

GLOBAL POWER SECTOR

The global power sector which contributes to 17% of TFCF is a crucial part of the global economy, providing electricity needed for lighting and appliances, around the world. The sector is responsible for generating and distributing electricity from a wide variety of sources, including renewable sources like biomass, wind and solar, along with fossil fuels, nuclear energy, etc. With the growing demand for energy and the need to reduce carbon emissions, the power sector is undergoing a significant transformation towards cleaner and more sustainable sources of energy. This transition is expected to accelerate in the coming years, as countries and companies strive to meet their climate targets and achieve a more sustainable future.

During a year of tentative economic recovery, the renewable power sector took a large step forward, deploying a record amount of new capacity and experiencing greater geographic diversification. However, projects continued to be disrupted by supply chain issues and shipping delays, and a global rise in commodity prices led to surging prices for wind and solar power components. Despite the record capacity additions, the trends remain far from the deployment needed to keep the world on track to reach net zero emissions by 2050.

INDIAN POWER SECTOR

The Indian power generation industry has observed some key trends, like sustainable power development, enhanced focus towards concerns related to climate change, as well as eco-friendly policies. It is largely expected that the industry may witness greater acceleration towards eco-friendly “Green Power” solutions going forward. The past few years have seen India’s energy needs go up exponentially on account of rapid economic growth, as well as overall industrialisation and urbanisation. As per Ministry of New and Renewable Energy (MNRE), as of March 2023, India has total installed power generation capacity of 415 GW – a growth of 5% over March 2022. Of this, 41% share, i.e. 172 GW, is renewable power generation capacity, as of March 2023.

INDIAN MANUFACTURING SECTOR – SIGNIFICANCE OF CAPTIVE POWER GENERATION

The sector is fast emerging as one of the high growth sectors, driven by the Government’s ‘Make in India’ programme aimed at placing the country on the world manufacturing map. Rising input costs (energy) and electricity prices, coupled with stringent Government regulations, are expected to drive investment in the establishment of captive power plants for continued uninterrupted power supply, leading to sustainable industrial operations.

Captive power generation is emerging as a key requirement for many manufacturing companies, where grid disturbances in power supply can affect the operations. Improvement in coal supply, growing awareness about renewable energy, and eco-friendly power generation policies will enhance the captive power additions in the country. The largest market for captive power generation in the country is the Industrial sector, mainly on account of the increasing demand for electricity from energy-intensive industries such as Cement, Steel, Petroleum Refineries and Chemicals, etc.

Captive power generation units can be fired using both fossil fuel and renewable fuel. The renewable fuel sources comprise non-thermal (such as Hydro, Solar Photovoltaic (PV) and Wind) and thermal (such as Bio-Power, Waste to Energy (WtE), Waste Heat, Concentrated Solar Power and Geothermal Power).

INTRODUCTION TO TRIVENI TURBINES AND THE OPPORTUNITIES FOR STEAM TURBINES IN POWER GENERATION APPLICATIONS

For the last 50 years, Triveni Turbines has manufactured and assembled engineered steam turbine solutions for meeting the heat and power requirements of industrial customers across the globe. The Company is a focussed, growing and market-leading corporation having core competency in the area of industrial heat & power solutions and decentralised steam-based renewable turbines up to 100 MW size. Our customers include end-user industries like Sugar, Distillery, Cement, Steel, Food Processing, Pulp & Paper, Pharmaceuticals, Petroleum Refineries, Chemicals, Petrochemicals and Fertilisers etc.

Steam turbines play a critical role in meeting the global energy requirements. These machines are widely used to generate electricity from steam, and are considered to be one of the most efficient ways to convert heat energy into mechanical energy, which can be further converted into electrical energy.

