GEOTHERMAL POWER SOLUTIONS

Hydro
Wind
Geothermal
Solar
Tidal
Biomass
Nuclear
Coal
Gas
Oil

Air Quality Control Systems
Power Automation and Controls
Lifecycle Management
CO₂ Solutions
Cutting-edge solutions from the geothermal power pioneers

Alstom is a global leader in steam turbine technology with more than 100 years of experience in manufacturing, delivering, installing and servicing steam turbine generator sets from 5 MW to 1,800 MW for a wide range of applications, including geothermal.

Geothermal is one of the most reliable sources of renewable power. Alstom pioneered the commercial exploitation of geothermal power in New Zealand in the 1950s.

Today, we offer an extensive portfolio of cutting-edge solutions for geothermal applications that are grounded in technologies that have been proven in geothermal applications worldwide.

For the most challenging geothermal applications, we are able to tailor our solutions to take account of aggressive steam conditions.
Harnessing the planet’s core for power

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A worldwide presence
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Over 50 years of experience in geothermal power
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 THE COST OF ELECTRICITY**

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

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

**LOWERING THE 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
- Land use, visual impact and noise
- Water intensity reduction & recyclability

**INCREASING THE 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
Clear Solutions
you meet the challenges of energy sustainability

Geothermal is one of the cleanest and most cost-efficient sources of power

OUR COMMITMENT TO OUR CUSTOMERS

REDUCING THE COST OF ELECTRICITY
Optimum solution tailored to match the long-term geothermal resource assessment

LOWERING THE ENVIRONMENTAL FOOTPRINT
615,000 t of CO₂ per year avoided in Mexico in comparison with the global electricity system emissions

INCREASING THE FLEXIBILITY & RELIABILITY
≥90% capacity factors regularly achieved by Alstom equipment in service
A WORLDWIDE PRESENCE

Alstom’s global commitment to be at the forefront of clean power technologies goes hand in hand with our commitment to have a sustained and long-term local presence. Local expertise provides the backbone and strength of our global presence, which aims to deliver high quality, cost-effective equipment and related services to our customers around the world. We pride ourselves on using consistent processes in execution, engineering, manufacturing and services across all the continents – delivering product excellence in every location.
One of the most reliable renewable energy sources

Geothermal power is a key component of Alstom’s clean power offering. Irrespective of most weather conditions, a geothermal power plant provides steady output that has a stabilising influence on grid networks that experience fluctuations in demand. We also recognise that long-term variations in the geothermal steam supply may occur over time and as a result are able to provide solutions that can adapt to the expected range of steam conditions over the power plant lifetime.

We deliver

Alstom’s Plant Integrator™ philosophy underpins the approach we take to delivering projects. Our focus is on providing a turnkey solution to our customers that maximises the benefits achieved through the integration of Alstom produced components. We have a track record of being a committed and reliable turnkey supplier, successfully delivering hundreds of megawatts of turnkey geothermal power plants, along with hundreds of gigawatts of conventional power plants, often in challenging locations and circumstances.

We lead

Alstom is a leader in the harnessing of geothermal energy for power production. In 1958, we pioneered the construction of the world’s first large-scale commercial geothermal power plant in Wairakei, New Zealand. This project married the scientific vision of local geologists with our power plant experience to deliver a project that is still in operation today. We remain at the cutting edge of geothermal innovation and offer a range of solutions in different sizes and configurations, including modular solutions for rapid and cost-effective deployment.

We care

Alstom can deliver geothermal solutions to customers anywhere in the world. Our geothermal business leverages our extensive engineering, manufacturing, sourcing and project management base around the world. Our geothermal offering is supported by a global network of local service centres, giving us a global reach and the ability to serve customers wherever the opportunity surfaces.
By 2030 the world will have seen a significant change in the power generation mix with an increased share of CO$_2$-free and renewable power. Alstom’s geothermal solutions help to prevent 1.74 tonnes of CO$_2$ per MWh* from being emitted.
Design and development

Geothermal energy is available adjacent to porous and fractured hot rock along the earth’s tectonic plate fault lines. Once a suitable site is located, Alstom can help you analyse a suitably optimised plant configuration adapted to the local climate, terrain and most importantly, the resource available. Our goal is to increase the project realisation chances while lowering the development risk.

