



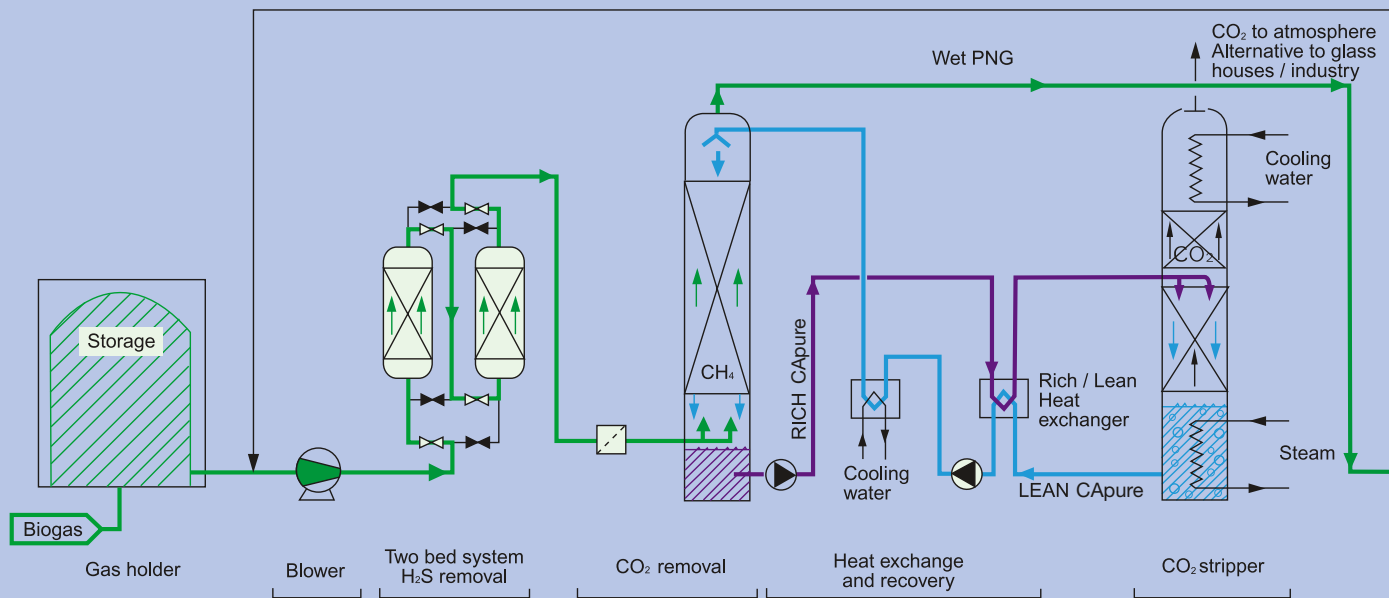
## PRODUCTION OF HIGH-QUALITY BIOGAS

**CApure™ is an advanced technology for biogas upgrading. Removal of CO<sub>2</sub> and H<sub>2</sub>S from biogas results in a gas quality with the same properties as natural gas.**

Biogas from anaerobic treatment of wastewater sludge, organic solids and manure is a valuable sustainable energy source reducing global warming from fossil fuels. As the demand for alternative renewable energy sources is rapidly increasing, biogas will play an important part. Upgraded biogas can be used as vehicle fuel, electricity and heat production.

The CApure™ technology is based on a low pressure chemical absorption process specially designed to remove CO<sub>2</sub> from biogas. The most important part of the CApure™ process is the absorption liquid, a specially composed amine for CO<sub>2</sub> removal named CApure™.

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- Less than 0.1 % methane loss to atmosphere.
  - Natural gas quality.
  - Operation cost proportional to actual capacity.
  - High purity CO<sub>2</sub> for commercial re-use.
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## The Upgrading Process

**Incoming raw biogas, depending on production source, is saturated with water, contains H<sub>2</sub>S and is slightly pressurised. In most cases the pressure must be increased to overcome the pressure loss over the upgrading system.**

