AIR QUALITY
CONTROL SYSTEMS
PURE AIR, CLEAN SOLUTIONS
With over 80 years’ experience providing Air Quality Control Systems (AQCS), Alstom has the expertise, technology and the product portfolio to meet our customers’ specific requirements.

Our global network delivers high quality, cost-effective equipment and related services to customers around the world. We pride ourselves on using consistent processes in execution, engineering and manufacturing – delivering the highest level of product excellence in each of our locations. In fact, Alstom’s local expertise is what strengthens our global presence.

Alstom is committed to continuous improvement and innovation. With our extensive R&D efforts, we provide our customers with the most advanced technologies in emissions control that ensures the highest performance while complying with stringent environmental regulations.
Best-in-class technologies
Alstom delivers power solutions that are fully integrated, optimised, designed and manufactured in house. Our portfolio also includes equipment for NO\textsubscript{x}, SO\textsubscript{x}, particulate matter and mercury. Alstom’s vast portfolio of products combined with a comprehensive knowledge of all types of equipment and technologies both original and third party makes us the ideal partner for your AQCS needs. To date we have supplied 500 GW of AQCS for power generation worldwide, thus confirming Alstom is the market leading provider of AQCS products.

Integrated approach for optimised performance
Our comprehensive product portfolio, decades of expertise and plant integration capabilities make us the ideal partner for improving water and power cost efficiencies, reducing emissions and recovering waste heat in industrial plants. We provide gas cleaning systems for a variety of industries including: aluminium, iron and steel, waste to energy, pulp and paper, oil and gas, cement and other industrial applications. Having installed 2,800 gas cleaning systems worldwide, Alstom is the number one provider of AQCS solutions for the industry.

Worldwide no. 1 supplier for AQCS products

For decades Alstom has been setting the benchmark for excellent performance and the cleanest solutions, producing close to 25% of the world’s power capacity and through our clean technologies generating electricity equivalent to the needs of 1.2 billion homes.
How Alstom is helping you meet the challenges of energy sustainability.

**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

**Lowering 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, NO₂, PM, mercury)
- CO₂ emission reduction and CCS
- Land use, visual impact and noise
- Water intensity reduction and recyclability

**Increasing Flexibility & Reliability**

Intermittent power generation is a growing challenge of energy security, as is maintaining an ageing 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
R&D investments and capability

In order to develop market-leading products for air pollution control and CO₂ capture, Alstom has established one of the world’s largest air quality laboratory in Växjö, Sweden. Since 1983, this state-of-the-art facility has been at the forefront of advanced research and development into air quality and CO₂ control solutions that meets the most stringent environmental regulations. The modern technology centre comprises 3,500 m² test halls for pilot operations and flow modelling, an analytical laboratory specialised in particle and environmental analyses, an instrument workshop for maintenance and calibration of instruments as well as a mechanical workshop for pilot manufacturing.

Providing added value

Reducing cost of electricity
With more than 80 years of experience, Alstom is a global leader in Air Quality Control Systems.

Alstom Electrostatic Precipitators (ESP) offer a reliable and cost effective solution thanks to our proprietary Transformer Rectifier and ESP control technologies, meeting the challenges of increasingly stringent environmental regulations for particulate matter emissions worldwide.

Customer benefits
• Lower power consumption
• Optimal sizing for low sulphur, high resistivity ash coals
• Robust design for low maintenance costs

Lowering environmental footprint
Alstom’s Seawater FGD technology offers an optimal solution to your air pollution problem. With more than 40 years of experience in SWFGD for power generation and industry, Alstom helps to reduce your plant operating costs.

The Seawater FGD process takes advantage of the natural properties of seawater to absorb and neutralise sulphur dioxide. Alstom’s simple process designs increase the reliability and ensure a very high availability.

Customer benefits
• An unrivalled SO₂ removal efficiency of above 98%
• No by-products or reagents
• Lowest power consumption
• Superior discharged seawater quality

Increasing flexibility and reliability
In today’s dynamic market, operational and fuel flexibility is increasingly important while air quality regulations are becoming more stringent. Our NID™ process is the Flue Gas Desulphurisation system of choice for most types of inland power, waste-to-energy and industrial plants.

The NID™ includes independent modules and a variable reactor width, which allow exact matching to process requirements. Excellent turndown of up to 50% per module with no flue gas recirculation required at lower loads.

