Leveraging heat transfer

in the carbon capture process

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Alfa Lavals solutions for CCS

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Carbon capture and storage
A keystone in climate change mitigation

The three primary approaches to carbon capture and storage in the industrial sector include pre-combustion, post-combustion, and direct air capture. For most industrial processes, post-combustion carbon capture is the most commonly used approach and an Alfa Laval area of expertise.

In post-combustion carbon capture, a solvent- based absorption/stripping system removes CO_2 from the flue gases and process streams. Solvent-based absorption/stripping CO_2 capture has been in use for more than 30 years but has typically been very energy-intensive, requiring a lot of cooling, heating, condensation, and reboiling, making the energy cost a large part of the process cost. This has meant high capital and operating expenses, limiting the broad-based uptake and implementation in the market.

The energy cost can account for up to 60% of a plant's operation cost. Efficient heat transfer systems are a fundamental factor in reducing these costs and making the carbon capture process commercially more viable. Fortunately, with advancements in heat transfer technologies, large-scale facilities are now becoming more common, with significantly lower CAPEX and OPEX.

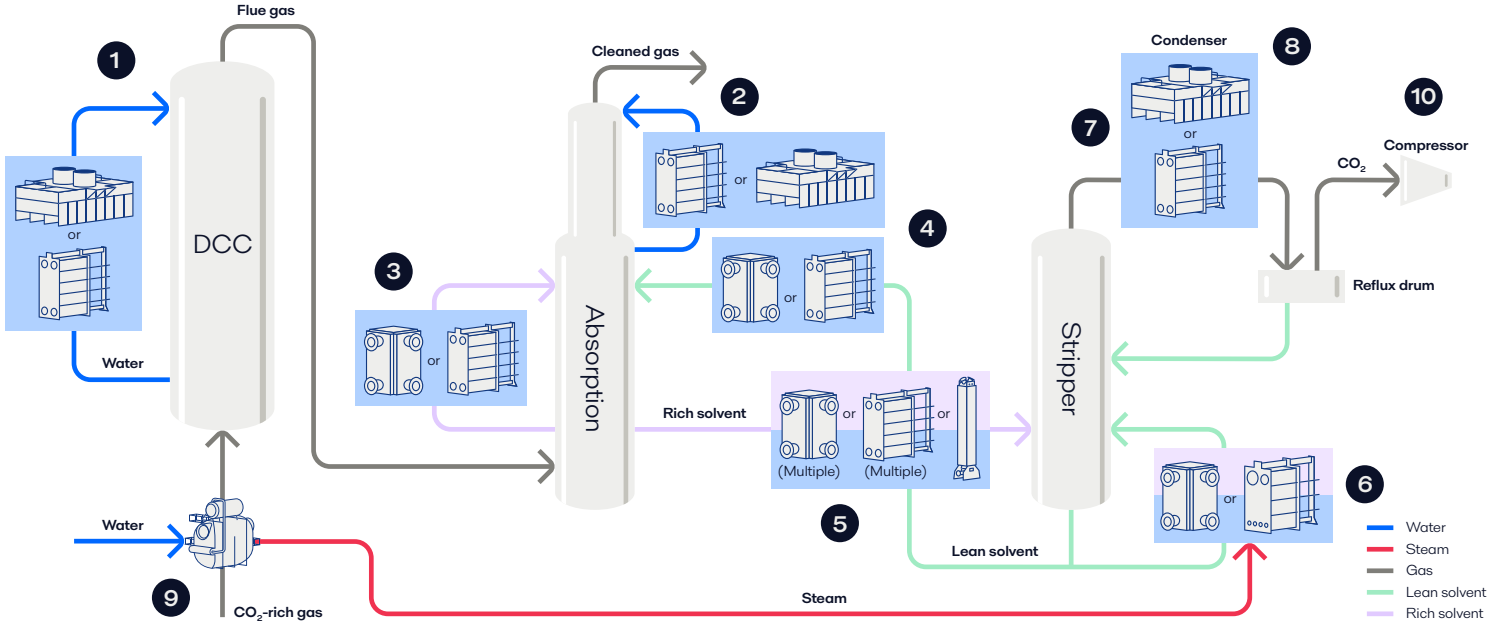
While new technologies have helped drive a broader uptake of carbon capture systems, you will still need to find the right technology to fit your unique application needs. Factors such as space requirements, water availability, energy consumption, and CAPEX can affect the successful deployment of your carbon capture technology. That's where having the right partner can be valuable.

