



Small Scale and MiniLNG™ Systems

for LNG production and emission recovery

Gas Systems



we deliver

Hamworthy Gas Systems AS is a leading developer and supplier of gas handling and liquefaction technology.



Our greatest resource is our human capital. At our head office outside Oslo, Norway, 250 highly qualified engineers are involved in seeking innovative solutions within engineering and design of LNG production plants suitable for small to medium size liquefaction capacities.

Our global environmental ambitions include gas emission reduction and flare gas recovery systems on land and at sea. Hamworthy delivers VOC recovery systems for shuttle tankers and terminals and has solutions for anti-flaring systems. Hamworthy has also developed environmental friendly fuel gas systems for ferries and coastal trading vessels to reduce NO_x and SO_x emissions.

engineering, procurement, construction, installation and commissioning

Hamworthy takes the EPCIC responsibility for small to medium size LNG production plants. We delivered our first plant in 2003.



Our reliable and innovative solutions are based on 45 years extensive experience of cargo handling systems for LPG and LNG.

Pioneering the LNG reliquefaction systems for ultra-large LNG carriers, using the same liquefaction technology as the land based plants, the technology will serve a growing world fleet of LNG carriers.

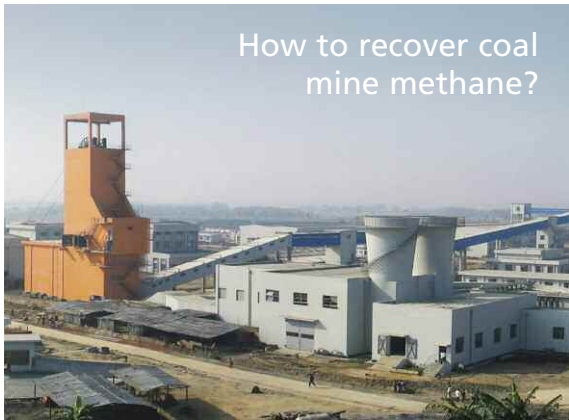
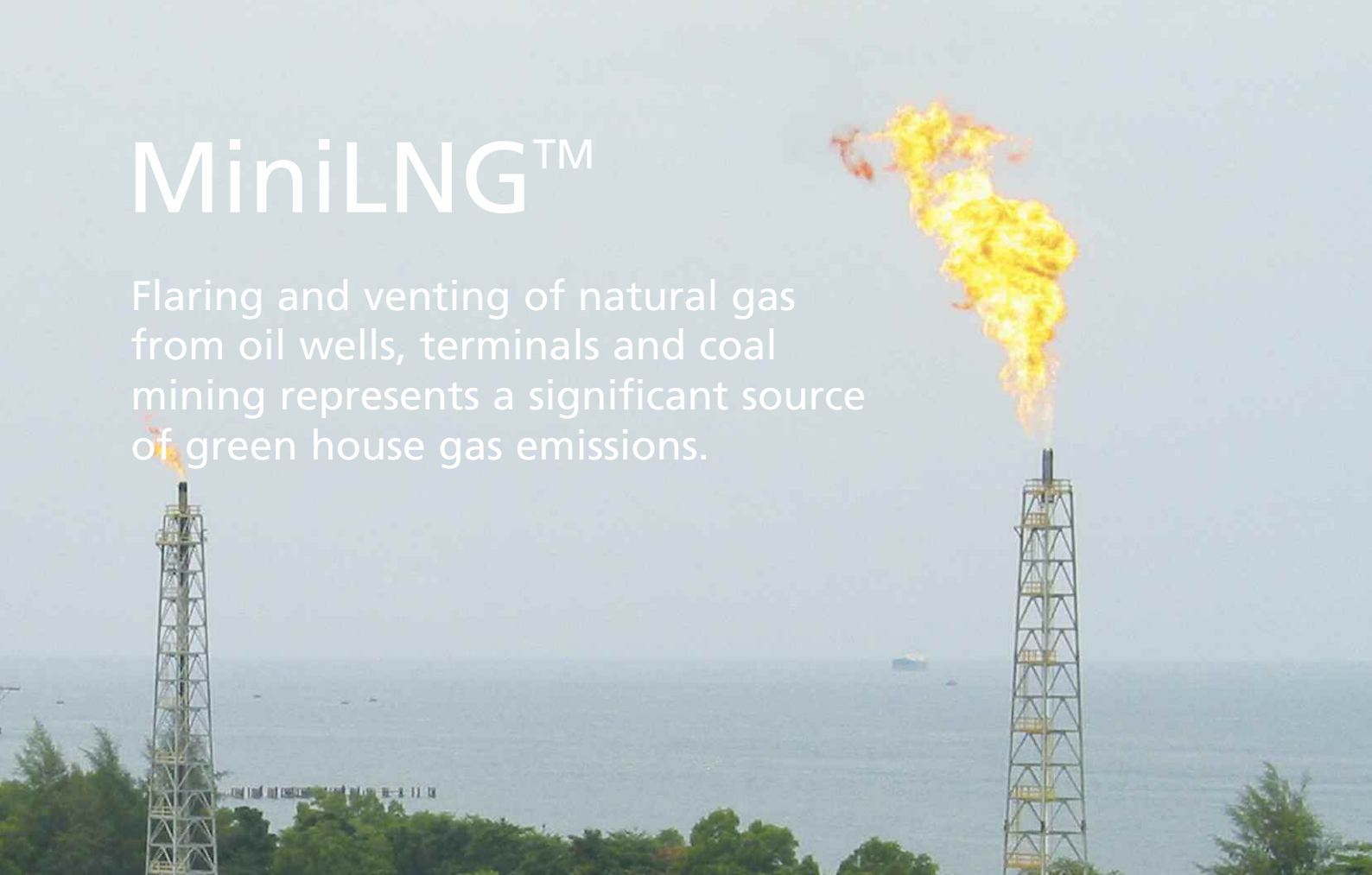
Hamworthy also delivers LNG regasification systems for receiving terminals and experience gained with our LNG carrier reliquefaction technology is now applied on LNG FPSOs.



