



# Blue hydrogen production



Hydrogen is becoming a more important feedstock for removing impurities in hydrotreatment processes, maximizing yield of high-value products in hydrocrackers, and producing renewable fuels in HVO plants. For many refineries, hydrogen imbalance requires investments in hydrogen production units to supply sufficient amounts for their processes. As a very energy demanding process, production through steam methane reforming (SMR) drastically increases a refinery's carbon dioxide footprint when added to the plant. The solution to this is called carbon capture: turning the grey hydrogen produced into blue.

### Alfa Laval in blue hydrogen production

Today, Alfa Laval has supplied around 30 Olmi process gas boiler packages to hydrogen plants all around the world. Several Alfa Laval Compabloc and DuroShell heat exchangers are also used in various syngas cooling services in the SMR process.

When it comes to carbon capture, we also have a complete range of heat exchangers to maximize CO<sub>2</sub> removal efficiency at lowest energy input. More than 100 of our plate heat exchangers are operating in various services in CCU processes around the world, with around an additional 1000 in normal gas treatment systems.

To learn how other refineries use Alfa Laval solutions in their blue hydrogen production, visit [alfalaval.com/refinery/experience](https://www.alfalaval.com/refinery/experience).

### Improved CO<sub>2</sub> capture efficiency

There are many ways to maximize CO<sub>2</sub> capture efficiency. One of them is to simply optimize the mass and heat balance of the process design, and this is where Alfa Laval can help.

Designing a process to maximize preheating of rich solvent before the stripping column removes more CO<sub>2</sub> without increasing the steam requirements of the column reboiler. With Alfa Laval plate heat exchangers, it is possible to maximize energy recovery from lean solvent into rich, providing you with an optimal solution in terms of investment cost, stripper energy consumption and CO<sub>2</sub> removal.

Similarly, by designing the process to cool the lean solvent closer to the supply temperature of cooling media, a higher amount of CO<sub>2</sub> can be absorbed in the solvent and removed from the gas being cleaned. Alfa Laval plate heat exchangers or wet surface air coolers can achieve this type of minimized temperature approach, maximizing the solvent absorption efficiency.

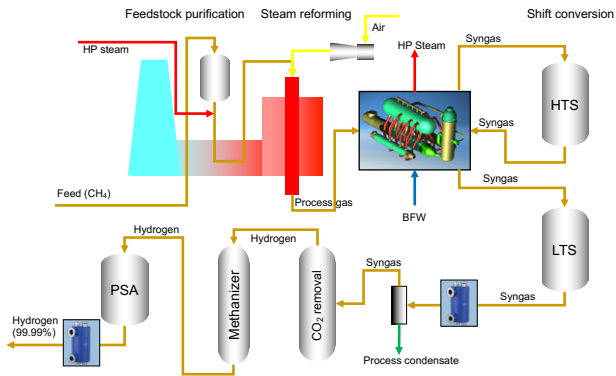
### Energy efficiency improvement

Both the SMR and the carbon capture processes demand high amounts of energy. To maximize production of high pressure superheated steam by cooling secondary reformer process gas, the entire waste heat boiler package must be optimized in terms of process gas cooler design as well as in the layout and elevation of the risers/downcomers and the steam drum. The Alfa Laval process gas boiler package design will do just that.

Additionally, you can also design the hydrogen production process to maximize waste heat recovery from hot syngas. By using Alfa Laval welded plate heat exchangers, such as a Alfa Laval Compabloc or Alfa Laval DuroShell, this waste heat can be used for boiler feed water preheating, district heating or low pressure steam generation. The steam generated can be used to off-load the solvent stripper reboiler in the carbon capture unit from the use of fresh steam, thereby reducing the energy cost of this process.



## Hydrogen (SMR) production



Designing the process with maximal energy recovery in the lean/rich solvent interchanger is another solution for minimizing energy consumption in the stripping section of the carbon capture unit. This maximizes preheating of the rich solvent before the stripping column. With an Alfa Laval Packinox heat exchanger, you can achieve a hot approach temperature of less than 10°C (18°F) in a single heat exchanger, thereby reducing the steam requirement of the stripper reboiler with a minimal equipment footprint.