We can closely collaborate with our customers and provide inputs early in the process for the following areas:

- Geothermal water & steam analysis for power plant design
- Early stage power plant configuration and design
- Project planning and advisory services for the power plant construction
- Indicative pricing and supply scheme

Turbine and component supply

Geothermal turbines must withstand corrosive impurities, wet steam and high seismic conditions typically encountered in geothermal areas. Building on Alstom’s extensive experience in industrial, conventional and wet steam turbines for nuclear power plants, we offer robust designs and durable components that are adapted to the challenges of the geothermal steam resources. All our plant systems are designed to resist wear and damage and to facilitate practical inspection, maintenance and replacement.

We engineer reliable solutions with the following services:

- Turbine selection and design
- Component and material sourcing
- Manufacturing
- Transport and assembly

Alstom’s Plant Integrator™ approach helps you to maximise the total plant performance while fully complying with environmental, regulatory and commercial constraints. Our geothermal engineering team assesses steam conditions, site location and commercial requirements to meet your specific requirements.
As the engineering, procurement and construction (EPC) provider, Alstom has commissioned more than 360 conventional steam power plants during the last 30 years. Drawing on this expertise, we provide full EPC services for geothermal power plants.

We construct optimised solutions covering the:

- Steam receiving and gathering system
- Turbine and generator
- Condensing, gas ejection and cooling system
- Power plant distributed control system (DCS)
- Piping, valves and power island balance of plant (BOP)
- Electrical cabling and high-voltage power export
- Civil engineering
- Plant construction management

Having supplied major components to more than 1.2 terawatts of power generation around the world, Alstom is not just a leading global original equipment manufacturer (OEM) and an EPC provider. We are also responsible for the operation and maintenance (O&M) of a major portion of non-Alstom equipment and plants worldwide.

The base-load nature of geothermal steam plants means that unplanned downtime is especially costly. We understand the balance between maintaining everyday base load plant output and the need to undertake preventative measures to avoid costly unplanned outages. We are able to offer a range of operation and maintenance services packaged either as long-term service agreements combined with the plant warranty, or as troubleshooting services on a case-by-case basis.

Lifecycle Management

When considering the environmental balance of a given fuel type or technology, Alstom takes into account the full lifecycle. This means assessing the process from procurement and construction to operation and maintenance. Our support and commitment throughout the component or plant lifecycle allow you to maximise your return on investment while minimising negative environmental effects.
Flexible configurations

Alstom can provide plant up to 135 MW in order to meet each customer’s needs:

- Small plant layouts of approximately 15-35 MW using single flow turbine modules
- For medium size plants (35-65 MW): plant layouts may be based around a single flow module in 50 Hz and double flow module in 60 Hz
- For larger steam fields with proven steam resources in 50 Hz markets we offer power plant sizes in the 65-135 MW range based around a double-flow turbine configuration

Each plant configuration benefits from customised elements covering:

Design features

- The plant layout and component design protect auxiliary and electrical systems from corrosion that could occur during steam venting.
- To reduce erosion of the moving blades, efficient Alstom water traps drain excessive steam condensate between each turbine stage.
- Instant closure of the inlet valves is critical to the safety of a geothermal plant. Alstom valves are specified to prevent blocking through fouling or scaling.
- Labyrinth seals are used for the main shaft, these being simple, robust and easily maintained.
- Triple control security prevents backflow from the condenser to the turbine.
- Hybrid ejector and vacuum pump systems extract non condensable gases from the condenser to maintain condenser efficiency.
- The Alstom distributed control system (DCS) minimises false alarms and maximises plant protection.

Materials

- Alstom geothermal steam turbines are built with special steel alloys and are heat-treated to protect against the corrosive effects of dissolved gases, impurities and water droplets.
- Induction hardening or stellite shielding can be employed to extend the lifetime of the last-stage blades where lower temperatures increase the risk of water droplet erosion.
Validated technological approach

The geothermal products and services offered by Alstom incorporate the latest know-how and technology focused on the particular challenges of geothermal steam. Our turbines offer an excellent combination of performance and durability, balancing the gains from high turbine efficiency with availability achieved through durability. In geothermal, we use robust direct drive turbines to cope with the demands of wet steam with dissolved impurities. By working with optimised blade forms, fewer stages and broader clearances, our turbines cope reliably with even the most challenging steam compositions.

