STEAM TURBINES
A FULL RANGE
TO FIT YOUR NEEDS

ALSTOM
Shaping the future
Alstom is a global leader in power generation with a portfolio of products covering all fuel types. From fossil and biomass to nuclear and renewables, close to 25% of the world’s power production capacity depends on Alstom technology or services.

Our portfolio includes steam turbines, generators and boilers, as well as balance of plant components, air quality control systems and carbon capture and storage solutions.

We have an extensive product offering based on innovative technologies that provide clean and efficient power solutions. Our tailored approach helps you to maximise power output and profitability, from initial design to plant configuration and from construction to maintenance.
“Dynamic” is the only way to describe the electricity market. Fast-growing demand in developing countries requires new power production capacity. Elsewhere, ageing fleets need to be replaced. Despite increased focus on renewables, thermal power plants continue to dominate electricity production – and will do so for many years to come.

However, environmental concerns encourage thermal power plant operators to use the best technology available. The best steam turbine technology is the obvious choice.

Alstom has been designing and building steam turbines for over 100 years. In that time, we have constantly driven their performance, efficiency and reliability.

Today, Alstom offers a complete range of advanced, highly efficient and reliable steam turbine generator sets for fossil, industrial, nuclear and renewable applications up to 1,800 MW in 50 Hz and 60 Hz networks.
Clean Power, How Alstom is helping you

CLEAN POWER CLEAR SOLUTIONS™

Our Power generation offering is based on a deep understanding of power markets and our customers’ needs. It is organised around three levers to maximise the return of assets over their entire lifecycle.

**REDUCING COST OF ELECTRICITY**

It takes competitive assets to keep electricity affordable. We enable power companies to compete successfully in the marketplace and provide affordable electricity to consumers. We help you reduce the cost of electricity through:

- Efficiency improvements
- CAPEX reduction/scaling up
- Capacity Factor increase (renewable)
- Lead time reduction
- Competitive O&M
- Competitive financing

**LOWER ENVIRONMENTAL FOOTPRINT**

Clean generation is one way of demonstrating environmental responsibility. Another is lowering resource usage, visual impact and noise pollution. In both cases, we can help you meet or exceed regulations and environmental standards. That is why Alstom innovates in the following areas:

- Renewable portfolio
- Natural resource optimisation
- Pollutants control (SO₂, NOₓ, PM, mercury)
- CO₂ emission reduction & CCS
- Land use, visual impact and noise
- Water intensity reduction & recyclability

**INCREASING FLEXIBILITY & RELIABILITY**

Intermittent power generation is a growing challenge of energy security, as is maintaining an aging installed base and adapting it to changing market conditions. We help you tackle both issues so that you can enjoy dependable operations with:

- Maintainability and outage time reduction
- Operational and fuel flexibility
- Designs and service for improved availability and reliability
- Climate packages
- Energy storage
Our commitment to customers

Alstom steam turbines have a number of key technical features such as the single bearing design or advanced 3D-blading that reduce operating costs and increase efficiency.

Our products continue to demonstrate their outstanding reliability and flexibility, with features such as the shrink ring design and welded rotors.

REDUCING COST OF ELECTRICITY

2.2 million tonnes of lignite
Saved per year as result of ultra-supercritical steam parameters*

INCREASING FLEXIBILITY & RELIABILITY

99.5%
Average reliability on combined-cycle steam turbines**

*Savings for Neurath USC power plant, vs. average German lignite plant fleet in 2012. Alstom calculations using ENERDATA figures.
**99.5% average reliability achieved at Polk II plant; calculated from the data of the North American Electric Reliability Council between 2001 and 2010.
To date, Alstom has supplied steam turbines totalling almost 580 GW and its fleet has conquered more than 20% of the world’s installed steam turbine capacity.

Alstom is a global leader in steam turbines and builds the world’s largest single-shaft steam turbine generator sets with a power output of more than 1,100 MW. The world’s seven largest fossil units, each producing 1,300 MW in a cross-compound arrangement, were designed and built by Alstom.

Alstom is also recognised as a leading supplier for steam turbine generator sets in combined-cycle and co-generation applications.

