Natural Gas Capture – Clean and Economic

Martin Layfield
Impacts of Flaring

5% of world’s gas supply is flared and vented

- Equivalent to 110 – 140 bcm of gas
- More than Africa’s yearly electricity consumption
- 750 billion kWh/year of power could be produced
- Equivalent to gas consumption of Central and South America
- Equivalent to 350 million tonnes of CO₂
Impacts of Flaring

Gas flaring produces an estimated 66% of the black carbon emissions in the Arctic.

In 2013, 7,500 songbirds were killed at Canaport gas plant in Saint John, Canada.

Valuable natural resources are wasted by flaring. The gas could have been used to generate electricity and for cooking.
Top 20 Flaring Countries in the World

Gas flaring (bcm): Top 20

<table>
<thead>
<tr>
<th>Rank/Country</th>
<th>Year 2007</th>
<th>Year 2011</th>
<th>Change</th>
<th>% of 2011 Total</th>
</tr>
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<tbody>
<tr>
<td>01 Russia</td>
<td>52.3</td>
<td>37.4</td>
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<tr>
<td>02 Nigeria</td>
<td>16.3</td>
<td>14.6</td>
<td>-1.7</td>
<td>10.4</td>
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<tr>
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<td>+2.7</td>
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<td>-0.8</td>
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<tr>
<td>08 Angola</td>
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<td>09 Saudi Arabia⁴</td>
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<tr>
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<td>-1.6</td>
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<td>+0.1</td>
<td>1.2</td>
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<td>TOP 20 TOTAL</td>
<td>132</td>
<td>121</td>
<td>-11.0</td>
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<td>Rest of the World</td>
<td>22</td>
<td>19</td>
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<tr>
<td>GLOBAL FLARING</td>
<td>154</td>
<td>140</td>
<td>-14.0</td>
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</tbody>
</table>

The most recent World Bank estimates from US National Oceanic and Atmospheric Administration satellite data showing American shale oil production driving up flaring there. Flares off Bakersfield, by far the most, but has been reducing this.

Notes
1 bcm = billion cubic metres
2 includes North Dakota shale fields
3 was reported as much lower
4 includes Saudi share of Neutral Zones with Kuwait
5 was reported as much higher

Source: Satellite data from US National Oceanic and Atmospheric Administration analysed by the World Bank
Challenges to Reduced Flared Gas

- Volume of gas from each well is small
- Distance to market is far
- Involves significant capital cost
- Cheaper to flare
- No global cost penalty for emitted carbon
- Concerns of technical risk
Alternatives to Flaring

Source of Flared Gas → Capture & Process

Transport

Convert

Bring Market Closer

Other Solutions
Creating Value from Flared Natural Gas

Creating Value from Flared Natural Gas

- Re-usable pipelines
- LNG
- ANG
- CNG
- NGHs
- Gas to Liquids
- Hydrogen
- Dimethyl Ether
- Ammonia/Urea
- Methanol
- Ethylene
- Propylene
- Water Evaporation
- Desalination
- Air Separation
- Gas to Wire
- LPG & NGL Recovery
- Batteries
- Carbon Black

Cost effective ways of transportation
Convert into products of higher values
Bring market closer
Other solutions
North Dakota
North Dakota at Night
North Dakota

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

Most technically and economically promising solutions
From single well pad:
- CNG, Methanol Mixes, Gas to Wire, LPG/NGLs
From multiple well pads:
- LNG, Gas to Wire, LPG/NGLs
More Cost Effective Ways of Transporting Gas
Convert into Products with Higher Values
Bring Market Closer to Source of Flaring
Calculating the techno economic viability and environmental impact
Assessing the economics and environmental impact

Decision Support Tool

Aims to give a brief overview of potential technologies that may apply to the customer’s situation.

Shows potential economic and environmental impact of flaring.

Provides a high level economic calculation (CAPEX in the range of +/- 50%)

The Environmental and Economic Impact of Flaring and Deferred Production

Managing methane is equivalent to...
DNV GL’s 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
Thank you.

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