Modular and flexible scope for maximum customer value

We can provide you with tailored solutions, from single component to turnkey power plant, to meet your specific needs. Alstom geothermal steam turbines generators and plants have a history of excellence since the 1950s.
With more than **47,000 employees** in **80 countries**, Alstom Power combines local presence and knowledge with global resources in order to deliver the technology and service that meet our customers’ high expectations and needs.
Automation control and protection

Alstom is a world leader in the field of automation and energy management. We provide state-of-the-art solutions for power plant automation, control, protection and optimisation as well as the management of grid connections and substation equipment. Using an advanced architecture, ALSPA® offers an unparalleled level of control, integration and performance enhancement for geothermal power plants.

A seamless platform: ALSPA® Series 6

Taking advantage of our in-depth knowledge of power plant processes, Alstom has developed a comprehensive control and instrumentation system. Alstom’s flagship ALSPA® platform extends across the entire plant, from the control room with plant management and optimisation tools, through plant and machine automation to asset management and remote diagnostic systems. The ALSPA® Series 6 product platform provides consistent hardware and network technology from low-level controls to high-level asset management. It ensures data consistency and is an ideal platform for power operators requiring remote feature centralisation.

A strategy for improvement

In accordance with our Clean Power, Clear Solutions™ strategy our solutions for geothermal plants are designed to reduce the cost of electricity through operational and maintenance cost optimisation. We also increase plant reliability and flexibility through system and component optimisation and work holistically to lower the environmental impact of operations.
Geothermal plant operators are looking for straightforward solutions from reliable partners. That is why Alstom offers a range of reliability, flexibility and performance boosting solutions:

- Parts
- Repairs
- Field service
- Technical expertise and operational support
- Performance improvements
- Service contracts
- Services on other original equipment manufacturers’ products

A portfolio of solutions for lifetime value optimisation

Steam impurities and corrosive gases pose specific challenges for steam turbines and generators in geothermal plants. With our comprehensive portfolio of service solutions and OEM experience we can help you protect your components and enhance your plant performance.

**Performance improvements**
Performance and lifetime assessments, training, monitoring and diagnostics: advanced analysis of fleet-wide data allows us to help you reduce risks and optimise availability.

**Parts and repairs**
We offer spares, repairs custom-made components and retrofit solutions to keep your plant working reliably and optimise the lifetime return on investment. And our advanced component management system ensures part traceability, accessibility of data and competitive pricing.

**Field services**
Supported by our global network of execution centres, the local service network provides a rapid response capability to reduce outage time and increase performance.

**Service contracts**
As a full-service provider, we offer contracts, tailored to meet all the operational, maintenance and support requirements of all types of geothermal power plants irrespective of steam turbine technology or equipment OEM.
We offer a portfolio of operations and maintenance contracts based on performance commitments and incentives. The flexible offering covers engineering, products and services over the plant’s full lifecycle and can be tuned to match your business objectives.

Alstom’s solutions are tailored to match the long term geothermal resource assessment.
Alstom pioneered the commercial exploitation of geothermal power in New Zealand in the 1950s. Our geothermal competence leverages the full global reach of our network to provide you with tailor-made solutions.

**Wairakei, New Zealand**

- **Customer**: Contact Energy Ltd
- **Steam source**: Single flash geothermal steam
- **Electrical output**: 2 x 5.5 MW, 8 x 11 MW, 3 x 30 MW
- **Commercial operation**: 1958

**Lahendong, Indonesia**

- **Customer**: Perusahaan Listriik Negara (PLN)
- **Steam source**: Single flash geothermal steam
- **Electrical output**: 1 x 20 MW
- **Commercial operation**: 2001

**Los Azufres, Mexico**

- **Customer**: Comisión Federal de Electricidad (CFE)
- **Steam source**: Single flash geothermal steam
- **Electrical output**: 4 x 25 MW
- **Commercial operation**: Unit 13 to 16: 2003

**Los Humeros II and III, Mexico**

- **Customer**: Comisión Federal de Electricidad (CFE)
- **Steam source**: Single flash geothermal steam
- **Electrical output**: 3 x 25 MW
- **Commercial operation**: Los Humeros II (Units 9 & 10): 2013
  Los Humeros III (Unit 11): 2016
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.