Over 30% of nuclear power plants feature Alstom steam turbine generator sets. The world’s four largest operating nuclear units, with a capacity of 1,550 MW each, are ARABELLE™ steam turbines from Alstom. Flamanville 3 will push this breakthrough further, when its 1,750 MW single shaft ARABELLE™ steam turbine and GIGATOP generator enter operation.

Over a century of leading expertise
The early roots of Alstom steam turbines bring us back to 1884, when Charles Parsons invented the first multi-stage reaction turbine. A decade later, the first impulse turbine was presented by Auguste Rateau.

Since then, Alstom’s steam turbine technologies kept evolving and improving, while delivering outstanding results. Many of today’s output or efficiency world records are directly linked to Alstom technologies invented more than a century ago.

Flexibility to meet your needs today and tomorrow
- In combined-cycle plants with advanced gas turbines, the flexible thermal design of the Alstom steam turbine generator sets results in a highly efficient heat-recovery cycle and fast start-ups.
- In fossil-fired steam plants, Alstom steam turbines lead the way in efficiency with the highest ultra-supercritical steam parameters today’s materials can deliver.
- In co-generation plants, Alstom steam turbines enable highly flexible operation between power and process steam demand, efficiently accommodate wide variations in process steam flows.
- The Alstom ARABELLE™ nuclear steam turbines fit any reactor type; its unique design and reliability provide optimum efficiency.

ALSTOM’S STEAM TURBINE MAIN MILESTONES
- 1901 First Brown Boveri-Parson steam turbine
- 1930 Welded rotor feature introduction
- 1936 Single bearing design introduction
- 1960 First shrink ring design for HP turbine
- 1973 First 1,300 MW cross compound unit in USA (TVA)
- 1984 Leibstadt 950 MW – the largest full speed nuclear unit (Axpo)
- 1991 Shindongkou 1 & 2, 2 × 628 MW – the first SC units in China
- 2013 Massvlakte 4 × 1,100 MW – world’s most powerful USC steam turbines
Alstom modular design for reliability and performance

Alstom steam turbines are configured from pre-engineered standard modules. This modular concept governs all engineering and manufacturing processes and results in the shortest possible erection and commissioning times, high reliability and optimum efficiency. However, to maximise performance, the steam path is always adapted to the specific project requirements and that includes material selection.

Operational feedback is systematically used to create customer value. Because of Alstom’s modular turbine concept, such feedback benefits the entire product portfolio. Alstom generally supplies the steam turbine together with the turbogenerator, delivering an integrated system with high performance and optimised shaft dynamics.

All Alstom steam turbines are the result of continuous, evolutionary development, maximising efficiency for lower fuel consumption and carbon emissions.
Designed to last

**Shrink ring design**
The high-pressure steam turbine modules are of a unique double-shell design. Shrink rings hold the two halves of the inner shell together, forming a rotationally-symmetric inner casing enhancing the thermal flexibility of the entire turbine.

Shrink rings also require less space than bolted flanges. The HP turbine is therefore more compact and lighter. Both shells have comparatively small wall thicknesses, allowing fast steam temperature changes. The advantage of this design is not only outstanding operational flexibility, but also long-term stable clearances and efficiencies.

Alstom’s intermediate-pressure turbines are also of double shell design, which has been enhanced to minimise the casing distortions, particularly at very high temperature applications. This ensures sustained clearances and therefore efficiencies.

Alstom’s unique steam turbine features provide competitive advantages in a dynamic environment.
**Welded turbine rotors**

Alstom large-diameter rotors are manufactured by welding together separate smaller forgings. The material is selected according to the mechanical requirements of each rotor section, making the stress levels of welded rotors significantly lower compared to monoblock rotors – in particular during thermal transients.

Welded rotors allow faster start-up and load cycling, consuming lifetime slower than mono-block rotors. The combination of the materials and mechanical design eliminates critical conditions that can lead to stress corrosion cracking resulting in increased rotor lifetime.

Alstom low pressure turbine rotors are not subject to mechanical shrinkage stresses, compared to rotors of shrunk-on disc design. The blade attachment integrity of Alstom rotors is far superior to that of monoblock designs.

