OIL AND GAS

NATURAL GAS CAPTURE

Clean and economic
Five percent of the world’s gas supply is wasted through flaring and venting. It is equivalent to about 110–140 billion cubic metres of gas which is the combined gas consumption of Central and South America in 2013. The World Bank estimates that flaring 140 bcm would cause more than 350 million tonnes of CO₂ to be released into the atmosphere. If this could be harnessed for power, for example, it could produce 750 billion kilowatt hours per year, more than Africa’s entire annual electricity consumption.

Gas flaring releases toxic components and greenhouse gases into the atmosphere that can have harmful effects on the health and well-being of local communities and contribute to climate change. Our methodology explores local solutions for capturing associated gas that would normally be flared, transforming it into useful product.

This service was developed as part of an Extraordinary Innovation Project to investigate solutions for capturing unprocessed gas and present technically and economically promising options that are sustainable for their application.
THE IMPACTS OF FLARING

It is well known that flared gas is a significant contributor to global warming. However, some other important issues that are not so well known exist.

Complete combustion does not occur during flaring and this leads to the production of black carbon particles. These particles strongly absorb sunlight and emit heat to the surroundings which warms the air and can affect regional cloud formation and precipitation patterns. When deposited on snow and ice, melting is accelerated. Gas flaring produces an estimated 66% of the black carbon emissions in the Arctic.

Flaring can be fatal for some species of birds and airborne insects that are attracted to the heat and flames. Migrating birds can be killed by the heat and flames from flaring. For example in 2013, 7,500 songbirds were killed at Canaport gas plant in Saint John, Canada.

Valuable natural resources are wasted by flaring. According to the World Bank, 20% of the world’s population do not have access to electricity and 40% rely on solid fuels for cooking. This results in over four million premature deaths due to indoor air pollution every year. The natural gas could have been used to generate electricity and also for cooking.
CHALLENGES TO REDUCE FLARED GAS

Most of the flaring occurs at either ageing and/or remote installations. The associated gas at these installations is usually small in volume and requires moderate gas processing. Retrofits and transportation of recovered gas to processing facilities also involve significant capital cost. Without a global cost penalty for emitted carbon, there are few business incentives to capture the flared gas. Financial barriers can significantly impede the efforts to reduce emissions and this is particularly true for countries with developing economies.
Capture of flared gas presents an opportunity to reduce the environmental impact as well as providing an economic opportunity. The gas captured can be used to create new value chains that can benefit not only the industry but also people’s quality of life.

DNV GL can help to identify technology solutions to capture associated gas that is currently being flared in oil production fields and assess how these resources can be converted, transported and utilised.

Technology solutions are largely dependent on the flow rate, gas compositions and distance to market. DNV GL has carried out conceptual studies based on real locations and real field conditions both onshore and offshore. The cases cover different small-scale flow rates and gas compositions in four countries; Russia, USA, Algeria and Vietnam. DNV GL acted as an independent party and reviewed all the existing and innovative technologies as alternatives to flaring to reduce the amount of flared gas, taking into account various aspects during the studies as shown on the right. The details and results can be found on pages 08–11.
By capturing the associated gas that would otherwise be flared, we can create new value chains that are sustainable. These bring benefits such as:

- Reduced carbon footprint
- Revenue generation
- Improvements to people’s quality of life
Novelty of the Technology Solutions: Many of the technology solutions are mature at large scale but few technologies have been used commercially at small-scale. Therefore most of the technology solutions shown are novel except for Gas to Wire.

**Alternatives to Flaring**

**Using more cost-effective ways of transporting natural gas where there is no existing pipeline**

**Adsorbed Natural Gas (ANG)** is natural gas stored in a porous adsorbent material.

**Compressed Natural Gas (CNG)** is a pressurised form of natural gas at around 250 bar.

**Liquefied Natural Gas (LNG)** is a liquid form of natural gas at cryogenic state of around -160 °C at atmospheric pressure.

**Natural Gas Hydrates (NGHs)** are crystalline solids composed of water and natural gas in physical combination where individual gas molecules exist within ‘cages’ of water molecules.

Novel solutions such as **reusable pipes** can be used to transport the associated gas to other users. This will result in cost savings as these pipes are cheaper and can be re-used many times.

**Converting gas into products with a higher economic value through chemical processes**

**Compact Gas to Liquids** processes are being developed for small-scale applications that generate valuable products such as synthetic crude oil, petrol (gasoline), diesel and jet fuels.

**Ammonia** is used in the paper and pharmaceuticals industries whereas urea is used for fertilisers.

**Methanol and Methanol Mixes** (Methanol/Ethanol/Formalin) are used for a variety of purposes including automotive fuels as well as for industrial uses.

**Dimethyl Ether** is used for a wide range of fuel applications including domestic cooking.

**Hydrogen** is often used as an industrial chemical as well as for automotive fuel.

**Ethylene** and **propylene** are used for plastics production.

**Novel Concepts**

**Bringing the market closer to the source of gas flaring**

The power generated can either be used on site immediately or stored in **battery** form for future use such as back-up supply.

Moreover, the power generated can be used for **air separation** which is an energy intensive process.

The associated gas can also be used as fuel gas to heat up the wastewater to **evaporate the water** for ease of waste disposal.