Snurrevarden LNG plant, Norway.

MiniLNG™

Flaring and venting of natural gas from oil wells, terminals and coal mining represents a significant source of green house gas emissions.



How to recover coal mine methane?

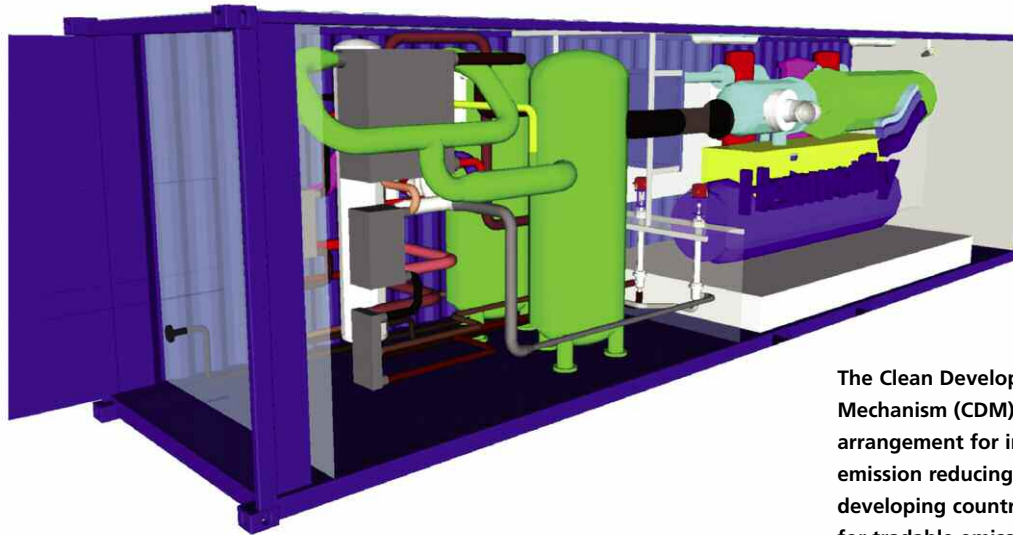
The World Bank estimates that over 150 billion cubic metres (bcm) of natural gas are being flared and vented annually corresponding to the combined yearly consumption of Germany and France. Some 10,000 coal mines in the top five coal producing nations only represents a considerable sources of methane venting to the atmosphere.