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Steam turbines can also serve as a decentralised renewable energy provider, particularly in areas where there is a lack of access to the main power grid or unreliable power supply. In this context, steam turbines can be used in conjunction with renewable energy sources, such as solar or geothermal, to provide reliable and clean energy to users. Decentralised power generation refers to the production of electricity closer to the point of consumption, which can help to increase energy efficiency and reliability, reduce transmission losses and costs, and promote energy security. By using steam turbines in conjunction with solar, geothermal, or waste-to-energy sources, communities can generate clean and reliable energy while reducing their dependence on fossil fuels and increasing their energy security and resilience.

The Bio-Power industry turns many potential feedstocks into solid fuels (biomass or wood pellets, sugarcane residues and palm oil residues etc.), liquid biofuels (ethanol etc.) and gaseous fuels (biogas, landfill gas), which are then used to produce electricity, heat and transport fuels.

The residues from Sugar industry in the form of Biomass (Bagasse) are used as fuel to generate power that is sustainable. Aided by the National Policy on Biofuels and the incentives offered by the Government (on soft loans etc.), India is witnessing huge investment by sugar companies in both Greenfield and Brownfield expansions of sugarcane-based and grain-based distilleries. This will open up huge opportunity for steam turbines in the future.

The Pulp and Paper industry constantly focusses on improving energy efficiency, which is attained through increased use of non-Bagasse (e.g. wood waste) based fuel for power generation, and through appropriate usage of steam. With many paper companies in India looking at energy conservation through eco-friendly ways, this will lead to more opportunity for steam turbines.

The industrial use of biomass, particularly from sugar and palm oil mills, as well as wood waste from pulp and paper

mills, is conducive to the production of power for captive consumption. About 70% of the biomass power globally is currently co-generated with process heat, as seen in the use of heat sources for district heating in European countries, and for industrial process heating applications the world over.

The drive to utilise locally available agricultural and forest residues has enabled generation of power closer to the point of consumption, which in turn has facilitated setting up of biomass-based power production facilities.

Waste-to-energy (WtE) Industry refers to a variety of treatment technologies that convert waste to electricity, heat, fuel or other usable materials, as well as a range of residues. There are several primary waste streams in urban areas, with Municipal Solid Waste (MSW) being one among them. MSW streams are disposed of in municipal landfills, followed by Commercial and Industrial Waste (CIW), to set up WtE based power production facility that utilises energy value in waste to generate electricity and/or heat.

Thermal treatment of waste is an environmentally acceptable alternative method, also known as incineration with energy recovery. It is a major waste treatment method in some developed countries, and by far the most widely adopted technology that dominates the global WtE industry. The Refuse Derived Fuel (RDF) production involves separating, sorting, drying and compressing the combustible portion of the waste, resulting in a product which can be used as a feedstock for any of the three thermal processes, or combusted in an industrial application.

Energy efficiency has become a top priority for the Cement industry but adoption of Waste Heat Recovery (WHR) systems in cement facilities still has a long way to go. Large cement companies are primarily considering WHR based power plants for their Greenfield projects, which will lead to more opportunities for steam turbines and create awareness among medium and small sized cement companies. Triveni Turbines has developed efficient injection condensing

Triveni Turbines provides steam turbine solutions that use low pressure steam, generated through extraction turbine for heating application by producing both heat and electric power. The cost of power generated through this process is 14-15% lower as against that of power generated through IPPs.



turbines that use medium pressure steam as turbine inlet and low pressure as injection steam.

The Steel industry is characterised by high load variations on account of many on and off conditions of furnace and kiln, causing load fluctuations in furnaces and kilns, and thus affecting the stability of the grid and quality of power supply. Therefore, it is extremely critical to have a constant and reliable source of power. Power has been one of the major cost components of the Steel industry. Hence, the availability of captive power becomes crucial for continuous operation of a steel plant. The opportunity for steam turbines from integrated steel plants in India for Direct-Reduced Iron (DRI) processes is quite significant. The waste heat recovered from the DRI plant will meet the captive power requirement of the steel plant.

