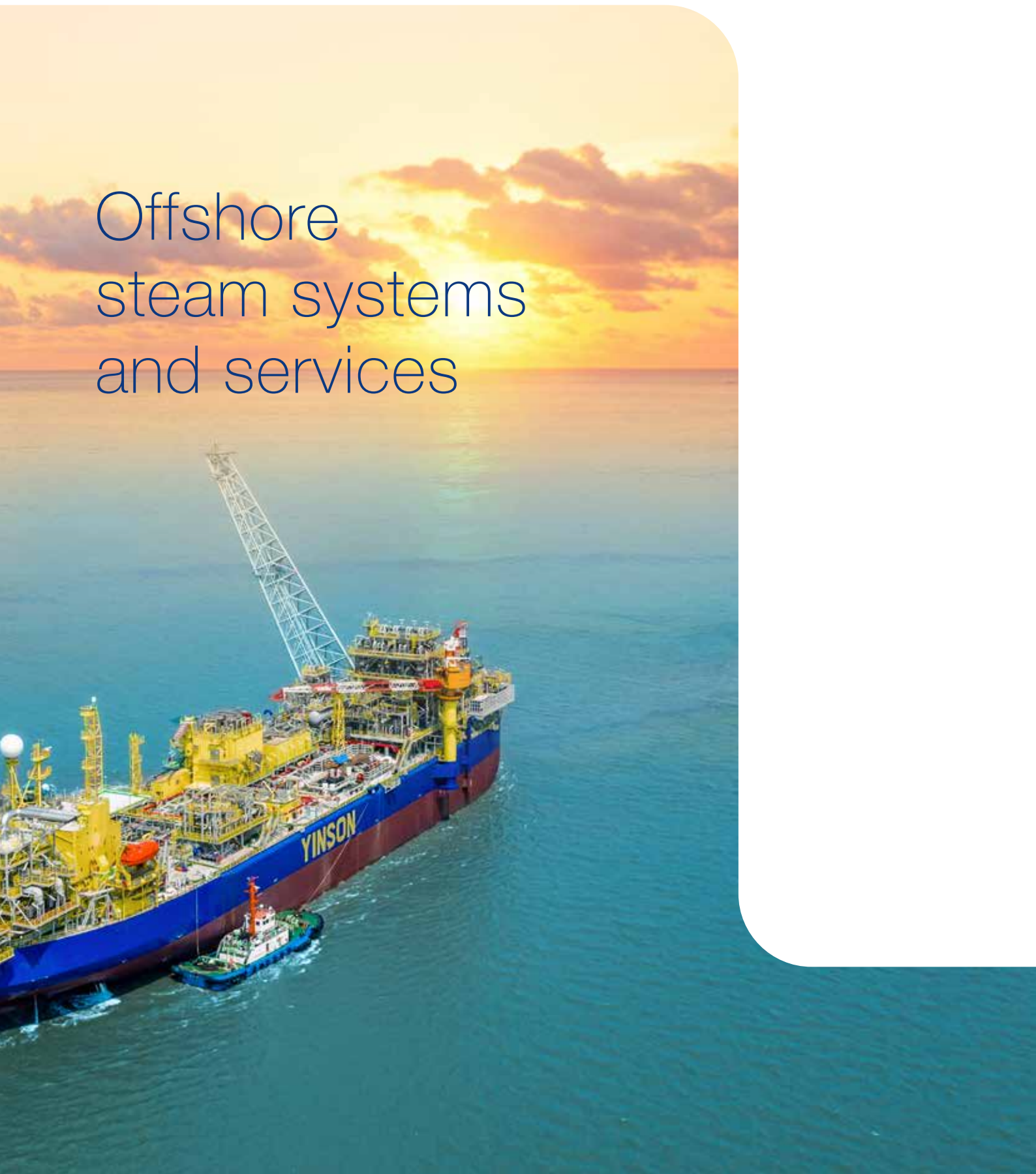
Offshore steam systems and services



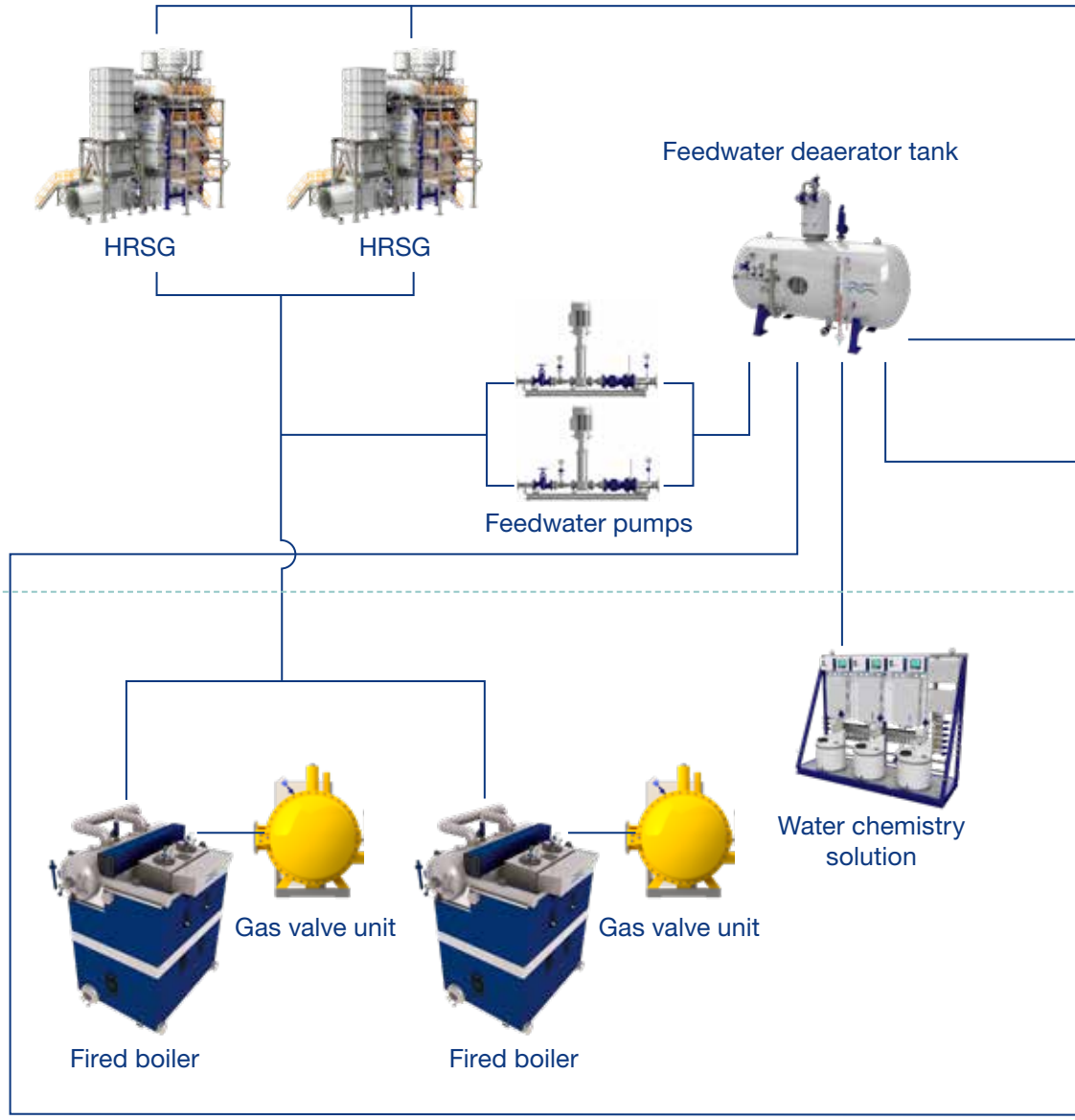
The steam boiler system concept

To function properly, all parts of a floating production system's (FPS) steam system must fit and work together seamlessly. To achieve this goal, we've created the Alfa Laval FPS steam boiler system concept using a full-system delivery approach.

Our boiler systems are tailored to your needs, while remaining compliant with necessary offshore requirements, industry-recognized standards and regulations. Our control system design meets applicable classification and IEC requirements, and in fired systems it supports the use of all established fuel types and emissions reduction technology.