In many places there are also reserves of "stranded" natural gas resources that are abandoned because currently there is no economical way to get it to the markets. Coal bed methane is a largely untapped gas source with a potential that requires new innovative solutions to be commercially attractive. Liquefied bio gas (LBG) is also an emerging industry.



How to liquefy bio-gas?

Turning these reserves of gas into value-added liquid fuels is very attractive from an environmental stand point. As a way to meet these demands Hamworthy has developed a very small liquefaction plant we have called MiniLNG™. A project using the MiniLNG™ might qualify for the Clean Development Mechanism (CDM) if the project helps reduce net emission of greenhouse gases.

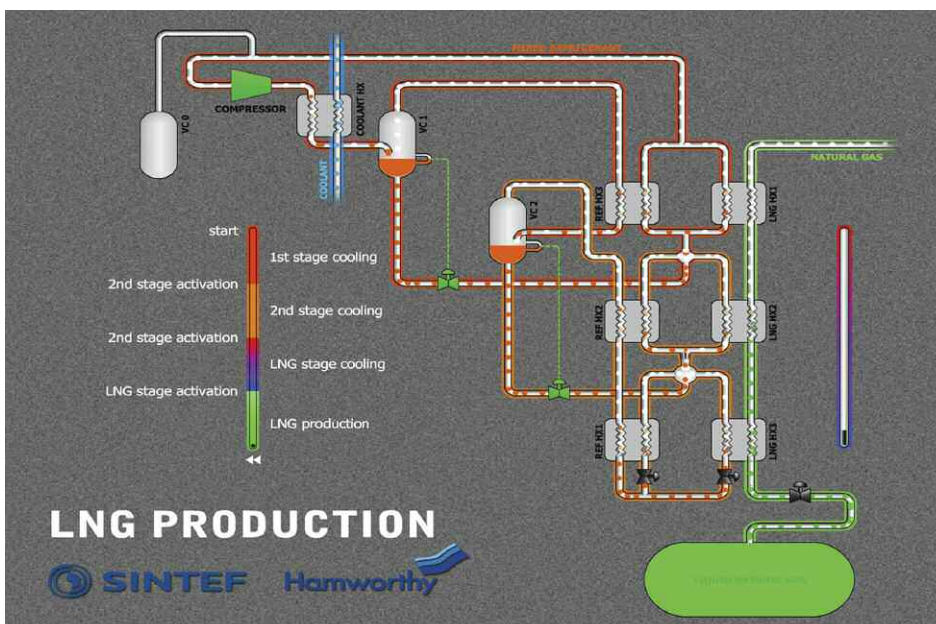


The Clean Development Mechanism (CDM) is an arrangement for investments in emission reducing projects in developing countries in return for tradable emission reduction certificates.

green-house gas emissions recovery

The MiniLNG™ is a liquefaction plant in a standard 40" ISO container optimized for low pressure gases with high content of contaminants based on a technology licensed to Hamworthy. Pre-treatment and pre-cooling takes place in separate containers and is gas source specific. The plant can be relocated to other locations and sources.

The plant uses only standard equipment for low investment cost and fast manufacturing at an assembly site. It is easily shipped and installed at the chosen location with a "Plug and play" design philosophy. For a non-disruptive production of liquefied gas the MiniLNG™ plants will be powered by a gas engine using the feed gas or regeneration gas, or a mix of both.



