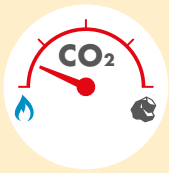
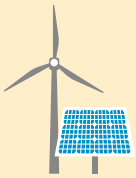
TACKLING METHANE EMISSIONS

PROVIDING MORE AND CLEANER ENERGY

With the world's population expected to increase by a billion by 2030, gas is one of the few energy sources that can meet growing demand while reducing greenhouse gas emissions when used in place of coal or diesel.

Air quality is also improved when **natural gas is used in place of coal or diesel**.





Gas supports an increasing role for renewables, **providing support for wind, solar and hydroelectricity,** helping match the supply and demand of cleaner electricity.

Gas will continue to play a **critical role in difficult to electrify sectors** such as the production of steel, cement and chemicals, as well as long-distance transportation.

WHAT IS METHANE?

Methane is a potent greenhouse gas, which has a **higher impact on global warming than carbon dioxide**. It is emitted during the production, processing, transport and incomplete combustion of oil and natural gas.

WHERE DOES METHANE COME FROM?

Globally, around **60% of total methane emissions come from human activities,** according to the International Energy Agency (IEA).

The remaining **40%** of global methane emissions are naturally occurring, from natural seeps, wetlands, animals such as termites, and vegetation decay.

About **13%** of total global methane emissions come from oil and gas related activities, split roughly equally.

SECURING THE FUTURE OF GAS

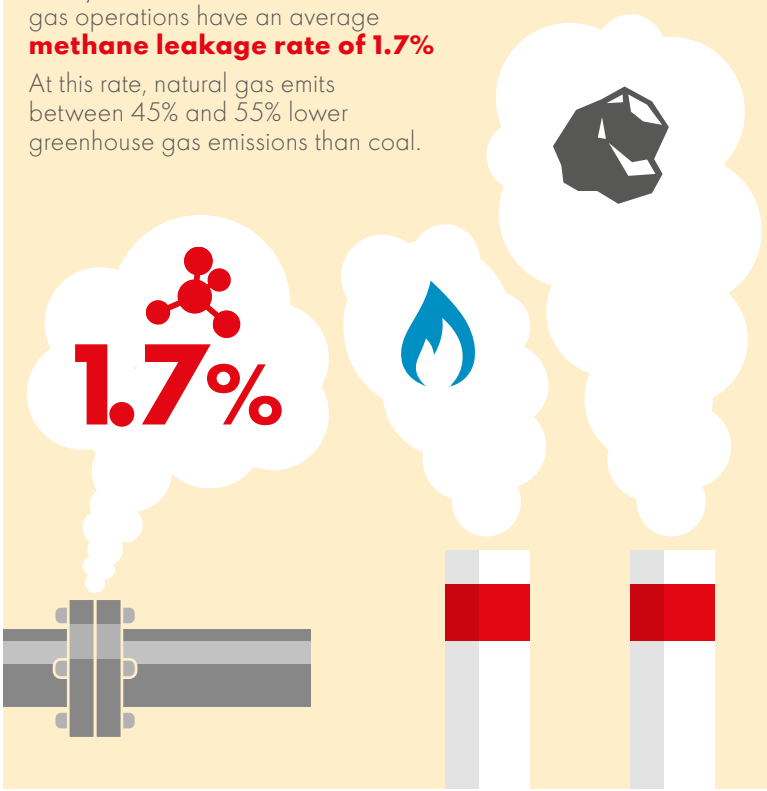
To realise greater greenhouse gas emissions benefits, the gas industry must increase its focus on **reducing emissions of methane across the supply chain.**

IMPACT ON GLOBAL WARMING

Greenhouse gas emissions from natural gas are lower than coal in electricity generation up to a methane leakage rate of 3.5% when measured over 20 years. This jumps to 7.5% over 100 years.

Today, the IEA estimates that natural gas operations have an average **methane leakage rate of 1.7%**

At this rate, natural gas emits between 45% and 55% lower greenhouse gas emissions than coal.



SHELL TARGET 0.2 BY 2025

Shell has announced a target to maintain methane emissions intensity below 0.2% by 2025. This target covers all oil and gas assets for which Shell is the operator.

DATA UNCERTAINTY: The total methane intensity number is an estimate only as there continue to be limitations to the comprehensive measurement of methane emissions. Regulatory recording and reporting requirements for methane emission varies significantly between countries. We are working, both within Shell and in collaboration with other oil and gas producers, to improve the accuracy of the quantification of methane emissions data.