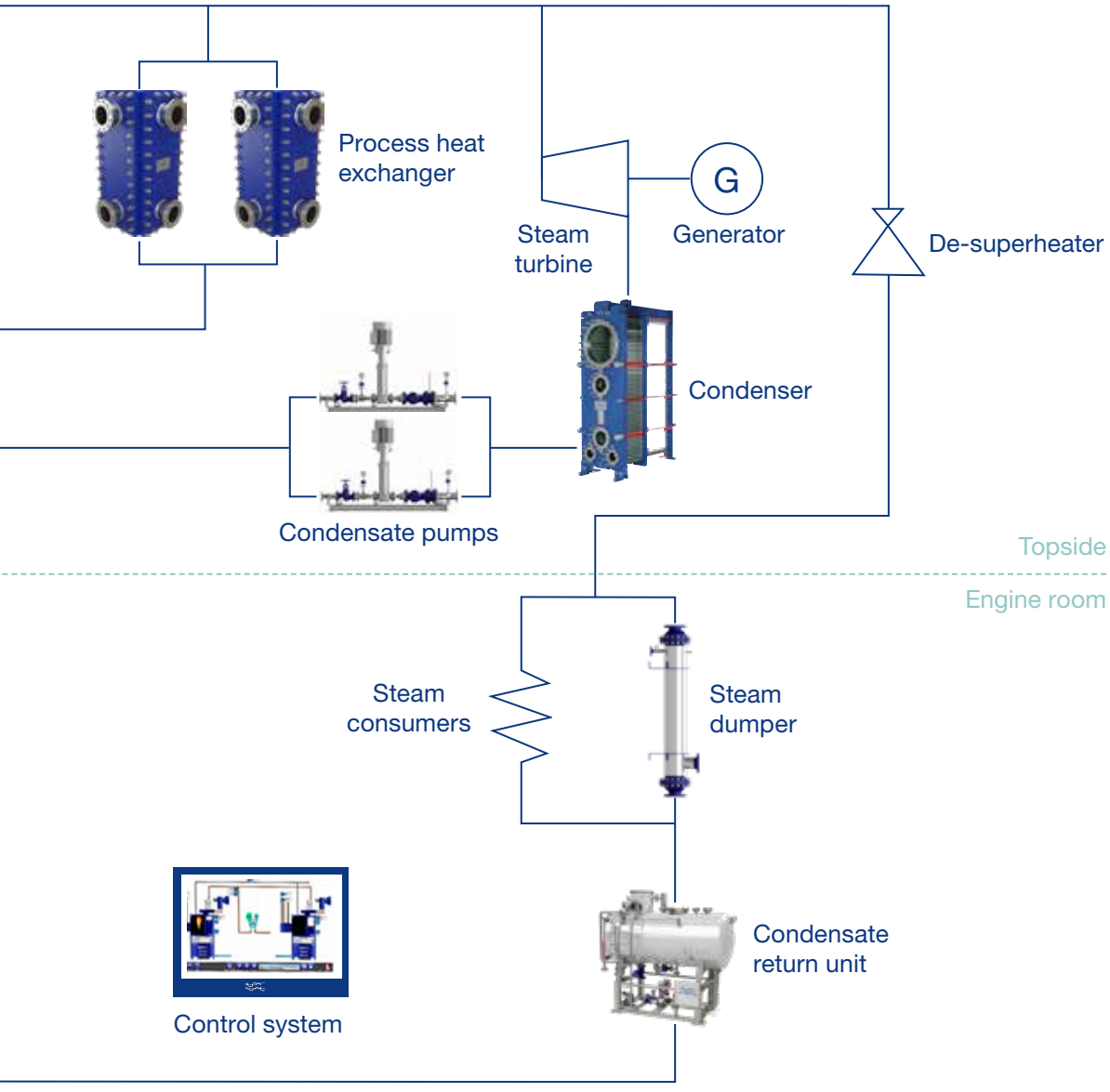
Alfa Laval's scope includes:

- Heat recovery steam generators (HRSGs), exhaust gas boilers or waste heat recovery units (WHRUs)
  - Heating applications
  - Steam turbine power generation applications
- Fired boilers with burners
- Complete steam system controls
- Complete feed water and condensate water systems
  - Deaerator feed water tank, blow-down tank
  - Feed water pumps, condensate recovery pumps
  - Automatic water chemistry sampling and dosing, blow-downs
  - Control valves, piping armatures
  - Steam dumping condensers, steam-to-hot water heat exchangers, etc.
- Fuel system
  - Multi-fuel delivery skids
  - Gas valve units (for safe area use)
  - Fuel oil pump units


HRSG
HRSG
Feedwater deaerator tank
Feedwater pumps
Water chemistry solution
Gas valve unit
Gas valve unit
Fired boiler
Fired boiler

Offshore steam boiler system

Typical FPS layout



Control systems

Smart control makes modern steam boiler systems efficient and easy to operate. A system-tailored control system based on programmable logic controllers (PLCs) supports a wide range of features, including intelligent boiler load sharing, automatic water quality control and efficient burner load control with flue-gas oxygen feedback. In addition, it provides highly effective troubleshooting tools. Alfa Laval control systems are available in various configurations – stand-alone, fail-safe, redundant, and are marine and offshore compatible.

From fired boilers to waste heat recovery

With more than a century of boiler and WHR expertise and a deep understanding of FPS needs, we take a holistic approach to steam production on board.

Fired boilers, burners and fuel systems

A reliable fired boiler is the heart of any ship's steam boiler system. Our proven boiler designs combine reliability and robustness with the highest efficiency on the market. All of our fired boiler models support a wide range of burners, so you can use the fuel of your choice: produced gas, MGO, crude, HFO, tank VOCs or any of these in combination.

A complete fuel delivery system is included in our scope. For liquid fuels, we supply a fuel pump unit that includes the temperature control for fuel heating or cooling. For gas, we have both hazardous-area solutions and a gas valve unit for safe-area systems. Our valve design incorporates the whole fuel train in a single compact unit in accordance with IGF and IGC codes.

Heat recovery steam generators

No modern offshore steam system is complete without a safe, reliable and effective waste heat recovery system for the gas turbine or engine exhaust gas. Waste heat recovery is vital to fuel efficiency and reducing FPS carbon footprint.

As well as providing traditional systems with forced circulation, we use a heat recovery steam generator concept based on natural circulation. Natural circulation uses changes in fluid density to drive water through the boiler unit, which eliminates problems associated with circulation water pumps. With natural circulation, the usual boiler water treatment technologies apply, without the need for sophisticated water treatment, such as those associated with once-through steam generator designs.