The SINTEF refrigeration cycle uses a closed loop mixed refrigerant cycle for low energy demand. The capacity is in the range from 2000 to 6000 tons of liquefied gas per year.

N₂ refrigerant

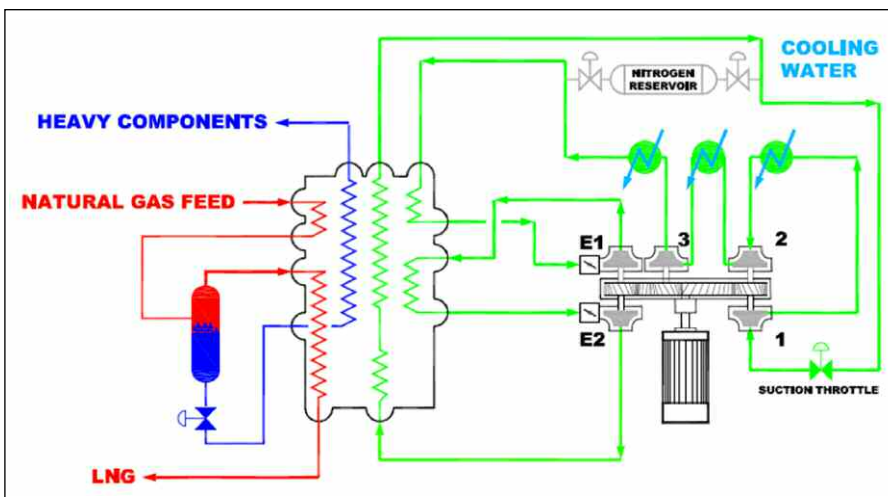


Kollsnes II LNG plant

Hamworthy's liquefaction plants with a production capacity between 20,000 and 500,000 tons per year are based on the Brayton nitrogen refrigeration cycle. Nitrogen is the sole refrigeration medium, and used in a process of compressing and expanding the nitrogen to obtain the required cold temperature.

These liquefaction plants are easy to operate, reliable, fully automated and represent a low life cycle cost solution in the small to medium size liquefaction capacity range. Normally these plants require a pre-treatment system to handle water, CO₂ and other impurities.

Small scale liquefaction plants open new market opportunities to develop local or regional gas distribution networks. This is based on liquefied natural gas where gas as an environmentally friendly and competitive energy source did not previously exist as an alternative.



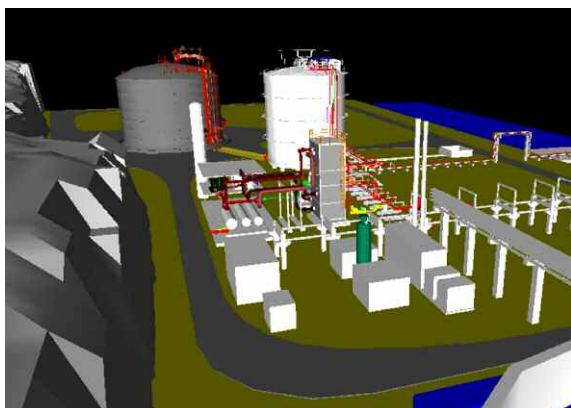
Schematic shows a typical nitrogen refrigeration cycle with double expanders and cold box as installed at the Kollsnes II plant.

environmentally friendly, reliable, robust, flexible and low maintenance

Hamworthy's first small scale LNG liquefaction plant with a capacity of 20,000 tons per year has been operating reliably since 2003. Outside Bergen in Norway, we delivered a full separate extension at an existing plant. This new plant, called Kollsnes II, went into operation in August 2007 with a capacity of 84,000 tons per year.