In 2018, Shell[1] announced a target to keep its own methane emissions intensity, for both oil and gas, below 0.2% by 2025. This target covers all Upstream and Integrated Gas oil and gas facilities for which Shell is the operator. We have a range of technologies and work practices in place to help find and fix methane emissions in our operations. This is done by improving methane emissions reporting, using advanced equipment to detect and repair methane leaks and replacing older equipment.

Reducing emissions

EcoVapor, Permian Basin, USA

The natural gas extraction and production process leaves excess oxygen in the gas. EcoVapor ZERO2 is a third-party technology introduced to solve this issue at Shell's oil and gas operations in the Permian Basin in western Texas. The ZERO2 technology removes the oxygen, so the gas can meet the pipeline oxygen standards required for it to be sold. In 2019, this reduced flaring by 32 tonnes of methane, compared to 2018. Shell has 32 ZERO2 units at 11 sites in the Permian, and is looking to add more.

Upstream improvements to well maintenance process, Australia

At the Shell-operated QGC site in Australia we safely reduced the time spent maintaining the site's 2,600 wells, which resulted in less methane venting into the atmosphere. This improvement in procedures reduced methane emissions by 4,083 tonnes in the six months from July to December 2019.

EcoVapor ZERO2 installations on Shell sites in the Permian

Equipment optimisation


A worker inspects an electric actuator at a Groundbirch well site.

- **Shell's Appalachia gas operations** use gas-assisted pumps to remove water from the natural gas. In 2019, four pumps were replaced with electric versions to reduce methane emissions by 625 tonnes. There are plans to introduce four more electric pumps in 2020, further reducing methane emissions by 700 tonnes.
- **Shell Canada's Groundbirch natural gas project** is reducing methane emissions from existing gas wells. Electric powered mechanisms that open and close process valves, called actuators, have been introduced to replace older actuators that vented methane to the atmosphere by design during valve operation. In 2019, 12 valves were removed and four were replaced with new electric powered 'zero emission' valves, resulting in a reduction of 13 tonnes of methane emissions. In 2020, around 50 valves are planned to be replaced, to further reduce methane emissions by 74 tonnes.

  In addition, a new well design, known as the 'Gen 4 Multi-Well Pad', has been introduced at Groundbirch's newest 25 wells to reduce methane emissions further. The design is electrically operated and has become the standard for future wells built in the Groundbirch field. Along with reduced emissions, this optimised well pad design also increases production capacity by 40% and decreases costs by 15%.

[1] The companies in which Royal Dutch Shell plc directly and indirectly owns investments are separate legal entities. In this document "Shell" is used for convenience where references are made to Royal Dutch Shell plc and its subsidiaries in general, and where no useful purpose is served by identifying the particular company or companies.

Finding methane leaks and improving reporting

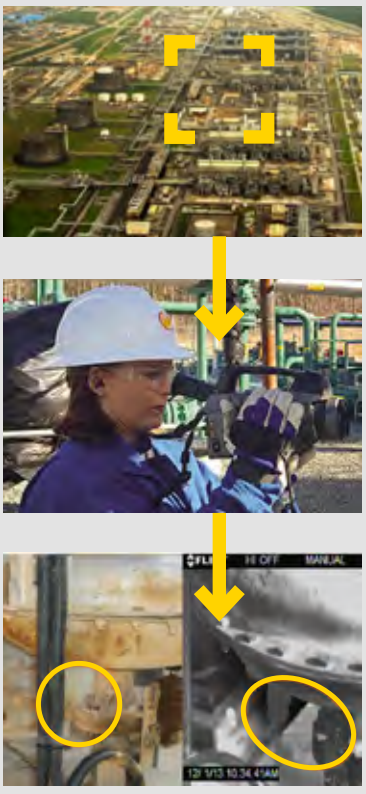
Before methane leaks can be stopped, the sources must first be identified. To do this, we use a broad range of methods and technologies. These include implementing leak detection and repair programmes and using the best available technologies – like optical gas imaging cameras – to reduce methane emissions at our sites.

