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Up to 100 MW

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# Clean Energy Turbine Solutions



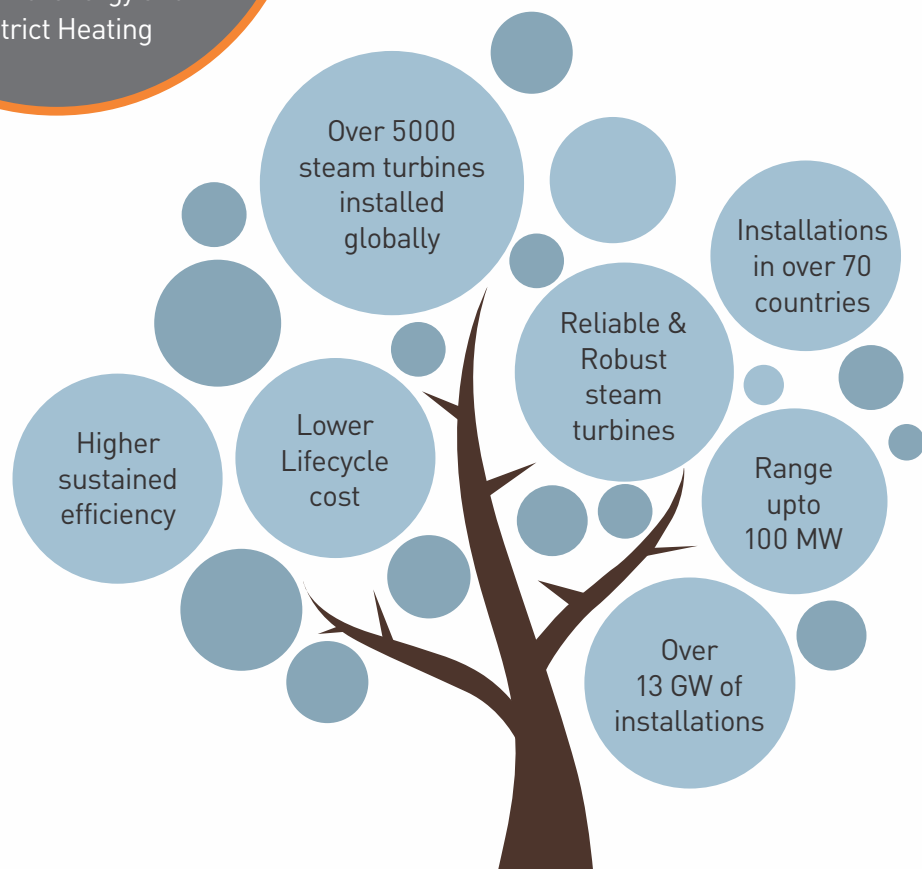


# Clean Energy Turbine Solutions

The power generation industry is evolving continuously. The demand for higher efficiencies and lower cost are constantly being stretched. At Triveni Turbines, we understand the economics and needs of the power producers to have equipment with better operating efficiencies, long term reliability, maximum availability and extended operating life to maximise return on investment.

We offer steam turbine solutions for Industrial Captive and Renewable Power. We manufacture world class steam turbines up to 100 MW that enable our customers to achieve unhindered performance and power self-sufficiency at an optimal cost while minimizing environmental impact. Triveni Turbines partners with customers to provide a comprehensive range of service solutions for the complete life cycle of steam turbines.

Triveni Turbine Limited is the world's largest manufacturer of steam turbines ranging up to 100 MW for providing renewable power solutions specifically for Biomass, Sugar & Process Co-generation, Waste-to-energy and District Heating



# Global Presence



Our focus on entering new markets and geographies has led to a strong and credible presence in the global market. We have already installed globally competitive and technologically advanced products in over 70 countries. The important aspects of expanding our horizons in the global markets include our capability to offer customer specific solutions in new geographies while serving them efficiently.

Triveni Turbines has a dominant market share in India and is constantly increasing its market share globally. Our market leadership has been built on a foundation of strong and continuously evolving product research, development and engineering capabilities.



We have a capacity range of upto 100 MW Steam turbines. Triveni Turbines limited is engaged in the design, supply and service of steam turbines. Manufactured in a state-of-the-art plant at Triveni Turbines, Bengaluru, located in Peenya and Sompura.