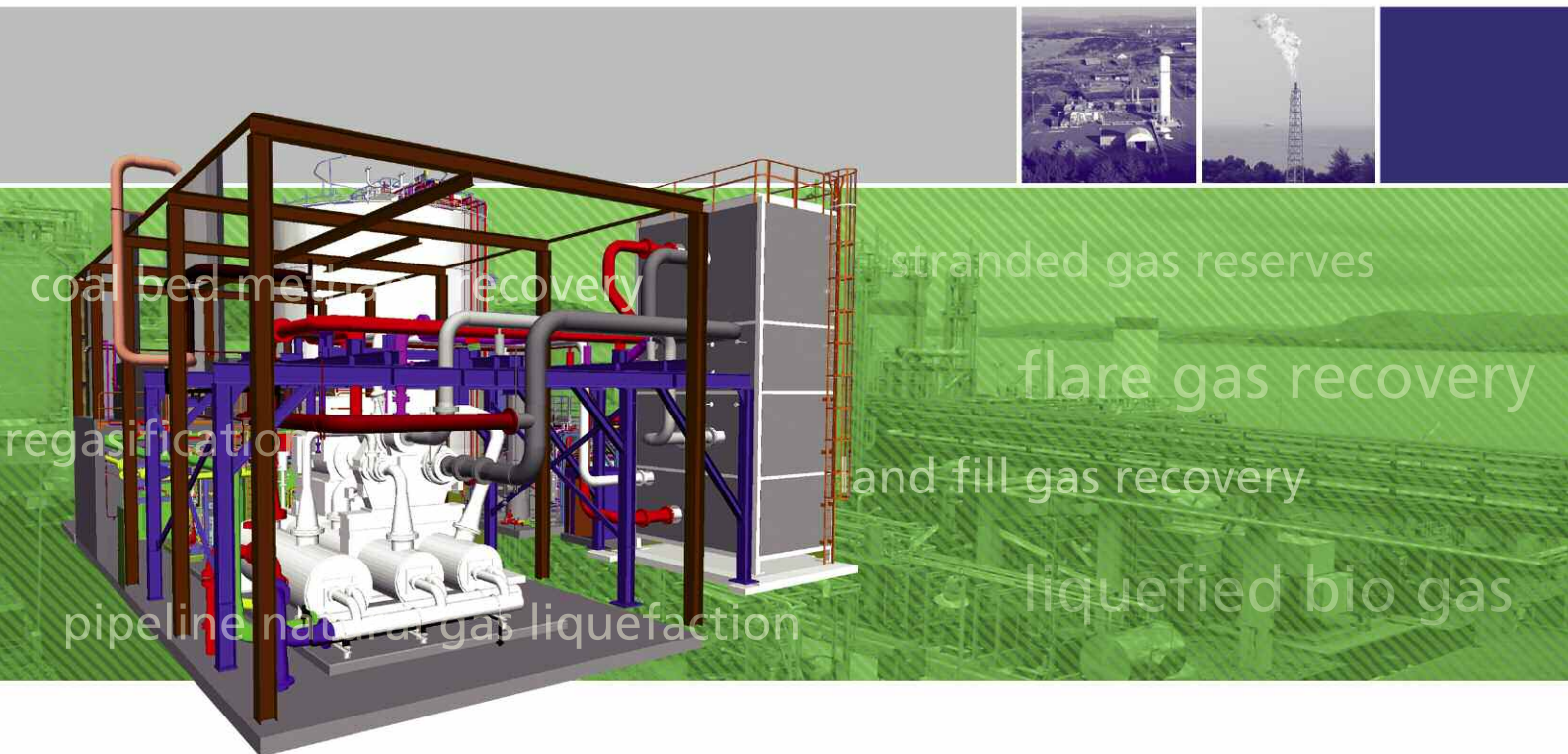
Snurrevarden LNG plant, Norway.



Kollsnes II LNG plant

The liquefaction process is all about storing the energy for later use and/or to transport the gas to (or from) places where economical or technical constraints makes pipeline transportation not suitable. Other applications for smaller liquefaction plants are:

- Small and remote gas fields
- LNG as fuel for vehicles
- Boil off gas handling at terminals
- Flare gas recovery
- Coal bed methane recovery
- Landfill gas or bio gas production
- Security of supply



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