Alfa Laval is the industry leader and expert in heat transfer and has a wide variety of technologies you can leverage to help advance the implementation of efficient and cost-effective carbon capture processes into your operations.

We have been an integral partner in developing numerous post-combustion carbon capture installations in various industries. With our broad portfolio of heat transfer equipment, we support customers in meeting the demands of this energy-intensive process, by optimizing CAPEX and OPEX (including reduction of cooling water and power needs).

Alfa Laval heat transfer technologies in solvent absorption carbon capture process

Alfa Laval heat transfer technologies can increase energy efficiency, improve absorption efficiency, reduce utility (cooling water, power, steam) requirements, save space, and reduce total installation cost.



Maximize solvent cooling to increase absorption efficiency and maximize heat recovery in lean/rich interchanger to minimize steam consumption in reboiler; with more than 450 gasketed plate heat exchanger (GPHE) references for this position (5 in figure).

1. Direct contact cooler (DCC)
Using our heat transfer technology at this position optimizes the temperature approaches to cool down the DCC water and reduces the flow of cooling media.

2. Wash water cooler
Our heat transfer technology allows for colder wash water at this position, which improves solvent removal efficiency. It can also reduce and optimize the required flow of the cooling media.

3. Absorption tower pump-around cooler
Increased heat removal and improved absorption efficiency can be achieved using our heat exchanger technology, as well as lowering the temperature of treated gas leaving the absorption tower and entering the wash water section. This minimizes the size of the wash water section and improves solvent removal efficiency. Our technology can also reduce and optimize the required flow of cooling media at this position.

4. Lean solvent cooler
Our heat exchanger technology allows for a colder lean solvent to enter the absorption tower at this position, resulting in either improved absorption efficiency or reduced quantity of recirculated solvent. It also optimizes the flow of cooling media at this position.

5. Lean/rich solvent interchanger
Our plate heat exchangers excel in this position by allowing the closest temperature approaches compared to any other heat transfer technology.

The result is fewer required units and lower installation costs. Our technology also allows for a hotter rich solvent to enter the stripper column at this position, reducing the reboiler's heat duty and steam consumption and, thus the required size for the reboiler. The higher the heat recovery from the lean to rich solvent, the colder the lean solvent, which reduces the cooling media flow rates, the stress on the lean solvent cooler and the size required.

6. Stripper reboiler
This position is the most energy-consuming in the carbon capture process. Our plate heat technology allows for a lower-grade heat source for reboiling. With lower heating media temperatures, solvent degradation risk is reduced and less makeup solvent is needed. A smaller footprint also reduces the total installed cost (>15 references with Compabloc).

7. Stripper condenser
Our heat transfer technology can maximize the condensing of water vapor and cooling of CO_2 vapor, reducing total volumetric flow to the compressor, which reduces the compressor's size and energy consumption.

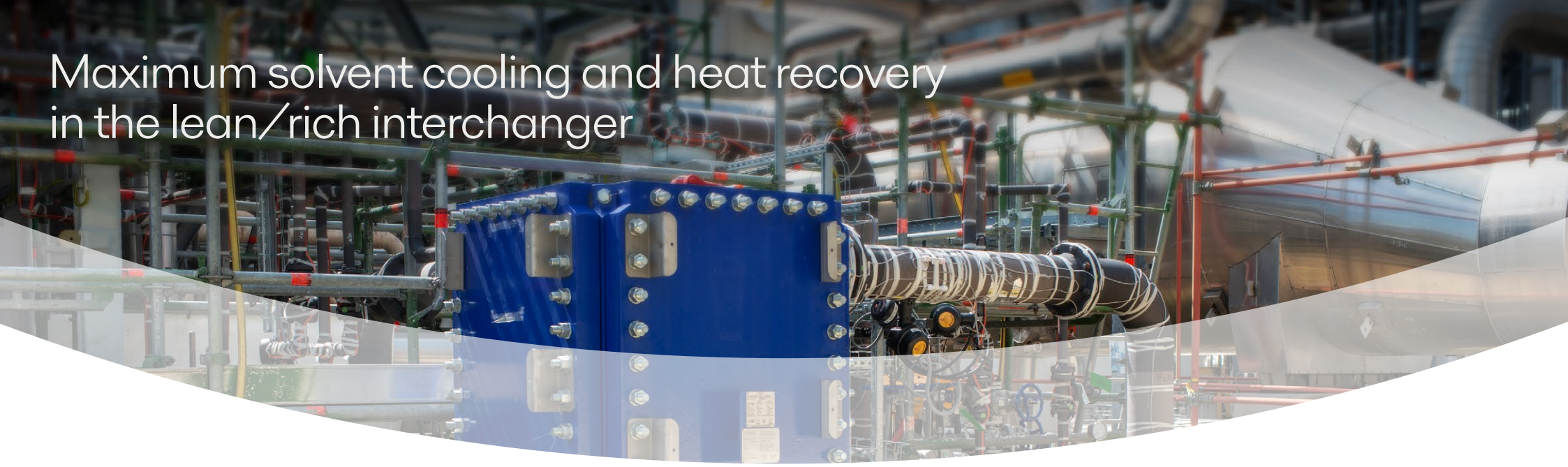
8. Compressor interstage cooler
Our heat transfer technology can maximize interstage cooling, reducing the compressor's size and energy consumption. They can also help send drier CO_2 to the drying system, thereby reducing the system size before it's injected into the pipeline.