Up to 100 MW



# Robust and Reliable Steam Turbines

We design, manufacture and supply industrial steam turbines up to 100 MW with the flexibility to meet customer requirements for today and tomorrow. Our commitment to set benchmarks for reliability and robustness of turbines has resulted in bringing world class turbine solutions to our customers globally.

## EXTENSIVE PRODUCT RANGE

Triveni Turbines offers robust and reliable back-pressure and condensing steam turbines up to 100 MW that work across a wide range of pressure and flow applications with a choice of impulse and reaction technology.

Upto 100 MW Range

	Condensing Steam Turbines	Back Pressure Steam Turbines
<b>Types</b>	<ul style="list-style-type: none"> <li>* Straight Condensing Type</li> <li>* Bleed Condensing Type</li> <li>* Extraction Condensing Type</li> <li>* Double Extraction Condensing</li> <li>* Injection Condensing Type</li> <li>* Axial Turbines</li> <li>* Reheat Turbines</li> </ul>	<ul style="list-style-type: none"> <li>* Straight Back Pressure Type</li> <li>* Bleed Back Pressure Type</li> <li>* Extraction Back Pressure Type</li> </ul>
<b>Specifications</b>		
Power Generation Capacity	Up to 100 MW	Up to 100 MW
Steam Inlet Temperature	Up to 545°C	Up to 545°C
Steam Inlet Pressure	Up to 140 Bar(a)	Up to 140 Bar(a)





Up to 100 MW Standard scope includes Supply and Commissioning of:

- ✦ Steam turbine and its control system
- ✦ Control oil system
- ✦ Lubricating oil system
- ✦ Condensing system (as applicable)
- ✦ Gear box
- ✦ Alternator
- ✦ Electrical metering/control/protection system
- ✦ Turbovisory system

## INDUSTRIES & APPLICATIONS

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Triveni Turbines serves the power generation needs in diverse industry segments like Sugar, Steel, Cement, Distillery, Pulp & Paper, Textiles, Chemicals, Palm Oil, Food Processing, Waste to Energy, Biomass, Geothermal etc. The turbines are used in a wide range of applications such as Cogeneration, Combined Heat & Power Generation, Captive Power Generation and Independent Power Generation.

## MANUFACTURING EXCELLENCE

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Our state-of-the-art facility, with an installed capacity to manufacture over 200 turbines annually, is equipped to provide complete manufacturing, assembly, testing and refurbishing services. The facility is equipped with precision equipments and the latest softwares for seamless manufacturing of all critical components. Our in-house manufacturing for all critical components along with a strong network of global suppliers enables faster delivery of products to our customers.







- ☀ Integrated CAD/CAM
- ☀ Five-axis CNC Machining Center
- ☀ Large Fleet of Four-axis CNC Machines
- ☀ Five-axis CNC Mill Turn Center
- ☀ GHTM Goratu Turn Milling Machine
- ☀ 5-Face CNC Gantry Machine
- ☀ Zeiss Co-ordinate Measuring Machines
- ☀ Computerised Test Facility
- ☀ Vacuum Tunnel
- ☀ Full-speed Mechanical Steam Run Test

AS9100D  
ISO 14001 EMS,  
OHSAS 18001  
Standards

IEC, BS, API,  
NEMA, DIN,  
ASME, CE,  
PED, AGMA,  
TEMA, HEI

5S, TPM,  
employee  
involvements  
through QCs

Industry  
Best Practices





# Higher Sustained Efficiency

Our advanced design concepts have been developed in collaboration with the world's leading design houses in India & the USA to provide maximum performance. Globally benchmarked well proven processes are adopted at Triveni Turbines. Our turbines meet even the most stringent international quality standards which lead to maintaining efficiency throughout the turbine lifecycle.



We use the latest design tools and software to deliver higher performance and added value to our customers