Since 2018, a full leak source inventory has been conducted to improve detection and reporting at five facilities including:

1. Pearl Gas to Liquids (GTL), Qatar
2. Shell Middle Distillate Synthesis (SMDS), Malaysia
3. Trinidad and Tobago, Upstream
4. Gasnor LNG, Norway
5. Oman LNG (OLNG) - a non-operated venture

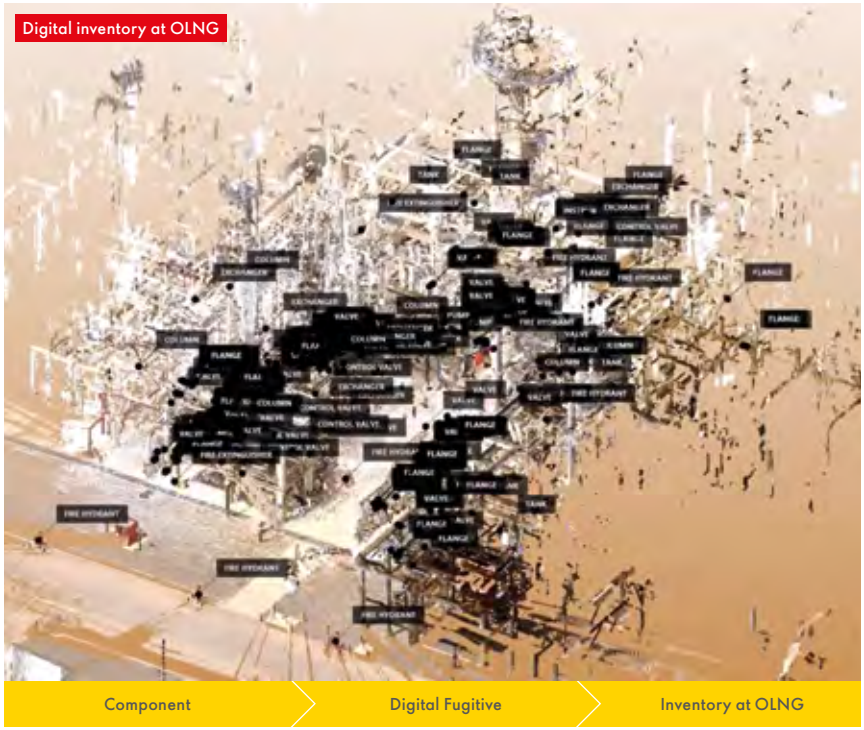
For example, at Pearl GTL in Qatar we scanned 33,000 components and detected 48 leaks, most could be repaired almost immediately.

Optical gas Imaging in action



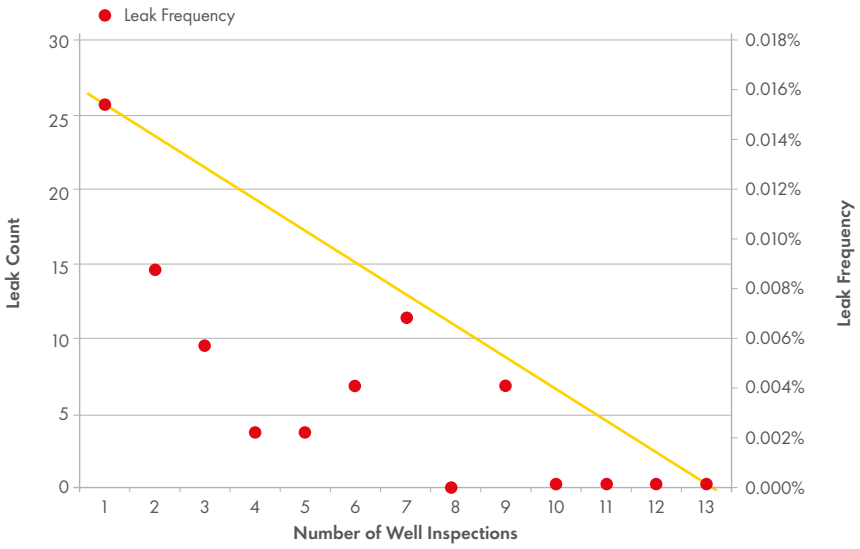
Methane Digital Accelerator Pilot, Oman

At the Oman Liquified Natural Gas Plant (OLNG; Shell interest, 30%) an innovative approach to capture digital data on leak sources was tested in October 2018. The digital inventory of around 3,000 components with the potential to leak methane was automated so leaks could be plotted on a 3D map as they were identified. The 3D map, similar to Google Street View, was developed with laser scanning technology to create 360-degree images of potential leak hot spots. This results in leaks being pinpointed immediately and repaired more quickly.



Appalachia, Pennsylvania, USA

Shell's Appalachia gas operations have been using an optical gas imaging (OGI) camera to identify methane emission leaks since 2012. More than 400 wells and around 143,000 individual components were inspected during 800 trips to individual wells between 2012 and 2019. This leak inspection programme has not only identified leaks as they occur but has led to less methane leakages over time, with no leaks identified on the last four visits.