At the same time, natural circulation simplifies the overall system design and maximizes the energy savings. No electric pumps are needed to drive the water circulation, and no heat energy is transferred out when the engine or gas turbine is shut down.

Control system

Our FPS steam boiler control system concept features workstations and touchscreen panels, or a combination of both, with an intuitive graphical user interface. It incorporates all burner and boiler specific controls, as well as controls for all other devices in our delivery scope.

Based on programmable logic controllers (PLCs), the control system is fully redundant and complies with necessary IEC requirements for SIL 2 compliance. Combined with the internal process automation network, this lets us include smart features as standard, such as balance of plant from our range of Alfa Laval in-house solutions.


PETROBRAS

Alfa Laval Aalborg D

Alfa Laval Aalborg OL

Alfa Laval Aalborg D

The Alfa Laval Aalborg D is a standard vertical two-drum boiler. The furnace is built of membrane walls and contains minimal refractory. The convection section consists of straight pin tubes with bent pins that provide a high heat transfer coefficient and low pressure loss. Circulation is ensured by downcomers arranged outside the furnace. Capacity range: 25 – 120 t/h.

- Standard medium-pressure water tube boiler
- Two-drum D-type design boiler configuration
- Delivered as a complete unit for easy installation
- Available as satured steam or superheated steam design
- Footprint and layout optimized for restricted space applications
- Available as multifuel and multiburner designs

Alfa Laval fired boilers can be further enhanced by adding state-of-the-art external Alfa Laval XW/AV-6/ Micro economizers for preheating needs.

Alfa Laval Aalborg OL

The Alfa Laval Aalborg OL is a large-capacity fired boiler for marine vessels that require significant amounts of steam or hot water. Available in two design pressures, 9 or 18 bar(g), it has a top-fired design that maximizes heat transfer and minimizes pressure loss. Besides operating on today's fuels, including low-sulphur fuels and LNG, it is designed for compatibility with methanol and other future emission-reducing fuels.

The Aalborg OL is mainly used to generate steam and heat for cargo tank heating, tank cleaning, heating for ventilation and sanitary purposes, and engine room consumers. In addition, the Aalborg OL can function as a steam drum for one or more exhaust gas boilers. On vessels using LNG as fuel, the Aalborg OL can support boil-off gas (BOG) management. It can safely combust BOG that cannot be consumed by the auxiliary engine or genset, and it can handle free flow from the LNG tank if the vessel's compression train should fail. It can even combust the mix of inert gas and methane that arises before and after tank inspection.

- Easy operation thanks to straightforward and user-friendly design
- Robust and proven construction
- Easy access to the boiler furnace chamber for inspection – no dismounting the wind box
- Future-proof compatibility – equivalent steam capacity from future fuels compared to traditional fuels

Dual-fuel burners

Alfa Laval dual-fuel burners can be used seamlessly with a wide range of fuel types in both liquid and gas form. Our proven burner design offers emission-limiting combustion efficiency, combined with robust stability. The burners can be fired with gas and one liquid fuel simultaneously, and their design is adapted and sized for a perfect fit with the furnace geometry.

Alfa Laval Aalborg Hukka-8

Alfa Laval Aalborg AV-14

Alfa Laval Aalborg Hukka-8 (HRSG)

The highly efficient and robust Alfa Laval Aalborg Hukka-8 water-tube heat recovery steam generators (HRSGs) and related steam system equipment are always tailored to your specific requirements. Alfa Laval's Hukka-8 design offers the possibility of natural-circulation evaporators, which combine maximum uptime with reduced capital and operational expenditure.

Benefits of choosing Alfa Laval Hukka-8

- Improved efficiency of electricity production (up to 20% increase in fuel-to-power efficiency
- Smaller carbon footprint
- Support from Alfa Laval steam system experts
- Possibility of seamless integration with Alfa Laval steam system equipment, designed and manufactured specifically for marine and offshore applications
- Availability of Alfa Laval's global service network

Benefits of natural circulation

- Lower capital expenditure (CAPEX)
- Lower operational expenditure (OPEX)
- Maximized uptime and operational safety
- Lower parasitic electricity consumption for steam generation
- Lower weight and less crowded layout due to simpler circulation line piping when compared to conventional forced-circulation systems

Alfa Laval Aalborg AV-14 (WHRU)

The Alfa Laval Aalborg AV-14 is designed to efficiently recover energy from the exhaust gases downstream from gas turbines. It is primarily intended for hot water and thermal oil applications for heating and process duties.

The Aalborg AV-14 can be supplied as a unit with or without integrated bypass and as a complete system including silencer, ducting and stack. Its design offers the best solution with respect to efficiency, accessibility, weight and footprint. Other advantages of the Aalborg AV-14 include its low maintenance costs and high reliability, as well as the simple control that allows easy integration into any existing control system.