Turbine rotors are coupled with expansion sleeves instead of fitting bolts. The sleeves provide zero-clearance seat and better torque transmission, even in extreme operating situations.

**Single bearing design**

Alstom multiple-casing turbines have a single bearing between each turbine section, aiding sustainable rotor dynamics. Load shifting between adjacent bearings is not possible. Problems with oil whip, foaming and vibration excitation through partially loaded bearings cannot occur. The result is increased turbine availability.

**Separate HP and IP turbine modules**

Alstom turbines feature separate HP and IP modules. The high power density of these cylinders, together with the compact single-bearing concept, leads to footprints similar to those of combined HP/IP turbines. Simplicity, robustness and higher sustained efficiency are the main advantages of this concept.
Designed for efficiency

Alstom is constantly enhancing turbine efficiency and reliability, contributing to our commitment to lowering the environmental footprint of our customers.

Advanced blading

Over our 100-year history, Alstom has always driven steam turbine efficiency, in both reaction and impulse technology. Today, Alstom steam turbines have blades with the most modern three-dimensional aerofoil designs in both technologies. The impulse design is used in new nuclear units, whereas all new steam turbines in fossil applications are based on reaction technology.

So-called “aft-loaded” profiles produce less turbulence and lower secondary flows. Enhanced blade hub and tip shapes ensure that the leakage flows merge smoothly with the main flow. This reduces flow disturbances and leads to the higher steam path efficiencies.

Each of Alstom’s HP, IP and LP front stage blades are milled from a single forging, ensuring excellent mechanical integrity.

LP large last stage blades

The large last stage blades of the LP turbines are key to improving steam turbine efficiency. Alstom’s LP turbine last stage blades are selected based on the project-specific cold end conditions.
components
to minimise fuel consumption

Alstom continues to demonstrate its technology leadership, designing highly efficient machines that help your power plant deliver the electrical power you need.

Low admission losses
High-pressure turbines for sliding pressure operation and all intermediate-pressure turbines have one or two spiral-shaped inlet scrolls; all double flow LP turbines are equipped with a single scroll. They help convert the steam’s kinetic energy into mechanical energy with lower losses, contributing directly to higher overall turbine efficiency. This design is of particular advantage for high temperature applications.

Optionally, HP turbines with inlet scrolls can be equipped with integrated second main steam injection bypassing the first stages by means of integrated overload valves. This method provides additional load reserve at constant pressure.

For hybrid pressure operation with a wide constant pressure range, mainly used in subcritical applications, Alstom offers an inlet module with a control stage that efficiently allows partial arc admission. The control wheel is formed out of a solid ring and welded onto the rotor. The resulting absence of mechanical fixation means high mechanical integrity, robustness and a long maintenance-free component lifetime.

Shaft and balance piston sealing
Brush seals contain a welded brush seal assembly including flexible super alloy bristle pack. They are fitted to seal rings at pistons and glands, replacing some fin strips, to provide reduced operational clearances and low leakage flows.

New generation brush seals achieve significant leakage reduction compared to standard glands.

High pressure and intermediate pressure turbines with inlet scrolls for smooth steam admission
Designed to reduce costs

Axial and lateral exhaust options for lower initial plant cost
Alstom steam turbines can be arranged on the floor level, so the condenser can be placed in the axial direction or at the side of the steam turbine. As no turbine table is required, the foundation can be kept very simple. In addition, the size of the turbine hall can be significantly reduced – which also simplifies piping, HVAC, stairways, intermediate floors, amongst others, significantly reducing initial costs.

Compact reheat steam turbine generator sets up to 350 MW are available with an axial LP exhaust saving plant first cost.

The unique Alstom lateral LP exhaust design is applied not only to single and double flow exhausts, but also to multiple flow arrangements.

Short erection time
Alstom steam turbines are fully assembled on leaving the factory. Site assembly or opening for commissioning is not necessary. The only exceptions are large LP turbines that cannot be transported in one piece. In such cases, their outer casing parts and fully bladed inner casings and rotors are shipped separately and assembled on site.

 Auxiliary equipment, such as the control oil and lube oil skids, is assembled before shipping. Pipes and supports are premanufactured and shipped ready for installation. Electronic control cubicles are completely wired and tested in the factory.