Technology pilots

Drone performs aerial inspection at Shell's Permian Basin operations

Drone-based remote inspection, Permian Basin, USA

In July 2018, Shell started using cameras and sensors mounted on drones in the Permian Basin to detect and monitor methane leaks together with Avitas Systems, a Baker Hughes venture (formerly GE). Initial trials have demonstrated potential for more accurate and efficient leak detection, monitoring and quicker repairs.

Drones have multiple benefits including removing vehicles from the roads, increasing the efficiency of Shell's workforce, and gathering detailed digital data on assets.

In 2020, we are continuing to test drone mounted cameras and other new technologies with a goal of expanding their use if proven cost-effective.

Watch a drone in action:
https://youtu.be/8NhEphNAP2k

Remote leak detection, Pernis, Netherlands

The Pernis Refinery in the Netherlands is using an optical gas imaging camera capable of detecting up to eight gases in real time. The automated monitoring system continuously scans the site from a high vantage point and can detect gases up to 1 kilometer away. It sounds an alarm when a leak is detected, provides video and photos of the leak sources and identifies the type and amount of gas that has been released. Since the system was introduced, no significant leaks have been found at Pernis.

NUMBERS

Gas has
45-55%
lower greenhouse gas emissions than coal

2.5x
Methane concentration in the atmosphere vs pre-industrial levels

1.7%
Average methane leakage rate of oil and gas operators

<0.2%
Shell's target: to maintain methane emissions intensity below 0.2% by 2025

Maarten Wetselaar, Shell Integrated Gas and New Energies Director

"The environmental advantage of gas over coal has led to significant reductions in greenhouse gas emissions. This drives the industry to continually address methane emissions, which can reduce the relative emissions benefits of natural gas. Shell has a continued focus on tackling its greenhouse gas emissions. Such efforts are a critical part of Shell's strategy to thrive during the global energy transition by providing more and cleaner energy."

Infrared camera being used to detect leaks in Appalachia, USA

The role of industry

A worker at Pearl GTL (gas-to-liquids) in Qatar

Driving down emissions across the full supply chain

Shell collaborates with industry, international institutions, non-governmental organisations and academics to mitigate methane emissions through a range of initiatives, including:

METHANE GUIDING PRINCIPLES

Methane Guiding Principles (MGPs)
methaneguidingprinciples.org

In 2017, Shell led the development of a set of non-binding Methane Guiding Principles, with a coalition of industry, international institutions, non-governmental organisations and academics. Actions resulting from the MGP initiative include: the development of Best Practice Guides, Synopses and Tools, which offer practical solutions for companies looking to manage their methane emissions; the development of a Global Outreach Programme which comprises of two courses – an Executive Course and a Masterclass; and the development of a Policy Framework to provide a common basis for discussion between relevant stakeholders in the development and implementation of effective methane abatement policies.

OGCI OIL AND GAS CLIMATE INITIATIVE

Oil and Gas Climate Initiative (OGCI)
oilandgasclimateinitiative.com

Shell is one of 13 members of the OGCI, a CEO-led programme to address the industry's response to climate change. One of OGCI's focus areas is methane management. In 2018, OGCI announced a methane intensity target of 0.25% by 2025, with an ambition of 0.20% by 2030, for its member companies. Meeting the 2025 target would result in reducing collective methane emissions by 350,000 tonnes per year, compared to 2017.

CLIMATE & CLEAN AIR COALITION

UN environment programme

Climate and Clean Air Coalition – Oil and Gas Methane Partnership (OGMP)
ccacoalition.org/en/resources/oil-gas-methane-partnership-ogmp-overview

The OGMP is a multi-stakeholder partnership focusing on improved methane emissions reporting and abatement. Shell joined the OGMP in 2017 and has been working to provide detailed methane emissions reporting from its operated assets. Shell also updated its internal methane reporting in 2018 to align with key sources identified by the OGMP.

GGFR Global Gas Flaring Reduction Partnership

Global Gas Flaring Reduction Partnership
worldbank.org/en/programs/gasflaringreduction

Shell is an active member of the World Bank-sponsored Global Gas Flaring Reduction partnership. As part of the partnership, the World Bank has developed the 'Zero Routine Flaring by 2030' initiative, signed by Shell in 2015. This encourages governments, companies and development organisations to work together to end flaring.