9. Flue gas heat recovery and conditioning
Two of our heat transfer technologies could be used. Our Aalborg Gas Heat Recovery Boiler can recover heat from the flue gas and generate LP steam at this position. The result is that the stripper reboiler steam consumption is offloaded, and colder flue gas sent to the DCC is reduced in volumetric flow, ultimately decreasing the size of the DCC column.

Our 100% tailor made Ziepack could also be utilized to recover heat from the flue gas and generate LP steam, but is very well suited for rich flue gas/depleted flue gas interchangers.

10. Super critical CO_2 cooler
CO_2 inter-stage and after-cooling with Wet Surface Air Coolers (WSAC) offers lower temperatures which in turn provides greater compression ratios and throughput. WSAC also minimizes water usage over traditional shell-and-tube (S&T) or similar heat exchanger technologies in this position.

Maximum solvent cooling and heat recovery in the lean/rich interchanger



In the lean/rich interchanger position, the use of plate heat exchangers is already industry standard, but very often, it is seen that the processes are not fully optimized for the maximum capacity of what plate exchangers can achieve. For example, very often a -9 to -6 °C approach temperature is specified in this position when a much lower approach, say -12 °C or less, can be achieved with the latest innovations in plate heat exchanger technology.

Higher heat recovery in this position also leads to a colder lean solvent entering the lean cooler, thereby further reducing the size of the lean cooler position.

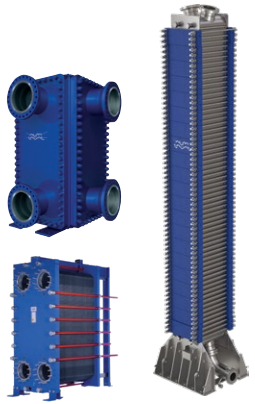
Are you working with a small plot space?
Alfa Laval's plate heat exchangers have a smaller footprint than traditional shell and tube heat exchangers, allowing you to make the most of your available plot space.

Our plate heat exchangers also require fewer units and piping than shell and tube ones, reducing the need for additional plot space and increasing ease of i stallation.

Interested in saving more energy? Our plate heat exchangers are 3-5 times more efficient compared to traditional shell and tube heat exchangers.

Implementing a technology solution tailored to your specific needs can make the process both energy-efficient and cost-effective.

Learn more about integrating carbon capture with the lowest OPEX and CAPEX.



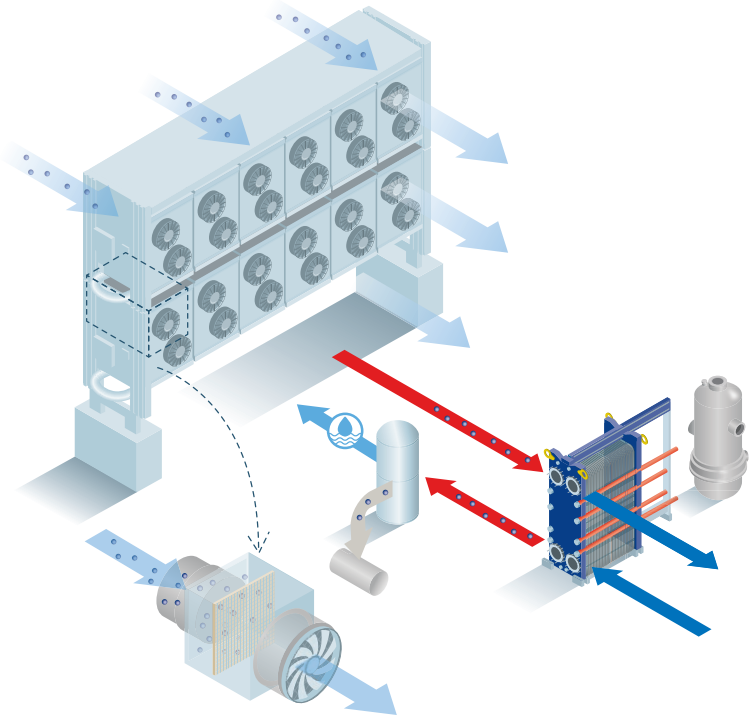
Alfa Laval heat transfer technologies in Direct Air Capture

