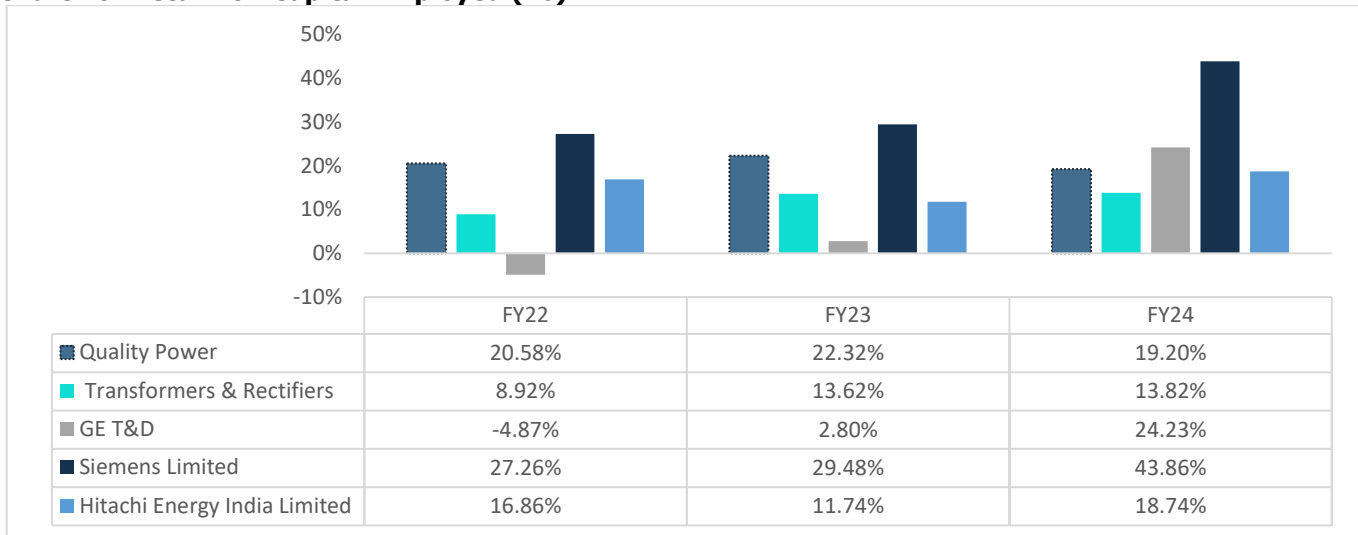


Source: Annual Reports, Company Financials.  
The figures are on consolidated basis.  
Hitachi Energy India Limited figures are unaudited for FY22.

- In FY24, Quality Power Electrical Equipments Ltd. ROE was the highest among its peers at 29.15%. Notably, Transformers & Rectifiers has the lowest ROE at 8.35% for the same period.
- Quality Power Electrical Equipments Ltd. was above average from its peers in all three years where profit after tax has grown at a CAGR of 14.62% from FY22-FY24 and equity has grown at a CAGR of 8.96% in same time frame.
- Quality Power Electrical Equipments Ltd. achieved highest Return on Equity amongst peers consistently across FY22, FY23 and FY24. Industry average of margin was at 10.13%, 10.34% & 15.82% for FY22-FY24 respectively.