- Production of hot water, hot oil and other mediums by choice
- Efficient heating surface design that reduces weight and footprint
- Design to suit gas turbines in the oil and gas market
- High-grade material and surface treatment options for the offshore environment
- Delivery with silencer
- Delivery with integrated bypass
- Delivery with modulating dampers for partial-load control
- Well-proven and reliable technology for easy operation and maintenance

Waste heat recovery with pump-driven circulation

In case of forced (pump-driven) circulation, the exhaust gas heat recovery system can be configured in multiple ways - either in conventional marine-type economizer configuration, drum configuration or in once-through design. For optimized safety and reliability of the system, Alfa Laval promotes natural circulation unless otherwise required by client.

Alfa Laval Aalborg feed water deaerator tank

Alfa Laval Aalborg water chemistry solution

Feed water deaerator tank

Quality feed water safeguards the operation and service life of any marine steam system. Water quality control begins with clean source water, which is de-gassed and temperature-controlled in the feed water deaerator tank to produce feed water. By detecting and removing oil and other impurities before they reach the feed water system and steam boilers, the feed water tank also plays an important role in controlling the quality of returning condensate water.

Atmospheric hotwell tanks are available. However, for the best possible results, we recommend a pressurized hotwell, which has a deaerator capable of de-gassing without chemicals.

- Thermal de-gassing of feed water with a deaerator
- Temperature control of feed water
- Oil detection for condensate water
- Oil skimming section for condensate water

Water chemistry solution

In addition to de-gassing, chemical treatment is necessary to manage key parameters of feed water. Our automatic water chemistry solution monitors the water quality in all parts of the steam boiler system, and doses chemicals as needed. In addition to chemical dosing, the water chemistry solution performs the final crucial step of the fully automated water treatment solution, by controlling the automatic blow-down valves for each boiler and tank according to the results of the water analysis.

- Automatic water sampling
- Automatic dosing of chemicals
- Automatic saving of water records
- Automatic blow-down according to water quality
- Integrated control system

Alfa Laval Aalborg enclosed gas valve unit

Alfa Laval Aalborg fuel pump unit

Gas valve unit

The design and functions of our compact gas valve unit are tailor-made for FPS installations and fully compliant with regulatory requirements. The unit incorporates the entire burner fuel train within a small footprint, opening to expose the fuel train for easy service. Modular and easily scalable, it can accommodate a wide range of power ratings. Alfa Laval GVU's are available in both open and enclosed designs.

The gas valve unit also features an inline methane analyser, which accommodates variable gas compositions and enables more flexible burner control. Combined with our steam boiler control system, the unit can be used for different modes and load profiles, including boil-off burn mode and normal modulation mode. It can also be operated with various fuel line setups and pressure levels.

- Compact, integrated fuel train in an enclosed or open configuration with a small footprint
- Easy service access
- Methane analyser for flexible burner control and variable gas compositions
- Multiple operating modes, including boil-off and normal modulation
- Support for various pressure levels and fuel line setups
- Engineered for safe- or hazardous-area applications

Fuel pumping and heating unit

Our fuel units for traditional liquid fuels include supply pumps, ignition oil pumps, heaters and coolers. All equipment is incorporated in a single modular unit. Fuel temperature can be adjusted with steam and electric heaters for heavy fuel oils, and with water coolers for light fuel oils.

Exhaust Gas Cleaning Solutions

Alfa Laval's marine exhaust gas cleaning solutions help shipowners meet emissions regulations with flexibility and economy. With over 50 years of marine scrubber experience, we provide open-loop, closed-loop and hybrid scrubber systems that lead the way in SOx compliance and are ready for onboard carbon capture (OCC). They are supported by our regulatory insights, water treatment technology and global service – factors that will also be part of tomorrow's exhaust gas cleaning solutions.

Feed water pumps

Heat exchangers for steam condensing, heating and cooling

Feed water pumps and other pumping modules

Feed water system design is key to the steady, accurate control of boiler water levels. Depending on the installation, the feed water flow can be controlled with either continuously modulating control valves or variable-frequency pumps. Variable-frequency drive pumps offer improved energy efficiency and reduced wear on the pumps themselves.

Condensate pump unit (various)