Unlike the point source emission, Direct Air Capture (DAC) extract CO_2 directly from atmosphere. Due to diluted CO_2, the cost of these solutions can be significantly higher compared to amine absorption systems. In other words, the developing technology used to capture CO_2 from the air consumes a high amount of energy per tonne of carbon captured. Compared to amine solution, heat transfer technologies play a limited role in DAC systems but still critical for energy efficiency.

Alfa Laval's gasketed plate heat exchangers are a reliable solution to make sure that your DAC technologies are optimized with efficiency in mind and reduced cost.

For CO_2 condensation and vacuum duties, we also offer our 100% tailor made Ziepack heat exchanger (with possibility to integrate gas liquid separation in the same vessel).

Image: Climeworks' Mammoth plant



Our heat transfer solutions for CCS

Gasketed plate & frame heat exchangers

Semi-welded plate & frame heat exchangers

Welded plate and block (Compabloc) heat exchangers

Spiral heat exchangers

Plate and shell/frame (Packinox) heat exchangers

Printed circuit heat exchangers

Air coolers

Wet surface air coolers

Gas-to-Liquid heat exchangers

Fusion bonded heat exchangers

Brazed heat exchangers

High pressure & tube heat exchangers

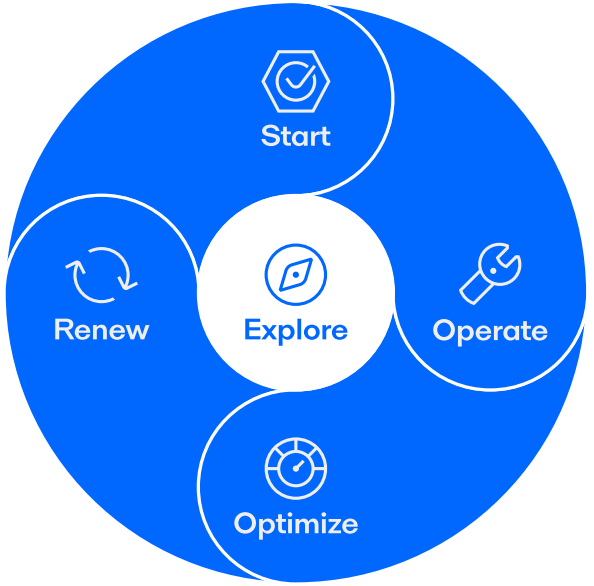
Start your journey to improved energy efficiency, sustainability and a reduced carbon footprint

Carbon capture and storage is not a one-size-fits-all process, and neither are Alfa Laval's solutions. Wherever you are on the sustainability journey – if you are already actively planning or still just thinking about taking your next steps – Alfa Laval is ready to partner with you.

24/7/365 Service and Support

With service centres, field service engineers and spare parts distribution hubs around the world, the Alfa Laval Service network is always on the job for you.

When you contact our 24/7/365 Service and Support, our experts coordinate everything to quickly address your needs – either remotely via our digital tools or on site.



The right partner

Selecting the optimal technology and process solutions has a profound impact on the return on energy efficiency investments, both from a sustainability and financial perspective. As the industry leader in heat transfer technology, we at Alfa Laval can support you with everything from design solutions to state-of-the-art equipment and complete service programs.

With our comprehensive range of high-efficiency heat exchangers, we can provide the ideal heat transfer solutions for your plant, whether you require a unit capable of handling aggressive process media at high pressures and temperatures or one for less demanding utility applications.

By involving Alfa Laval already in the conceptual design phase of your project, you can improve project economics, avoid costly redesigns later in the process, and accelerate the implementation of your new investment.

Our experts offer advice on optimizing your process to fully leverage the capabilities of our heat exchangers. The resulting benefits can extend far beyond the heat exchanger itself, delivering substantial OPEX and CAPEX savings for other equipment such as compressors and distillation columns.

Contact us