Customer benefits
• High reliability achieved through installed spare module
• No scale-up issues for large applications
• Easy retrofit options
• Multi-pollutant control
• Smaller footprint
• Short execution schedule
Alstom’s centres of competence for AQCS

Plant owners need to constantly adapt their flue gas systems to new operational, commercial and regulatory parameters. We offer the best performance and cleanest solutions with our advanced air quality control technologies for new plants, retrofits, upgrades as well as maintenance services.

As an OEM supplier of turnkey power plants with over 80 years experience in the field of air quality control, Alstom is the recognised authority with a comprehensive portfolio of innovative solutions covering all pollutant classes. We offer high quality, cost effective and cutting-edge products as well as services for Air Quality Control Systems that meet even the most stringent regulatory requirements.

The Alstom advantages
Purer output, cleaner solutions
All our AQCS solutions are based on proven design concepts that are customised to meet the specific requirements of industry, plant and process. We also take into account upstream processes and operational optimisation to help achieve emission targets in the most cost effective and efficient manner.

Adding long-term value

The Plant Integrator™ approach creates added value by optimising the entire value chain and overall plant performance. In pollution control, complex interactions between sub-systems are particularly important. We provide flue gas treatment for the entire line – from pre-combustion to stack.

Our holistic perspective as an OEM, EPC and O&M provider allows analysis of the whole plant and the full lifecycle as an integrated system. Thus, specific investment costs can be framed in terms of their impact on key performance parameters such as emissions, efficiency, reliability and ultimately plant profitability.

Alstom’s Plant Integrator™ approach

NOx Control
- Selective Catalytic Reduction Systems
- Combustion Modification

Mercury Control
- Mer-Cure™
- Filsorption™

Particulate Control
- Fabric Filter
- Electrostatic Precipitator
- Wet Electrostatic Precipitator

Flue Gas Desulphurisation
- Wet FGD
- Seawater FGD

Integrated Systems
- NID™
- Spray Dryer Absorber
Widest integrated portfolio

Whether you are a national power utility, an independent power producer or a primary sector industrial company, Alstom’s AQCS has the perfect solution for your emissions control requirements.

Our AQCS solutions and Plant Integrator™ skills cover the following industries:

**Power & Heat Generation**
Comprehensive emissions control systems for coal, oil, biomass and gas-fired plants.

**Aluminium**
The market-leading recovery and recycling systems providing comprehensive emissions control for electrolysis, anode bake and green anode applications.

**Iron & Steel**
Innovative designs to reduce particulates, sulphur dioxide and dioxin emissions, cut cooling costs, reduce noise levels and improve water treatment efficiency at mini mills and integrated steel plants.

**Non-ferrous Metal**
Comprehensive emissions control in the copper, zinc, lead and nickel industries.

**Pulp & Paper**
Comprehensive emissions control systems and a unique concrete bottom electrostatic precipitator for Kraft boilers, lime sludge kilns and power boilers to reduce fine particulates and collect recyclable by-products.

**Waste-to-Energy**
The most compact solutions to achieve emissions compliance for municipal solid waste, hazardous and special waste incineration plants.

**Cement**
Our particulates matter, sulphur dioxide and nitrogen oxide emissions solutions are suitable for kilns, clinker cooler and mill stations.

**Oil and Gas / Petrochemicals**
Innovative integrated NOx and SOx solutions such as combining nitrogen oxide control with temperature control and heat recovery – that are designed for both new and retrofit installation.

**Glass**
Particulates matter emissions for float glass, container or mineral wool plant.
Alstom has taken a revolutionary, all-in-one approach in fume treatment technology for the aluminium industry.

Building on the success of the HEX series, Alstom's new AHEX FTC combines an advanced heat exchanger for energy recovery with a dry scrubber for fume treatment. The ingenious space and energy saving package offers compelling benefits by avoiding moisture-related problems and energy losses associated with conventional approaches.

The AHEX FTC offers:

- An integrated heat-exchanger reactor, meaning less ducting and a significantly smaller footprint
- Simultaneous cooling of the flue gas and adsorption of Polycyclic Aromatic Hydrocarbons (PAHs), condensed tars and HF on alumina
- No increase in humidity with significant reductions in corrosion, tar deposits and filterbag hydrolysis
- Higher efficiency in pollutant capture with lower emissions of HF, tars and PAHs recognised as human carcinogens
- Reduced maintenance costs
- Substantial recovery of waste heat
- Wide-ranging improvements in operational efficiency
- Elimination of Conditioning Tower (CT) effluents
Engineering
Alstom offers the best in air pollution control engineering, from process and equipment design to construction, operations and maintenance.