Similarly, the same concept can be used for **desalination** to provide clean water for nearby communities.

**Other Solutions**

The gas can also be used for power generation, i.e. **Gas to Wire**. Associated gas usually has lower methane content and higher heavy hydrocarbons, therefore **Liquefied Petroleum Gas (LPG)** and **Natural Gas Liquids (NGLs)** can be recovered during the gas processing treatment.

**Carbon Black** can be produced by incomplete combustion or thermal decomposition of hydrocarbons. It is mainly used in the rubber industry for tyre production as well as for plastics and paints.
CREATING VALUE FROM FLARED NATURAL GAS

- Gas to Liquids
  - Dimethyl Ether
  - Hydrogen
  - Methanol
  - Propylene
  - Ammonia/Urea
  - Ethylene
- Water Evaporation
  - Desalination
- LPG & NGL Recovery
- Batteries
  - Carbon Black
- Gas to Wire
- Air Separation

Cost effective ways of transportation
Convert into products of higher values
Bring market closer to flaring source
Other solutions

NGHs
CNG
ANG
LNG
Re-usable pipelines
Most technically and economically promising solutions

From single well pad
- CNG, Methanol Mixes, Gas to Wire, LPG/NGLs

From multiple well pads
- LNG, Methanol Mixes, Gas to Wire, LPG/NGLs

**Location**  Onshore
**Solutions**  Mobile and permanent
**Flowrate**  
- 0.3 MMscfd (from a single well pad)
- 10 MMscfd (from multiple well pads)
NOVEL CONCEPTS

Batteries
The associated gas can be used to generate electricity to store in batteries.

Re-usable pipes
The associated gas can be transported to other users via pipelines that could be re-used eliminating the use of road or rail transport. These pipes can be taken up after the well is depleted and re-laid elsewhere.

Air separation
The associated gas can also be used as fuel gas to separate air into nitrogen and oxygen. Nitrogen can be used for industrial uses or for well stimulation. Oxygen can be used for domestic/industrial processes.

Produced water evaporation
The associated gas can be used as fuel gas for evaporation of the produced water stream to reduce water removal transportation costs.

Desalination
The associated gas can be used as fuel gas for desalination of the produced water stream which will produce a clean water source. This is extremely useful for remote areas where clean water is often an expensive and scarce commodity.

Most technically and economically promising solutions
LNG, Gas to Liquids, Methanol, Methanol Mixes, Dimethyl Ether, Ammonia, Propylene, Gas to Wire

RUSSIA
Location: Onshore
Solutions: Permanent
Flowrate: 30 MMscfd

ALGERIA
Location: Onshore
Solutions: Permanent
Flowrate: 20 MMscfd

VIETNAM
Location: Offshore
Solutions: Floating/Mobile
Flowrate: 25 MMscfd

Most technically and economically promising solutions
CNG, Gas to Wire, Gas to Liquids and Methanol Mixes are promising for the future

RUSSIA ALGERIA VIETNAM

Location
Solutions
Flowrate

Most technically and economically promising solutions
LNG, Gas to Liquids, Methanol, Methanol Mixes, Dimethyl Ether, Ammonia, Propylene, Gas to Wire
It is a complex process to determine suitable technology solutions as alternatives to flaring. The flowchart shows DNV GL’s methodology. This methodology uses the gas flowrate and the distances to market for various products to select the most appropriate technology solutions for a particular case.
PROMISING TECHNOLOGY OPTIONS

Onshore technology options chart based on uncontaminated flared gas flowrates and the distance to product markets. Each geographical setting provides different technical, regulatory and economic challenges and, therefore, the boundaries of each study should be framed prior to starting any study. The above graph reflects a generic set of solutions based on the cases studies assessed in our work to date.
THE WAY FORWARD

DNV GL has performed thorough conceptual studies based on real locations and real field conditions in four countries.

We have found that there are solutions and new concepts that can contribute to safer and sustainable future. We have identified novel techniques for addressing this topic that could present new revenues.

The technology solutions and means of transportation that we have explored can also be applied to:

- Monetisation of small-scale stranded gas fields
- Monetisation of associated gas from extended well tests
- Resolve demands at remote areas where there is no infrastructure
- Capturing vented gas

Services

DNV GL can provide a wide range of services for stakeholders to better utilise the associated gas, such as:

- Conceptual studies
- Techno-economic studies
- Technology qualification
- Verification of conceptual designs
- Development of innovative solutions
- Provide technical advice to policy makers and regulators

CONTACT

For more information on how to capture flared gas, please contact Martin Layfield: Martin.Layfield@dnvgl.com
At DNV GL we have researched a wide range of market scenarios and solutions that can help developers and operators to capture flare gas and to create value. We believe there are economically viable solutions that assist in carbon abatement and that develop flare gas for societal use. At DNV GL we are committed to helping stakeholders make these opportunities a reality.

Martin Layfield, Gas Segment Director, DNV GL
ABOUT DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries.

Combining leading technical and operational expertise, risk methodology and in-depth industry knowledge, we empower our customers’ decisions and actions with trust and confidence. We continuously invest in research and collaborative innovation to provide customers and society with operational and technological foresight. With our origins stretching back to 1864, our reach today is global. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping customers make the world safer, smarter and greener.