### H<sub>2</sub>S Removal

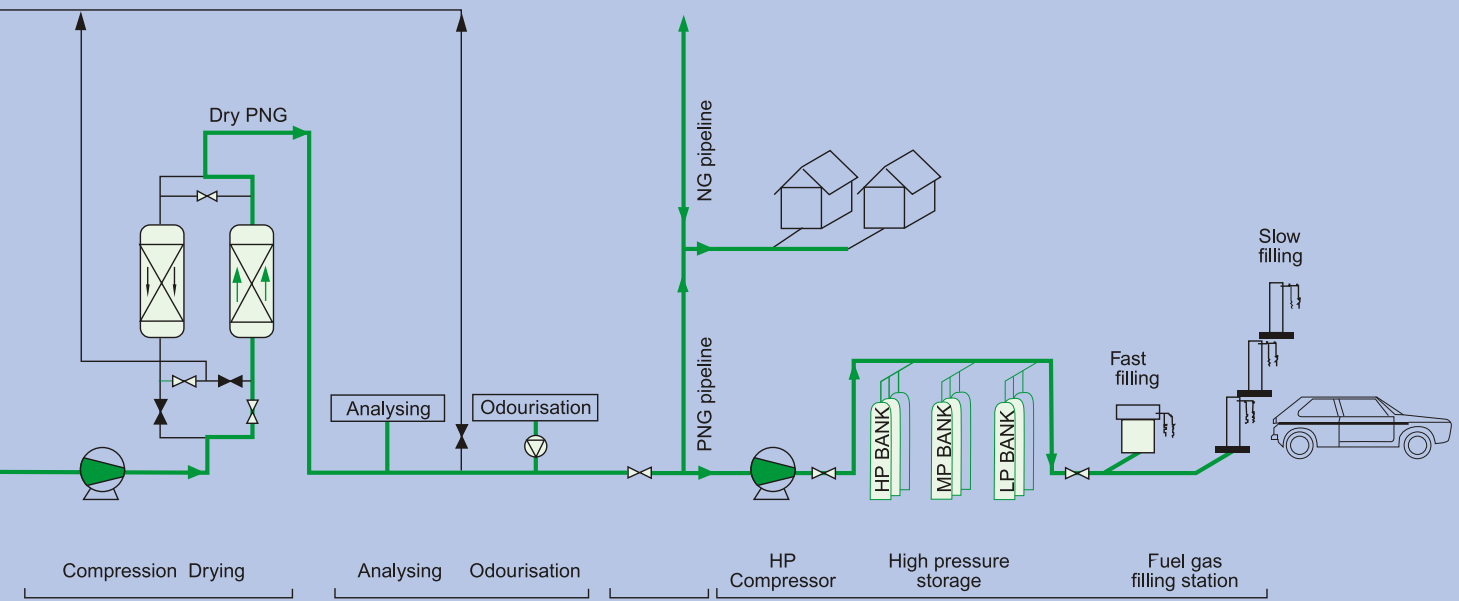
When the H<sub>2</sub>S concentration is above 500 ppm, a two stage H<sub>2</sub>S removal system will be applied.

The first stage, where the bulk of the H<sub>2</sub>S is removed, is a combined caustic scrubber and bioreactor system. More than 90 % of the H<sub>2</sub>S is removed in the first stage.

The second stage is an activated carbon bed, where H<sub>2</sub>S is absorbed. The H<sub>2</sub>S is removed to very low concentrations, typically below 0.5 ppm. Elementary sulphur will be formed by the process and adsorbed on the activated carbon. Traces of oxygen in the raw biogas or a very small air dosing ensure sufficient oxygen for the process. The activated carbon is replaced when saturated with sulphur. When the inlet H<sub>2</sub>S concentration is less than 500 ppm, only the activated carbon bed will be applied.

The two-stage removal gives the overall lowest investment and running cost at high inlet H<sub>2</sub>S concentrations.





### CO<sub>2</sub> Removal

CO<sub>2</sub> is removed in a counter current packed absorption column. CO<sub>2</sub> enters the column at the bottom and recirculated absorption liquid is sprayed from the top.

The CO<sub>2</sub> removal is a fully reversible chemical absorption process and the specially composed amine absorbs more than 99.5 % of the CO<sub>2</sub>.

The biogas with more than 99.0 % methane leaves the column from the top. The CO<sub>2</sub> enriched absorption liquid is pumped to the CO<sub>2</sub> stripper.



### CO<sub>2</sub> stripping

The CO<sub>2</sub> enriched absorption liquid is warmed by heat exchange and enters the packed counter current stripper column from the top.

As warm absorption liquid vapour rises from the lower part of the column, the chemical absorption will be reversed and CO<sub>2</sub> released. Gaseous CO<sub>2</sub> will leave the stripper column from the top and the absorption liquid vapour will condensate.

In the bottom of the column the absorption liquid is heated above its boiling point by steam injection. The lean absorption liquid, free from CO<sub>2</sub>, is cooled down and recirculated to the CO<sub>2</sub> absorption column.

The high purity of the CO<sub>2</sub> stream makes it suitable for use as cooling agent, in green houses and other CO<sub>2</sub> applications.



### Compression and drying

The upgraded biogas leaving the CO<sub>2</sub> absorption is on specification however at slight overpressure and saturated with water. The gas will be compressed to 5 – 8 barg depending on the required delivery pressure. Drying takes place in an adsorption drier of the PSA or TSA type.

### Odourisation and analysing

As the produced gas is almost free from smell, an odourant as THT is added for safety reasons to detect leaking gas at any point where it is being used. Gas analysing equipment is installed according to the client's requirements. Typical gas flow, CH<sub>4</sub>, H<sub>2</sub>S and O<sub>2</sub> concentration are measured and also the energy content like Wobbe index.

### Using upgraded biogas

The upgraded biogas meets the same specifications as for natural gas and thus it can be used likewise. Compression to 250 – 300 barg makes it suitable to be used as vehicle fuel for city buses, private cars, garbage trucks and similar. The gas can also be injected into a natural gas grid and be used as green energy.

Purac is a part of Läckeby Water Group, an independent, privately-owned Swedish group, which offers contracting, products and servicing for water and wastewater treatment and biogas production. We are established on three continents and have to date completed contracts in 70 countries worldwide. With sales of around EUR 70 million, Läckeby Water Group is a leading company in its field.

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