**Chart 76: Return on Capital Employed (%)**



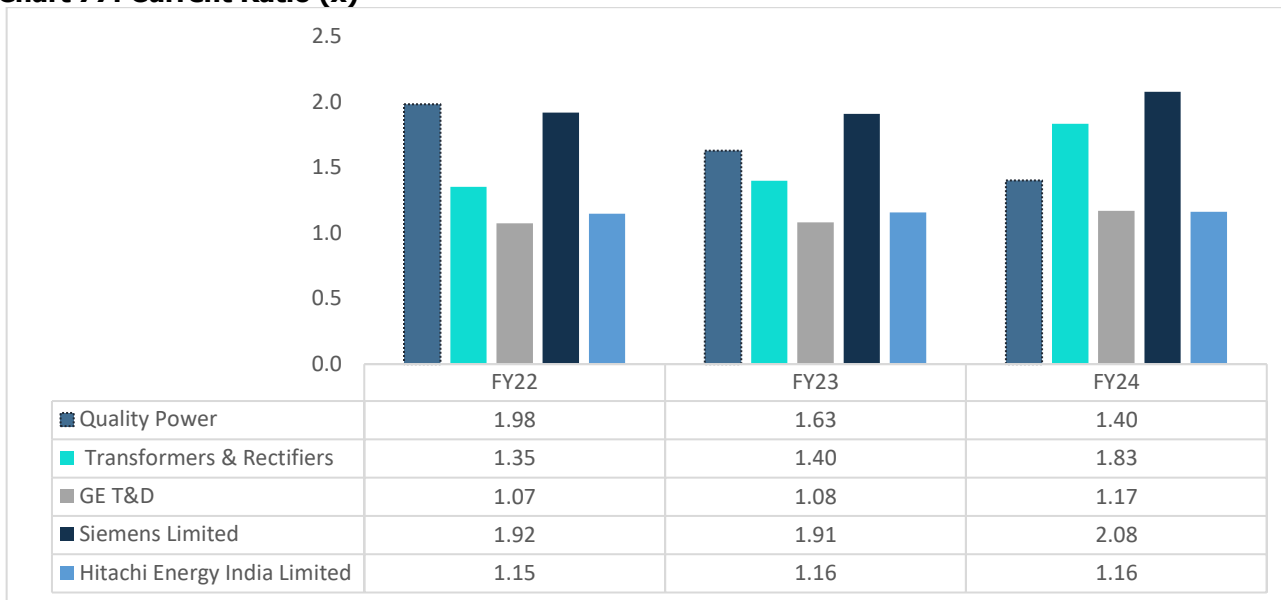
Source: Annual Reports, Company Financials.

The figures are on consolidated basis.

Hitachi Energy India Limited figures are unaudited for FY22.

- Quality Power Electrical Equipments Ltd. Return on Capital Employed (ROCE) has been lower as compared to the peers, mainly due to increasing debt levels. Quality Power Electrical Equipments Ltd. has ROCE at 19.20% as of FY24 with second best at 22.32% in FY23.
- Quality Power Electrical Equipments Ltd. 3-year average ROCE is ~20.70% as compared to the peers' 3-year average ROCE in the range of 7.39%- 33.53%. This in turn also results in lower interest cost as compared to peers for quality power. Decrease in ROCE is led by higher debt levels of the company.

**Chart 77: Current Ratio (x)**

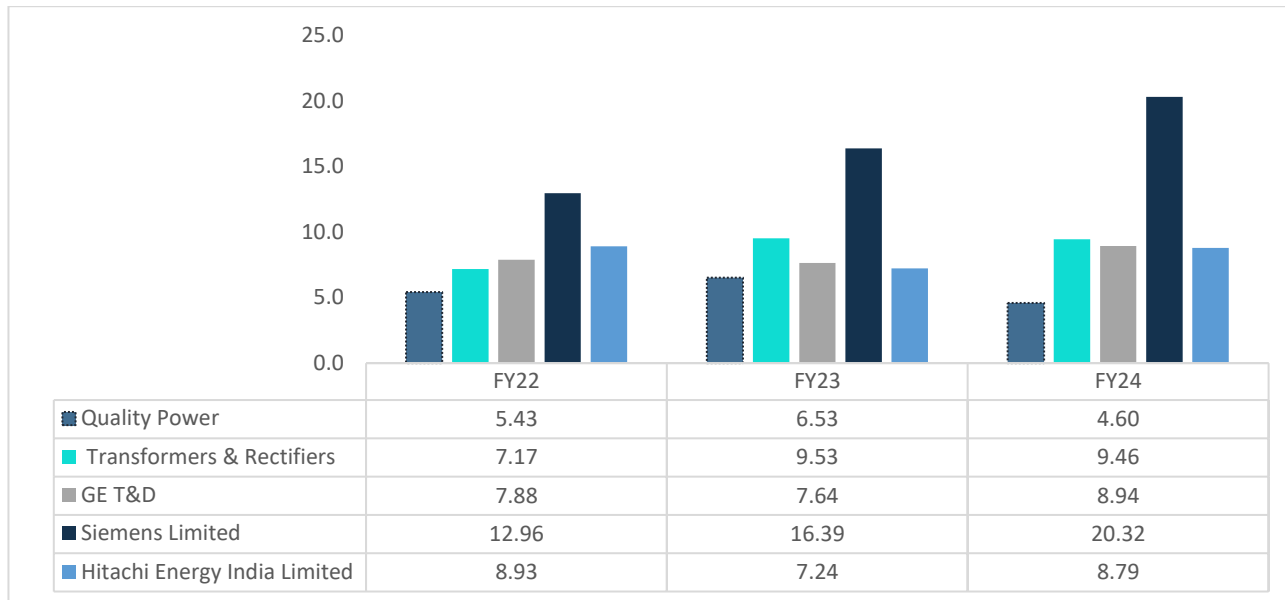


Source: Annual Reports, Company Financials.