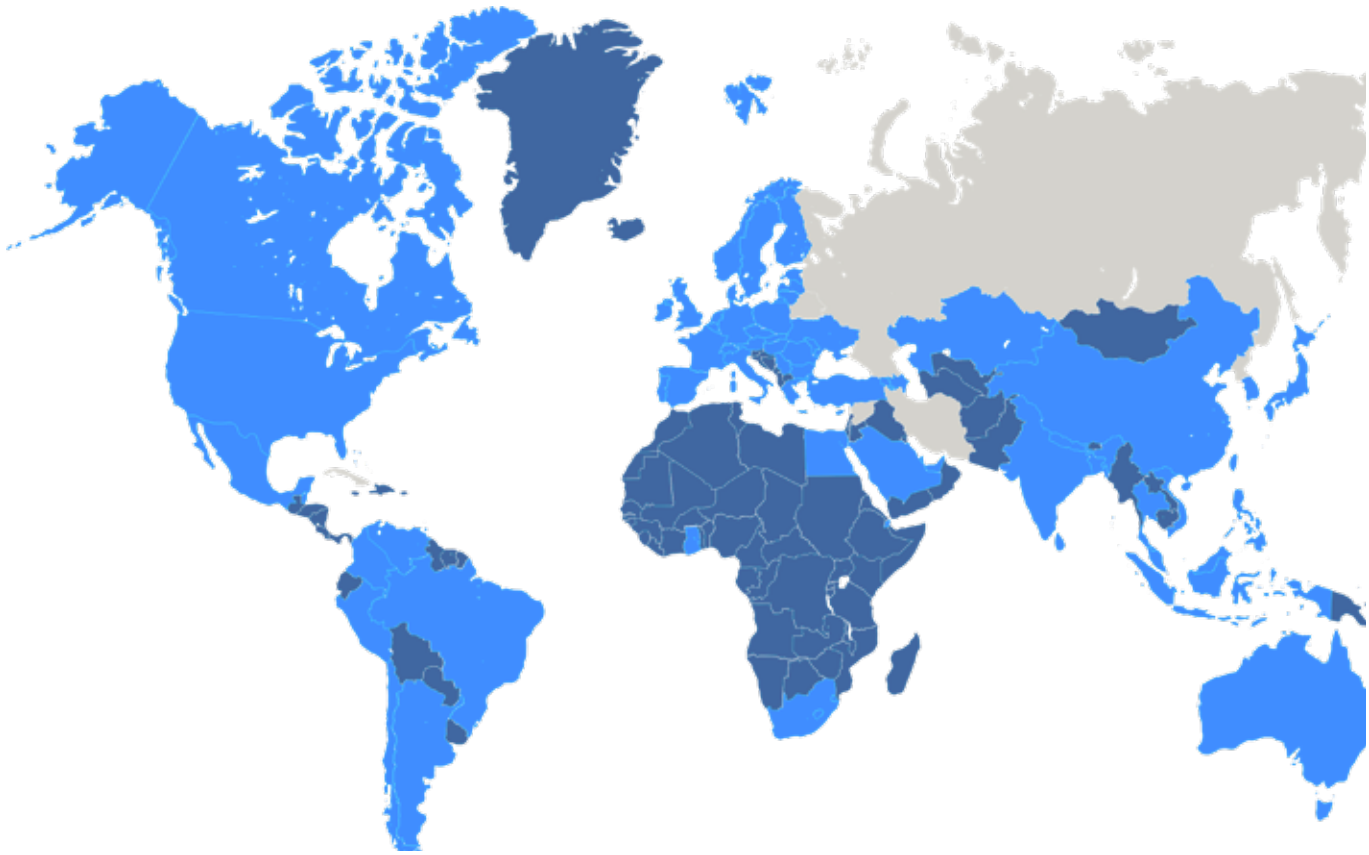
Circulation pump unit

Similar pumping modules as for boiler feed water are also available for various condensate pump units and circulation water pump units.

Heat exchangers for steam heating, condensing and cooling

Our full-system deliveries include various heat exchangers, including controls and skidded solutions. Conventional shell-and-tube or space and weight saving plate-type heat exchangers, both welded and gasketed designs available. Typical applications include steam to Heating Medium heat exchangers, excess heat surplus condensers, oil heaters, system preheaters, coolers and condensers.

- Available both in shell-and-tube as well as plate-type designs, welded or gasketed
- Minimal space and weight requirements, in horizontal and in vertical designs
- Available in subcooling designs, where needed
- For installation in engine room or topsides, safe and hazardous area designs available
- Full control of pressure and temperature in the steam/heat generation system, integrated control systems
- For steam, condensate, hot water, TEG, fuel oil, thermal oil and many more applications and fluids
- Total optimization of heat & power generation system energy balance, with minimal process waste and maximum heat recovery



A strong local presence

Alfa Laval has a strong local presence globally, including

- 37 major production units (along with several smaller production and assembly units)
- More than 100 service centres
- Sales companies in 55 countries
- Additional sales representation in 45 countries

Applications for improved efficiency

There are possibilities to get even more from your steam boiler system. We can help you achieve additional savings and further enhance your green profile.