On site erection is greatly simplified by Alstom’s single-bearing concept. Moreover, the axial and lateral LP exhaust designs enable parallel erection of the steam turbine generator set and the condenser significantly reducing erection time.

REDUCING COST OF ELECTRICITY

2.2 million tonnes of lignite
Saved per year as result of ultra-supercritical steam parameters
Alstom’s R&D is market and customer oriented and focuses on creating innovative technologies to apply at all stages of our products’ life cycles.

World class R&D capabilities

We aim for the best utilisation of customers’ investment, through efficiency, availability and cost reduction. Increasing environmental concerns have led Alstom to focus on minimising CO₂ emissions through the development of technologies that can be applied in new and retrofit installations.

Alstom Power’s R&D policy takes a global approach putting work where the expertise is located. This global approach helps to nurture close contacts with universities and design institutes that can complement our in-house efforts. Furthermore, it enables Alstom teams to stay in touch with our customers’ expectations, anticipate their needs and lead the technology trends around the world.

Alstom Power works with more than 30 universities worldwide. Long-term links have been established with institutions such as the Massachusetts Institute of Technology (MIT) and Stanford CO₂ Research Institute, Grenoble and Lausanne universities for hydro turbines research, Cologne’s Deutsches Zentrum für Luft- und Raumfahrt (DLR) on combustion, Oxford University on heat transfer, as well as with engineering institutes in China, India and Russia.

In the field of international collaboration, Alstom Power has played a leading role in establishing the European technology platform for Zero Emission fossil fuel Power generation (ZEP).
Steam turbine manufacturing locations

**Global manufacturing capabilities**
Alstom manufactures components across Europe, North America and Asia. With further R&D facilities and resources in strategic locations around the globe, Alstom prides itself on maintaining the same high level of quality and effective international collaboration worldwide. The support of local service centres in 70 countries assures customers that Alstom can deliver efficient steam turbine solutions and services anytime, anywhere.

**Experienced leader**
With over 100 years of experience in building turbines, Alstom has the expertise, technology and the product portfolio to meet our customers’ specific requirements.
and project highlights that stand the test of time

Project highlights worldwide

Alstom’s steam turbines are known all over the world for their high efficiency and adaptability. Each of our turbines is optimised for each customer’s needs and parameters to maximise efficiency, reliability and availability.

NEURATH (GERMANY)
STF100 steam turbine and GIGATOP 2-pole turbogenerator in STPPs
With its 2 × 1,100 MW steam power plant at Neurath, Germany, RWE has set a new size and efficiency benchmark for lignite-fired power plants. Alstom has provided some of the most advanced steam turbine and generator technology in the world today.

PINGWEI II (CHINA)
STF60 steam turbine and GIGATOP 2-pole turbogenerator in STPPs
Alstom has supplied 2 supercritical, 600 MW STF60 steam turbines. Following the outstanding performance of Alstom steam turbines, the China Power Investment Corporation ordered in 2012 the supply of 2 ultra-supercritical, 1,000 MW STF100 steam turbines for the plant’s second extension.

FUJAIRAH (UNITED ARAB EMIRATES)
STF30/STF15 steam turbines and TOPGAS turbogenerators in a co-generation power plant
This combined-cycle co-generation power plant has an electrical output of 2,000 MW.
Due to the high flexibility of the steam turbines, the steam extraction to the desalination plant can be kept constant, while the electrical output can vary in a wide range from 40% to 100%. This way the water production can be kept at maximum throughout all normal operating conditions.

FRONT RANGE (USA)
STF30C steam turbine 2 × 230 MW and TOPAIR turbogenerator in a CCPP
Alstom developed its products to meet the needs of large combined-cycle power plants using air-cooled condensers. The STF30C with the TOPAIR generator was the ideal match. Alstom’s unique lateral exhaust reduced cost and improved efficiency by keeping the foundation height low and exhaust ducts to the ACC short. Standardised modules led to fast delivery and the customised steam path to optimised performance.
Full and dedicated support for the whole power plant

Our wide range of experience enables us to ensure that steam power generators stay competitive with changing market requirements over the lifetime of their assets. We support customers with tailored solutions that ensure maximum efficiency, emissions reduction and flexibility.