The figures are on consolidated basis.

Hitachi Energy India Limited figures are unaudited for FY22.

- Quality Power Electrical Equipments Ltd. has current ratio of 1.40x as of FY24 below average of 1.53x in FY24.
- The average current ratio of peers was at 1.50x, 1.44x & 1.53x from FY22-FY24 respectively. Siemens Limited had the best ratio in FY24 at 2.08x and the best average amongst peers at 1.97x from FY22-FY24.

**Chart 78: Asset Turnover Ratio**


Source: Annual Reports, Company Financials.

The figures are on consolidated basis.

Hitachi Energy India Limited figures are unaudited for FY22.

- Quality Power Electrical Equipments Ltd. has Asset Turnover Ratio of 4.60x as of FY24 below average of 10.42x. The best ratio is of Siemens Limited at 20.32x in FY24 followed by Transformers & Rectifiers at 9.46x.
- The average Asset Turnover Ratio of peers was at 8.47x, 9.47x and 10.42x from FY22-FY24 respectively. Siemens Limited has the best ratio at an average of 16.56x from FY22-FY24 followed by Transformers & Rectifiers at 8.72x.

**Table 15: Number of Operating Facilities Unit**

Company Name	FY22	FY23	FY24
Quality Power Electrical Equipments Ltd	7	7	7
Transformers & Rectifiers India Limited	4	4	4
GE T&D	5	5	5
Siemens Limited	6	6	6
Hitachi Energy India Limited	8	8	8

Source: Company Filings, Annual Reports.

Hitachi Energy India Limited figures are unaudited for FY22.

Hitachi Energy India Limited has the highest number of operating facilities followed by Quality Power Electrical Equipments Ltd at 7 as of FY24.

**Table 16: Exports as % of Revenue**

Company Name	FY22	FY23	FY24
Quality Power Electrical Equipments Ltd	64%	71%	73%
Transformers & Rectifiers India Limited	16%	5%	11%

<b>GE T&amp;D</b>	30%	30%	31%
<b>Siemens Limited</b>	NA	18%	16%
<b>Hitachi Energy India Limited</b>	23%	27%	25%

Source: Company Filings, Annual Reports.

Hitachi Energy India Limited figures are unaudited for FY22.

Quality Power Electrical Equipments Ltd has the highest % share of exports amongst peers. The company has increased its exports from 64% in FY22 to 73% in FY24.

### 8.3 About Quality Power Electrical Equipments Ltd

Quality Power is an Indian player serving global clients in critical energy transition equipments and power technologies. The Company provides high voltage electrical equipment and solutions for electrical grid connectivity and energy transition. Quality Power is a technology-driven company specializing in the provision of power products and solutions across power generation, transmission, distribution, and automation sectors. Besides, the Company offers equipment and solutions tailored for emerging applications such as large-scale renewables

The Company's manufacturing facilities adhere to the quality and sustainability standards required by its global conglomerate clientele, including those listed on the Fortune 500. Additionally, the Company's Test & Research Lab in Sangli holds ISO 17025 accreditation from the National Accreditation Board for Testing and Calibration Laboratories (NABL), certifying it as an independent test laboratory that complies with both Indian and international standards for systems up to 765kV.

Quality Power is among the few global manufacturers of critical high voltage equipment for High Voltage Direct Current (HVDC) and Flexible AC Transmission Systems (FACTS) networks. These equipments and networks form key components for energy transition from renewable sources to traditional power grids. With over two decades of experience in the energy transition space, the Company provides an extensive range of products crucial for effective power transmission and advanced power automation. The Company's offerings include reactors, transformers, line traps, instrument transformers, capacitor banks, converters, harmonic filters and reactive power compensation systems. Additionally, the Company's grid interconnection solutions feature technologies such as STATCOM and static var compensator systems ("SVC"). The Company's domestic and global footprint allows it to cater to both Indian as well as global customer base

HVDC technology is transforming the landscape of energy transition equipment and power technologies by enabling efficient, long-distance power transfer with markedly reduced energy losses. This advancement is crucial for integrating renewable energy sources from remote locations, such as offshore wind farms and solar plants in remote regions, into urban areas. FACTS devices, including Static Synchronous Compensators (STATCOM), are pivotal in ensuring grid stability and reliability. They manage fluctuations from variable renewable energy sources through dynamic voltage regulation and reactive power compensation. The adoption of HVDC and STATCOM technologies is vital for the green energy transition, as they facilitate the efficient and stable integration of renewables into the power grid.