Steam turbine

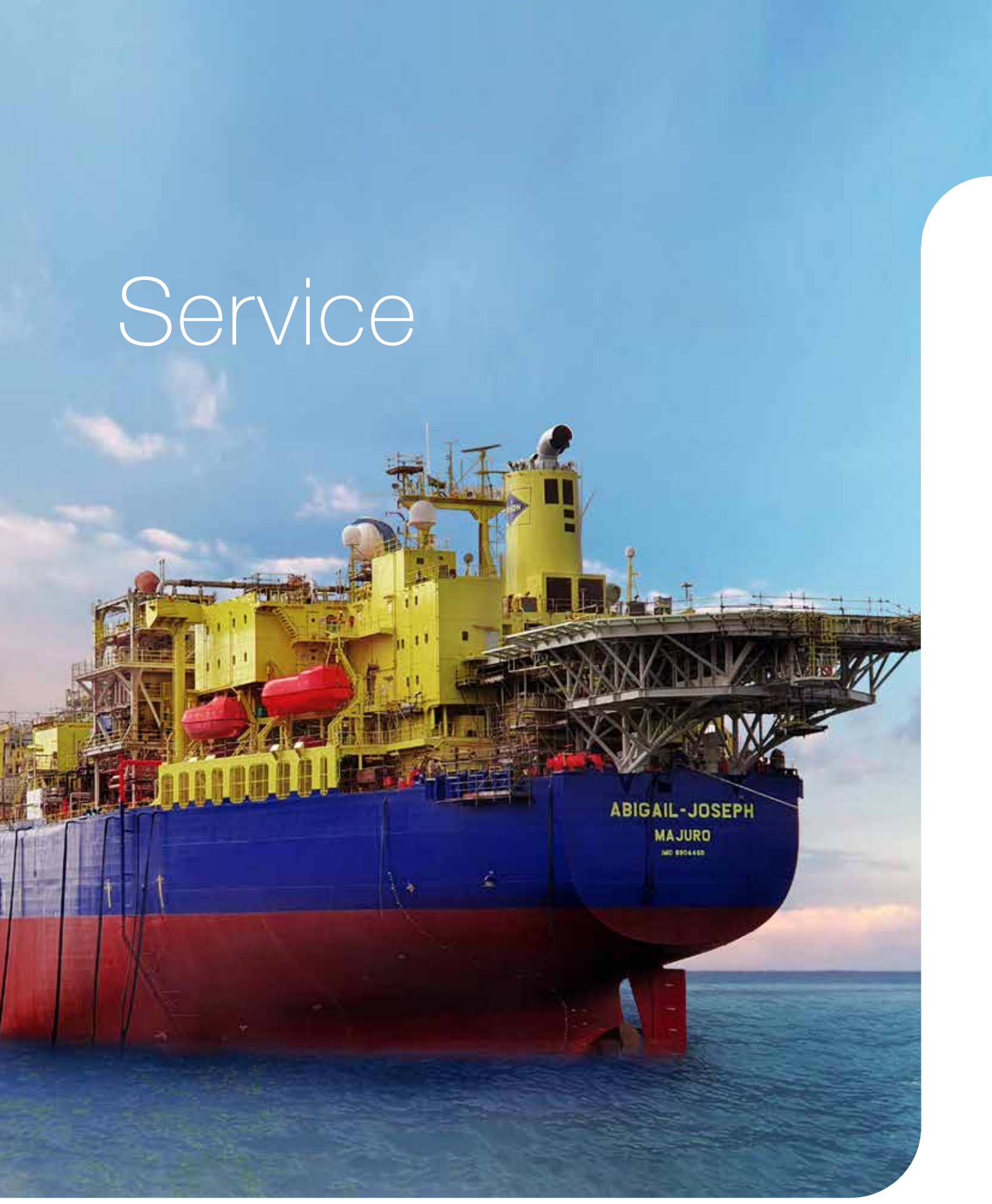
Whether you are considering conventional steam power generation by fired boilers or state-of-the-art heat recovery steam generators, Alfa Laval is here to support you. Derived from decades of experience with both floating and land-based steam power generation systems, our solutions are fully marine-adapted and meet the highest safety and operational standards. Moreover, they can be configured for best-in-class efficiency.

Alfa Laval's product range covers the full spectrum from steam generation to heat consumers, including the Balance-of-Plant (BOP) systems in between. We also provide steam turbine auxiliary systems, such as vacuum condensers and condensate return systems.

Emissions reduction with combined cycle

Using Alfa Laval Hukka-8 for steam power generation, the overall efficiency of your FPS installation can be improved significantly – by up to 50%. Whether your power generation is based on gas turbines or reciprocating ICEs , we have the experience to support to you. We can help you future-proof your installation by making maximum use of exhaust gas waste heat streams.

Service



We provide full support for our FPS steam boiler systems. Our support covers their entire life cycle, beginning with design, installation and commissioning and extending past warranty throughout the service life.

Service Agreements

We can't predict the future, but Alfa Laval Service Agreements can make it less uncertain. A fixed-period Service Agreement makes operation planning and cost projections more secure.

A well-crafted maintenance strategy offers transparent cost control and safeguards performance, lengthening your equipment's lifespan and reducing your total operating costs. Expert maintenance not only improves the performance of your Alfa Laval equipment, but also helps you get more from the equipment surrounding it.

Maintenance services

Preventive maintenance is the key to reliable performance. Our Preventive Maintenance Programme comprises annual and 30-month services that comply with regulatory inspection schedules for marine and offshore boiler systems.