Emission reduction targets are achieved in the most cost-effective manner by our skilled engineers, using modular systems which are configured and adapted to new plants or retrofit applications.

Alstom goes even further to ensure the best performance and highest quality under all conditions by optimising the interactions between different equipment and pollutants at the design stage.

Alstom’s engineering services optimise:
- Process efficiency and performance
- Configuration and design for new and existing plants
- Plant integration
- Construction and installation

Equipment supply
Alstom’s comprehensive AQCS portfolio of products covers all types of equipment and all classes of pollutants to offer the best-in-class technology for a single process or for the entire chain. This allows discerning customers the flexibility to address complex interactions between components and processes.

We supply equipment for:
- **NOx**
  - Retrofits: Selective Catalytic Reduction
  - New plants: Combustion Modification
- **SOx**
  - Dry, Wet and Seawater Flue Gas Desulphurisation systems
- **Particulate matter**
  - Electrostatic Precipitators and Fabric Filters
- **Mercury**
  - Oxidation coal additive, proprietary sorbent and delivery system and conventional powdered activated carbon solutions
Supervision and construction
Alstom has the reputation of being a reliable partner, whether customers require turnkey construction of the whole process chain or supervision during the installation of an individual piece of equipment.

Leveraging the global construction capabilities and extensive experience of Alstom Power, we ensure that our supply chain and construction processes are fully optimised to create the most value for our customers. We also engage and cooperate with local contractors as appropriate, to ensure the safest and highest quality execution strategy for our projects.

Alstom has established robust quality and safety systems and processes to consistently deliver projects on budget and on time. The modular strategy of our designs also allows for better testing, transportation, construction and assembly, leading to a well integrated end-result.

We offer:
• Construction supervision
• Construction on a turnkey basis
• A one-stop shop from engineering to commissioning
• Construction synergies beyond AQCS

Retrofit / service and maintenance
In addition to being a leading OEM and EPC provider for clean air solutions, Alstom is also responsible for the Operation and Maintenance (O&M) of a large fleet of plants and equipment all over the world.

We help our customers create more value in a rapidly changing environment with:
• Equipment and performance warranties
• Trouble-shooting on a case-by-case basis
• Long Term Service Agreements
• Spare parts
• Retrofits
• Upgrades
Nitrogen Oxides (NOx) are by-products of all air combustion processes that lead to acid rain and photo-chemical oxidation in the atmosphere. Alstom addresses NOx pollutants with two strategies.

**New plants or boilers**
Our low NOx firing system which includes the low NOx burner with Overfire Air System has been designed to minimise NOx formation in the combustion process.

If additional NOx reduction is required, our post-combustion techniques utilising either non-catalytic or catalytic reduction technologies can be incorporated. This ability to optimise control of NOx emissions by both combustion modification and post-combustion techniques provides the most cost-effective emission control system.

**Retrofits**
We are a leading supplier of Selective Catalytic Reduction (SCR) systems that can be precisely adapted to site conditions to achieve superior flow dynamics and constructability.

SCR systems rely on ammonia injected into the flue gas to chemically reduce the NOx. Our proprietary injection and the IsoSwirl™ mixing systems allow very precise ammonia dosage, which is the primary driver of system efficiency and performance.

**Key figures**
- References: 48 GW
- NOx removal efficiency: > 95%
- Unit size: Up to 1,300 MW
- All configurations: High dust, low dust or tail-end
- Catalyst: Honeycomb or plate
SO\textsubscript{x}

Alstom’s comprehensive portfolio of Flue Gas Desulphurisation (FGD) products is unrivalled and based on over 40 years experience and one of the largest FGD installed bases in the world. We cover all types of fuels, and customer needs with wet, seawater and dry processes.

**Limestone based Wet FGD**
- Open Spray Tower (OST)
  - References: 58 GW
  - SO\textsubscript{2} removal efficiency: > 99%
  - Unit size: Up to 1,300 MW
  - Fuel flexibility: All types of fuel including heavy fuel oil and up to 6% sulphur in fuel
  - 3\textsuperscript{rd} generation OST high performance absorber

**Seawater FGD**
- Flowpac™ Absorber
  - References: 1,000+ MW
  - SO\textsubscript{2} removal efficiency: Approaching 100%
  - Unit size: Up to 360 MW
  - Fuel flexibility: All types of fuel including heavy fuel oil and up to 6% sulphur in fuel
  - Compact design and low power consumption