The Oil & Gas Industry is encountering several difficulties due to contemporary energy refining methods. As a result, customers are actively seeking ways to optimise energy efficiency, decrease their carbon footprint, and reduce operating expenses. The cost-competitive nature and the ever-changing demands of end-users have motivated them to pursue plant efficiency improvements through energy recovery technologies, ultimately minimising energy wastage. In this scenario, the potential for steam turbines can be harnessed by providing high efficiency turbines for both power generation and drive applications.

ADVANTAGES OF TRIVENI'S STEAM TURBINE GENERATORS IN COMBINED HEAT AND POWER APPLICATIONS (CHP)

Triveni Turbines provides steam turbine solutions that use low pressure steam, generated through extraction turbine for heating application by producing both heat and electric power. The cost of power generated through this process is 14-15% lower as against that of power generated through IPPs.

While solar renewable energy is used as a utility power plant only during the day, power produced through CHP/ cogeneration benefits the plant throughout the day by addressing its combined heat and power requirements. This gives the latter a strong edge. As a result, the ongoing rapid increase in electricity consumption, coupled with growing focus on electricity generation through biomass energy sources, thermal treatment of waste and recovery of waste heat, is expected to unleash sustainable power generation through the cost-effective approach of combining both heat and power.

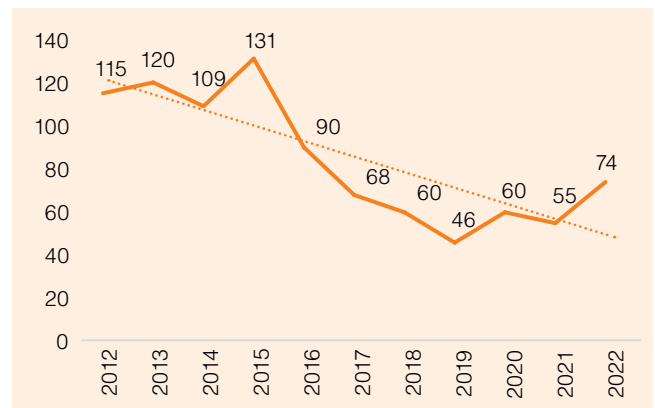
GLOBAL STEAM TURBINE MARKET OVERVIEW

Utility Turbines leading to long-term decline in global steam turbine market

The global steam turbine market has witnessed a decline of 4% per annum, from 115 GW in 2012 to 74 GW in 2022. This is largely attributable to a 4.7% p.a. decline during 2012-2022 in the >100 MW market category (utility turbines), due to transition to renewable and clean energy technologies from coal-based power technologies in countries across the globe. This segment currently accounts for 88% of the overall market.

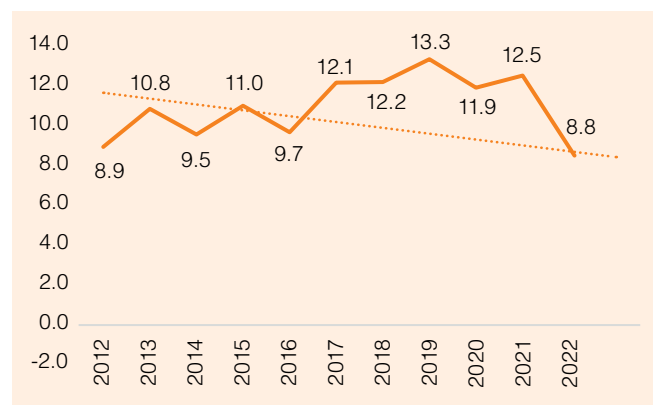
In 2022, the overall global steam turbine market grew to 74 GW, up 34% year-on-year driven by growth in the segment of utility turbines driven by increased global demand following a sluggish year due to the pandemic.

Overall Global Steam Turbine Market has been Declining over the years (in GW)



...However the Below 100 MW Segment where Triveni Turbines operates is largely flat

Steam Turbine Market Below 100 MW (in GW)



Source: Mc Coy Report 2022

Note: Data pertains to calendar years