Because we take a full-system approach, we address every part of the steam boiler system in our services, for example by checking water quality throughout. After each completed service, we issue an original equipment manufacturer's service certificate.

Remote connectivity services

Adding a connectivity gateway to the boiler control system enables a number of remote services, including secure remote monitoring, online technical support and remote software updates, as well as collection and storage of process data.

Condition inspections for steam boiler systems

Alfa Laval condition inspections let you know the current condition of your equipment, which is critical to making informed decisions about future operations and maintenance. Our specialists in steam boiler systems can perform condition inspections with different scopes, but their efforts always go beyond inspecting individual components. In each audit, they take the entire steam boiler system into account.

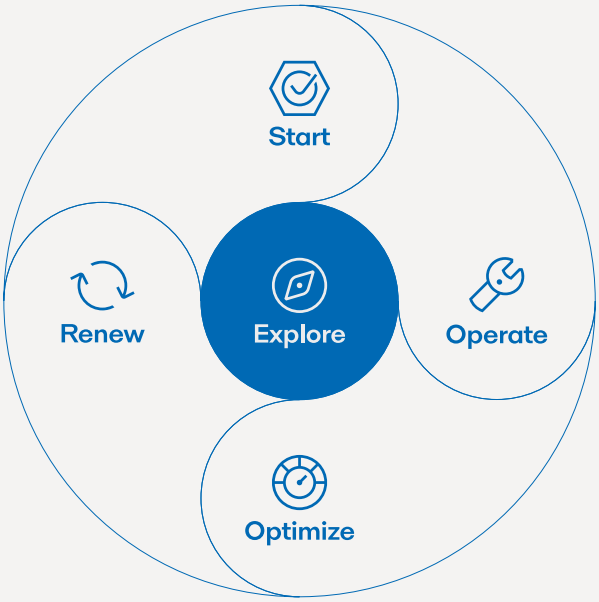
Restart and lay-up services

Without the right precautions and system checks, returning to normal operation after prolonged downtime or a period of low-load operation may not be easy. Alfa Laval's restart inspection service includes all the inspections and tests necessary to ensure a smooth return to normal operation.

If you are planning an extended pause in boiler operations, proper steps will be needed to prevent the deterioration of your system. Our boiler lay-up service makes sure the correct steps are taken to protect your boiler until you bring it back into service.

Spare parts

Using Alfa Laval original spare parts is key to maintaining the superior quality of your steam boiler system – and ensuring it will work as intended throughout its life. Based on our extensive experience, we've created tailored spare part packages with preventive maintenance in mind. A variety of spare part packages are available to meet your specific needs, so that you can always have the correct parts on hand.



Explore
Discover the possibilities

Through assessments and monitoring, we advise you on defining your operational and maintenance strategy, assuring optimal performance and long-term reliability.

Start
Get ready and running

Ensure an effective and safe startup. We help you to get up and running to meet committed performance standards.

Operate
Rely on seamless operations

Achieve peak performance with seamless operations. Through training and proactive maintenance, we maximize uptime and enhance production efficiency.

Optimize
Unlock your peak performance

Secure lower operational costs and higher uptime in the most sustainable way, ensuring a smooth transition from current performance to the expected level of stability and efficiency.

Renew
Navigate change with ease

Effortlessly navigate change by proactively planning and managing your equipment's lifecycle transition. Achieve long-term operational efficiency through cost-effective and sustainable circularity.

Service offerings overview

Explore	Assesment and advisory	• Performance assessment
		• Condition assessment
		• Sustainability assessment
		• Preventive maintenance plan
	Monitoring	• Condition monitoring
		• Performance monitoring
Start	Installation and commissioning	• Commissioning
		• Installation
Operate	Customer training	• Customer training
	Maintenance and repair	• Maintenance
		• Repair
	Spare parts and tools	• Spare parts
		• Service kits
		• Tools
	Troubleshooting	• Troubleshooting
	Compliance package	• Compliance package
Optimize	Upgrades	• Sustainability upgrade
		• Performance upgrade
		• Automation upgrade
Renew	Replacement	• Replacement
	Retrofit	• Retrofit

This is Alfa Laval

Alfa Laval is active in the areas of Energy, Marine, and Food & Water, offering its expertise, products, and service to a wide range of industries in some 100 countries. The company is committed to optimizing processes, creating responsible growth, and driving progress – always going the extra mile to support customers in achieving their business goals and sustainability targets.

Alfa Laval's innovative technologies are dedicated to purifying, refining, and reusing materials, promoting more responsible use of natural resources. They contribute to improved energy efficiency and heat recovery, better water treatment, and reduced emissions. Thereby, Alfa Laval is not only accelerating success for its customers, but also for people and the planet. Making the world better, every day. It's all about Advancing better™.

How to contact Alfa Laval

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Contact details for all countries are continually updated on our web site. Please visit www.alfalaval.com to access the information.

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