**Dry FGD**
- Spray Dryer Absorber (SDA)
  - References: 15 GW
  - SO\textsubscript{2} removal efficiency: > 95%
  - Unit size: Up to 900 MW
  - Fuel flexibility: All types of fuel and up to 2.5% sulphur in fuel
  - Online atomiser maintenance
  - Multi-pollutant control: SO\textsubscript{3}, HCl, HF, Hg and PM

- NID™
  - References: 16 GW
  - SO\textsubscript{2} removal efficiency: > 98%
  - Fuel flexibility: All types of fuel including heavy fuel oil and up to 4% sulphur in fuel
  - Modular design allows for great scalability from small to very large applications
  - No slurry handling
  - Small footprint for easy retrofit and lower construction costs
  - Multi-pollutant control: SO\textsubscript{3}, HCl, HF, Hg and PM
Particulate Matter

With more than 70 years of experience in Particulate Matter (PM) removal systems, Alstom has been leading the design and technology development with unique performance enhancing features.

**Electrostatic Precipitators (ESP)**

Thanks to our leading EPIC III Controllers, advanced Precipitator monitoring and diagnostic tool - ProMo and Switch Integrated Rectifiers (SIR), we can offer clear performance benefits and cover the widest range of fuel types with maximum efficiency.

**Dry ESP**
- References: 233 GW+
- <10 mg/Nm³ emissions guaranteed
- Unit size: Up to 1,300 MW
- Fuel flexibility: All types of fuel including heavy fuel oil
- Extensive experience with low sulphur, high resistivity ash coals
- Multiple designs tailored to specific applications

**Wet ESP**
- More than 90 references for various applications
- Meet the most stringent standards for particulate emissions control
- Effective gaseous acid pollutants control

**Fabric Filters (FF)**

Alstom’s pulse jet fabric filters are suited for both new and retrofit applications that require a large filtering capacity, high and low capital investment.

- References: 46 GW
- <5 mg/Nm³ emissions guaranteed
- Unit size: Up to 1,000 MW
- Fuel flexibility: All types of fuel
- Mega FF with 12+ metre bags
- Compact and flexible design suitable for new or retrofit applications
- Optimised gas flow enhances collection of fine dust
- Online cleaning with an energy efficient pulse system
- Easy maintenance concept for minimal shut-down times
Mercury emissions are a growing area of concern for the power industry. Alstom has three effective process solutions, all of which have been deployed in power applications, exceeding 30 GW in total.

Mer-Cure™ – a proprietary sorbent approach
Alstom’s Mer-Cure™ advanced mercury control technology uses a proprietary patented sorbent designed for high removal efficiencies across a wider temperature range.

Mer-Cure™ offers lower sorbent consumption thanks to:
1. High temperature sorbent injection upstream of the air heater for faster oxidation and longer contact with elemental mercury
2. De-agglomeration of the sorbent particles enhancing uniform distribution in the flue gas stream

Filsorption™ – enhanced PAC process
The Filsorption™ process uses powdered activated carbon to bind mercury to carbon for subsequent collection in a particulate filter. The system includes a sorbent storage silo and an injection system comprised of a series of lances in the ductwork upstream of the AQCS to optimise contact between the flue gas and PAC.

Clean air and a stable climate have become a top priority for regulators. **Alstom develops state-of-the-art technologies** to further advance mercury control systems such as Mer-Cure™ and Filsorption™ which achieve high removal efficiencies at drastically reduced sorbent consumption rates.
The need to protect our priceless environment is driving new developments in air quality control systems.
A tailored offering

Offering a full range of products that comply with the strictest international standards, requires the ability to constantly improve existing technologies and develop new added-value solutions.

Whether for retrofits or new plants, customers are looking for higher performing and more compact solutions that operate with less sorbent usage and fewer by-products. Alstom is the only supplier to offer a complete portfolio of products for flue gas cleaning in power and industrial applications. This leadership is built on our commitment to technological innovation through applied research and development.

Driving developments across the product portfolio

Founded in 1983, Alstom’s Växjo R&D centre in Sweden is a state-of-the-art purpose built facility with labs and workshops focused on the areas of:

- Applied physics and Computational Fluid Dynamics (CFD)
- Physical model testing
- Chemical engineering
- Analytical studies
- Instrumentation and measuring techniques

The goal of Alstom’s Växjo R&D centre is to support Alstom engineering in specific commercial projects while developing product-enhancing technologies through fundamental studies. To date, our Växjo team has been granted more than 80 patents for technologies that find applications in our ESPs, Fabric Filters, Wet and Dry FGD and other AQCS products.