We provide comprehensive services for boilers, steam turbines, generators, air quality control systems, balance of plant and instrumentation and controls at all stages of the plant lifecycle:

- Parts
- Repairs
- Field service
- Advice and operational support
- Performance improvements
- Service contracts
- Services on other original equipment manufacturers

Expertise in components and systems interaction: the Plant Integrator™ solution

Our in-depth plant knowledge and expertise in product and component integration enables us to offer comprehensive solutions. From operational and fuel flexibility to total plant optimisation with life extension and performance requirements, we will help you to meet your business and plant operation needs.

Experience on other OEM’s equipment

Through a series of acquisitions and mergers over the last century, we have developed a broad technical product portfolio and project expertise. We have extensive experience in interfacing and integrating Alstom and other suppliers’ equipment and are able to service, upgrade or retrofit the widest range of third party components and systems – regardless of the original technology and unit configuration.
Performance improvements: retrofit expertise for the full plant

**Boilers**
With more than 1,400 retrofits performed worldwide on boiler islands (more than 40% being third party equipment), we are the leading global supplier of performance optimisation solutions. We also have more than 35,000 MW of fuel switching experience.

**Steam turbines**
We have the capabilities to perform steam turbine retrofits on both Reaction Turbine Blading (RTB) and Impulse Turbine Blading (ITB) technologies, irrespective of the original blading technology.

**Generators**
We have accumulated and developed a broad technical product portfolio, enabling our customers to benefit from upgrades and rewind solutions either on Alstom or third-party fleet.

**Air quality control systems**
We offer a complete range of solutions, including electrostatic precipitators, fabric filters, flue gas desulphurisation and selective catalytic reduction for most components associated with the flue gas line.

**Integrated retrofits**
By combining our component retrofit solutions, O&M experience and plant integration expertise, we can offer one-stop solutions. These are optimised for cost, performance and efficiency, depending on your requirements and come with global performance guarantees.

Our worldwide presence ensures we have strong technology and engineering capabilities and you have immediate local access to Alstom experts.
Our steam turbine-generator package

Take full advantage of Alstom’s proven expertise in steam turbines and generators with a fully optimised package combining both technologies and features.

With more than 100 years of expertise and over 814,000 MW installed worldwide, Alstom has the capability to offer reliable turbogenerators, designed for outstanding performance. Having supplied thousands of turbogenerators to projects all over the world, Alstom has an unrivalled level of global experience, providing the best solution for your power plant.

The core turbogenerator technologies were developed decades ago and have evolved continually ever since, leveraging the feedback collected from operating experience. Our pioneering work includes the world’s first turbogenerator in 1898, the first 2-pole turbogenerator in 1901 and the invention of the Roebel bar in 1912.

The GIGATOP 2-pole technology was developed for over 40 years and supports today the largest steam power plants. Our simple and robust designs and our patented features have proven to ease maintenance. TOPAIR and TOPGAS are perfect examples, showing simplicity of operation.

Alstom’s steam turbine-generator package is more than just the sum of key components, it is a proven, advanced solution that is judiciously designed to maximise reliability and facilitate maintenance.
Alstom

Alstom is a global leader in the world of power generation, power transmission and rail infrastructure and sets the benchmark for innovative and environmentally friendly technologies.

Alstom builds the fastest train and the highest capacity automated metro in the world, provides turnkey integrated power plant solutions and associated services for a wide variety of energy sources, including hydro, nuclear, gas, coal, wind, solar thermal, geothermal and ocean energies. Alstom offers a wide range of solutions for power transmission, with a focus on smart grids.

Power generation

Alstom Power offers solutions which allow their customers to generate reliable, competitive and eco-friendly power.

Alstom has the industry’s most comprehensive portfolio of thermal technologies – coal, gas, oil and nuclear – and holds leading positions in turnkey power plants, power generation services and air quality control systems. It is also a pioneer in carbon capture technologies.

Alstom offers the most comprehensive range of renewable power generation solutions today: hydro power, wind power, geothermal, biomass and solar. With ocean energies, we are developing solutions for tomorrow. Alstom is one of the world leaders in hydro power, the largest source of renewable energy on the planet.