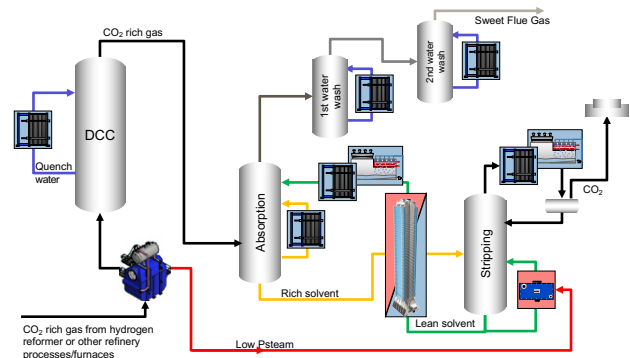
Designing the stripper column to operate at lowest possible pressure further reduces steam consumption in the reboiler. This requires condensers that can operate at minimal vapour saturation pressure and temperature. With Alfa Laval plate exchangers or wet surface air coolers, a closer approach to the supply temperature of cooling media makes it possible to minimize the operating pressure of the stripper.

### Improved sustainability

With the energy efficiency solutions above, more steam is generated in the hydrogen production unit and less is needed for the stripper reboiler. This reduces the steam boiler capacity, and as a result, it also reduces CO<sub>2</sub> emissions.

By improving CO<sub>2</sub> capture efficiency, you may think you have already done everything to maximize the sustainability of your plant. But even more can be achieved.

## Carbon capture unit



Designing the process to maximize the return temperature of the cooling water from the coolers and condensers reduces cooling water consumption by at least 50%. Alfa Laval plate heat exchangers can do this very cost effectively, in a single heat exchanger, while requiring minimal plot space.

### Improved reliability/availability

Recovering energy from the hot process gas stream in the SMR process to generate superheated steam requires highly reliable and potent solutions. Alfa Laval Olmi process gas boiler packages are designed for maximum tolerance and reliability. The patented Olmi design for gas by-passing minimizes the risk for metal dusting. Proper design and material selection also minimize the risk of tube sheet failures and tube bundle buckling. What's more, high quality, crevice-free full penetration or internal bore welding minimizes the risk of cracks in tube-to-tube-sheet welds.

While the carbon capture plant is operating at much lower temperatures and pressures, the highest concern is minimizing the risk of solvents leaking into the environment.

Alfa Laval's wide selection of highly efficient plate heat exchangers, ranging from gasketed types to fully welded types, such as Packinox and Compabloc, offer you the optimal balance of reliability and investment cost.

### Minimizing CAPEX

When investing in a new blue hydrogen unit, installing cost-efficient heat exchangers installed on minimal plot space in just the start for how you can minimize project CAPEX. By optimizing the process design, you can even achieve the lowest overall process cost.

- Maximum energy recovery in the lean/rich solvent exchanger reduces the size of the stripper reboiler or increase CO<sub>2</sub> capture capacity without additional investment in reboiler capacity.
- Maximizing the energy recovery from hot process streams also means reduced cooling capacity, thereby minimizing the investment of the final syngas or solvent coolers.
- Additional cooling/condensing of stripper overhead vapour minimizes cost in downstream CO<sub>2</sub> compressor systems or increases capacity in an existing plant without requiring investment in more compressor capacity.

- Reduced cooling water requirements minimizes investment cost in the cooling water system or increases capacity in an existing plant without additional investment in this system.

These savings will be much higher than the savings in heat exchangers and their installation cost, but it requires optimizing the process around the efficiency of Alfa Laval heat exchangers. This is why you need to involve Alfa Laval early in the project, before the process design is fixed. We will help you optimize the mass and heat balance of your process to make sure you will get the most efficient design – both for OPEX and CAPEX savings.



With Alfa Laval as your partner, you get access to world-leading expertise in process optimization. Together with your process engineers, we create highly efficient and reliable solutions that will take your plant to the next level.

Learn more and see all the facts from real-life customer cases at [www.alfalaval.com/refinery](http://www.alfalaval.com/refinery)

### Our service offerings

Every Alfa Laval solution is backed by the market's only supplier with deep process knowledge and a global network of experienced experts.

Get to know more about our maintenance solutions at [www.alfalaval.com/refinery/service](http://www.alfalaval.com/refinery/service)

### Products and solutions featured

Take a closer look at:

- **Aalborg Waste Heat Recovery boilers**
- **Compabloc**
- **Duroshell**
- **Gasketed Plate Heat Exchangers**
- **Niagara Wet Surface Air Coolers**
- **Olmi shell-and-tube**
- **Packinox**