Quality Power's portfolio of high voltage products and solutions is critical for advancing and modernizing electrical networks. The Company's technologies are designed to enhance grid reliability and performance by providing critical support for power grid management and overall network stability. Engineered to meet the demanding requirements of contemporary electrical infrastructure, these products ensure optimal efficiency and resilience. The Company's high voltage solutions helps to maintain and improve network performance, offering advanced capabilities to address the complexities of modern energy systems and assist operators in effectively managing power quality and operational reliability. The Company's product portfolio contributes in advancing decarbonization efforts, sustainability, and green energy initiatives. The Company offering a range of technology-driven products, comprehensive system solutions, and professional services tailored for the power sector. Since its inception in 2001, the Company's operations spans across multiple key areas, including (i) power transmission, providing effective transfer of electricity over distances, (ii) power

distribution, ensuring the delivery of electricity to end users, and (iii) power automation, integrating advanced technologies for efficient power management. The Company also specializes in grid interconnection equipment, which addresses infrastructure and devices needed to connect multiple power grids or electrical systems. This equipment is crucial for facilitating the smooth transfer of energy between various stages: from generation to transmission, and from transmission to distribution, ensuring that energy flows throughout the power system, promoting integration and consistent operation.

The Company's manufacturing operations in India are spread across two locations, including Sangli, Maharashtra and Aluva (Cochin), Kerala. As part of its global expansion, the Company acquired Endoks Enerji Degitim Sistemleri Lth Lhr Sti ("Endoks") in 2011, which has design, operation, assembly and project management & delivery facilities in Ankara, Turkey.

The Company's manufacturing facilities are accredited as ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018 by TUV India Private Limited. Further, the Company complies with ISO standards for customer satisfaction, energy management, occupational health and safety, environmental management, quality management, and information security, reflecting its commitment in diverse operational areas. The Company has been awarded the status as a 'One Star Export House' in accordance with the provisions of the Foreign Trade Policy, 2023 by the Directorate General of Foreign Trade, Ministry of Commerce & Industry.

## 8.4 Threats and Challenges to Quality Power

- **Project Approval and Permitting Delays**

Navigating the complex and government approvals processes can delay project timelines, Frequent regulatory changes can create uncertainty and hinder long-term planning with delays in approvals and adapting to new regulations can result in increased costs and missed opportunities. Securing environmental clearances can be particularly challenging, involving extensive documentation and assessments. Additionally, projects may encounter opposition from environmental groups, leading to further delays and heightened scrutiny.

- **Lack of Skilled Talent**

Designing and engineering advanced electrical equipment require highly skilled engineers and designers. The need for highly skilled engineers and designers and retaining top talent can create a talent acquisition challenge with Rapid changes in technology necessitate continuous learning and adaptation, which can be resource-intensive and meeting specific customer requirements with customized solutions increases complexity and cost.

- **Grid Compatibility and Interoperability**

Adhering to various national and international standards for electrical equipment can be complex and expensive, as obtaining the necessary certifications and approvals is often a lengthy and costly process. Ensuring new equipment is compatible with existing grid infrastructure presents significant technical challenges, leading to additional costs for modifying existing systems to accommodate new equipment.

- **High Initial Investment**

Electrical equipment manufacturing requires significant upfront capital for setting up manufacturing units, procuring raw materials, and implementing advanced technologies. Securing new funding can be a challenging task for scaling up due to long payback period and rapid technological change in power sector.

- **Maintenance, Reliability, and Safety**

Equipment failures or maintenance downtime can cause significant financial losses and disrupt operations. Frequent downtimes can harm the company's reputation for reliability. Meeting strict safety standards to prevent accidents is resource-intensive and failures can lead to legal issues, fines, and compensation claims. Consistently maintaining high reliability levels for customer satisfaction can be challenging, especially in harsh or variable environmental conditions.