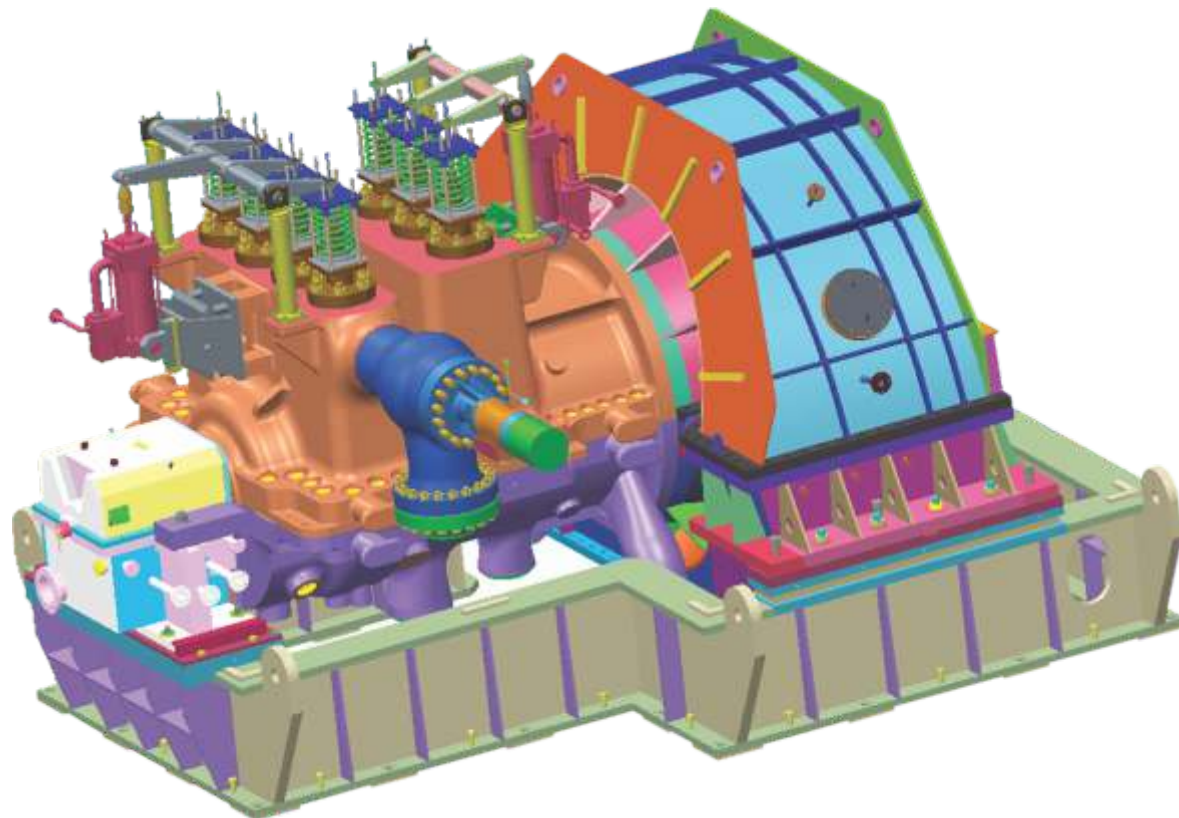
## INNOVATION & TECHNOLOGY

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Our endeavour towards continuous product development by deploying cutting edge technology has delivered innovative solutions to customers. Our time tested product development process constantly upgrades steam turbine designs for higher inlet temperature and pressure, to maximise efficiency and reliability features in the turbine. We are constantly working towards developing technologically superior designs using the latest design tools and software, like Turbo-machinery CFD tools, FEA tools, CAD modelling, lateral and torsional rotor dynamics software, that deliver higher performance and add value to customers.

Our product development program is designed to meet all customer requirements for economic installation and operation. Various reliability and operations improvement features such as quick start cycles and high automation levels are incorporated in the steam turbines.

Triveni Turbines leverages on continuous technology development, which is the result of its innovative ecosystem. Triveni Turbines draws from the extensive knowledge base of domain experts in steam turbine technology as well as its related fields, which enhances the skill base of the entire R&D team.



## INTELLECTUAL PROPERTY RIGHTS

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Operating in a technology intensive industry, we value Intellectual Property Rights and ensure that our IP team gets involved from the planning and conceptualisation stage to the final design and development of products. We have a comprehensive IP strategy for creation and protection of long-term IP assets. The IP policy covers patents, industrial designs, copyrights and trademarks protection. The IP team undertakes complete technology scanning of all R&D projects as well as other protectable IPs.

## QUALITY ASSURANCE

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Our products are manufactured in accordance with international standards such as API, ASME, AGMA, NEMA, IEC, CE/PED Mark among others. Our best-in-class testing facilities for extensive validation of design help to ensure excellent products that meet even the most stringent international quality standards. We ensure that our network of quality suppliers and dedicated sub-contractors also comply with these standards through QAPs and Standard Operating Practices to maintain a comprehensive quality control of the turbine and its auxiliary systems.