Special services and project support

The Växjo centre also supports engineering and customer projects with a pilot plant and dedicated facilities for equipment testing. For example, customers can bring samples of their flue gas for analysis and test the effectiveness of alternative system options.

Furthermore, our physical test models and testing rigs are used in conjunction with CFD analysis to produce accurate results and customised solutions, which ensure the success of our customer’s projects.
Spotlight on recent product advances

**Mega Fabric Filter**
Based on our proven particulate solutions, Mega Fabric Filters were developed to increase filtration performance in the most cost-effective manner for large power plants.

By using longer bags (12+ metre) and more bags per pulse valve, the Mega Fabric Filter:
- Minimise the footprint of the fabric filter
- Lower the capital cost with reduced steel weight

**Sulphite Analyser**
Alstom’s Sulphite Analyser uses a sensor to control the forced oxidation air rate in Wet Flue-Gas Desulphurisation (WFGD) absorbers and thus minimise wasted power. Consisting of a probe and housing, the sensor uses proprietary software to calculate the correct sulphite concentration and collect measured data.

The concept was successfully demonstrated at pilot scale and in full-sized WFGD absorbers. Next step for the technology is to target mercury re-emissions and other trace metals in the scrubbing solution.

**SCR IsoSwirl™ mixer and high efficiency Ammonia Injection**
Alstom developed the high efficiency Ammonia Injection Grid (AIG) and IsoSwirl™ mixing system to meet the increasingly stringent NOₓ emission targets being imposed by regulatory authorities worldwide.

Ammonia is injected into the flue gas duct using the optimised AIG design and is efficiently mixed with the boiler flue gas using proprietary IsoSwirl™ static mixers. The intense turbulent mixing patterns created and the even flow distribution of the flue gas into the catalyst layer(s) allow up to 95% NOₓ removal. The high efficiency AIG and the IsoSwirl™ mixers support the SCR catalyst in reliably meeting NOₓ removal guarantees for long term operation, delivering the most competitive initial capital investment and lowering operational and maintenance costs.
Global presence and project
Our AQCS references

World’s no. 1 AQCS supplier – over 500 GW supplied for power and 2,800 systems for industry globally.
As the world’s leading provider of Air Quality Control Systems, Alstom has been working to create a healthier atmosphere and cleaner environment for over 80 years.

**BRAYTON POINT (USA)**
Retrofit solution to reduce SOₓ, mercury and other pollutants.

Dry FGD-NID™
Unit 3: 630 MW

**TAWEELAH SMELTER (UAE)**
Gas and fume treatment for world’s largest aluminium smelter.

Gas and Fume Treatment Centres
474,000 tonnes per year

**MANJUNG (MALAYSIA)**
AQCS for South-East Asia’s first Ultra-supercritical power plant.

SWFGD & ESP: 3 × 700 MW
SWFGD & FF: 1 × 1,000 MW

**ROVINARI (ROMANIA)**
Achieving extremely low emission from very high sulphur lignite.

Wet FGD
3 × 330 MW

**TARAPACÁ (CHILE)**
Particulate reduction for Chile’s coal-fired power plant.

Fabric Filter
1 × 158 MW

**TALCHER (INDIA)**
ESP technology to meet India’s environmental requirements.

Electrostatic Precipitator (ESP)
4 × 500 MW
A partnership for performance

When you choose Alstom as your OEM or EPC provider, you are buying into a wealth of air pollution control know-how and experience that sets the stage for a long-term effective air pollution control strategy. As a full-service provider, we offer on-demand services or contracts, tailored to meet all your operational, maintenance and support requirements.

Whatever your needs, Alstom has the products and engineering capabilities to offer the optimal solution for each specific case. But we don’t just sell you products, we can partner with you to guarantee your AQCS compliance now and in the long term.

We offer
• Consulting and support
• Spare parts and spare parts management
• Remote monitoring and control diagnostics
• Field service for planned and unplanned outages
• Control systems
• Upgrades
• Long Term Service Agreements
• Operations and Maintenance contracts
• Performance guarantees

With our proven range of services, you can focus on your core business. Because we help you to maximise plant availability and performance while still minimising emissions, energy consumption and maintenance costs. Component optimisation, effective planned maintenance and suitable upgrades and retrofits are our specialities and the keys to achieving these goals.
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.