Ultrasonic Test

Thermal Stability Test

Natural Frequency Test

Magnetic Particle Test

Sound Level Measurement

Alignment Check

Radiography

Profile Measurement Through CMM

Full Speed Mechanical Steam Run Test

Zygo Test

Low Speed Dynamic Balancing

Governor Response

Casing Hydro Test

Full Speed Vacuum Tunnel Balancing

Vibration Measurement



Our products meet the most stringent international quality standards



# Lower Lifecycle Cost

Our products are designed to meet all customer requirements for an economic installation, generating competitive power and reduced operating cost. Maximum availability and extended operating life of the product leads to lower lifecycle cost.



Custom-built software is used for steam path  
aero and structural design of each turbine





## BENEFITS WITH TRIVENI TURBINES



### COMPACT DESIGN

- ✦ Lower civil cost
- ✦ Quicker installation
- ✦ Easier maintenance



### EXCELLENT ROTOR DYNAMICS

- ✦ Solid forged rotor with integral discs to improve reliability. Rotor dynamic analysis for lateral critical speeds for each shaft and bearing configuration.



### OPTIMISED CASING

- ✦ Horizontally split casing is designed symmetrically to reduce thermal stress.



### ADVANCED TECHNOLOGY FOR HIGHER EFFICIENCIES

- ✦ Auto-start option for turbines
- ✦ Custom-built software used for steam path aero and structural design of each turbine
- ✦ Advanced aero LP modules
- ✦ Optimum combination of Impulse and Reaction blade path that maximises efficiency



### ADVANCED BLADING

- ✦ Blades are designed to achieve maximum performance. Disc & blade stress and vibration simulations carried out for each turbine stage



### ROBUST & RELIABLE

- ✦ High speed vacuum balancing of rotors
- ✦ In-house thermal stability test
- ✦ Transient Analysis for faster start-ups



## COMPREHENSIVE SERVICE SOLUTIONS

We offer a unique combination of the latest equipment, a highly skilled team and OEM expertise to provide a comprehensive range of customised service solutions for industrial steam turbines. Our aim is to deliver total customer satisfaction and this customer centric approach has enabled us to attain extremely high repeat customer orders. Our customers can visit the facility during the repair process and review the progress.

## SERVICE OFFERINGS

- 1 Full speed Schenck Rotec vacuum balancing tunnel for balancing turbines, compressors/alternators
- 2 Overhauling & troubleshooting
- 3 Customisation & upgradation of old turbines for both industrial and utility segments
- 4 Refurbishment solutions for higher MW turbines, upto 500MW for all makes
  - ✦ Efficiency restoration/improvement
  - ✦ Health survey & condition assessment
  - ✦ Relocations of turbine
  - ✦ Upgradation
  - ✦ Re-engineering
  - ✦ Full speed balancing under vacuum
  - ✦ Retrofitting turbovisory systems
  - ✦ Modernisation of power plants
  - ✦ Indigenisation
  - ✦ Residual Life Assessment







## CONTINUOUS LEARNING

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Our Learning Centre is the fulcrum for all the technical training needs of Triveni Turbines. We have a world-class learning centre to enable continuous learning for our own corporate, design and field service engineers on a variety of subjects including the latest technology offerings and solutions. This is congruous to our goal of human resources development to meet the growing challenges in terms of engineering, design and development that in turn helps us to serve our customers better.

The Company also undertakes training of customers' personnel in the areas of operations & maintenance. Apart from training in advanced CAE system such as ANSYS, ABACUS, CFX and so on, Engineers are also trained in the following:

- ✦ Turbine aero design/ computational fluid dynamics
- ✦ Advanced structural design which includes elasto plastic analysis, turbine transient analysis, creep-fatigue damage analysis, heat transfers etc.
- ✦ Lateral, torsional rotor dynamics of geared and direct drive trains
- ✦ Lifting analysis of Turbo machinery components
- ✦ State-of- the-art control system including dynamic load simulation
- ✦ Prototype developments and validation tests
- ✦ Training with US design houses and universities



## GLOBAL NETWORK

### INDIA

#### SALES, SERVICE AND MANUFACTURING FACILITY

##### Triveni Turbine Limited

12-A, Peenya Industrial Area,  
Bengaluru-560 058,  
Karnataka, India.  
Phone: +91 80 22164000  
Fax : +91 80 22164100  
www.triveniturbines.com

#### SALES, SERVICE AND MANUFACTURING FACILITY

##### Triveni Turbine Limited

Plot No.491, Sompura  
2<sup>nd</sup> Stage, KIADB Sompura  
Industrial Area  
Nelamangala Taluk,  
Bengaluru Rural - 562 123

### SOUTH AFRICA

#### MARKETING AND SERVICE OFFICE

##### Triveni Turbines Africa (Pty) Ltd.

AMR Building, 3 Concorde  
East Road, Bedfordview,  
2007, South Africa  
Phone: +27 10 007 5245 / 5246

### THAILAND

#### MARKETING AND SERVICE OFFICE

##### Triveni Turbines DMCC

571 RSU Tower, Unit 903,  
9<sup>th</sup> Floor, Sukhumvit 31 Road,  
Klong Ton Nua, Wattana,  
Bangkok 10110, Thailand  
Phone: +66 2 117 9575  
Fax : +66 2 662 3416

### UAE

#### SALES AND SERVICE OFFICE

##### Triveni Turbines DMCC

4502-16, 45<sup>th</sup> Floor,  
Al Mazaya Business  
Avenue - Tower BB2,  
Jumeirah Lake Towers,  
Dubai, United Arab Emirates,  
P.O. Box 393509  
Phone: +971-4 5670752  
Fax : +971-4432 8232

### UNITED KINGDOM

#### REGISTERED OFFICE

##### Triveni Turbines Europe Private Ltd

C/O Vistra UK (3<sup>rd</sup> Floor)  
11-12 St James's Square, London,  
SW1Y 4LB, United Kingdom  
Phone: +44 203 872 7310  
Fax : +44 203 872 7311  
www.triveniturbines.co.uk

Email: [mktg@triveniturbines.com](mailto:mktg@triveniturbines.com), [customer@triveniturbines.com](mailto:customer@triveniturbines.com)



## COUNTRIES OF PRESENCE

- |                                  |                             |                      |                              |
|----------------------------------|-----------------------------|----------------------|------------------------------|
| 01. Ankara                       | 19. Ethiopia                | 38. Malawi           | 58. Spain                    |
| 02. Australia                    | 20. Finland                 | 39. Malaysia         | 59. Sri Lanka                |
| 03. Austria                      | 21. France                  | 40. Mauritius        | 60. Swaziland                |
| 04. Bangladesh                   | 22. Ghana                   | 41. Mexico           | 61. Sweden                   |
| 05. Belize                       | 23. Guatemala               | 42. Mosambique       | 62. Switzerland              |
| 06. Bosnia and Herzegovina       | 24. Guyana                  | 43. Myanmar          | 63. Tanzania                 |
| 07. Brazil                       | 25. Honduras                | 44. Nepal            | 64. Thailand                 |
| 08. Cameroon                     | 26. India                   | 45. Netherlands      | 65. Tunisia                  |
| 09. China                        | 27. Indonesia               | 46. Nicaragua        | 66. Turkey                   |
| 10. Colombia                     | 28. Ireland                 | 47. Nigeria          | 67. Uganda                   |
| 11. Costa Rica                   | 29. Italy                   | 48. Pakistan         | 68. Ukraine                  |
| 12. Cote d'Ivoire (Ivory Coast)  | 30. Jamaica                 | 49. Panama           | 69. United Arab Emirates     |
| 13. Croatia                      | 31. Kenya                   | 50. Papua New Guinea | 70. United Kingdom           |
| 14. Democratic Republic of Congo | 32. Kingdom of Saudi Arabia | 51. Peru             | 71. United States of America |
| 15. Ecuador                      | 33. Korea (South)           | 52. Philippines      | 72. Uzbekistan               |
| 16. El Salvador                  | 34. Kuwait                  | 53. Poland           | 73. Venezuela                |
| 17. Eritrea                      | 35. Laos                    | 54. Romania          | 74. Vietnam                  |
| 18. Estonia                      | 36. Lebanon                 | 55. Russia           | 75. Zamb                     |
|                                  | 37. Lithuania               | 56. Serbia           |                              |
|                                  |                             | 57. South Africa     |                              |



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Up to 100 MW

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Visit our website:

