UN environment programme

An Eye on Methane

International Methane Emissions Observatory 2022 Report

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Glossary

- **Bottom-up**
  Bottom-up methods are based on direct measurements at a source-level.

- **Distribution System Operator (DSO)**
  The entities responsible for distributing and managing energy from the generation sources to the final consumers.

- **Divestment**
  The process through which fossil fuel companies sell off assets to another company.

- **Emission factors**
  An emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant.

- **Fat tail**
  A probability distribution that exhibits a large skewness. In the context of methane, this refers to a few emissions sources representing a disproportionate amount to share.

- **Global Warming Potential**
  A measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide.

- **Global Methane Pledge**
  Global Methane Pledge is an initiative to reduce global methane emissions to keep the goal of limiting warming to 1.5 degrees Celsius within reach. A total of over 120 countries representing 70% of the global economy and nearly half of anthropogenic methane emissions have now signed onto the pledge.

- **Gold Standard**
  "Gold Standard" refers to both the highest reporting levels under OGMP 2.0 and companies' plans to achieve this level.

- **Intergovernmental Panel on Climate Change (IPCC)**
  The Intergovernmental Panel on Climate Change is an intergovernmental body of the United Nations responsible for advancing knowledge on human-induced climate change.

- **Levelized Cost of Electricity (LCOE)**
  A measure of the average net present cost of electricity generation for a generator over its lifetime. It is used for investment planning and to compare different methods of electricity generation on a consistent basis.

- **Liquefied Natural Gas (LNG)**
  Liquified Natural Gas (LNG) is natural gas that has been cooled to a liquid state, at -162oC (-260oF), for shipping and storage.

- **Metallurgical coal**
  Metallurgical (met) coal (or coking coal) is a naturally occurring sedimentary rock found within the earth's crust and an essential ingredient in the production of steel.

- **Measurement, Reporting, and Verification (MRV)**
  The multi-step process to measure the amount of greenhouse gas emissions reduced by a specific mitigation activity, over a period of time and report these findings to an accredited third party, which then verifies the report so that the results can be certified and carbon credits can be issued.

- **Non-operated asset**
  A non-operated asset (NOA) is an asset at which another oil and gas company than the OGMP2.0 member who is reporting its emissions, has the role of asset operator.

- **Oil and Gas Methane Partnership 2.0 (OGMP 2.0)**
  A multi-stakeholder initiative helping the industry to better understand and manage methane emissions through a comprehensive measurement-based methane reporting framework that standardizes rigorous and transparent emissions accounting practices.

- **Remote sensing**
  The process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance (typically from satellite or aircraft).

- **Scope 1, 2, and 3 emissions**
  - Scope 1 emissions are direct emissions which occur from sources that are controlled or owned by an organization.
  - Scope 2 emissions are indirect emissions associated with the purchase of electricity, steam, heat, or cooling.
  - Scope 3 emissions are all other indirect emissions that occur in a company's value chain.

- **Source-level**
  Emissions attributed to an entire site or facility, rather than specific pieces of equipment.

- **Site-level**
  Emissions that are attributed to individual pieces of equipment.

- **Top-down**
  Top-down methods are based directly on empirical, atmospheric data of emitting units or facilities, which ensures that all emission sources are covered by the measurements.

- **Transmission System Operation (TSO)**
  An entity entrusted with transporting energy in the form of natural gas or electrical power on a national or regional level, using fixed infrastructure.

- **United Nations Framework Convention on Climate Change (UNFCCC)**
  The body responsible for supporting the global response to climate change. The Convention has near universal membership (197 Parties) and is the parent treaty of the 2015 Paris Agreement.

- **Upstream, Midstream, and Downstream Sources**
  - "Upstream" refers the industry segment that explores and produces oil and fossil gas.
  - "Midstream" refers to the industry segment that transports and stores crude oil and fossil gas before they are refined and processed.
  - "Downstream" refers to the industry segment that transforms crude oil and fossil gas into finished products.109IMEO 2021 Report

- **Ventilation Air Methane (VAM)**
  Methane contained in exhaust air of the ventilation system of a mine, which originates across the mine workings and is diluted to low concentrations by the circulation of outside air.

Executive Summary

IMEO is on the road

The International Methane Emissions Observatory (IMEO) of the United Nations Environment Programme (UNEP) was launched at the G20 meeting in November 2021; it is now fully operational. The announcement of the Global Methane Pledge, at which countries added their collective commitment to reduce methane emissions, further strengthened the methane ecosystem and affirmed IMEO's role.

In less than two years, membership of IMEO's flagship oil and gas reporting and mitigation programme, the Oil and Gas Methane Partnership 2.0 (OGMP 2.0), has expanded to more than 80 companies from around the world, with U.S. companies ConocoPhillips, Devon and Pioneer joining recently. IMEO's science programme is filling knowledge gaps with studies in Angola, Australia, Azerbaijan, Canada, Colombia, Gabon, Oman, Poland, and Romania, covering oil, gas, coal and waste operations. The U.S. government has joined IMEO's Implementation Committee, and additional funding discussions are under way with several other governments and foundations.

UNEP is supporting the implementation of the Global Methane Pledge, convened by the U.S. government and the European Commission, with IMEO and Climate and Clean Air Coalition appointed as core implementing partners. Moreover, IMEO is now covering sources of methane emissions beyond fossil fuels, including waste, rice cultivation and livestock.

At the 27th Conference of the Parties to the UN Framework Convention Climate Change (UNFCCC), to be held in Sharm El-Sheikh, Egypt in November 2022, IMEO will launch the first iteration of its public "data to action" platform, the Methane Alert and Response System (MARS). IMEO will use this platform to bring together and release emission data collected and integrated from diverse data streams. MARS will be ready to integrate other data as new measurement-based approaches (e.g., newer satellites) become available. This integrated dataset will provide actionable data to companies and governments. It will allow IMEO to corroborate the emissions reported by companies and to characterize changes in emissions over time – thereby tracking progress towards mitigation targets.

OGMP 2.0 is delivering a community for collective action

This report covers the second year of reporting by OGMP 2.0 member companies. Sixty members are on the programme's "Gold Standard" pathway – having committed in their implementation plans to sequentially improve the quality of their reported data – and are showing progress in moving towards measurement-based estimates of methane emissions. Twelve member companies are not on the Gold Standard pathway this year: two lost it compared to last year, seven did not achieve it either year, and three companies reporting for the first time this year did not achieve it.

As committed by the companies, the quality level of measurement and reporting has continued to increase, on the way to full Level 4 and Level 5 reporting by the end of the commitment period (three years for operated assets and five years for non-operated assets). However, further progress is needed to be able to reliably quantify industry emissions. Recently published studies set the estimate for total global methane emissions from industry at 80-140 million tons per year, based on a combination of atmospheric inverse modelling and isotope source apportionment (Schwietzke *et al.* 2016; Hmiel *et al.* 2020; Saunois *et al.* 2020). The International Energy Agency's (IEA) methane tracker estimates emissions at the lower end of this range (IEA 2022).

Total emissions from this year's reporting by OGMP 2.0 member companies are 1.3 million tons of methane for both operated and non-operated assets. This represents a large discrepancy between the estimates of global industry emissions and the proportional share reported by OGMP 2.0 member companies. Although the quality of reported data has improved, the majority of assets are not yet reporting measurement-based emission estimates (i.e., OGMP 2.0 Level 4 and Level 5). Moreover, a significant amount of assets non-operated by OGMP 2.0 member companies were not yet reported.

Continued improvements in measurement-based reporting from member companies and expanding OGMP 2.0 membership is expected to reduce the gap between

estimated global emissions and the sum of the companies reported emissions. IMEO's approach to multi-scale emission data will further characterize this discrepancy by integrating OGMP 2.0 data with satellite remote sensing data, and by commissioning science studies in regions with limited data.

OGMP 2.0 is already establishing itself as a robust Measurement, Reporting and Verification (MRV) framework. For it to fully succeed, however, reported data must point directly to effective mitigation actions. In line with this vision, OGMP 2.0 has been built as a platform for collective action. Companies share practices and challenges and evolve new industry norms on methane management, as occurred in the past on improving safety and handling spills. Member companies are encouraging non-members to join, and peer relationships are being established between companies around the world to overcome specific challenges. The interaction between study results and company practice is starting to take flight.

In 2022, IMEO was engaged in jointly designing a second industry partnership framework with the global metallurgical coal industry. Whereas thermal coal has clear low-carbon alternatives, and the United Nations Secretary-General has called for a rapid end to the practice of burning coal for power, metallurgical coal will likely remain in the energy mix for longer as a basis for steel production. As is the case for oil and gas, under any decarbonization scenario, accurate measurement and substantial mitigation of metallurgical coal emissions represent material climate action.

Based on this initial momentum, IMEO was asked by funding governments to explore expanding its scope to include methane emissions from three additional sources: waste, rice cultivation and livestock. Section 2 of this report includes a reflection on the differences among the sectors and how IMEO's data-driven approach might apply. Subject to approval and funding, inclusion of these sectors can then be delivered in the near future.

IMEO is a catalyst for action on the Global Methane Pledge

One of the major results of COP26 was the signature of the Global Methane Pledge (GMP), with 122 countries pledging to collectively reduce 30 per cent of global methane emissions by 2030. The GMP was coalesced by the U.S. government and the European Union, and IMEO is a core implementing partner tasked with various functions. IMEO's MARS data to action platform, to be launched at COP27, reflects the first phase of a strategy to get policy-relevant emissions data into the hands of asset operators, companies, policymakers and civil society for the mitigation action needed to deliver on the GMP. IMEO is particularly well-positioned, as OGMP 2.0 member companies hold assets in the majority of the largest methane emitting GMP countries, as well as other major emitting countries. Data on coal, waste, livestock and rice will be added gradually to support the GMP implementation. UNEP's IMEO further supports countries to build capacity to access and understand these data in support of science-based mitigation strategies and targets.

Introduction

Foreword from the European Commissioner for Energy

The Earth has a finite capacity. To preserve the environment and sustain life in all its forms we need to reduce the emission of greenhouse gases into the atmosphere, and we have to do it fast. Reducing all emissions is necessary, but in the short term, reducing methane emissions is the fastest way to decrease the rate of warming globally and to keep us on track to meet the Paris Agreement objectives. Methane emissions contribute between a third and a half of all the warming we have had to date, yet this greenhouse gas is entering the atmosphere in unprecedented amounts today.

To reduce methane emissions, we need to know more. Who is emitting, where, and how much. These basic facts will allow us to target the largest sources immediately and identify the chronic emitters sources that need to be addressed systemically. The lack of verified emissions data has made it hard for governments to carry out targeted action at the scale and speed needed to achieve our climate goals, or even to raise political awareness of the problem. What you do not measure, does not get addressed.

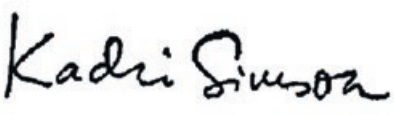
This is the reason why the European Union has supported the inception of UNEP's International Methane Emissions Observatory (IMEO) at the G20 Summit in 2021. The IMEO is a crucial instrument in creating a sound and independent scientific basis to measure methane emissions transparently.

The second Annual Report of the IMEO is titled An Eye on Methane, and it analyses progress made to achieving a deep reduction of methane emissions. The European Commission commends the IMEO for focusing on the energy sector, which the International Energy Agency has identified as the cheapest and quickest sector to reduce methane emissions.

Leveraging the United Nations Environment Programme global leadership and the UN Oil and Gas Methane Partnership 2.0 (OGMP 2.0), the IMEO paves the way for reducing methane emissions in the oil, gas, and, increasingly, coal sectors. The oil and gas sector has an opportunity to reduce methane emissions by 75% by 2030 without significant cost and no impact on overall functioning of the market. OGMP is the only comprehensive, direct source measurement-based international reporting framework for the sector. It has served as the basis for the European Commission's proposed methane regulation to measure, report, verify, mitigate and bring more transparency on methane emissions. We hope that it will inspire equivalent frameworks in the coal sector and elsewhere in the world. The European Commission is committed to work with partners to achieve that.

At COP 26, the global community embraced to the Global Methane Pledge, sponsored by the European Commission and the United States government. At the heart of the Global Methane Pledge is a requirement for good numbers and sound science. It is the IMEO's role to fulfil that requirement. With its unique global database of verified methane emissions, the IMEO can support companies as well as governments across the globe to implement strategic mitigation actions and develop science-based policy options. As a core implementing partner of the Global Methane Pledge, the IMEO will also track the progress that governments and companies are making towards their targets.

It gives me great pleasure to welcome this pioneering and necessary work, and to wish the IMEO great success in its continued ambitions.



Kadri Simson
European Commissioner for Energy

Foreword from UNEP Executive Director

We are in climate emergency and slipping towards a climate disaster, which will bring devasting consequences for human health, economic prosperity and, of course, nature. To halt the slide towards the edge of the cliff, we need to urgently slash greenhouse gas emissions – including methane, the second most significant climate warming gas behind carbon dioxide.

Cutting methane emissions is the fastest way to tackle climate change in the short-term, as it remains in the atmosphere for far fewer years than carbon dioxide. It is for this reason that many nations have joined a global pledge to cut 30 per cent off methane emissions by 2030. This second report of UNEP's International Methane Emissions Observatory (IMEO) looks at the essential role the fossil fuel industry must play in taking immediate and strong action on methane to meet this goal.

As a core implementing partner of the Global Methane Pledge, IMEO provides decision makers with a framework to take ambitious, targeted actions that can be tracked and reported. This report highlights how IMEO has become a blueprint for transparency in methane reporting through the Oil and Gas Methane Partnership 2.0. This partnership is a platform for collective action amongst its 80+ member companies as they evolve new industry norms on methane measurements and – more critically – measures to cut emissions.

Cutting methane emissions from oil and gas operations is indeed worthwhile, particularly as a short-term measure to buy time for the full decarbonization of the energy system. I commend all members of the partnership for their commitment. However, the industry must move faster and harder. Companies must be bolder. Sustainability can no longer be on the fringes, left to Corporate Social Responsibility Directors. Senior corporate management in the oil and gas industry must empower line managers to hit methane emissions hard, actively supported by government policy.

Looking at the bigger picture, the best way for the oil and gas industry to end methane emissions, and all emissions, is to rethink entirely their roles as energy companies. If the industry is serious about a net-zero future – as it must be to provide a shot at health, wealth and prosperity for all – this must be the long-term goal.

Inger Andersen
Executive Director
United Nations Environment Programme

1.

Five Sectors, One Gas

Photo credit: QatarEnergy

1. Five Sectors, One Gas

IMEO's scope is expanding to cover other sectors with methane emissions

Five key sectors – oil and gas, metallurgical coal, waste, rice and livestock – all emit large quantities of methane, a powerful greenhouse gas.

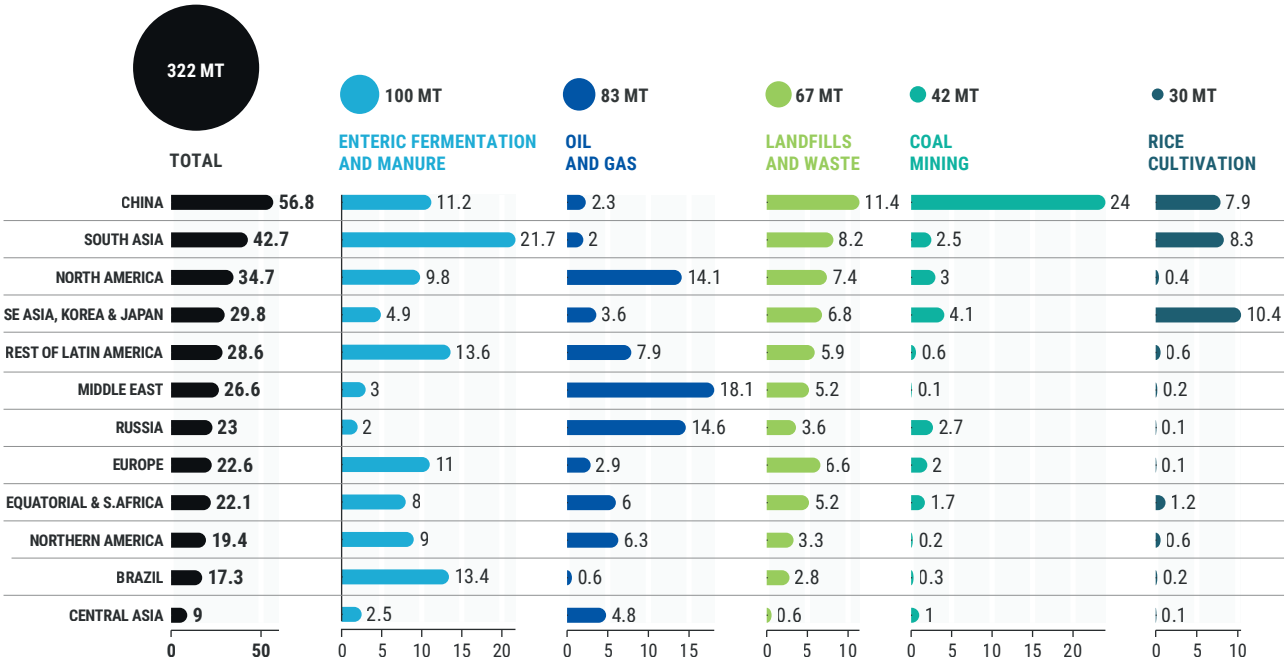
These sectors have interactions at different levels that suggest a system approach is desirable to assess the impact of mitigation actions. Often, focus on climate-altering emissions has centered on the pollutant, rather than on the polluter or agent. In the case of a methane molecule, it has the same climate impact whether it is emitted by a cow, or by a leaky valve in an oilfield. Meanwhile, vast differences exist among the sectors that produce methane emissions – in the degree of agency among participants, in access to capital and knowledge, and in technical and regulatory solutions. From a mitigation perspective, these emissions need to be treated distinctly (Box 1).

IMEO aims to provide policy-relevant data that will enable those who have the agency to reduce methane emissions to take effective action. The goal is to ultimately bridge the high-level ambition of the Paris Agreement and the Global Methane Pledge with the reality on the ground.

Another thing these five sectors have in common is high uncertainty regarding the magnitude and location of methane emissions from the data illustrated in Figure 1. Methane data are incomplete for several reasons, including the inherent uncertainties in methane estimation methods based on emission factors, the challenge of quantifying diffuse methane, and the fact that global attention towards methane as a greenhouse gas is relatively recent. Because methane has not been a political priority until recently, the availability of measurement-based estimates at different scales is limited. Most emission estimates at the national and entity levels currently rely on standard emission factors.

The mission of IMEO is to rapidly evolve from generic estimation to state-of-the-art, multi-scale, measurement-based emission estimates, thus providing actionable data that can be used to further reduce emissions and track changes in emissions over time.

Figure 1. Estimated annual methane emissions by sector and region, excluding Oceania, in 2017



Source: Saunois *et al.* 2020

1.1 Five Different Systems

IMEO considers the following diverse sectors: oil and gas, coal, waste, rice and livestock

— *Oil and gas*

For the oil and gas sector, methane emissions are a consequence of extraction, processing, and delivery, either intentional (venting and flaring) or unintentional (e.g., equipment leaks). Methane is emitted because of a combination of design choices in equipment, operational practices and equipment failures or leaks. As such, many mitigation measures can be readily engineered, without impacting the main processes of producing oil and gas. An additional benefit is that often by reducing methane emissions, the captured product can be sold, offsetting some of the cost.

Consequently, oil and gas operations that target near-zero methane emissions (for example, a methane intensity target of 0.2 per cent) are entirely plausible without greatly affecting operational activities, although potentially adding some cost and obviously not addressing the impact of consuming the product. The primary agents of change are the asset managers, who must plan, implement and monitor the changes in equipment or process. To prioritize mitigation actions cost-effectively, asset managers need to have a comprehensive understanding of the scope and scale of emissions across infrastructure. They then need access to the required resources from the company capital allocation process. They also need to be encouraged by company priorities, the regulatory context, as well as the social norms of their industrial community.

— *Metallurgical coal*

Metallurgical coal is used to produce steel, and during mining operations methane is released from the coal seams and primarily managed for safety concerns. Emissions can fluctuate widely as they result from processes such as the displacement of natural soil layers or microbiological activities. Mitigation actions must not affect safety in any way, which means that the methane is diluted as quickly as possible during underground operations. The main mitigation option is drainage of the methane from the mine before production, which both increases safety and delivers higher-concentration streams of gas that can be destroyed or monetized. The other important mitigation option is destruction of Ventilated Air Methane (VAM), a technology that is already operational in several mines around the world and needs to be substantially scaled up.

Emissions from the production of metallurgical coal should be considered for their materiality in the overall emissions of the steel supply chain. In most cases, methane represents a majority of the Scope 1 (direct) emissions from metallurgical coal producers, as well as material Scope 3 (indirect) emissions by customers in the steel industry (using a 20-year global warming potential for both Scope 1 and Scope 3 emissions). Consequently, mitigating methane emissions is essential to reduce the greenhouse gas footprint of metallurgical coal and steel. While a substantial reduction in the steel sector's 2030 emissions by lowering the methane emissions in its supply chain appears technically realistic, the incentive structure is more complicated than for oil and gas. The immediate addition of net cost makes it more difficult to allocate capital towards mitigation actions, and requires explicit choices by metallurgical coal companies, by their steel-making clients and by steel-importing countries.

As with the oil and gas sector, participants in the metallurgical coal sector have ready access to capital and knowledge, and the asset managers generally have a high degree of agency over their emissions. This is often not the case for other key methane-emitting sectors such as waste, rice and livestock.

— *Waste*

For the waste sector, IMEO's initial focus is on solid waste, whereas wastewater might be addressed later. In the solid waste sector, methane emissions stem exclusively from the organic component of the waste, which comprises 30-50 per cent of waste streams. Organic waste in anaerobic conditions is decomposed by bacteria, which produces methane that escapes into the atmosphere if not captured. Globally, around 37 per cent of municipal solid waste is disposed of in some type of landfill, 33 per cent is openly dumped, 19 per cent undergoes materials recovery through recycling and composting, and 11 per cent is treated through modern incineration (World Bank 2018). These systems are highly diverse, ranging from highly managed facilities to unmanaged dumps.

Waste management is expensive, accounting for between 4 per cent and 20 per cent of a typical municipal budget. While solutions for capturing the methane from well-managed landfills have been developed, the degree of agency of the entities managing the sites varies greatly. Unlike with the fossil fuel sector, the waste management landscape ranges from a small number of multinational companies to many local municipalities; it is also a very low margin activity, with often scant access to capital and knowledge.

Upstream mitigation, such as the separation of organic and non-organic waste at the household or commercial level, can reduce methane emissions if the organic waste is properly managed (through anaerobic digestion, composting, combustion, etc.). In principle, targets for near-zero methane emissions are technically possible, but they are harder to achieve. Better data are useful but are more difficult to translate into emission reductions at a material scale.

— *Rice*

The solutions to mitigate methane emissions from rice production are relatively well established. The source of emissions is anaerobic decomposition of organic matter in flooded rice paddies. Mitigation can be accomplished through management practices such as alternate wetting and drying, direct seeding, using short-duration varieties and shifting to different crops. However, it is important to ensure that the interplay between methane and nitrous oxide is also considered, given that in reducing one of these greenhouse gases, it is easy to inadvertently increase the other. How these emissions vary over space and time is not well understood.

The sector is also highly fragmented, which limits the avenues for sector-wide interventions. The mitigation trade-offs are not only economic (as in the oil and gas, metallurgical coal and waste sectors) but also impact food security, water usage and nitrous oxide emissions. Targets for near-zero methane emissions by 2030 are plausibly beyond reach.

— *Livestock*

Livestock produce methane both through the digestion of feed in ruminant animals (i.e., enteric fermentation in cattle, buffalo, sheep) and the operations through the handling and storage of liquid manure. Unsurprisingly, emissions vary greatly by animal type, feed quantity and quality, and environmental context. These emissions are part of meat and dairy supply chains. As such, the methane footprint of livestock is deeply interconnected with food security, cultural and behavioural patterns of food consumption, and, in many parts of the world, rural livelihoods.

The livestock sector is further complicated because concentrating and intensifying livestock production can reduce enteric methane emissions per unit of output but increase absolute emissions of methane. Concentrated livestock facilities also have animal welfare and health implications, such as contributing to increased antibiotic resistance (UNEP 2020). There is a need for better quantification of methane emissions in intensive and extensive livestock systems, especially in low- and middle-income countries.

Technological mitigation options are limited for enteric fermentation, the largest source of livestock emissions, since feed additives only reduce, but do not eliminate, methane emissions. More mitigation options are available for manure management. However, there are no clear pathways to scaling the limited solutions for livestock methane. The diverse actors are far more numerous than in either the fossil fuel or waste sectors, and they have a relatively low degree of agency. Scaling is the major challenge in both the rice and livestock sectors.

Photo credit: unsplash / Filip Bunkens

In all five sectors, IMEO's approach is to establish a public record of empirical data, collected through state-of-the-art scientific methods. This allows for a characterization of uncertainty, and provides the various actors of the methane ecosystem with a sound basis for action.

1.2 Multi-scale Measurement-Based Approaches

Reducing uncertainty in methane emissions and tracking progress in support of the GMP

Over the past decade, significant progress has been made in empirically characterizing the magnitude and location of methane emissions from different sources. This work has catalysed the development of effective empirically-based approaches for estimating emissions that have greatly reduced the uncertainty of emissions, improved inventories and provided insights into additional mitigation opportunities.

Empirically-based estimates of emissions at the regional and country-scale can provide useful information for quantifying current emissions and tracking changes over time, both of which are critical to successful implementation of the Global Methane Pledge. At the regional scale, measurement-based approaches have relied mainly on airborne measurements using mass balance and atmospheric transport models (Gorchov-Negron *et al.* 2020; Neininger *et al.* 2021; Foulds 2022) and more recently on satellite remote sensing (Zhang *et al.* 2020; Shen *et al.* 2021; Shen *et al.* 2022). Existing methodologies can now be deployed rapidly and, if applied under the right conditions (e.g., sampling with enough frequency to capture potential variability in emissions), can provide accurate estimates of emissions.

A key challenge in performing regional and country-scale quantification of methane emissions is partitioning the emissions between fossil sources (i.e., oil, gas, coal) and biogenic sources (i.e., solid waste, wastewater, livestock, rice cultivation). Robust analytical methods have been developed that allow emissions to be partitioned among sources through the use of isotopes (Neininger *et al.* 2021) as well as hydrocarbon ratios (i.e., methane-to-ethane ratio, ethane being only co-emitted from fossil sources) (Smith *et al.* 2015).

Historically, most countries have relied on relatively simple emission factors to estimate methane emissions included in their national emissions inventories (e.g., the Intergovernmental Panel on Climate Change (IPCC) Tier 1). In the case of the oil and gas industry, recent studies have pointed out large discrepancies between inventories and empirically-based (top-down) emission estimates – indicating both underestimation and overestimation (Alvarez *et al.* 2018; Shen *et al.* 2021; Zavala-Araiza *et al.* 2021).

A recent study found that methane emissions from the oil and gas supply chain in the United States are underestimated by roughly 60 per cent when compared to empirically-based, top-down estimates (Alvarez *et al.* 2018). Similarly, satellite-based estimates of total methane emissions in Mexico are 45 per cent higher than emissions presented in the inventory (Shen *et al.* 2021), with emissions from the oil and gas sector being 100 per cent higher. Notably, when the Mexican emissions data are split into offshore oil and gas production versus onshore production, top-down estimates point to a significant overestimation of emissions from offshore production compensated by an even higher underestimation of emissions from onshore production.

Technically feasible mitigation options are readily available across sectors (Global Methane Assessment 2020; Ocko *et al.* 2021), and their implementation need not wait for better data. At the same time, empirical data are essential to further expand mitigation efforts to reap the full potential of methane mitigation and to track progress towards methane emission reduction targets.

IMEO's approach relies on the integration of multi-scale emission data streams. Source-level data provide insights useful for driving mitigation actions by allowing disaggregation into specific components within each sector or industry. The source-level data shed light into emission reduction actions that need to be prioritized and components where a more thorough characterization of their emission patterns is required. This is also why OGMP 2.0 considers source-level, measurement-based data as a key element of its Gold Standard reporting. Source-level data can also be used to evaluate the emission factors used by national inventory compilers, provided that the data are at the same granularity as used by the inventory (e.g., higher IPCC Tier methods).

Characterization of the distribution of emissions at the site/facility-level across a diversity of sites – the other key component of the OGMP 2.0 Gold Standard reporting – has greatly reduced the uncertainty of methane emissions from oil and gas infrastructure, where a common characteristic across the supply chain is the presence of a subset of high-emitting facilities with a disproportionate contribution to total emissions. The population of high emitters varies in both time and location.

Therefore, accurately estimating overall emissions requires understanding the frequency and magnitude of emissions across a wide range of sites, rather than monitoring emissions from a few sites. Effective approaches need to recognize the stochastic nature of the distribution of "super emitters" and should characterize the entire emission distribution (i.e., characterizing the "fat tail" is necessary but not sufficient). Easily deployed ground-based and airborne approaches are needed to acquire the large sample sizes required to effectively characterize emission distributions, which in turn can inform country-specific national inventory development (e.g., refine emission factors and/or activity data).

Finally, top-down data based on direct measurements at the regional- and country-level can more effectively constrain the magnitude of emissions and how they are changing over time. Reconciling top-down and bottom-up estimates has been accomplished at the regional- and country-scale for different geographies, for example the United States (Alvarez *et al.* 2018), Australia's Surat Basin (Neininger *et al.* 2021), Mexico (Shen *et al.* 2021) and Norway (Foulds *et al.* 2022). The iterative reconciliation process between these two types of emissions estimates can help to assess both approaches, and in the process lead to better country-level emission reporting.

Photo credit: TRP Energy / EDF

Box 1. Three ways to change systems

Systems can be changed from the top, through market forces, or from within

There are three main approaches to changing systems. All can work in different societal contexts and at different times, so the question is not so much which is the correct one, but rather which is the right approach at a given time and place. The approaches are also not mutually exclusive. Many misunderstandings can be avoided by being explicit about why a particular approach is chosen at a certain time, rather than making the choice implicit.

1. Top-down – A central authority can change systems by changing the rules and regulations that instruct agents in the system to act differently. For this to work, several things must be assumed: 1) the process for deciding on the regulations is effective and does not lead to a prohibitive level of dilution of their effectiveness; 2) the agents apply and follow the regulations sufficiently; and 3) a system of verification and enforcement is in place.

2. Market-based – Instruments such as the U.S. methane fee, carbon taxes, carbon border adjustment mechanisms and traded emissions certificates fall into this category. For market-based instruments, a market is required in the first place with appropriate rules, and the price signal must be strong enough to influence behaviour and norms at the required scale. For methane, this will be effective in some cases (when accompanied by an accurate, measurement-based, comprehensive reporting and verification scheme – such as OGMP 2.0 for the oil and gas sector); however, in other cases the methane emission footprint will have only a minor influence on the purchasing or investment behaviour of market players.

3. Emergence – This occurs in systems when an entity has properties that its parts do not have on their own – properties that emerge only when the parts interact in a wider whole. In this approach, the context and the interconnection between actors in the system is changed, so that their collective behaviour leads to different emergent patterns. This approach assumes that the actors have a sufficient degree of agency to make the required changes. For example, this can be achieved by modifying the information that is available to the relevant actors, such as when emission information is made relevant at the level of an individual gas plant manager, or when communities of rice farmers are collectively empowered to change farming practices.

2.

OGMP 2.0 Oil and Gas Analysis for 2022

Photo credit: Eustream, a.s.

2. OGMP 2.0 Oil and Gas Analysis for 2022

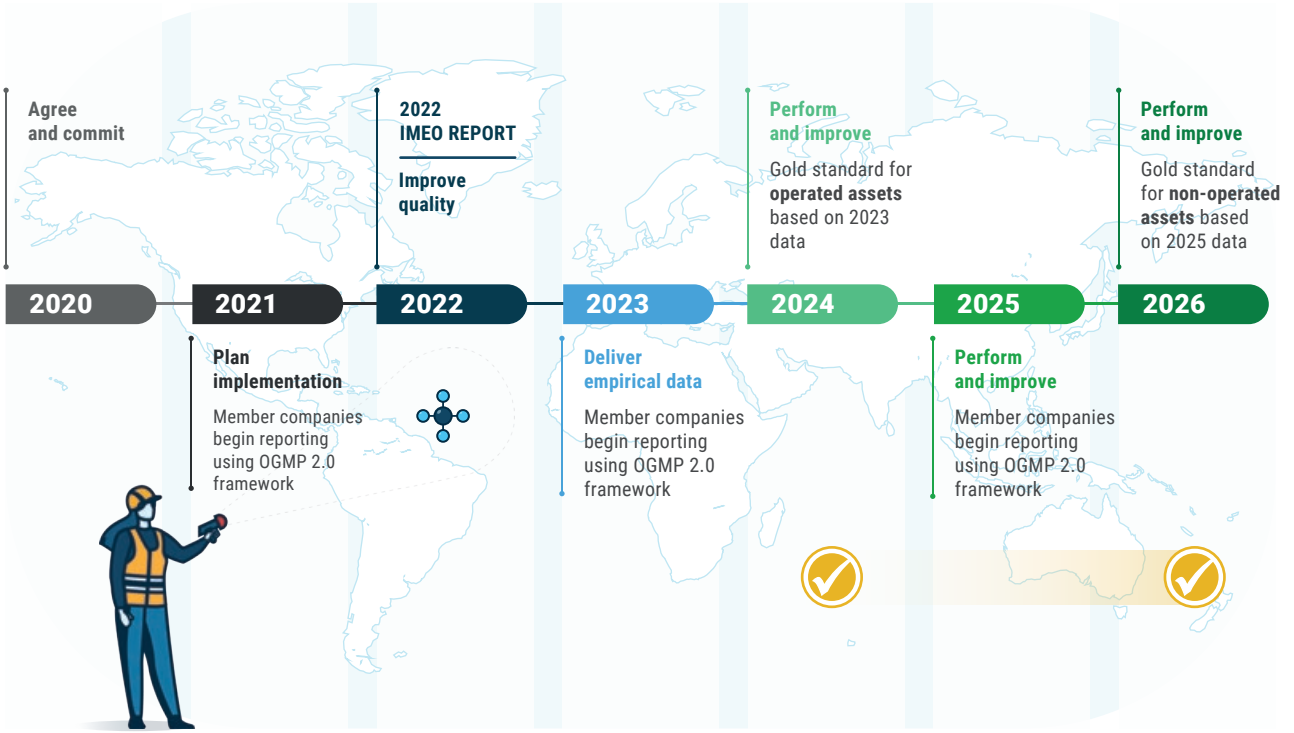
2.1 OGMP 2.0 in Its Second Year

OGMP 2.0 grows and is a community of practice for continuous learning and improvement

OGMP 2.0 was intended and designed as a system to deliver ambitious results at scale. It evolved from OGMP 1.0 – launched under the Climate and Clean Air Coalition at the United Nations Secretary General's Climate Summit in New York in September 2014 with a focus on a handful of upstream companies reporting on mitigation efforts – to the most comprehensive and advanced measurement-based reporting initiative. That necessarily implies organic growth to build the capacity and practice that will produce the kind of quality data that enable deep reductions in methane emissions. The journey is still in early days, transitioning the global industry from a practice of simple, generic emission factors to comprehensive, measurement-based emissions estimating that allows for a targeted deployment of resources to reduce emissions.

During this past year, OGMP 2.0 increased its asset coverage (i.e., new membership), experienced more comprehensive reporting by member companies supported by the development of Technical Guidance Documents, and saw member companies discover additional emission sources as they started incorporating measurement-based methods. However, until representation of emissions at higher levels of reporting is more comprehensive, as is planned in the coming years (Figure 2), the uncertainty in the data is still much too large to allow any meaningful quantification of progress towards emissions reduction targets. Importantly, the very process of collecting data at the asset level with the participation of local facility managers can result in mitigation measures being taken, even if that mitigation cannot yet be reliably quantified. Notwithstanding the small share of the 80-140 million tons of global emissions that is currently being reported from OGMP 2.0 (see section 2.3), mitigation action may be undertaken which can only be confirmed when higher level reporting becomes available.

Figure 2. OGMP 2.0 member company timeline



OGMP 2.0 established five reporting levels that increase in granularity and accuracy (Box 2). The highest of these levels, Level 5, requires emission estimates that include the reconciliation of source-level estimates with site-level measurements. OGMP 2.0 members commit to achieving the highest level of reporting (the "Gold Standard") for operated assets within three years and for non-operated assets[1] within five years. In the intervening years, the Gold Standard pathway is awarded on the basis of a credible implementation plan, outlining the specific steps to reach Levels 4 and 5 reporting within the set deadlines.

In this section, IMEO reports on the progress made, in terms of both the growth in membership and the improvement in the quality level of reported data. As expected, based on the various company implementation plans, there is not yet sufficient data reported at Levels 4 and 5 to allow for meaningful aggregation and quantification of the overall OGMP 2.0 emissions.

In 2022, 72 OGMP 2.0 company members reported 2021 emissions data from 1,002 assets across 63 countries on five continents. 60 companies achieved the Gold Standard pathway. 12 member companies are not on the Gold Standard pathway this year: two fell off the pathway compared to last year, seven companies did not achieve it last year either, and three companies, reporting for the first time this year, did not achieve it.

Box 2. The five OGMP 2.0 reporting levels

- **Level 1** – Emissions reported for a venture at the asset or country level (i.e., one methane emissions figure for all operations in an asset or all assets within a region or country).

- **Level 2** - Emissions reported in consolidated, simplified source categories (based on the International Association of Oil & Gas Producers five categories for upstream emissions and on MARCOGAZ' three categories for midstream and downstream emissions), using a variety of quantification methodologies, progressively up to the asset level, when available.

- **Level 3** – Emissions reported by detailed source type and using generic emission factors.

- **Level 4** – Emissions reported by detailed source type and using specific emission factors and activity factors. Source-level measurement and sampling may be used as the basis for establishing these specific emission factors and activity factors, although other source-specific quantification methodologies such as simulation tools and detailed engineering calculations (e.g., as referenced in existing OGMP Technical Guidance Documents) may be used where appropriate.

- **Level 5** – Emissions reported similarly to Level 4, but with the addition of site-level measurement reconciliation (site-level measurements characterize site-level emissions distribution for a statistically representative population).

OGMP 2.0 keeps growing

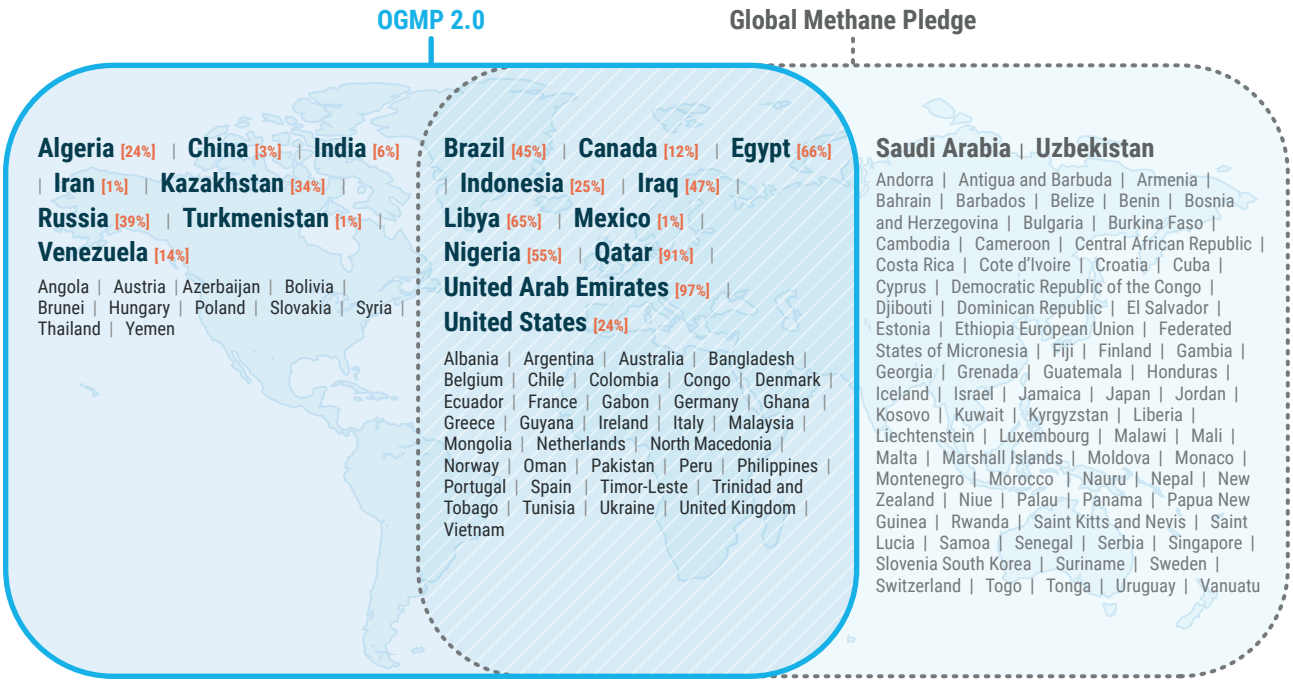
OGMP 2.0 continues to grow. In its second year of operations, the Partnership surpassed 80 members. In July and August 2022, five leading US-based companies joined OGMP 2.0: Pioneer, Devon, ConocoPhillips, TRP Energy and PureWest Energy. With Diversified Energy and PDC having joined earlier in the year, the five new companies mark a significant increase in US-based membership. The growth in U.S.-based membership is an encouraging development and should serve to entice additional North America-based companies to join the Partnership. Increasing OGMP 2.0 coverage in North America is a crucial step toward achieving the Global Methane Pledge, given the region's predominance in fossil fuel production. Of the other major oil and gas resource holders, Qatar is mainly covered under OGMP 2.0 – since Qatar Energy is an OGMP 2.0 member – while Iran is not yet included. OGMP 2.0 currently covers over a third of global oil and gas production through members' operated and non-operated ventures.

In addition, OGMP 2.0 covers more than 20 per cent of global natural gas transmission and distribution pipelines, more than 10 per cent of global storage capacity and nearly 15 per cent of global liquefied natural gas terminals.

OGMP 2.0 has substantial global reach. Its member companies operate or own assets in many of the signatory countries of the Global Methane Pledge, as well as in countries outside the Pledge (Figure 3). According to IEA data (IEA Methane Tracker 2022), 21 countries are responsible for roughly 85 per cent of global oil and gas methane emissions. Out of those 21 countries, 19 have assets that are under OGMP 2.0 scope, including eight major emitting countries that are not GMP signatories (Figure 3).

1 Non-operated assets are entities that are not under operational control of an OGMP 2.0 member company but where OGMP 2.0 member companies have ownership higher than 5% equity, while operated assets are entities under operational control of an OGMP 2.0 member whose emissions are reported by the OGMP 2.0 operator independently of ownership.

Figure 3. Share of oil and gas production under OGMP 2.0 and overlap with GMP participants



Analysis derived from Rystad Energy 2021 production data

The numbers in brackets represent the total production of assets under OGMP 2.0 scope in each country, for both operated and non-operated assets. Bolded countries represent the top 21 oil and gas methane emitting countries accounting for around 85 per cent of emissions (IEA Methane Tracker 2022).

Table 1. New OGMP 2.0 members since IMEO 2021 report

Company	Segment	Headquarters
1. ConocoPhillips	Upstream	US
2. Crescent Energy	Upstream	US
3. Devon Energy	Upstream	US
4. Diversified Energy	Upstream	US
5. Energinet	Mid- and Downstream	Denmark
6. Expert Petroleum	Upstream	Romania
7. Gas Storage Denmark	Mid- and Downstream	Denmark
8. Occidental Petroleum Corporation	Upstream	US
9. PDC Energy	Upstream	US
10. Pioneer Natural Resources	Upstream	US
11. PureWest	Upstream	US
12. TRP Energy	Upstream	US
13. 2iRete	Mid- and Downstream	Italy

OGMP 2.0 as community of practice

OGMP 2.0 is a community of practice, where the journey to higher-quality emissions data to underpin effective mitigation is accelerated through learning among oil and gas companies. The members leverage the experience and technical knowledge across the partnership to collectively develop guidance documents, participate in knowledge-sharing workshops and actively take part in the OGMP 2.0 annual implementation conference.

Technical Guidance Documents

The OGMP 2.0 Reporting Framework outlines the ambition of the partnership: companies committing to a methane reduction target by 2025 will progressively increase the accuracy of methane emission inventories by moving from generic emission factors to company-specific methodologies and measurements, underpinned by site-level measurement and reconciliation with source-level estimates. The improved accuracy at the source-level will guide the most effective measures to achieve the stated targets and provide external stakeholders with confidence that the goals have been achieved.

To expedite knowledge transfer and ensure a consistent application of the Framework, a series of Technical Guidance Documents was developed outlining the recommended estimation methodologies to report specific sources at Level 3 (estimates by detailed source type using generic emission factors) and at Level 4 (estimates by detailed source type using specific emission factors and activity factors). In line with the design of the Framework, and with the goal of allowing innovation by diverse operators, OGMP 2.0 guidance documents are principle-based rather than rule-based and prescriptive, and they highlight the role of operators' judgement and experience.

The Technical Guidance Documents Task Force, co-chaired by GRTGaz, Shell - then succeeded by BP - and UNEP developed 16 Technical Guidance Documents (Table 2), with 12 of them completed since the last IMEO annual report. UNEP's partner Carbon Limits drafted the documents, which were first discussed within the Task Force then shared with the two mirror groups (industry-only groups, one for the upstream segment and one for the midstream and downstream segments). These mirror groups provide technical feedback on the Technical Guidance Documents through the Task Force representatives, ensuring that all companies are engaged at the technical-level.

Technical Guidance Documents are approved by consensus of the OGMP 2.0 Steering Group. As new data and technologies become available, and based on the feedback from member companies that apply them to meet the OGMP 2.0 reporting requirements, these documents will be updated and additional ones will be created.

Table 2. OGMP 2.0 Technical Guidance Documents approved in 2021/2022

1.	Gas well hydraulic fracturing
2.	Oil well casinghead
3.	Purging and venting, starts and stops and other process and maintenance vents
4.	Incidents, emergency stops and malfunctions
5.	Liquids unloading from gas wells
6.	Reciprocating compressors
7.	Unintended equipment leaks
8.	Incomplete combustion
9.	Unstabilized liquid storage tanks
10.	Leaks and permeation from underground pipes
11.	Pneumatic controllers, pumps, shutoff valves and control instruments
12.	Centrifugal compressors
13.	Glycol dehydrators
14.	Flare efficiency
15.	Level 1 and 2
16.	General principles

Photo credit: QatarEnergy

2.2 Uncertainty & Reconciliation

Site- and source-level reconciliation, with rigorous characterization of uncertainty

OGMP 2.0's approach to uncertainty and reconciliation was approved and finalized in early 2022. As with the other Technical Guidance Documents, the guidance is principle-based rather than rule-based. This allows room for innovation and learning by companies, the scientific community, and service providers, instead of constraining approaches to a defined methodology. Within the context of the OGMP 2.0 Framework, progression from one reporting level to the next requires increased emission source granularity, methodological rigor in quantification and reduced uncertainty in the reported figures. Robust characterization and eventual reduction of the uncertainty of estimates for emissions on a source-by-source basis creates the confidence necessary for operators to create effective and demonstrable strategies to drive down methane emissions at the asset- and even portfolio-level.

When site-level methane emissions measurements began over the last decade a false dichotomy arose: the measurements often did not match the source-by-source inventory, and so one or the other had to be mistaken. While it is true that scientific studies have demonstrated that source-level estimates tend to underestimate total emissions, it seemed that individual emission factor discrepancies could not explain the totality of the gap between inventory-based approaches and site level measurements. Several studies described the presence of heavy-tailed emission distributions across the oil and gas supply chain (and across geographies) – whereas source-by-source inventories usually assume normal distributions and thus underestimate emissions or exclude some sources altogether (Brandt, Heath and Cooley 2016; Zavala-Araiza *et al.* 2017; Robertson *et al.* 2019; Gorchov Negron *et al.* 2020; Maazallahi *et al.* 2020). As described in the IMEO 2021 annual report: "A common characteristic across the oil and gas supply chain is the presence of a subset of sources or facilities with a disproportionate contribution to total emissions. Recent scientific literature has referred to this subset of super-emitter sites as the 'fat tail' of the emissions distribution."

Additional studies have described significant spatial and temporal variability in real emissions (Tegan *et al.* 2017; Cusworth *et al.* 2021; Cardoso-Saldaña *et al.* 2020) that is often not represented in the source-level data (i.e., when source-level estimates are based on generic emission factors) and can also make site-level measurements difficult to extrapolate. The reconciliation process at the core of OGMP 2.0 Level 5 reporting offers a robust framework through which to consider a comparison of source-level inventories with site-level measurements. Critically, this is more than a simple comparison of two numerical values. The Uncertainty and Reconciliation Guidance outlines the process through which a Level 4 inventory can be compared to site-level measurements. This improves the confidence in the accuracy of source-level data through the elucidation of discrepancies between these two independent approaches to deriving emissions numbers. Discrepancies should be investigated such that the outcome results in an adjustment (increase or decrease as appropriate) to the asset-level emissions report and the learnings are incorporated into an improved measurement strategy during the subsequent year for potentially implicated sources. Ultimately, reconciliation is an iterative process of investigation, year over year, and should not be thought of as a one-off comparison of two independent values.

The OGMP 2.0 Framework provides flexibility on the Level 5 measurement approaches, acknowledging that methane monitoring technologies are evolving rapidly. However, the Framework is also stringent by requiring that operators provide enough justification and information on the representativeness of their sampling strategy and selection of robust measurement approaches to ensure credibility.

Level 4 provides the foundation upon which the quality assurance check (site-level measurement and reconciliation) can be performed to reach the OGMP 2.0-required Level 5. Reconciliation should be carried out among emission data that have been determined on the same basis. This could be accomplished by developing source-level estimates with fine temporal details in order to compare to instantaneous site-level emissions, or that site-level emissions could cover a much longer time scale in order to be comparable to a monthly or even annual site-level estimate. Reconciliation could also be performed on a statistical population basis.

Irrespective of the approach, inventories must sufficiently represent the particular facilities under investigation, highlighting the importance of the progression to Level 4 (i.e., in contrast with annual, average, generic emission factors) prior to attempting site-level reconciliation. Operators and asset managers need high-quality source-level data to understand the relative contribution from each source as a basis for effective and credible mitigation strategies. So, while using generic emission factors (Level 3) and adjusting the total at an asset-level based on site-level measurement reduces the uncertainty in total emissions, the line of site to the equipment and processes generating the emissions is further blurred.

Annual conference and workshops

The strength of OGMP 2.0 as a community of practice goes well beyond the work of the Task Forces and mirror groups. The OGMP 2.0 annual conference and the more frequent experience-sharing workshops offer other opportunities for companies to learn from one another.

The first annual conference was held virtually in November 2021 over two days to share challenges and solutions for methane emissions reporting and mitigation based on lessons learned from the OGMP 2.0 implementation. The annual conferences also provided an opportunity to discuss the state-of-the-art in methane science, strengthen the network among member companies and generate ideas for the continuous improvement of the Partnership.

The conference confirmed the value of more frequent opportunities to share experiences. In 2022, the Partnership launched a series of quarterly experience-sharing workshops on the most relevant technical topics jointly identified with member companies.

The first OGMP 2.0 workshop took place in March 2022 to inform the upcoming round of reporting and offered member companies an opportunity to share their experience with the development of the implementation plans, target setting and the use of reporting templates. The second OGMP 2.0 workshop focused on Level 4 measurement technologies and methodologies centered on the three emission sources considered by companies as both prominent and difficult to measure: flaring, venting, and fugitives emissions. Subjects for future workshops include testing site-level measurements and reconciliation processes, as well as challenges and successful approaches to engaging non-operated joint venture partners to obtain data for OGMP 2.0 reporting.

Photo credit: SNAM

2.3 Key insights from 2022 company submission

Gradual improvement in the quality of data, with further progress expected

Total methane emissions reported across all segments for operated assets (which are reported as 100 per cent of emissions independent of equity) were 0.65 million tons. Emissions reported for non-operated assets were 0.61 million tons. This represents a small fraction of the 80-140 million tons of emissions from global oil and gas infrastructure estimated in recently published studies (Schwietzke *et al.* 2016; Hmiel *et al.* 2020; Saunois *et al.* 2020; International Energy Agency 2022). The relatively low contribution to total emissions can be attributed to a number of factors:

1. A number of high-producing / potentially high-emitting regions still are not covered in the Partnership. OGMP 2.0 operated assets cover 13 per cent of global oil and gas production, with the coverage increasing to 32 per cent when non-operated assets are included.

2. The current average data quality for operated and non-operated assets combined remains around Level 3 – which can plausibly explain part of the discrepancy from assets currently covered by OGMP 2.0.

3. A significant number of non-operated assets remain unreported. While material, OGMP 2.0 member companies were unable to collect the data from partners in a number of cases.

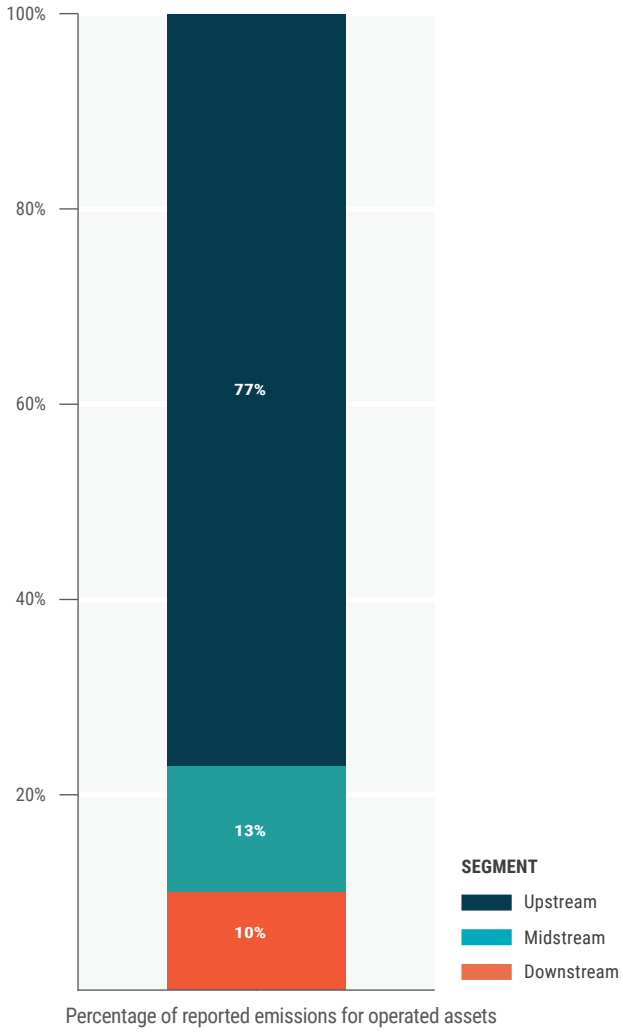
4. Other less-studied segments of the oil and natural gas value chain may contribute emissions at a greater rate relative to production than is currently thought to be the case.

As long as there are significant discrepancies between atmospherically-observed fossil methane emissions and those that have been attributed to specific sources, it is difficult to prioritize the most effective mitigation strategies. The current level of OGMP 2.0 total emissions when compared to total estimated global oil and gas emissions points to the importance of Gold Standard measurement-based reporting, the reconciliation process as a mechanism to greatly improve data quality and explain discrepancies, and the integration of the other emission data streams (i.e., satellite remote sensing data and science studies).

Despite the global industry discrepancy, OGMP 2.0 member companies made significant progress in developing and executing implementation plans to achieve the Gold Standard. This progress, coupled with an increase in the number of assets reported at Level 4, gives some confidence that the understanding of OGMP 2.0 reported emissions will continue to improve.

Figure 4 shows the breakdown by segment for operated reported emissions. As in the previous year, the largest contributor of emissions for operated assets was the upstream segment (77 per cent). The midstream segment accounted for 13 per cent and the downstream segment accounted for 10 per cent of total reported emissions.

Figure 4. Breakdown of operated reported emissions by segment



Data quality improved compared to 2021, with more companies incorporating Level 4 reporting for some of their assets. The emission-weighted average reporting level across all reported emissions for operated assets was 3.2, compared with 2.7 in the previous reporting year. Improvements in the average reporting level increased within each of the segments as well.

Table 3 shows the emission-weighted reporting level by segment for reported operated and non-operated assets in 2022 compared to the previous year, considering asset-wide emissions. Note that the downstream segment has a share of 99.9 per cent of emissions from operated assets and the midstream segment 90 per cent, compared to the upstream segment at 45 per cent considering asset-wide coverage. As explained above, there is a significant number of non-operated assets excluded from reporting due to lack of data in this reporting round. Therefore, the emissions-weighted mean reporting level for non-operated assets can be considered the upper bound since the level of reporting for missing assets would be 0.

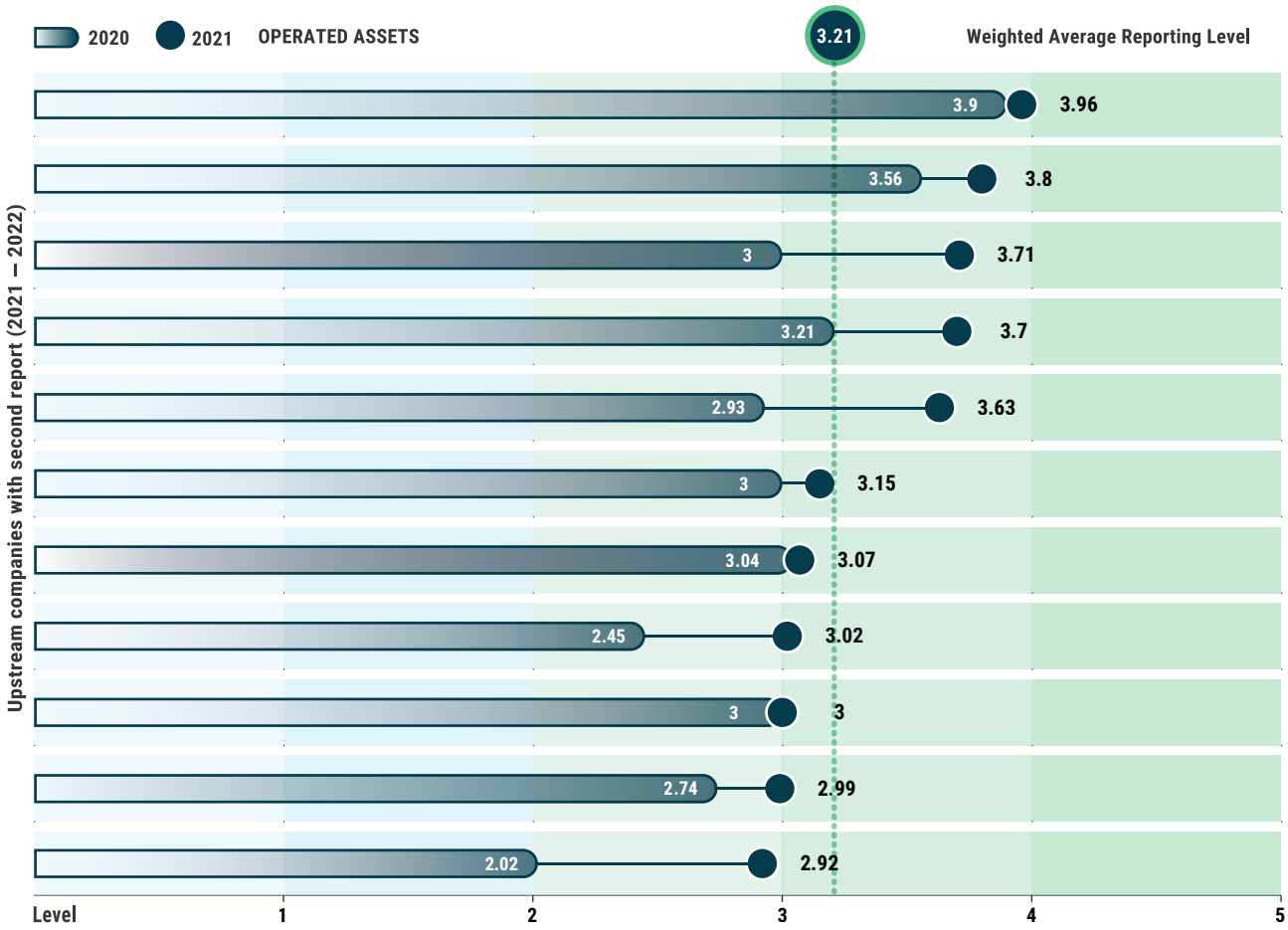
Table 3. 2022 Emissions-weighted mean reporting levels

	Operated	Non-operated *
Upstream	3.2	2.2
Midstream	3.3	1.4
Downstream	3.0	3.3
Average	3.2	2.2

**Upper bound due to incomplete data reporting*

Figure 5 shows the emissions weighted average reporting level for operated assets by company for those companies that reported both last year and this year. All companies considered in the graph below increased the level of reporting.

Figure 5. Reported emissions and weighted reporting levels for upstream operated assets in 2021 and 2020



Emissions from non-operated assets were excluded from the emission data analysis for this reporting cycle for several reasons. First, the quality of the data for non-operated assets is much lower than for operated assets (i.e., emission-weighted average reporting level is an upper bound of 2.2 because of assets that reported no data compared to 3.2 from operated assets). Additionally, more than 100 assets that fall within scope as non-operated assets were not reported this year. Companies have five years to gather data from non-operated assets, time that is needed to overcome possible jurisdictional, operational, logistical and financial challenges to obtain data. Even though there was progress in gathering information from non-operated assets compared to last year, including disclosure at a higher reporting level, there are still important gaps in emission data.

Photo credit: Martin Adams / unsplash

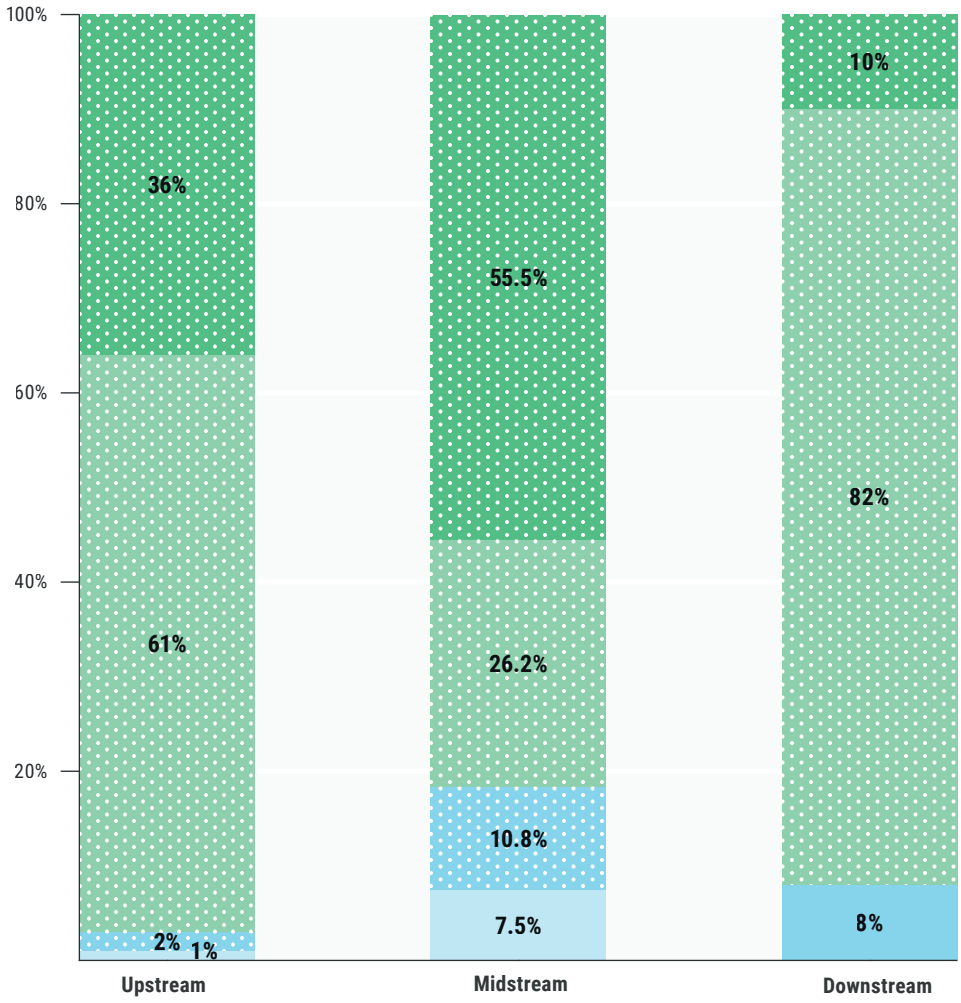


Figure 6. Share of emissions reported for operated assets, by level and segment, 2022

Note: The figure shows reported emissions allocated by level as a percentage of the total emissions reported by segment. Non-operated assets are not included.

The top three emission sources, as reported at Level 3 or Level 4, by segment, are shown in Table 4. However, many assets are reported across multiple levels, so this distribution is expected to change in future years as all sources transition from lower reporting levels into Gold Standard reporting.

Table 4. Top three emission sources, as reported at Level 3 or Level 4, by segment, 2022

Segment	Emission source	Share of each segment's total emission for operated assets' sources reported at Level 3 or Level 4
Upstream	Venting – Other[2]	22%
	Flaring (incomplete combustion)	19%
	Natural gas driven pneumatic controllers	17%
Midstream	Gas analysers and pneumatic devices – TSO[3] stations[4]	12%
	Purging and venting – TSO main lines	10%
	Connections (flanges, seals, joints) – TSO stations	8%
Downstream	Incident / emergency vents – service lines	41%
	Incident / emergency vents – main lines	19%
	Leaks derived from systematic survey – service lines	13%

The data reported at the source-level (i.e., Level 3 and Level 4) show that a small number of large emissions have a disproportionate contribution to total emissions. That is, they do not follow Gaussian (normal) distributions but are heavily skewed.

In the downstream segment, incident/emergency vents from main lines are the main source of emissions and have a fat tail distribution: just three of these reported sources accounted for 99 per cent of total emissions from this source type. In other words, 2 per cent of reported incident/emergency vents accounted for almost all of the total emissions from this main source in the segment.

In the midstream segment, one single source reported under the gas analysers and pneumatic devices source type from Transmission System Operators (TSO) regulating and reducing stations accounted for 57 per cent of total emissions from this source type, which is the highest emitting source for this segment while two per cent of reported pneumatic devices and gas analysers accounted for 95 per cent of emissions.

Nevertheless, it is hard to compare the previous figures to upstream given the allocation of assets. TSOs and Distribution System Operators (DSOs) commonly aggregate all of their facilities into one reporting unit, hence many of these sources are thousands of similar sources from a large regional grid, usually country-wide.

In the upstream sector, venting – others, the highest emitting source, also has a fat tail distribution. One single reported source accounted for 60 per cent of total reported emissions from the category, while 3 per cent of sources accounted for over 80 per cent of emissions. A few examples of fat-tailed, source-level distributions from the three segments are shown. For example, the distribution of flaring emissions is shown in Figure 9, where 22 per cent of reported flares accounted for 90 per cent of total emissions from flaring.

2 Venting – Other refers to emissions from vented sources either not covered by the sources indicated below, or that are emitted from one of the sources below but cannot be split (e.g. in case of one common vent): Natural gas driven pneumatic equipment / Centrifugal compressor shaft seals / Reciprocating compressor rod packing / Glycol dehydrators / Tanks / Well liquid unloading / Well casinghead venting / Hydraulic fracture completions

3 Transmission System Operator

4 Reduction & regulating stations / Measurement stations /Valve stations / Consumer supply stations for metering and regulating

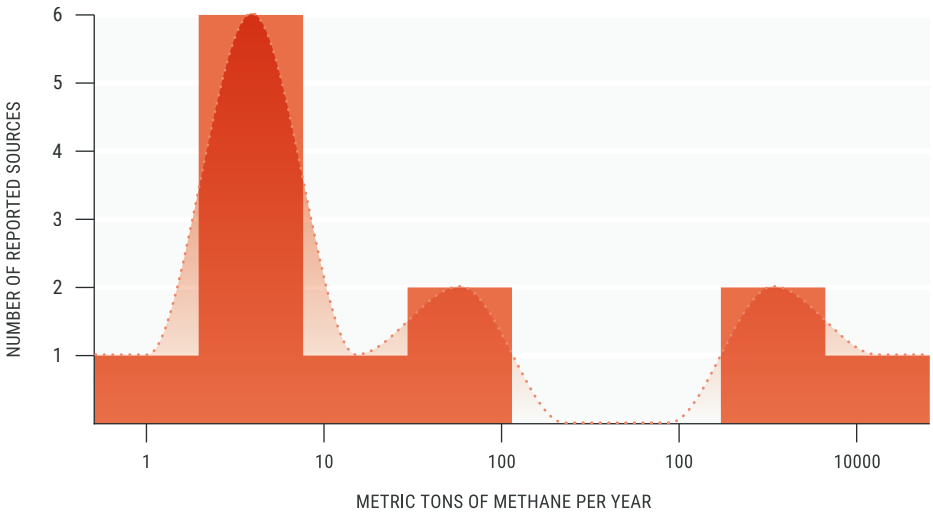


Figure 7. Distribution of Incident/ Emergency Vents from service lines, downstream.

Note: 2 per cent accounted for 99 per cent of total emissions from this source. Horizontal axis is using a logarithmic scale.

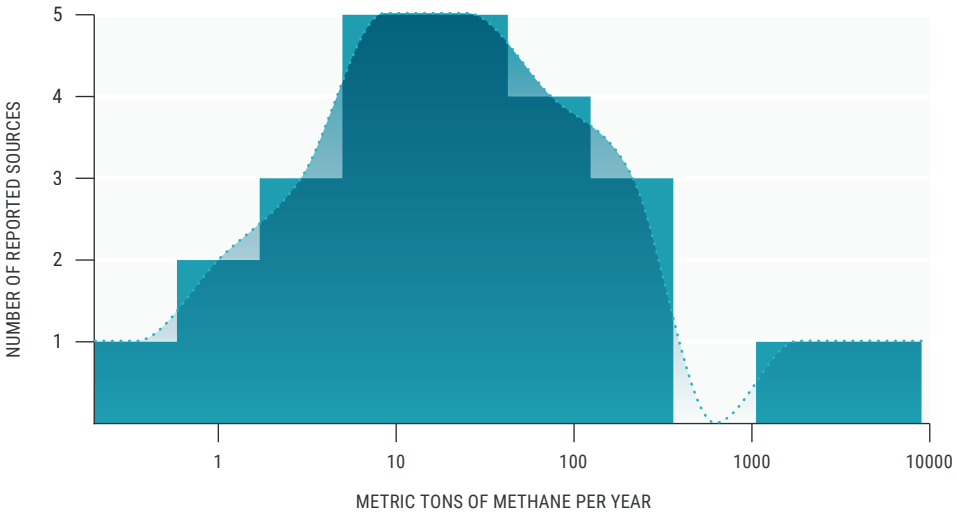


Figure 8: Distribution of midstream gas analysers and pneumatic devices from TSO stations.

Note: 2 per cent accounted for 95 per cent of total emissions from this source. Horizontal axis is using a logarithmic scale.

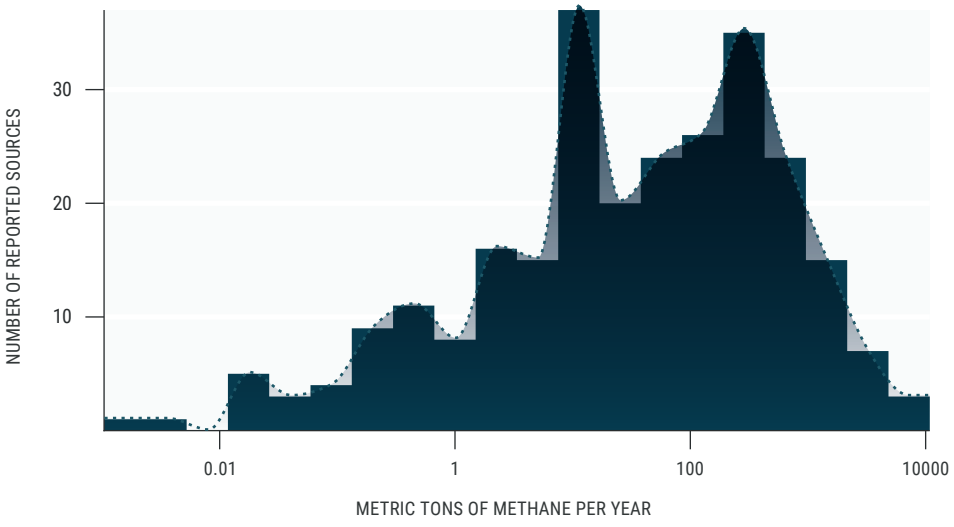


Figure 9: Distribution of upstream flaring.

Note: 22 per cent accounted for 90 per cent of total emission from this source. Horizontal axis is using a logarithmic scale.

Transition to Level 4 Reporting

Companies are using a mix of engineering calculations, measurement, and modelling to achieve Level 4 reporting. Generally, engineering calculations are most predominantly used at this stage within Level 4. It is unclear if this is a broad tendency that reflects a partiality to engineering calculations, or an indication that those sources reasonably represented by engineering calculations were addressed first.

2.4 Divestment

2.8 per cent of reported assets[5] were divested, all but four to non-OGMP 2.0 members.

Of the assets reported in 2022 (covering 2021 data), less than three per cent were divested. Of the divested assets, 46 per cent are in the United States, 21 per cent in Africa, 18 per cent in Europe, 11 per cent in the Russian Federation and 4 per cent in the Middle East. Four assets were sold

Photo credit: Eustream, a.s.

5 Partner companies can determine the appropriate level at which they describe their participating facilities, within the following criteria: 1) an operation/asset unit should be defined such that all facilities or sites of the unit are participating in the programme (e.g., several production batteries within a sub-region are listed as one operation/asset); 2) an operation/asset unit that is defined by geographical bounds should typically be smaller than a country, and could be one site/facility or a group of these.

to OGMP 2.0 members, and the rest were mostly sold to medium-sized companies in the sector. Based on member companies' public announcements, several divestments of facilities in the Russian Federation will be reported in the coming year.

Of the divested assets, 82 per cent were non-operated before their divestment, and 14 per cent were operated by OGMP 2.0 member companies. In addition, the pre-divestment status of one facility is unknown. In both the midstream and downstream segments, no divestments were reported.

Photo credit: SNAM

Table 5. Overview of divested assets

Region	Type of divested assets
Africa	The six divested assets in Africa are mature oil and gas fields. Two of the six located in Egypt are offshore platforms. The rest are conventional onshore fields.
Europe	Two out of five of Europe's divested assets are offshore oil and gas fields: one liquefied natural gas (LNG) production unit, a gas terminal and one asset that embraces several oil & gas onshore fields.
Russia	The three divested assets in Russia are onshore oil fields on the Volga and in the Ural mountains.
North America	In North America, thirteen assets were divested: two in Canada, the rest in the United States. Assets divested include unconventional oil and gas assets and conventional and unconventional onshore fields. Company partners also divested in the same region one offshore floating production storage and offloading (FPSO), pipeline facilities, LNG processing units, and upstream facilities (oil and gas processing units and gathering stations).
Middle East	There is an asset in the United Arab Emirates with insufficient information to be classified.

Box 3. Highlights of company reporting actions in 2022 under OGMP 2.0

In its first reporting year, ADNOC presented a clear and structured plan, showing the different groups of technologies/methodologies used to quantify bottom-up emissions, as well as technologies to perform measurements at the site level. The plan was based on an inventory at Level 3 of all the company's known emissions. The company is already carrying out tests with top-down technologies to define which of them best suits the conditions of its facilities and has planned some reconciliation processes by the end of 2022.

EQUINOR has put forward and followed an excellent implementation plan for the second year in a row, with an ambitious OGMP 2.0 intensity target to keep its methane emissions intensity at or below 0.02 per cent going forward, upgraded compared to last year. Considering its materiality analysis, the company reported over 96 per cent of the emissions generated in its operated assets at Level 4 and is performing site-level measurements on several assets.

JONAH continues to implement its proposed plan, reporting 74 per cent of its operated assets at Level 4 in its second report. The company is deploying site-level measurements to begin reconciling actual emissions and has shared information on a series of engineering models for calculating emissions from different sources, using information from supervisory control and data acquisition (SCADA) systems, real-time measurement sensors, information measured with bottom-up equipment and emission measurements at the asset level. Jonah's proposal includes operationalizing a system for reporting and detecting emissions in facilities, with the aim to reduce these emissions to a minimum.

TotalEnergies' plan includes strategies to execute measurements across a wide dispersion of facilities in different conditions (offshore, onshore) and different climatic characteristics, from the North Sea to Patagonia, across tropical and sub-tropical regions and other technical features of the facilities. The proposed plan and its implementation process includes various technologies to carry out measurements with different ranges and periodicity. The company's approach considers measurements with satellites, airplanes, and drones. This process is complementary to its bottom-up measurement campaigns.

ENAGAS presents one of the implementation plans with the highest level of detail and robustness. The company proposes a clear strategy to carry out bottom-up measurements for several operating facilities, including liquefied natural gas regasification stations, underground gas storages, compressor stations and transmission networks as well as site-level measurements, to determine the best technology for the type of installation and evaluate the precision considering the different climatic conditions. ENAGAS presented a report with a high percentage of measurements at Level 4 (98 per cent over its operated assets) and the results of site-level measurements at several of its facilities.

In conjunction with a group of OGMP 2.0 members, the company formed GERG, a research group to evaluate the precision of several bottom-up and top-down technologies. The GERG study results will provide reliable information for companies' decision makers regarding the accuracy and limitations of different methane detection and quantification technologies.

GRTGaz reported more than 97 per cent of its emissions from operated assets at Level 4. The company evaluates different technologies and methodologies to improve the monitoring of possible emissions using information from sensors in real-time gathered in the facilities' SCADA systems. The system was already in the testing stage in 2022. In addition to being part of the GERG research consortium, GRTgaz research and development centre tested different technologies on its facilities with various sensors to perform site-level measurements.

OGE presented a solid emission report with 94 per cent of all known sources from operated assets at Level 4. In addition to being part of the GERG project, the company has performed tests using site-level measurements with an Infrared Absorption Spectrometer over some assets.

Thüga Group's second annual report cover all known sources, increasingly relying on direct measurements. For example, one of its three subsidiaries, Thüga Energienetze, reported an emissions-weighted average reporting level of 3.7, covering 68 per cent of its emission sources with bottom-up measurements. In addition, the Group is testing technologies to verify underground emissions for pipes of different materials. In a parallel effort, the consortium is currently defining which technology to use for measurements at the site-level to reconcile the Level 4 inventories with site-level measurements.

Italgas gained experience performing site-level and source-level measurements with different technologies. Additionally, the company has shown excellent performance in convincing some of its non-operated joint venture partners to join the initiative, and others to report emissions at higher levels. This effort has been possible due to dedicated workshops and training on different technologies and methodologies.

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Photo credit: SNAM

Box 4. Areas of opportunity

Recent developments suggest the evolution of methane emissions transparency

Over the past year there have been three developments that suggest the evolution of transparency in oil and gas methane emissions reporting. The participation by more than 120 countries in the Global Methane Pledge, the gradual emergence of commercial emission certification, and the adoption by the United States of a methane fee based on measurement-based emission estimates, all suggest what might be the next evolution of OGMP 2.0.

OGMP 2.0 was a great improvement over previous reporting frameworks. This is due to the hard work by the companies and other stakeholders who learned from earlier efforts and co-designed the 2.0 framework. But OGMP 2.0 is not perfect and will continue to require innovation.

Delivering the ambition of the Global Methane Pledge will require taking transparency and performance to a new level. All assets, including non-operated assets, will need to be covered by performance targets, and emissions from divested assets will need to be tracked. The emergence of commercial emissions certification initiatives like the European Union's Methane Supply Index (EU 2020) and the U.S. methane fee will likely require disclosure at the individual asset-level.

Recent developments suggest that there are at least three areas where improvements may be made in the future evolution of the OGMP 2.0 framework:

- Disclosure per asset

As per the agreement with companies, emissions of OGMP 2.0 member companies are reported to UNEP by asset. The data are not disclosed at this level of granularity but are aggregated by company or by source across companies. The underlying reason is the legitimate interest of companies to protect their production data by asset, which could be inferred from emission data by assuming an emission factor. Yet this interest of companies is already under pressure:

First, as emissions become a factor in trading, either through certification tied to carbon border adjustments or for other reasons, emissions will need to be reliably disclosed by asset and aggregated in the supply chain into a specific market or contract. For example, the Methane Supply Index that the European Commission has announced for fossil gas supply into the European Union will require disclosure of OGMP 2.0-compliant data for all assets involved in the supply chain.

Second, several countries already require disclosure by asset. The U.S. methane fee will require empirical measurement reporting and public disclosure to the U.S. Environmental Protection Agency. Other countries such as the Netherlands and Norway already disclose production data per asset, which removes the argument that disclosing OGMP 2.0 data per asset is harmful.

Last, civil society pressure will continue to build to disclose emissions data per asset. There can be local air quality concerns with communities in proximity to the sites or requirements for better climate impact accounting of impact for the supply chain of industries.

- Non-operated joint venture targets

The current OGMP 2.0 framework requires setting performance targets by all member companies for their operated assets consistent with the required industry target of a 45 per cent reduction by 2025 and 60-75 per cent by 2030. Since OGMP 2.0 companies are plausibly the better operators in the industry and the industry target is one for collective action by the sector, the expectation is that partner companies ratchet their targets well beyond the industry average. Targets for non-operated assets are encouraged but not compulsory. However, those targets will scale up the collective industry impact, as they will also commit a much larger part of the industry through their shareholding and that of their non-operated partners. As a consequence, such performance targets will reduce the pressure on performance targets for their operated joint ventures, which will need to compensate for less of the rest of the industry.

- Divestments

As pressure mounts on companies to manage their methane emissions, a high emission intensity becomes one of the factors in divestment considerations. Of course, reducing emissions through divestment to companies with less focus on methane management does not contribute to climate mitigation. In the context of the Global Methane Pledge, it must be explored how these assets continue to be reported at the same standard as OGMP 2.0.

3.

Methane Science Update

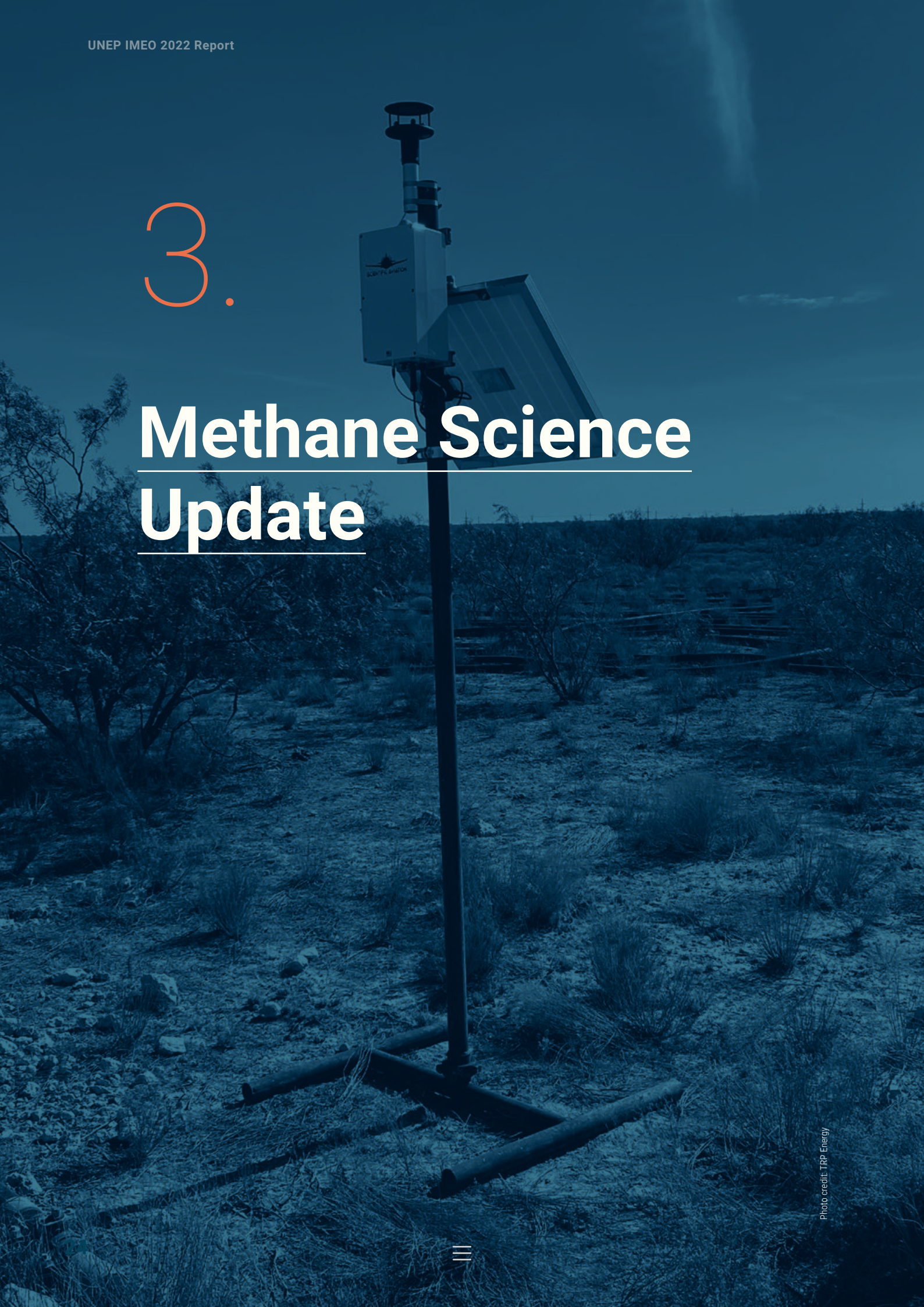

Photo credit: TRP Energy

3. Methane Science Update

3.1 Scientific Integrity

Core principles: Independence, peer review and a guarantor of scientific integrity

The goal of IMEO's science studies workstream is to reduce the uncertainty in the location and magnitude of methane emissions through measurement studies published in the peer-reviewed literature and the reconciliation of measurement-based emission data. The studies focus mainly on geographical regions and/or sources with limited or no publicly available empirically based emission data, and have the objective of improving the understanding of emission patterns and/or guiding mitigation action.

There are five core guiding principles of the studies, which are the basis for the integrity of IMEO's science work:

1. Studies are led by academic/research scientists.
2. Studies employ multiple measurement and emission quantification methodologies.
3. Feedback on the design and results of each study is solicited from external, academic scientific experts prior to the publication of results (i.e., IMEO's Scientific Oversight Committee).
4. Results are published in peer-reviewed journals.
5. All measurement emission data are made public (specific locations/owners may be masked to protect business interests in limited situations).

Photo credit: TRP Energy / EDF

3.2 Oil and Gas Emission Studies

Significant progress is being made in characterizing emissions: updates from IMEO science studies

IMEO's science studies aim to close knowledge gaps in emissions globally and produce policy-relevant scientific results. The programme includes studies started from the preceding Oil and Gas Methane Science Studies supported by the Climate and Clean Air Coalition (CCAC), which were co-managed with UNEP as an IMEO precursor. The current focus of IMEO's science studies is the oil, gas and coal sectors – with a first round of studies also looking at the characterization of emissions from the waste sector.

Data from these studies – in addition to the other data streams integrated by IMEO – will allow governments, industry and other stakeholders to identify effective policies and actions to reduce methane emissions. As shown in Figure 10, ongoing and already published work covers diverse geographic regions, types of oil and gas production, and different segments of the supply chain.

Depending on data availability for different regions and/or source types, results are expected to reduce uncertainty in various ways:

- In regions/sources with little or no measurement-based data (e.g., ongoing study in the Caspian region), studies can provide an initial empirical understanding of the magnitude and location of methane emissions.
- In regions/sources with some empirical methane emissions data (e.g., published study characterizing emissions in Mexico; see Zavala-Araiza *et al.* 2021), IMEO Science Studies should help improve the accuracy of inventories, identify key regions/sources where mitigation can be most effectively focused, and bring a clearer understanding of key emission sources.
- In regions/sources where more in-depth empirical data collection has occurred (e.g., Canada, the United States), IMEO anticipates collaborating on filling key data gaps and further improving a mechanistic understanding of emission sources. For example, linking measurement at different scales to allow for effective root cause analysis of the causes of emissions to be carried out, so that data can drive mitigation action effectively.

Figure 10. Ongoing IMEO studies

IMEO is also funding 8 global studies (7 oil and gas, 1 coal)

Table 6 summarizes published work, and Table 7 summarizes studies that have been initiated and are underway. As of September 2022, a total of 12 scientific papers had been published, and four additional papers are expected to be published by the end of the year.

Table 6. Summary of UNEP commissioned of science studies

Study	Rationale	Status	Key findings
Offshore production studies: Gulf of Mexico	Little to no empirical-based estimates exist of methane emissions from oil and gas offshore infrastructure. The first offshore study took place in the United States, where it was logistically easier to set up the study.	A methods paper relying on ship-based measurements was published (Yacovitch, Daube and Herndon 2020).	The published studies highlight important differences in emissions between shallow and deep-water production infrastructure, and also highlight the presence of super emitters.
Offshore production studies: North Sea	Data were collected on UK, Dutch and Norwegian oil and gas infrastructure in the North Sea.	A methods paper was published (France *et al.* 2021). A manuscript focusing on Norwegian infrastructure was published (Foulds *et al.* 2022), and a manuscript summarizing findings from the southern North Sea (i.e., United Kingdom and Netherlands) was in preparation.	The Norway study is one of very few papers indicating agreement between measurements and operator reports. Offshore facility-level emissions can vary substantially over time, and the paper shows that sufficiently large and representative sampling is needed for meaningful comparisons with reported emissions, which is relevant for OGMP 2.0
European downstream studies	There was interest in characterizing emissions from municipal distribution systems in Europe and comparing them to emissions from North American cities (Toronto). The set of studies also incorporates measurements of midstream facilities near sampling regions.	Four initial papers on Bucharest, Hamburg, Paris and Toronto were published (Ars *et al.* 2020; Maazallahi *et al.* 2020; Defratyka *et al.* 2021; Fernandez *et al.* 2022). Additional manuscripts for individual cities (i.e., London) and an overall synthesis paper were in preparation.	Initial papers highlight a small fraction of high-emitting leak indications with a disproportionate contribution to total emissions. The studies also highlight the importance of attribution methods to split thermogenic and biogenic methane emissions in urban environments.
Mexico onshore/ offshore	There was interest in characterizing the differences between onshore and offshore emissions for a major oil and gas production country that relies on simple emission factors for its inventory.	A paper was published (Zavala-Araiza *et al.* 2021).	This study integrates airborne-based measurements with remote sensing data (TROPOMI and VIIRS night-time flare data). It finds large discrepancies (more than an order of magnitude) in emission estimates, with offshore production being overestimated and onshore production being underestimated in current inventories.

Study	Rationale	Status	Key findings
Australia: Coal Seam Gas (Surat Basin)	The study provides the first comprehensive data on emissions from a coal-seam gas production region, an increasing phenomenon, and represents a critical first step in understanding other places where this production occurs.	Two papers were published (Lu *et al.* 2021; Neininger *et al.* 2021).	The Surat Basin is Australia's largest coal-seam gas basin, accounting for almost 20 per cent of Australian natural gas production. Coal-seam gas upstream sources emit around 0.4 per cent of produced gas, which is comparable to some onshore dry gas fields (Marcellus Shale in the United States and Groningen field in the Netherlands). However, it is substantially smaller than other regions, especially those where oil is co-produced (wet gas).
Romania onshore coordinated campaign	This was an opportunity to perform a coordinated campaign that includes the integration of top-down (i.e., airborne-based) and bottom-up (i.e., ground-based mobile measurements) in a country that relies on simple emission factors (IPCC Tier 1). Prior versions of the National GHG Inventory showed Romania as the European Union country with the highest production-related emissions. A recent update to Romania's inventory has greatly reduced the emissions. This study shows the value of incorporating multiple measurement methods at different scales.	A paper summarizing ground-based data collection was published (Delre *et al.* 2021). An additional paper was in peer review, and manuscripts integrating all collected data and synthesising results were expected to follow soon.	The findings are expected following the publication of the synthesis of all data, including (but going beyond) already published data.

Table 7. Summary of initiated and ongoing oil and gas science studies

Study	Rationale	Status
Global LNG study	Significant uncertainty exists regarding methane emissions from LNG facilities (liquefaction, regasification and shipping), with little to no empirical measurements publicly available.	Manuscript under review.
TROPOMI-based characterization of regional emissions	Significant uncertainty exists on methane emissions from several high-producing regions where TROPOMI can be used to quantify regional emissions.	Ongoing analysis is focusing on quantification of emissions in Algeria and Venezuela.
Aerial measurements and flux estimates in the Caspian region	There is interest in characterizing the differences between onshore and offshore emissions in the first locally studied former Soviet Union country. The study will compare empirical data with the simple emission factors used in the country's inventory.	Scoping project.

Study	Rationale	Status
Offshore measurement study in West Africa: Angola and Gabon	This offshore oil and gas methane study is focusing on Angola with potential additional measurements in Congo and/or Gabon. The region is home to substantial oil and gas production by both national and international oil companies and has been identified as a flaring hotspot.	Measurement campaign occurred September 2022.
Aerial methane survey in Oman	This aerial methane survey is characterizing oil and gas site-level emission distribution and potentially also regional-level fluxes. It will be the first in-depth, independent, study of oil and gas methane emissions on the Arabian Peninsula.	Measurement campaign scheduled for 2023.
Characterization of emissions in British Columbia, Canada: airborne-based measurements, improvement of inventory and root cause analysis.	The ultimate goal of this project is to establish robust procedures for producing quantitative, measurement-based methane inventories backed by uncertainty analysis, while supporting development of comprehensive Monitoring, Reporting and Verification (MRV) protocols. It is undertaken in close collaboration with the government of British Columbia, Canada to produce a measurement-based oil and gas sector methane inventory and to perform root cause analysis.	Project initiation in progress.
Combining measurements at different levels in Colombia	The study is combining measurements at the regional, site and source levels, characterizing emissions from oil and gas production in Colombia. Measurements in Colombia are timely since the country is working to complete its federal methane emissions regulations.	Project initiation in progress.
Synthesis study in Permian Basin	The research community has recently collected – using a wide diversity of techniques/approaches (satellite remote sensing, towers, overflights with several different platforms, drones, vehicles) – more data characterizing emissions from the Permian Basin in the United States than any other oil and gas producing basin the world. The goal of the project is to catalyse a synthesis of as much collected data as possible, allowing multi-scale observations to be compared and contrasted. This effort is anticipated to provide insights into the advantages and difficulties of different sampling approaches and strategies.	Research teams are working in data analysis.
Reconciling methane emissions inventories with site-level measurements globally	Most source-level models and estimates have not incorporated large emitters. This work will build time-resolved models of key facility types relevant to global oil and gas infrastructure. Comparison between the emissions distributions and bottom-up modelling will shed light into discrepancies. This work will also support further development and implementation of the OGMP 2.0.	Project initiation ongoing.

3.3 Coal Methane Science Studies

Studies will help to improve our understanding of coal mine methane emissions, with a focus on metallurgical coal

Oil and gas activities are the largest sources of anthropogenic methane emissions from the fossil fuel sector. However, around 15 per cent of anthropogenic methane emissions are associated with coal mining activities, which contribute around 43 million tons of methane to the atmosphere annually (Saunois *et al.* 2020). Accurately tracking emissions related to coal mine methane is key for prioritizing the mitigation efforts of companies and governments across sources, including active underground and open-cut mines, ventilation shafts, and draining stations. IMEO has initiated the Coal Methane Science Studies to improve the understanding of methane emissions from the coal sector.

The coal studies are important for several reasons. National reporting of coal mine methane emissions to the UNFCCC is largely based on bottom-up approaches such as engineering calculations, without an established and comprehensive comparison with top-down approaches based on atmospheric measurements and associated modelling. While coal mine methane emission estimates based on top-down approaches such as local and satellite studies exist for a small number of mines globally, the understanding of how to reconcile these with reported emissions is severely limited. To date, only one bottom-up/top-down comparison exists for a single day of aerial observations in Poland at the basin-level.

Despite the lack in the coal sector, this methodology for reconciliation has been successfully applied for many years in the oil and gas sector. It has both been published in top-tier scientific peer-reviewed literature and used in practice by oil and gas companies. The extension and validation of this reconciliation methodology for the coal sector will need to take into account the specific parameters of this industry (e.g., air pressure, different size assets, temporal variation, etc.), but the fundamental principles will apply. Simplifying factors include mine-level measurements in coal, instead of basin-level measurements as for oil and gas. Mines also have extensive emissions data collected for safety purposes that are not mirrored in the oil and gas sector.

Future studies are required at the mine-level to clearly characterize the benefits and limitations of mine operator emission reports. These studies will also incorporate current and future satellite missions to measure coal mine methane emissions at scale globally. The satellite-based emission quantifications are most accurately done at the mine-level given the relatively large amounts of emitted methane per mine. No bottom-up/top-down reconciliation at the mine-level has been done thus far, and IMEO will be the first to undertake this type of analysis.

One of the expected factors requiring careful examination relates to the temporal variability of emissions and the reporting methods applied across countries. Establishing a protocol for comparing coal mine methane emission estimates based on top-down and bottom-up approaches and reported values is a path towards enabling: 1) verification of currently reported global coal mine methane emissions, 2) verification of reporting of future mitigation activities, 3) characterization of uncertainties related to bottom-up and top-down approaches, and 4) potential re-assessment of the magnitude of mitigation across world regions.

Photo credit: pexels / Kelly

The goals of the studies include:

1. Establishing an approach for comparing top-down and bottom-up coal mine methane emission quantification and reporting via collaboration of experts in bottom-up and top-down methods as well as mine operators.

2. Applying the approach in different countries using local and satellite studies, reconciling top-down and bottom-up results and characterizing uncertainties.

3. Subject to data availability at the required scale and detection limit, quantifying coal mine methane emissions using satellite studies in additional countries as a means of deriving an empirically based estimate of coal mine methane global emissions.

The studies began with a literature review to identify gaps in understanding of global coal mine methane emissions and highlight uncertainties in recent emission estimates. The literature review discusses the various operational parameters such as geology, mine types, local mining techniques, and potential pre-mining drainage to collect and remove methane before emission to the atmosphere; all of these strongly affect the amount of mine-specific methane emissions and therefore complicate their estimation. The literature review further points out the highly variable nature of the emissions over time, given that coal mining is a dynamic process. Methane safety monitors in underground mines provide potential opportunities to quantify methane emissions to the atmosphere, yet it is currently unclear – given the lack of relevant data – how accurate such monitors are in different mining environments and modes of deployment.

Furthermore, the literature review points out the above-mentioned lack of bottom-up/top-down reconciliation, which this study will address as well. In the next step, two field studies were launched in Poland and Australia in 2022. Both studies include aerial and satellite measurements to quantify methane emissions at the individual mine level of several – mostly underground – mines. The Poland campaign is designed with the European Space Agency and GHGSat to obtain additional satellite and airborne imaging spectrometer capabilities.

Ongoing data analysis is planned to involve collaboration with mine operators to contextualize the snapshot top-down measurements with mine-level activity and continuous methane safety sensor data. Follow-up campaigns in Poland in Australia will collect additional top-down and bottom-up data to provide more granular insights and to develop more robust future measurement programmes. In parallel, IMEO is scoping similar field campaigns in other countries with metallurgical coal production.

3.4 Looking Forward

A portfolio of global studies is closing knowledge gaps while building scientific capacity

Future IMEO scientific studies will continue to address the core aim of closing knowledge gaps in fossil fuel methane emissions. Studies are in the planning stages for large-scale liquefied natural gas measurements in Australia, emissions from abandoned oil and gas wells in a number of countries, and scoping for new projects in Africa, South America and Southeast Asia.

Abandoned wells are predicted to be the tenth largest source of anthropogenic methane in the United States (Williams, Regehr and Kang 2021), with at least four million abandoned wells in the country alone. Currently, measurements of methane emissions from abandoned wells are limited to a very small number of studies (Kang *et al.* 2016), with very few emission estimations conducted outside North America. For new proposed work, abandoned wells in a range of geological and economic settings will be investigated across Europe (including in Azerbaijan, Germany, Italy and Romania) and North America.

Photo credit: Leslie Cross / unsplash

In Australia, LNG is forming a critical part of the economy, with exports in 2020-2021 valued at more than 30 billion Australian dollars (Department of Industry, Science, Energy and Resources of the Commonwealth of Australia 2021). Understanding supply chain emissions from this industry is increasingly critical as the production, liquefaction, transport, and re-gasification of LNG global. For Australia, IMEO aims to fund science to measure emissions from the main liquefaction plants well beyond the previously completed pilot study, to capture around 95 per cent of nameplate capacity and allow emission quantification at the facility-level.

Initial scoping work has been undertaken in the Caspian region (Azerbaijan), where there is interest in direct measurements of onshore and offshore emissions in the first locally studied former Soviet Union country. Studies will compare empirical data with emission factors used in the country's inventory. This work is also intended to cross-over with the abandoned wells measurement studies.

In addition to these targeted projects, preliminary scoping work has been undertaken in Central, Northern and Western Africa and in South America on the measurement programmes, reporting and regulatory framework of emissions to identify knowledge and data gaps. These scoping studies are designed to lead to the planning of future science studies. Very early preliminary planning for science studies to investigate methane emission estimates for the total supply chain for Southeast Asia's oil and gas sector is also under way.

IMEO is also widening its focus to include studies from other anthropogenic methane emissions. As much as 60 per cent of measures targeted at the waste sector have either negative or low cost and could reduce methane emissions from the sector by 30-40 million tons annually by 2030 if implemented (UNEP 2021). A large-scale landfill measurement campaign is in the planning stages and would serve as a method of intercomparison for area sources (ground-based and drone combined measurements versus aircraft mass balance) and IMEO's first measurements of sources in the waste sector.

► Organizations that are interested in collaborating with IMEO on methane research may apply for support, including access to data, scientific review and funding. Applications are available at:

https://www.unep.org/explore-topics/energy/what-we-do/methane/imeo-methane-science-studies

3.5 MARS: IMEO's Public Emissions Data Integration Platform

Methane Alert and Response System (MARS)

IMEO has initiated the design of a data framework that allows the merging and aggregating of data from diverse sources beyond the OGMP 2.0 company reported data. IMEO is creating a public emissions data platform – the Methane Alert and Response System (MARS) – to ingest, integrate, store, analyse and visualize data from the diversity of emission data streams. It will feature linked storage, but also analysis and visualization tools to facilitate general and advanced user assessment. It will also foster the development of new, derivative datasets and assessment metrics related to data quality, consistency and overall confidence in the aggregate emissions metric. First steps towards MARS are looking at the integration of satellite remote sensing datasets.

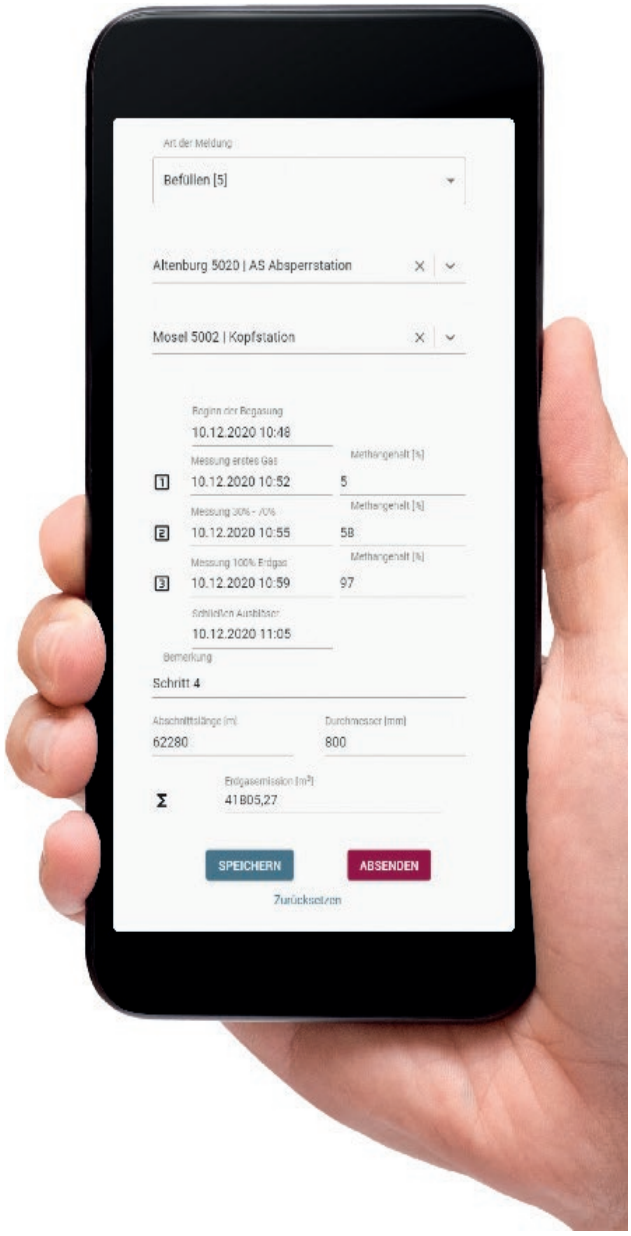

Photo credit: GASCADE

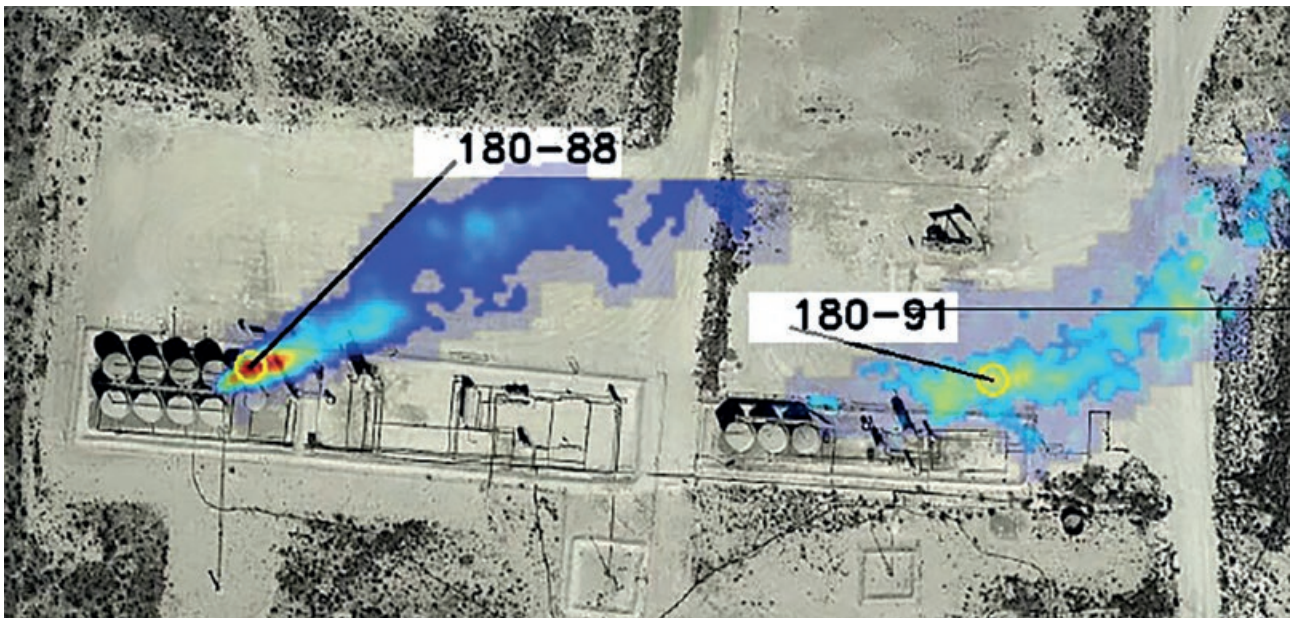

Photo credit: Bridger Photonics

3.6 Recent Advances in Satellite Remote Sensing Characterization of Methane Emissions

Synergies between current area flux mappers and point source detectors can be exploited

Satellites have the capacity to detect, quantify and monitor methane emissions at a variety of scales (point-source, regional and global) over long periods of time (Irakulis-Loitxate *et al.* 2022; Jacob *et al.* 2022). Area flux mappers (Jacob *et al.* 2022), such as the TROPOMI instrument aboard the European Space Agency's Sentinel-5P satellite, can both quantify regional-to-global total methane emissions over some integrated period (e.g., Zhang *et al.* 2021) and detect and quantify extremely large single-overpass methane plumes globally (e.g., more than 25,000 kilograms per hour for TROPOMI; Lauvaux *et al.* 2022). While such mappers lack sufficient spatial resolution for attribution to individual assets or facilities, analysis techniques such as wind-rotation (Varon *et al.* 2020; Maasakkers *et al.* 2021), estimating flow divergence (Liu *et al.* 2021, Schneising *et al.* 2020) with long-term averaging can be used to identify persistent "hotspots" where single large or multiple smaller emitters contribute to a detectable methane plume.

In most instances, attribution of area flux mapper-observed plumes to individual assets or facilities requires instruments with higher-spatial resolution – around 25-60 metre pixels for point-source detectors compared to greater than 1 kilometre pixels for area flux mappers (Jacob *et al.* 2022). Such instruments include "point-and-shoot" tasked satellites that lack spatial coverage but can detect emissions at high spatial resolution and lower emission rates (100 to 1,000 kilograms per hour, e.g., GHGSat, hyperspectral instruments like PRISMA) and multispectral, high-resolution global land imagers that observe more frequently but at slightly higher detection limits (greater than 1,000 kilograms per hour; e.g., Sentinel-2 and Landsat; Irakulis-Loixate *et al.* 2022).

While no single satellite can both detect and quantify methane globally and attribute it to individual point sources, synergies between current area flux mappers and point-source detectors can be exploited to monitor and address large point sources (Jacob *et al.* 2022). Detection of very large plumes (greater than 25,000 kilograms per hour) or persistent hotspots (greater than around 1,000 kilograms per hour) with area flux mappers can be used to "tip-and-cue" higher-resolution point-source mappers (or analysis of available multispectral data) for attribution. Mitigation of these sources alone addresses at minimum 10 per cent of global oil and gas production methane emissions (around 8 million metric tons of methane per year; Lauvaux *et al.* 2022).

As the satellite observing system continues to evolve, capabilities of both area flux mappers and point-source detectors will improve. For example, the MethaneSAT instrument ,with its 200 metre by 400 metre pixel size and very high precision (Rohrshneider *et al.* 2021), will be able to characterize oil and gas basin-wide emissions every few days (compared to approximately monthly with TROPOMI; Jacob *et al.* 2022). Additionally, with its comparatively lower single-plume detection limit (around 500 kilograms per hour; Jacob *et al.* 2022), MethaneSat will be able to target more plumes than TROPOMI for potential attribution and mitigation. Further, a growing constellation of point source detectors – such as GHGSat – enables more frequent attribution of these observed plumes to specific assets or facilities

Box 5. IMEO's relation to national emission inventories

Transparent measurement-based emission estimates can improve national inventories

Under the Paris Agreement, parties to the UNFCCC agreed to update and publish national greenhouse inventories using methodologies developed by the Intergovernmental Panel on Climate Change (IPCC). These national inventories of greenhouse gases help countries to "systematically and transparently report their anthropogenic emissions and removals of greenhouse gases and are essential for policy development and monitoring the impact of international agreements focused on addressing climate change" (IPCC 2019).

The 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006) and the subsequent 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2019) provide methodologies for estimating – by mass – the emissions (and removals) of specific gases, including methane.

Methodologies are structured in three tiers of increasing complexity in terms of accuracy and needed activity: First, the magnitude of anthropogenic emissions or removals occurring over a given time period from national statistics; then emission factors, and finally the emissions or removals of a gas per unit of activity. This data is required with the goal of ensuring comparable inventories between countries with potentially different resources. Emission factors used in the inventory building processes tend to be based on simple and generic assumptions for the systems they intend to characterize and even at the highest reporting tier are usually not based on representative measurement-based data.

The 2019 IPCC Refinement provided guidance on two areas for which emission data collected by IMEO will be relevant: use of facility-level data in inventories and comparison of greenhouse gas emission estimates with atmospheric measurements. IMEO's integrated measurement-based emission estimates, obtained from the company reports, science studies, satellite remote sensing, can contribute to deriving country-specific emission factors.

Similarly, these same observational datasets can be used to verify national inventories of methane emissions by being directly incorporated into models or by better constraining gridded prior inventories – the spatially and temporally disaggregated first-guess emission estimates used by inverse models. Ultimately, the use of empirical estimates based on atmospheric observations for inventory verification and improvement will involve an iterative, collaborative partnership between scientists and inventory specialists. IMEO can help to increase transparency and accuracy – key tenants of IPCC good practice – in methane emissions reporting by facilitating this collaboration between inventory compilers and the scientific communities developing inverse modelling tools and observational datasets.

Photo credit: GASCADE

Photo credit: Neptune Energy

Box 6. Flaring efficiency

Flares are neither always lit, nor destroy methane with 98 per cent efficiency

Current estimates of flaring's climate impact generally assume that flares are always lit and that they destroy methane with 98 per cent efficiency. Neither assumption is founded in real-world observations.

As part of the Flaring and Fossil Fuels: Uncovering Emissions and Losses (F3UEL) project, a research team led by Eric Kort (University of Michigan) conducted an airborne survey with the help of Scientific Aviation that directly measured flare performance across three basins (Permian, Eagle Ford, and Bakken) that are responsible for more than 80 per cent of flaring in the United States (Plant *et al*. 2022). This is the largest, by an order of magnitude, in-situ sampling of real-world flares ever done, with more than 600 intercepts of plumes for over 300 flares. The destruction removal efficiency for methane was determined for each intercept based on observed carbon dioxide and methane concentration measurements.

The team conducted a separate ground survey to assess unlit flare prevalence in the Bakken using thermal imagery, building on earlier surveys by the Environmental Defense Fund of unlit flares in the Permian. The results revealed that both unlit flares and inefficient combustion contribute comparably to ineffective methane removal, with flares effectively destroying on average only 91 per cent of methane. The average destruction removal efficiency from the measurements is 95 per cent, while 3-5 per cent of flares are unlit.

This means that nearly five times more methane is released to the atmosphere from flares than is presently assumed, which, if representative, totals 8-11 per cent of global oil and gas methane emissions. This finding highlights a previously underappreciated methane source and mitigation opportunity. Increasing flare efficiency, reducing the number of unlit flares and reducing flare volume overall would all be highly effective interventions.

Additional studies will be needed to assess flaring efficiency and unlit flare prevalence in regions of the world outside of the United States as well as to identify the root causes of inefficient combustion and unlit flare occurrence. The study by Plant *et al.* considered a number of variables that can potentially affect the destruction removal efficiency, including measured wind speed, flare gas volume, flare temperature, well age and gas-to-oil ratio. However, they did not find a significant relationship between the destruction removal efficiency and any of those variables.

Future studies should look more intensively into the relationships between flare performance and both physical and human/operational factors, as well as interactions among different factors. The findings could help to inform methane abatement strategies at the government and company levels, which might involve flare monitoring and maintenance, optimization of operational parameters such gas flow rates and amount of air or steam assistance, equipment upgrades, and adopting alternatives to flaring

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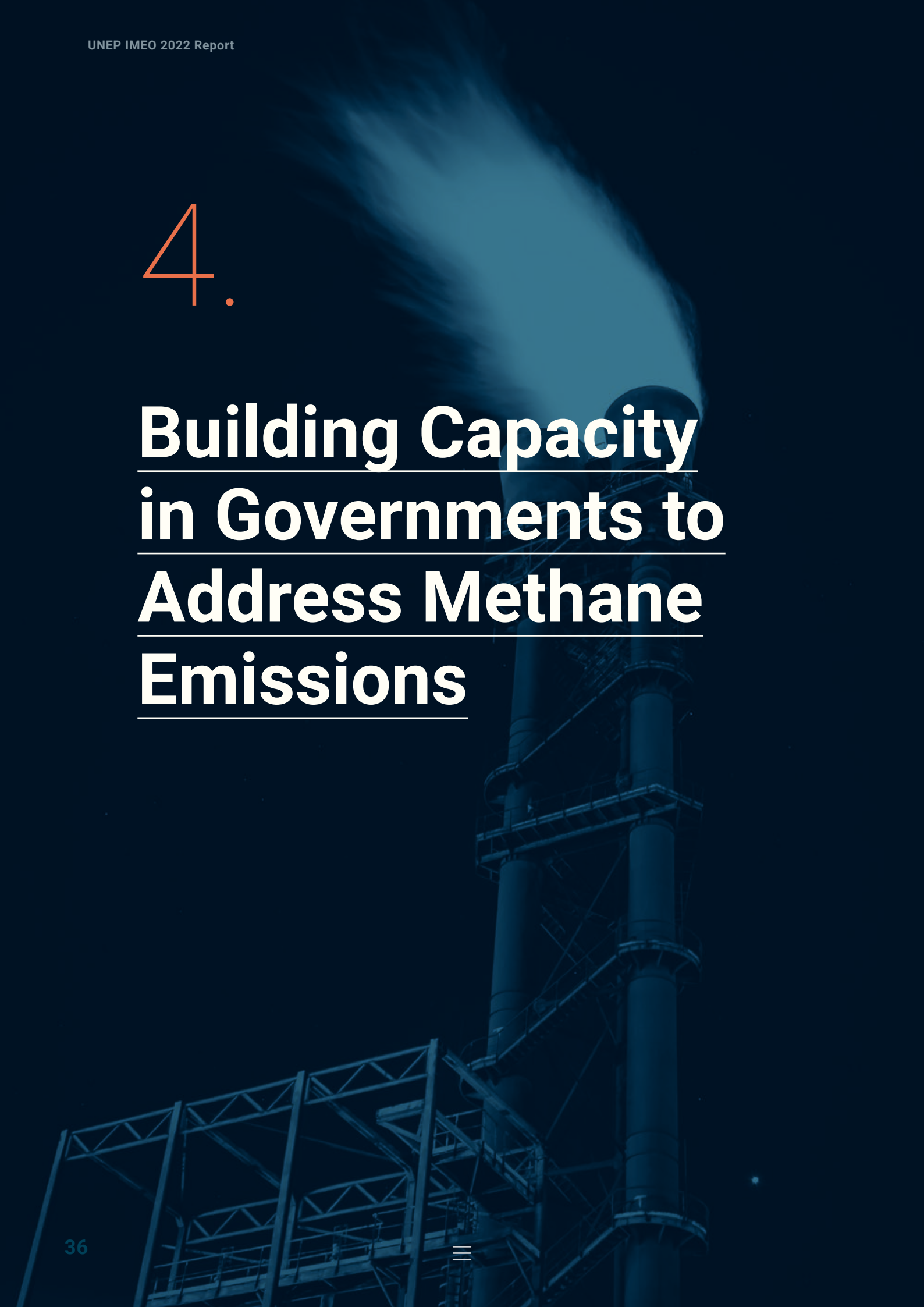


4.

Building Capacity in Governments to Address Methane Emissions

4. Building Capacity in Governments to Address Methane Emissions

IMEO is developing a range of capacity-building tools for methane mitigation

Improving the accuracy and granularity of data available on methane emissions is a critical goal but is not an end in itself. As progress continues towards improving data, IMEO is simultaneously working to raise awareness and increase the capacity of governments to access and interpret these data to encourage targeted action on methane emissions and support the development of science-based policies to reduce methane emissions. Recognizing the importance of the science-policy interface, IMEO continues to ensure that governments are equipped with accurate scientific data and information to support effective methane mitigation strategies and policies. IMEO shares best practices with partner organizations and governments in a non-prescriptive manner.

4.1 Developing and Deploying Trainings Globally

A portfolio of virtual training tools

In 2021, IMEO launched its methane training series, developed in collaboration with Carbon Limits and Environmental Defense Fund (Table 8), which can be delivered virtually or in person. The training initially comprised four modules (three core models and an optional fourth module on advanced upstream emissions) covering key information on methane sources, quantification, and mitigation, and was available in the six official United Nations languages. Over the last year, several new modules were developed to provide information on satellites, flaring and liquefied natural gas. An additional module is in development on OGMP 2.0.

In the future, IMEO will continue to expand the training series to incorporate new information, including in the agriculture and waste sectors.

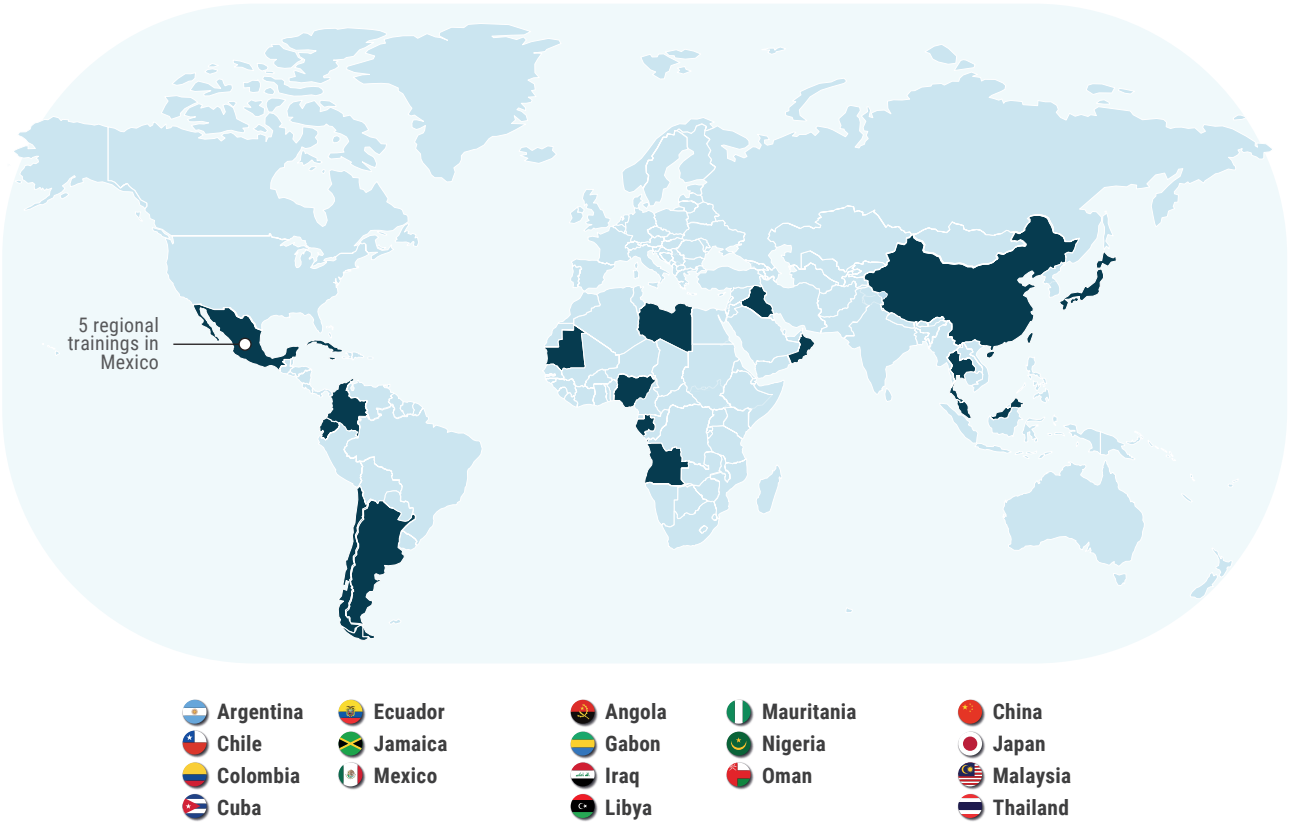
Table 8. Overview of IMEO's Virtual Methane Training Series modules

	Module	Description
Core modules	Module 1: Methane emissions in the oil and gas sector	Provides an overview of methane emissions, defining terminology related to methane and identifying major emission sources from the oil and gas sector. Explores how countries and companies can reduce emissions in pursuit of ambitious Nationally Determined Contributions.
	Module 2: Methane detection, measurement, and quantification	Provides an overview of the currently available technologies to detect and measure emissions. Demonstrates how total emissions can be quantified and explains why there is a need for better quantification technology and methodologies.
	Module 3: Methane mitigation	Explores the major sources of methane emissions and cost-effective abatement potential and mitigation activities through the efforts of governments, regulators and operating companies.

	Module	Description
Optional Modules	Overview Module	Provides a high-level summary of the contents of Modules 1 to 3, aimed at senior-level officials to cover the most important information without going to the technical level. Can be tailored to both a supply- and demand-oriented perspective.
	Module 4: Advanced upstream methane emissions	For those with a science or engineering background, serves as an optional module that provides a deeper understanding of existing best practices and technologies for detection, measurement, quantification and mitigation of upstream methane emissions.
	Module 5: Regulatory approaches to methane emissions	Explores how countries can develop policies and regulations to reduce oil and gas methane emissions, learning from experience to design frameworks that are tailored to local circumstances. Covers the main variables that should be considered when establishing new regulations, different existing regulatory approaches, and a set of essential elements of methane policies.
	Module 6: Satellite	Explores the main characteristics, limitations, and potential that satellite technology has for methane detection, measurement and quantification. Elaborates on the importance that satellites will have as an open-access source of information, and how this could impact the way governments, companies and society look at methane emissions globally.
	Module 7: Flaring	Presents a detailed explanation of flaring, discussing the main characteristics and challenges that flaring activities pose to climate change and resource management worldwide. Gives an overview of the different tools available for measurement, quantification and mitigation of flaring emissions.
	Module 8: LNG	Brings to light the unique challenges that the growing liquefied natural gas industry is having while acknowledging the lack of knowledge on emissions sources and mitigation practices, raising the need for further research in the area. Provides an overview of the main emission sources and mitigation options, as currently known. Presents some elements of policy and expected market developments specific to liquefied natural gas.

Since its launch, the training has been deployed to 18 countries (Figure 11) and 5 regional governments, providing critical information on methane emissions and mitigation strategies to more than 300 government officials and National Oil Companies' employees.

Figure 11. Countries where IMEO's Virtual Methane Training Series has been deployed



4.2 Information Leading to Action

Deployment across several countries

As countries receive information on methane emissions, increased action and ambition on methane emissions follows. Of the 18 countries that have received the virtual methane training, 11 have joined the Global Methane Pledge, making a concrete commitment to greatly reduce their methane emissions by 2030. Several countries have gone even further, taking targeted action to target methane emissions in the oil and gas sector.

Colombia received IMEO's methane training in October and November 2020, alongside support from the CCAC to develop methane emissions regulations for the oil and gas sector. In February 2022, the Colombian Ministry of Mines and Energy finalized regulations on flaring and fugitive methane emissions regulation from upstream oil and gas activities at a national level.

Over the course of 2020 and 2021, IMEO worked with partners to organize a series of workshops for the government of Iraq, culminating in a day-long, in-person deployment of the methane training series to Iraq's National Methane Task Force in November 2021. Following these trainings, Iraq included methane in its Nationally Determined Contribution, and its National Methane Task Force is currently exploring ways to improve methane monitoring, reporting and verification in the country.

The Angolan government has participated in a variety of UNEP IMEO trainings, including the virtual training series in August 2021. The government has now expressed desire to improve capacity to monitor methane emissions nationally and is collaborating with IMEO on a measurement study at offshore facilities in Angola. Representatives from the national agency ANPG will attend and participate in the field campaign to understand how to properly deploy measurement technology and methodologies that can be replicated throughout the country.

4.3 Looking Forward

Further collaboration opportunities

IMEO continues to seek opportunities to provide countries with the data and information necessary to address methane emissions. As more science studies are organized around the world, IMEO will identify other opportunities to collaborate with governments to engage officials in the measurement process to further develop technical capacity on monitoring and measurement.

Long-term collaboration with major oil and gas producing countries will also ensure that momentum is carried forward to concrete progress towards emission reduction. UNEP and the National Oil Company of Libya (NOC) recently agreed to collaborate on methane. IMEO will play an important role providing information and best practices to NOC, including an in-person delivery of the training series in October 2022 and a potential measurement study in the future. Other similar collaboration could deliver significant reductions in important methane emitters around the world.

As countries develop awareness and a better understanding about methane emissions, IMEO will also connect governments with other partners who are equipped to support the policymaking process. Partners such as the International Energy Agency and the CCAC have dedicated support to assist countries in designing policies to address methane emissions. IMEO engages closely with these organizations to ensure that policy is science-based and that progress can be tracked empirically.

Box 7. The Methane Policy Toolkit

The International Energy Agency is driving the adoption of a policy toolkit for methane mitigation

In the context of its Methane Policy and Regulation Database, the International Energy Agency is assembling tools useful for methane mitigation efforts. One example is the Methane Guiding Principles (MGP) Methane Policy Toolkit. The toolkit aims to support governments as they develop or update policies and regulations to reduce oil and gas methane emissions and work towards the goals set in the Global Methane Pledge. The Toolkit aims to connect policymakers and regulators with key resources and institutions supporting their efforts.

The Toolkit consists of three main components. The partners section describes the different organizations and initiatives that are working on reducing oil and gas methane emissions. Numerous organizations are active in this space, and each has a different topical or geographical focus. Some track methane emissions, others support policy development or abatement projects, while yet others aim to drive better industry standards and kick-start new technologies. The Toolkit maps out these different institutions to ensure that policymakers know where to turn depending on their needs.

The resources section introduces tools and publications that provide a technical and institutional basis for policy action. Considerable material is already available to inform action on methane, covering different aspects of the problem ranging from monitoring and measurement to abatement technologies. The Toolkit gathers all of the key resources in one place to help orient regulators to the landscape of materials and resources that are available.

Finally, the case studies section highlights key examples from contributing institutions and companies of the Methane Global Pledge. Although much work remains to be done, several success stories on methane emissions already exist. Some governments have started to regulate methane emissions, and in parallel companies have made great strides in improving measurement and management of emissions. The Toolkit collects case studies covering key examples to help policymakers understand what is possible.

Photo credit: GASCADE

Box 8. Climate and Clean Air Coalition (CCAC)

Supporting countries in the implementation of the Global Methane Pledge

The Climate and Clean Air Coalition (CCAC) is a voluntary partnership of governments, intergovernmental organizations, businesses, scientific institutions and civil society organizations working at the nexus of climate and clean air by reducing short-lived climate pollutants (SLCP). It is a core implementer of the Global Methane Pledge. UNEP serves as Secretariat to the Coalition.

As the first port of call for Global Methane Pledge countries, the CCAC is helping to identify methane mitigation needs and supporting resources while addressing development priorities. The CCAC fosters high-level commitments; supports countries to develop their methane roadmaps, sector policies, strategies and actions; and advances policy-relevant methane data analysis and tools:

► A new baseline report projects business-as-usual global methane emissions through 2030, and further makes the case for urgent action on methane alongside decarbonization efforts.

► Building on the 2021 flagship report by the CCAC and UNEP (the Global Methane Assessment) and on the new baseline report, "Country Methane Profiles" are being produced for all countries eligible for Official Development Assistance. They detail mitigation potentials, costs and benefits of methane mitigation measures at the individual country level and thereby support the formulation of more detailed roadmaps and greater mitigation ambition.

► A Methane Roadmap Development Programme has been developed to engage countries to identify and translate commitments, strategies and policies into building blocks of a methane action plan. The programme builds capacity within national institutions to identify priority actions in the major methane emitting sectors (fossil fuels, agriculture and waste) and to develop implementation plans for these priorities.

► The CCAC launched Engagement Strategies for all its Hubs, including on fossil fuels, agriculture and waste. The Hubs are platforms for peer-to-peer exchange, matchmaking between different efforts and creating a project pipeline.

► Through the CCAC's Funding Process, country support is approved in response to expressed country priorities. A first cohort of eight countries (Argentina, Cambodia, Costa Rica, Ghana, Morocco, Pakistan, Panama and Uganda) will receive support for their national roadmaps, taking a "whole of government" approach. Three countries receive national planning support for methane mitigation: Côte d'Ivoire, Dominican Republic and Togo. Support to sector level methane mitigation action has been approved, in the fossil fuel sector, for four projects in Côte d'Ivoire, Gabon, Iraq and Nigeria; in the agriculture sector for four projects in Cambodia, Central African Republic, Nigeria and Vietnam; and in the waste sector for 11 projects in Benin, Cambodia, the Central African Republic, the Democratic Republic of the Congo, Jordan, Liberia, Maldives, Morocco and Togo. Another call for proposals for transformative actions on methane was opened in 2022.

► CCAC is recruiting 15 national experts on short-lived climate pollutants to drive the SLCP/methane agenda at the national level. Further, 15 countries will be identified to receive similar support, including for the possible set-up of institutional structures in the form of National Methane Offices.

► Over the past year, 60 CCAC Partners submitted new or updated Nationally Determined Contributions that included methane. For example, Nigeria included a 60 per cent reduction in fugitive methane emissions from the oil and gas sector by 2031; Zimbabwe included measures to capture 42 per cent of methane generated from solid waste and compost 20 per cent of organic waste; and Iraq included a chapter on methane.

► Other methane-relevant achievements with CCAC support include: China's inclusion of manure management into the country's "Action Plan for Carbon Dioxide Peaking Before 2030"; Colombia's flaring and fugitive methane emissions regulations; and Kenya's Waste Management Bill.

5.

OGMP 2.0 Oil and Gas Company Reports for 2022

Photo credit: emmaus studio / unsplash

5. OGMP 2.0 Oil and Gas Company Reports for 2022

OGMP 2.0 company reports share a common format

Similar to the first annual IMEO report, company fact sheets for each OGMP 2.0 member are included in the appendix of this report and are accessible from the OGMP 2.0 website. The fact sheets include the company name, logo, and a narrative, supplied by the member company. Additionally, the fact sheets include the company's 2025 target (whether intensity or on an absolute reduction basis), a summary of reported emissions with data quality, and Gold Standard status.

As with the previous year's report, the data quality is illustrated separately for operated and non-operated assets. A colour gradient from light blue to dark green illustrates the emission-weighted reported emissions, where increased reporting levels is a proxy for higher quality and more certainty in reported emissions.

Finally, this report builds on the previous year with the addition of the total reported operated emissions under OGMP 2.0 scope for the 2021 reporting year. The inclusion of total operated asset emissions reflects an increased confidence in reported emissions due to the 20 per cent increase in the emission-weighted average reporting level. Its colour gradient illustrates the rounded emissions-weighted mean reporting level. Because the average non-operated asset reporting level is still relatively low and much more data are missing, this total has not been included.

Figure 12 provides an example of the common format of the company fact sheets.

Photo credit: SeekOps / Flylogix

Figure 12. Sample company fact sheet

COMPANY A

2025 TARGET (intensity*)

0.05%

*maximum amount of annual methane emissions by 2025 as a percentage of marketed gas

DATA QUALITY

OPERATED**

NON-OPERATED**

LEVELS

1 2 3 4 5

NO DATA POOR DATA EXCELLENT

**dotted pattern = incomplete data

2021 METHANE ESTIMATES (kt)

5000

Data not available for **15** out of **20** non-operated assets reported

GOLD STANDARD

2021 2022 2023 2024 2025

implementation plan approved for data quality improvement

COMPANY A

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INDEX

DATA QUALITY = measure of confidence in the company's self-reported data

GOLD STANDARD = assigned to companies in the first year that have submitted robust implementation plans on how to achieve level 4/5 reporting by 2024 for operated assets and 2026 for non-operated assets

SEGMENT

UPSTREAM

ANNEX 1.

Company fact sheets

Photo credit: Fluxys Belgium - David Samyn

ADNOC

Abu Dhabi National Oil Company (ADNOC) is one of the world's leading energy producers and a primary catalyst for the growth and diversification of the Abu Dhabi economy. With a production capacity of more than 4 million barrels of oil per day and around 11.5 billion cubic feet of natural gas per day, we operate across the entire hydrocarbon value chain to supply the world's energy needs with one of the lowest carbon intensities. We have a network of fully-integrated businesses for exploration, production, storage, refining, and trading, as well as the development of a wide range of petrochemical products.

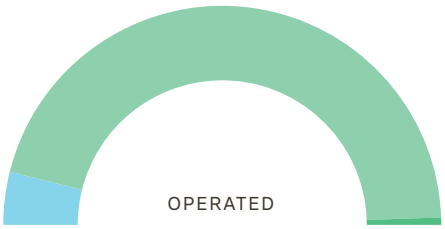
Founded in 1971, ADNOC has been responsible for harnessing the UAE's energy resources by meeting the demands of an ever-changing energy market and ultimately transforming our nation. Our work plays a crucial role in Abu Dhabi's global emergence and the broader United Arab Emirates economy. We empower our people to realize their full potential, help create thousands of jobs, drive economic growth, and invest in education and research for the future.

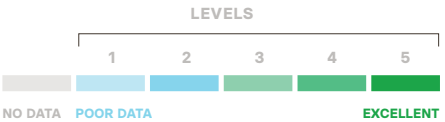
With an ambitious outlook for the future, we continue to look for innovative ways to maximize the value of our resources and support the energy transition, while applying the latest technology, developing mutually beneficial partnerships, and driving social and economic impact. Together, we are committed to creating long-term value in the communities where we operate.

2025 TARGET (intensity*)

* maximum amount of annual methane emissions by 2025 as a percentage of marketed gas

DATA QUALITY

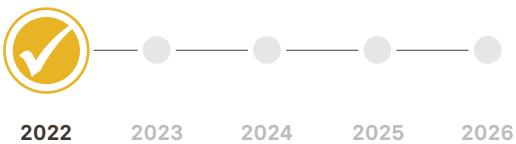




2021 METHANE ESTIMATES (kt)

37.92

GOLD STANDARD



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SEGMENT

UPSTREAM

BP

bp has an aim to install methane measurement at all its existing major oil and gas processing sites by 2023, in support of its ambition to be a net zero company by 2050 or sooner. This supports delivery of OGMP 2.0 requirements.

In 2021, bp's activity included the ongoing installation of enhanced metering as well as software for determining flare efficiency and gas turbine performance. bp also continued to reduce operational methane emissions. This included upgrades and optimisation as well as improved design and use of new technology.

bp's US onshore operations, bpx, continued to deploy drones and aircraft for methane detection and quantification. Additionally, new technologies were trialled for real-time site level emissions detection. bpx also continued to drive reductions in methane and aims to achieve zero routine flaring by 2025 or sooner.

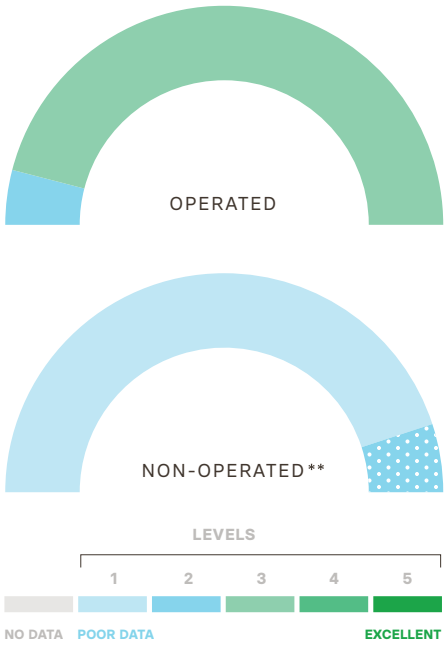
bp's strategy for site level reconciliation is based upon a learn-by-doing principle, in which field deployments are augmented with further assessment of core measurement parameters. Several pilots were undertaken in 2021.

bp looks to drive improvements in methane reporting and performance in its NOJVs through influence and knowledge sharing and, has identified certain NOJVs for priority action. bp is also working with partners in other industry initiatives to identify shared NOJVs where meaningful methane action can be undertaken.

2025 TARGET (intensity*)

*methane emissions based on measurement in line with the bp methane measurement hierarchy as a percentage of marketed gas

DATA QUALITY

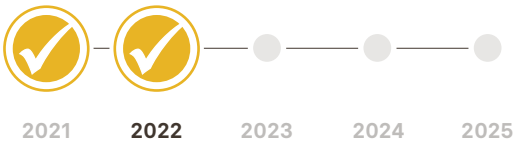


**dotted pattern = incomplete data

2021 METHANE ESTIMATES (kt)

30.20

GOLD STANDARD



implementation plan approved for data quality improvement

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SEGMENT

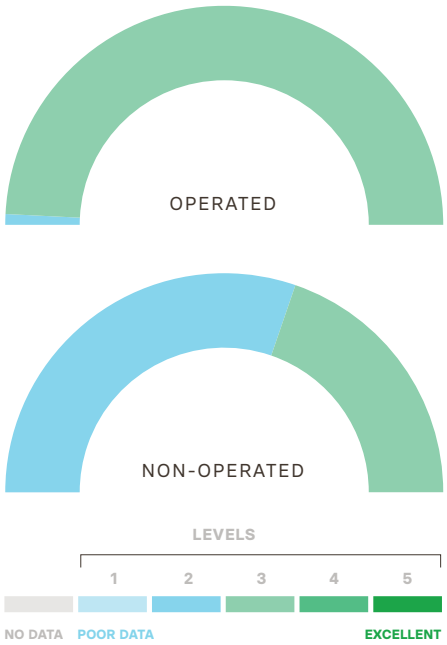
UPSTREAM

Crescent Energy

2025 TARGET (intensity*)

* maximum amount of annual methane emissions by 2025 as a percentage of marketed gas

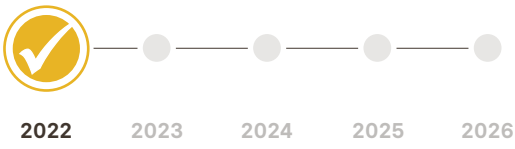
DATA QUALITY



2021 METHANE ESTIMATES (kt)

9.40

GOLD STANDARD



implementation plan approved for data quality improvement

CRESCENT ENERGY

Crescent is a well-capitalized, U.S. independent energy company with a portfolio of assets in key proven basins across the lower 48 states and substantial cash flow supported by a predictable base of production. Crescent's core leadership team is a group of experienced investment, financial and industry professionals who continue to execute on the strategy management has employed since 2011. The Company's mission is to invest in energy assets and deliver better returns, operations and stewardship. For additional information, please visit www.crescentenergyco.com.

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SEGMENT

UPSTREAM

DIVERSIFIED energy

DIVERSIFIED ENERGY COMPANY, PLC

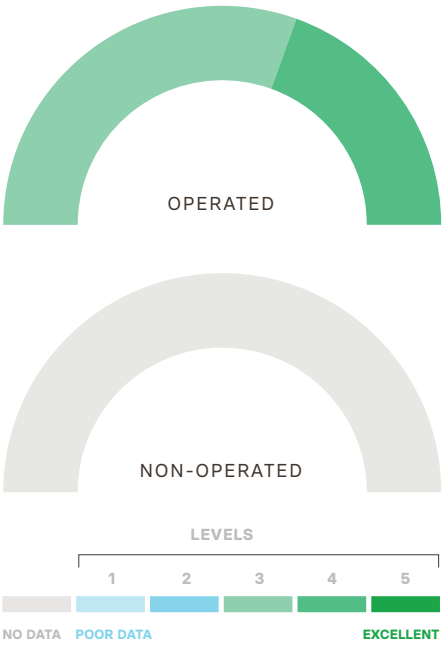
Diversified Energy Company is an independent energy company focused on acquiring and enhancing primarily natural gas producing assets and related midstream infrastructure in the US onshore, with current operations in the Appalachia Basin and the central US states of Louisiana, Oklahoma and Texas.

Our Appalachian operations are located throughout in the states of Tennessee, Kentucky, Virginia, West Virginia, Ohio, and Pennsylvania, where we are the largest independent conventional producer. Diversified entered into its Central Regional Focus Area in 2021 with operations in the states of Louisiana, Oklahoma and Texas.

2025 TARGET (intensity*)

* maximum amount of annual methane emissions by 2025 as a percentage of gross produced gas

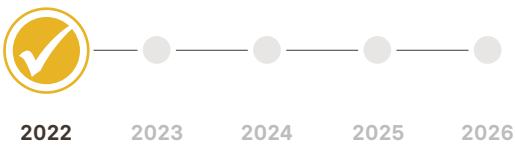
DATA QUALITY



2021 METHANE ESTIMATES (kt)

28.22

GOLD STANDARD



implementation plan approved for data quality improvement

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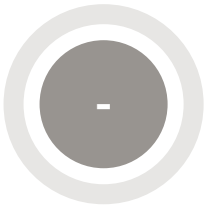
SEGMENT

UPSTREAM

NO TARGET



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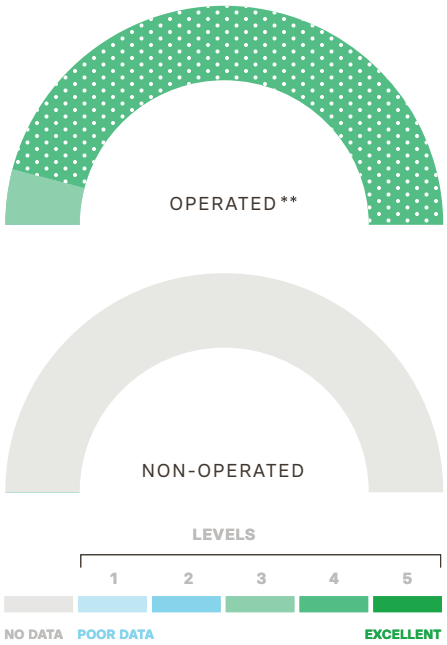

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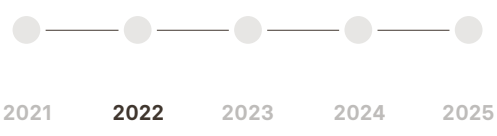
2021 METHANE ESTIMATES (kt)

83.71

GOLD STANDARD



ECOPETROL

Ecopetrol S.A. is a mixed economy company with a participation of 88.45% of the Colombian State, and is the head of the Ecopetrol Group, made up of multiple companies in which it participates directly or indirectly. Ecopetrol is an integrated energy group, which participates in all the links of the hydrocarbon chain (exploration, production, transportation, refining and marketing) and in linear infrastructure, both in energy transmission and road concessions, and hopes to continue diversifying towards businesses that allow us to continue reducing our carbon footprint. In 2021 Ecopetrol defined its corporate strategy ""Energy that transforms"" with a horizon of 2040, which comprehensively responds to current challenges in environmental, social and governance matters. The strategy is supported by four strategic pillars: i) Grow with the Energy Transition, ii) Generate Value with Sustainability, iii) State-of-the-Art Knowledge and iv) Competitive Returns.

In order to accelerate decarbonization, the company has defined a plan to achieve net zero carbon emissions by 2050 (scopes 1 and 2), and to reduce CO_2e emissions by 25% by 2030 compared to 2019 (scopes 1 and 2). The fulfillment of these goals involves the development of actions in energy efficiency, renewable energies, hydrogen, sequestration, use and storage of carbon and reduction of fugitive emissions, venting and flaring, the above aligned with the OGMP2.0.

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SEGMENT

UPSTREAM

ENI

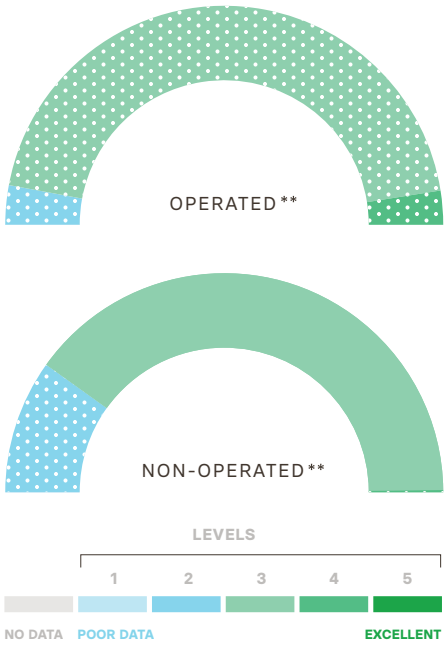
Eni is an integrated energy company with more than 30,000 employees in 69 countries around the world, whose dedication to the energy transition translates into tangible actions aimed at achieving the total decarbonization of products and processes by 2050.

Eni aspires to contribute to the achievement of the Sustainable Development Goals of the United Nations 2030 Agenda, supporting a just energy transition that meets the challenge of climate change with concrete and economically sustainable solutions by promoting efficient and sustainable access to energy resources, for all. Eni's strategy aims to achieve by 2050 the net zero target on GHG Scope 1, 2 and 3 emissions, on entire life cycle of the energy products sold, and net zero target on Scope 1-2 by 2035. Eni has long been committed on methane emissions mitigation, being one of the industry founders of the OGMP and among the first companies to set public targets for reducing methane emissions from operations. Through its participation to OGMP 2.0, Eni continues to enhance methane management practices and improve quality and transparency of methane emissions reporting, while reinforcing its commitment to reduce methane emissions throughout its value chain. In 2022, Eni is confirming its commitment to further reduce methane in line with the Global Methane Pledge and is actively supporting the "Aiming for Zero Methane Emissions Initiative", launched in 2022 by the Oil & Gas Climate Initiative, aiming to eliminate the industry's methane footprint by 2030.

2025 TARGET (intensity*)

* maximum amount of annual methane emissions by 2025 as a percentage of marketed gas

DATA QUALITY



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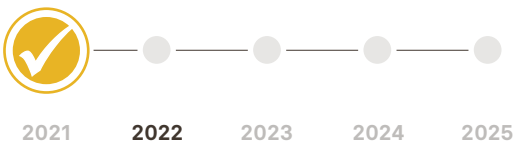
2021 METHANE ESTIMATES (kt)

51.10

Data not available for **41** out of **60** non-operated assets reported

GOLD STANDARD



implementation plan approved for data quality improvement

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SEGMENT

UPSTREAM

EQT

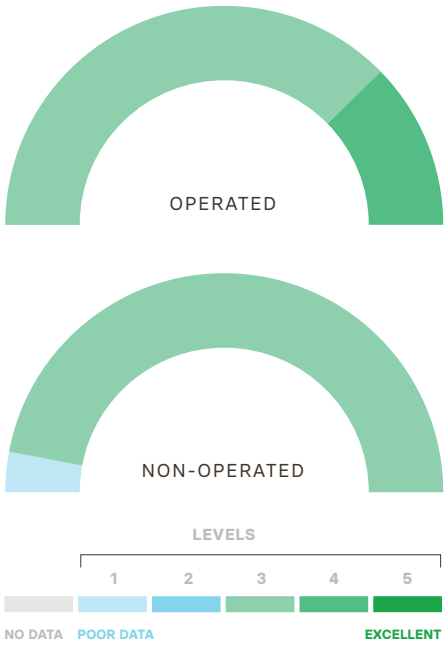
EQT Corporation (NYSE: EQT) is a leading independent natural gas production company with operations focused in the cores of the Marcellus and Utica Shales in the Appalachian Basin. We are dedicated to responsibly developing our world-class asset base and being the operator of choice for all stakeholders. By leveraging a culture that prioritizes operational efficiency, technology, and sustainability, we seek to continuously improve the way we produce environmentally responsible, reliable, and low-cost energy. Our values are evident in the way we operate and in how we interact each day -- Trust, Teamwork, Heart, and Evolution are at the center of everything we do.

As the largest producer of natural gas in the United States, EQT is responsible for producing the equivalent of over one minute of every hour of electricity consumed domestically. Our operational strategy focuses on the successful execution of combo-development projects, which involves the development of several multi-well pads in tandem. We maintain an integrated ESG program that interplays with our combo-development operational strategy. Core tenets of our ESG program include investing in technology and human capital, improving data collection, and engaging with stakeholders to understand and align our actions with their needs and expectations.

2025 TARGET (intensity*)

*maximum amount of annual methane emissions by 2025 as a percentage of gross produced methane

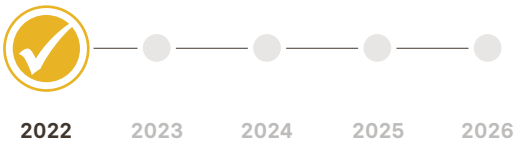
DATA QUALITY



2021 METHANE ESTIMATES (kt)

16.71

GOLD STANDARD



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SEGMENT

UPSTREAM

EQUINOR

Curbing methane emissions is a key priority for Equinor and we have a target to maintain a near-zero methane emissions intensity towards 2030.

Equinor's 2021 methane intensity for our upstream and midstream business was very low at approximately 0.02%, around one tenth of the industry average.

We have significantly improved quantification and reporting of methane emissions from our own operations. An independent study published in 2021 confirmed that measured methane emissions from Equinor operated fields on the Norwegian Continental Shelf were at similar or lower levels than those reported by Equinor. A separate 2021 report (available on equinor.com) shows that gas produced by Equinor had a lower carbon intensity compared with the average of consumed gas in Europe.

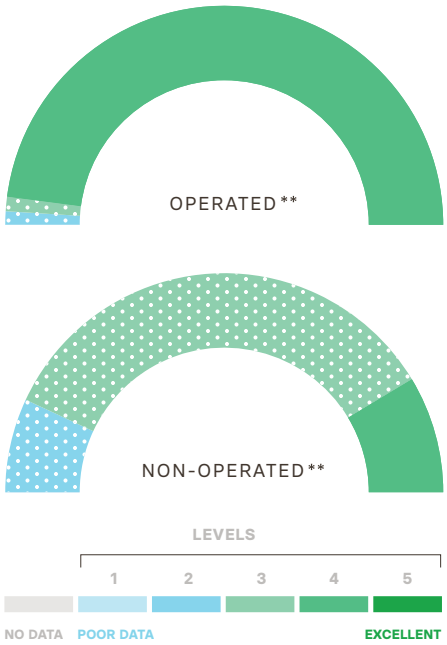
Also in 2021 Equinor initiated testing of methane measurement technologies at the Kollsnes facility in Norway, including use of mobile and fixed instruments to measure controlled methane releases, incomplete combustion from flares and other site methane emissions. Such testing is important when evaluating opportunities for site level measurement, as well as to further increase the credibility of current quantification methodologies.

As a member of several collaborative initiatives including the Methane Guiding Principles, the Oil and Gas Climate Initiative and the Oil and Gas Methane Partnership we collaborate with peers and partners to systematize methane emission source identification and quantification and to improve emissions management and reporting.

2025 TARGET (intensity*)

*maximum amount of annual methane emissions by 2025 as a percentage of marketed gas

DATA QUALITY



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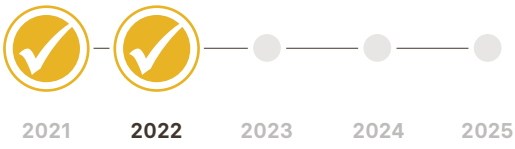
2021 METHANE ESTIMATES (kt)

9.91

Data not available for **5** out of **26** non-operated assets reported

GOLD STANDARD



implementation plan approved for data quality improvement

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SEGMENT

UPSTREAM

JONAH ENERGY
RESPONSIBLY PRODUCED GAS

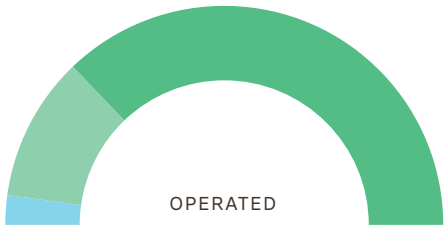
JONAH ENERGY LLC

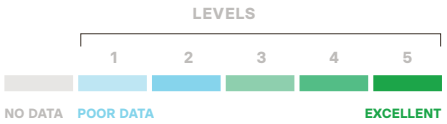
Jonah Energy LLC is an oil and gas exploration and development company headquartered in Denver, Colorado and operating in the Jonah and Pinedale Anticline Fields in Sublette County, Wyoming. The company is one of the largest privately held natural gas producers in the US and focuses on producing natural gas in an environmentally responsible manner.

2025 TARGET (intensity*)

* maximum amount of annual methane emissions by 2025 as a percentage of marketed gas

DATA QUALITY

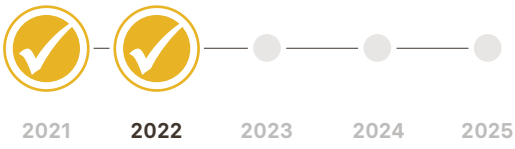




2021 METHANE ESTIMATES (kt)

3.44

GOLD STANDARD



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SEGMENT

UPSTREAM

NATIONAL JOINT-STOCK COMPANY NAFTOGAZ OF UKRAINE

NAFTOGAZ

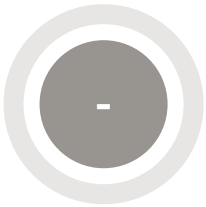
Naftogaz of Ukraine is a vertically integrated oil and gas company engaged in full cycle of operations in gas and oil field exploration and development, production and exploratory drilling, gas and oil transport and storage, supply of natural gas and LPG to consumers.

Naftogaz group includes operated assets like Ukrtransgaz (Undergound gas), Kirovogradgaz and UkrAvtoGaz (Distribution grid), Ukrgazvydobuvannya, Ukrnafta and Chornomornaftogaz (Upstream). Naftogaz has non-operated assets in Ukrnafta, only of 50%.

Naftogaz group's efforts to reduce emissions from natural supply gas chains are currently being supported by EBRD. As part of this support, a detailed bottom-up inventory of the company' methane emissions is being developed based on the technical information provided by individual business units, and further steps will be undertaken to establish procedures and methodologies for subsequent periodic reporting.

After the procedures have been established, Naftogaz will undertake subsequent preparation of inventories in line with OGMP timelines.

NO TARGET



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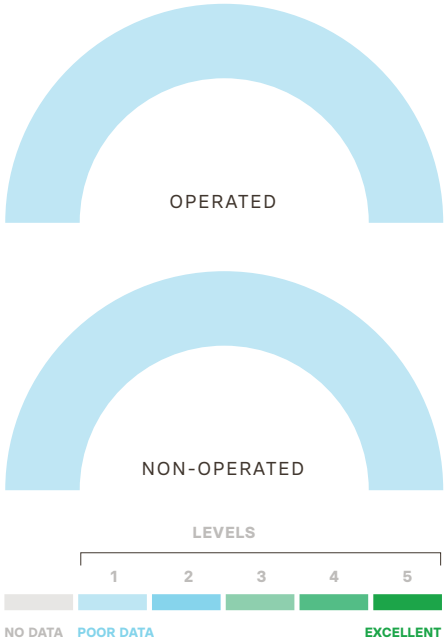
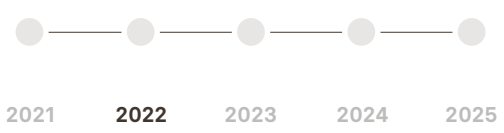


2021 METHANE ESTIMATES (kt)

11.09

GOLD STANDARD



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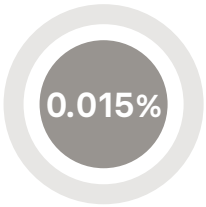
SEGMENT

UPSTREAM

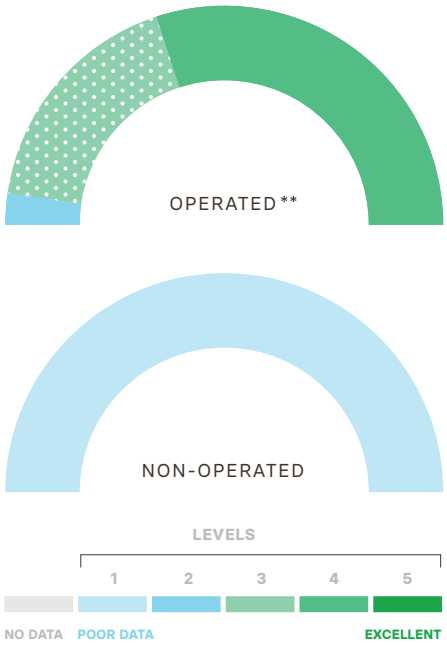
NEPTUNE ENERGY

2025 TARGET (intensity*)



* maximum amount of annual methane emissions by 2025 as a percentage of marketed gas

DATA QUALITY



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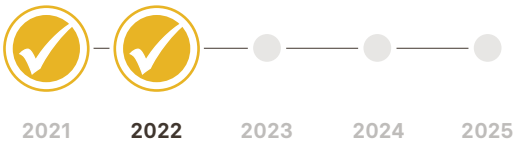
2021 METHANE ESTIMATES (kt)

1.48

GOLD STANDARD



implementation plan approved for data quality improvement

NEPTUNE ENERGY

Neptune Energy is an independent exploration and production (E&P) company with operations across Europe, North Africa and Asia Pacific. Our vision is to be the leading independent E&P company by meeting society's changing energy needs and creating value for all our stakeholders. Our differentiated portfolio is long life, low cost and lower carbon. We have a gas-weighted production portfolio and are uniquely positioned for the energy transition.

Our values of excellence in health, safety and the environment, accountability, integrity and teamwork are a core component of our business and help guide our actions. Established in 2018, we employ some 1,300 people in the UK, Norway, Netherlands, Germany, Algeria, Egypt, Indonesia and Australia. We recognise the role that reducing methane emissions plays in meeting global climate goals, which is why we have set an ambitious target to reach net zero methane emissions by 2030.

Our methane intensity in 2021 was 0.02% and methane makes up 7% of our total GHG emissions on a CO_2e basis. We are committed to achieving the highest reporting quality and deploy mitigation measures.

We partnered with the Environmental Defense Fund (EDF) and global investment firm Carlyle in 2021 to use advance drone technologies to measure methane emissions at one of our operated offshore platforms in the UK. We used fixed wing and rotary drones equipped with methane-sensing equipment at our Cygnus gas production facility to assess advanced methods for identifying and quantifying facility-level offshore.

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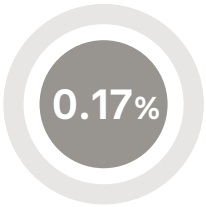
SEGMENT

UPSTREAM

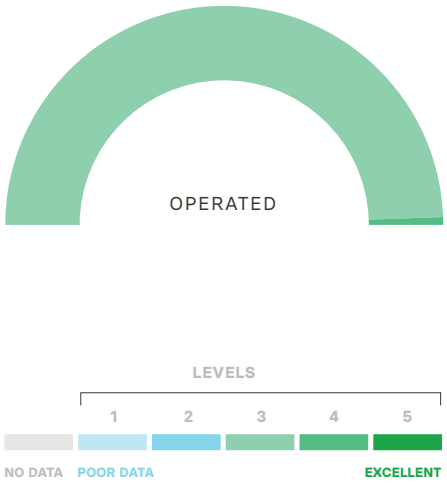
PDC ENERGY

2025 TARGET (intensity*)



* maximum amount of annual methane emissions by 2025 as a percentage of produced gas

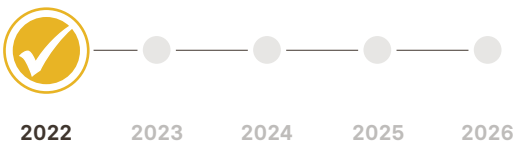
DATA QUALITY



2021 METHANE ESTIMATES (kt)

16.37

GOLD STANDARD



implementation plan approved for data quality improvement

PDC ENERGY

PDC Energy, Inc. is an independent exploration and production company headquartered in Denver, Colorado focused on the responsible development of natural resources in some of the most prolific oil and gas regions in the United States, specifically in the core of the Wattenberg Field in Colorado and the Delaware Basin in West Texas. PDC's mission is to efficiently and safely produce energy, while respecting the environment, in order to power and better peoples' lives.

Environmental protection is at the forefront of our ESG efforts. We play a critical role in reducing greenhouse gas emissions in the ongoing fight against climate change. We own this responsibility, and we will achieve meaningful improvement. In August 2021, PDC announced strong emissions reduction goals, including reducing our greenhouse gas intensity 60% and our methane intensity 50% by 2025. In addition to these aggressive targets, we have committed to eliminating routine flaring by 2025 – a significant acceleration from our previously-outlined 2030 commitment.

The urgency to combat climate change also requires sustained, long-term improvements. Recognizing this, we have also set internal longer-term targets to reduce greenhouse gas intensity 74% and methane intensity 70%, by 2030.

PDC believes robust reporting and independent third-party validation are crucial elements of a fulsome sustainability program. With that in mind we joined OGMP 2.0, a credible science-based initiative with climate goals that align with our own.

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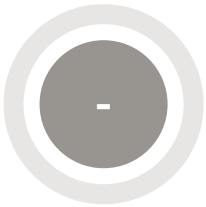
SEGMENT

UPSTREAM

شركة تنمية نفط عمان
Petroleum Development Oman

NO TARGET



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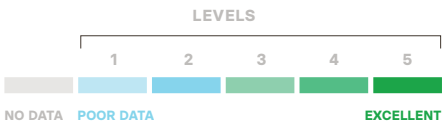

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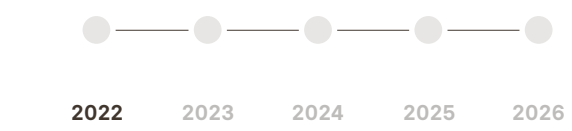
2021 METHANE ESTIMATES (kt)

22.57

GOLD STANDARD



PETROLEUM DEVELOPMENT OMAN-PDO

Petroleum Development Oman (PDO) is the leading oil and gas exploration and production company in Oman. Our operational scope encompasses a concession area of one third Oman's geographical area that is around 90,874 km^2, consisting of 269 producing fields, 29 production stations, approximately 8,400 active wells and more than 33,000 km of pipelines and flowlines.

PDO, however, is determined to join other national efforts and play a leading role towards decarbonization and environmental sustainability. Our energy strategy is set to adopt energy-light recovery mechanisms, enhance energy efficiency, energy conservation, increase the renewable energy resources and constantly aspiring to find creative and efficient means to deal with the growing demand for energy. Ultimately, PDO aspires to cut its emissions by half in 2030 and to achieve net-zero emission by 2050.

In particular, PDO has been actively engaged on methane reduction efforts. This is reflected in PDO's reduction efforts involved joining World Bank's "Zero Routine Flaring by 2030" initiative and implementation of flare reduction projects, facilities maintenance programmes, equipment electrification, and extensive flowlines and pipelines monitoring. In addition to a focused and tiered methane management campaign entailing the use of satellite surveys, drones and smart LDAR surveys. Building on this, series of engagements have been conducted with partners and technology vendors on Level 4/5 reporting instruments to advance our program to achieve OGMP 2.0 Gold Standard.

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SEGMENT

UPSTREAM

QATARENERGY

QatarEnergy is an integrated corporation responsible for the development of cleaner energy resources as part of the energy transition in the State of Qatar and beyond. It stands at the forefront of efforts for the long-term sustainable development, utilization and monetization of the energy resources in the State of Qatar. The company was established in 1974 as the state-owned petroleum company, responsible for the operation, management and development of all oil and gas activities in Qatar, including exploration, production, processing, and marketing and sales of its products to local and global markets. QatarEnergy supplies major customers around the world with various types of products. As "Your energy transition partner", QatarEnergy is the world leader in the production of Liquefied Natural Gas (LNG), the cleaner, safer, more flexible, and reliable source of energy, and an integral partner in the global energy transition.

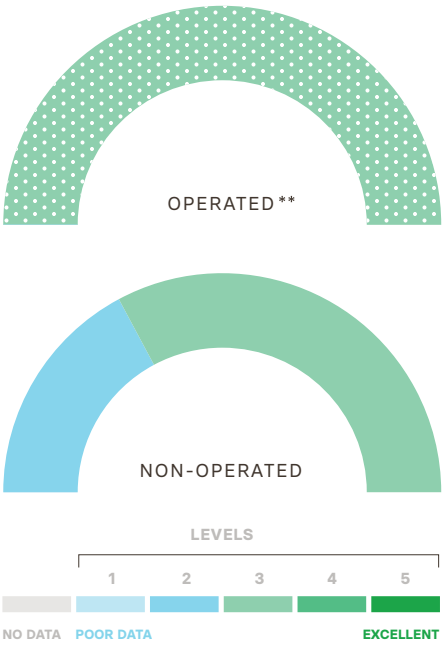
QatarEnergy commits to achieving low carbon operations, contributing to the faster transition towards a low carbon economy. Methane emission reduction is part of our strategy. We have an ambitious plan to curb our emissions which includes increasing our CCS capacity, expanding Solar PV power generation, and investing in nature-based solutions in addition to several flare and methane emissions reduction initiatives and energy efficiency improvements.

We at QatarEnergy make considerable progress towards our ambition to provide affordable and cleaner energy for people and our planet responsibly, for a better and prosperous future. A key part of our climate focus going forward is to track and reduce methane emissions throughout all stages of the natural gas value chain. QatarEnergy is committed to increase the measurement efforts and data sharing of methane emissions and supports ambitious actions to curb them.

2025 TARGET (intensity*)

*maximum amount of annual methane emissions by 2025 as a percentage of total monetizable products

DATA QUALITY



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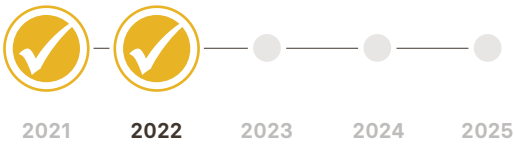
2021 METHANE ESTIMATES (kt)

4.34

GOLD STANDARD



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SEGMENT

UPSTREAM

REPSOL

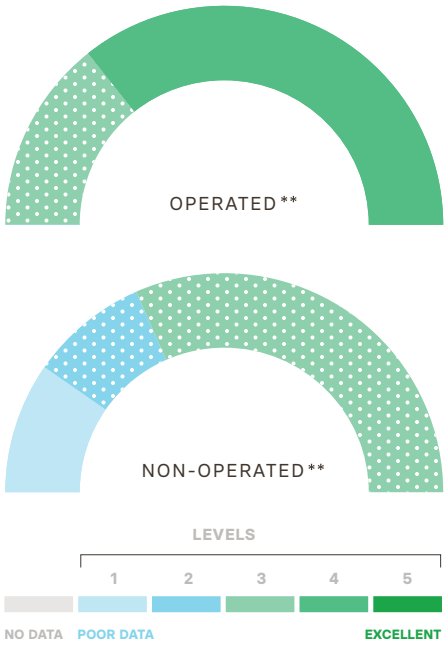
Repsol joined the CCAC OGMP in 2016 according to our commitment with the methane emissions reduction in the oil and gas sector. During these years we have been reducing venting, performing fugitive emissions surveys in our operated assets, improving flare management and retrofitting pneumatics devices.

Our company has been reporting CH_4 emissions externally and taking action on mitigation for many years, but in October 2020 Repsol's endorsement to OGMP 2.0 was confirmed, which shows the commitment to improve reporting and methane management in our operated and non operated assets. The endorsement to this partnership give us the opportunity to share knowledge on methodologies and technologies and to improve scientific and technical understanding of CH_4 emissions. Convinced of the importance of the role of natural gas in the energy transition, Repsol has announced a new target of reaching a methane intensity of 0.20% by 2025 in its operated assets.

2025 TARGET (intensity*)

* maximum amount of annual methane emissions by 2025 as a percentage of marketed gas

DATA QUALITY



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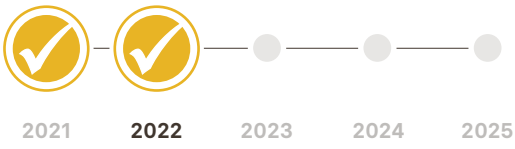
2021 METHANE ESTIMATES (kt)

88.81

GOLD STANDARD



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SEGMENT

UPSTREAM

SHELL

Shell is a global group of energy and petrochemical companies* with expertise in exploration, production, refining/marketing/trading of oil and natural gas, and manufacturing/marketing of chemicals. Shell's purpose is to power progress together with more and cleaner energy solutions. Our strategy is to accelerate the transition of our business to net-zero emissions, purposefully and profitably, transforming the business and providing more low-carbon energy. Safety, environment protection, and social responsibility are fundamental to our approach.

Shell's climate target is to become a net-zero emissions energy business by 2050. In 2021, we set a target to reduce absolute emissions by 50% by 2030, compared to 2016 levels. This covers all Scope 1 operational emissions, and Scope 2 emissions associated with the energy we buy to run our operations. Shell also has a target to maintain methane emissions intensity below 0.20% by 2025 for its operated oil and gas assets.

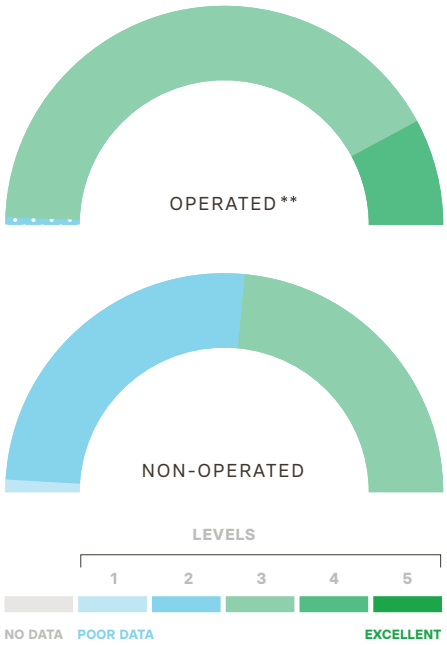
We continue to collaborate with industry, institutions, non-governmental organisations, and academia to improve data quality and abate methane. Shell signed the OGMP 2.0 Framework in 2020 with activities in 2021 including piloting a range of remote-sensing, satellite, and direct-measurement technologies to support its implementation and expand the variety of technologies and practices to reduce methane emissions from our operations.

* Please read the full Legal Disclaimer at: https://www.shell.com/energy-and-innovation/the-energy-future/our-climate-target.html

2025 TARGET (intensity*)

* maximum amount of annual methane emissions by 2025 as a percentage of marketed gas

DATA QUALITY



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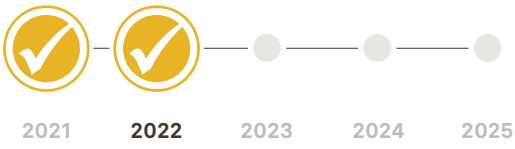
2021 METHANE ESTIMATES (kt)

46.01

Data not available for **7** out of **20** non-operated assets reported

GOLD STANDARD



implementation plan approved for data quality improvement

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SEGMENT

UPSTREAM

TOTALENERGIES

Since 2015 and the Paris Agreement, TotalEnergies has been taking steps to disclose and reduce its methane emissions. We have reduced our operated methane emissions by around 50% between 2010 and 2020.

In our Sustainability & Climate 2022 Progress Report, we presented a stepped-up ambition to eliminate methane emissions as a key contribution to early mitigation action. Aggressive targets for methane reduction in absolute terms have been included: -50% in 2025 and -80% in 2030 compared to 2020 on our operated assets. These measures put us on the right track to meet our methane intensity target of less than 0.1% of the gas produced for all our operated gas facilities.

TotalEnergies' journey toward zero methane is key to its strategy to support natural gas as a transition fuel. It is based on two pillars: measuring methane emissions more accurately and abating those emissions relentlessly, for each source and for each asset.

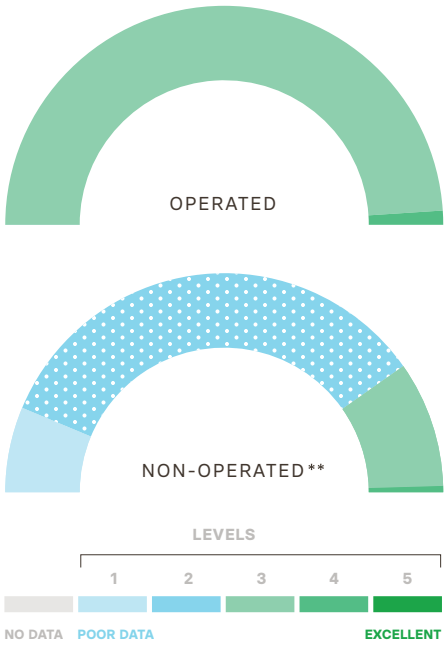
In 2022, TotalEnergies has launched a worldwide drone-based emissions detection and quantification campaign across all its upstream Oil & Gas operated sites. The campaign uses AUSEA technology (Airborne Ultralight Spectrometer For Environmental Applications) developed internally which consists of a miniature dual sensor mounted on a drone, capable of detecting methane and carbon dioxide emissions, while at the same time identifying their source.

As founding member of the OGMP 2.0 and of the OGCI Aiming for Zero Methane emissions initiative, meeting the highest standards of methane reporting for each of our material assets is key for the success of our strategy.

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane operated emissions by 2025 based on 2020 estimates

DATA QUALITY



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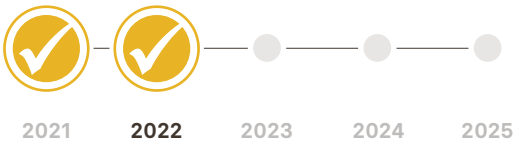
2021 METHANE ESTIMATES (kt)

47.65

GOLD STANDARD



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SEGMENT

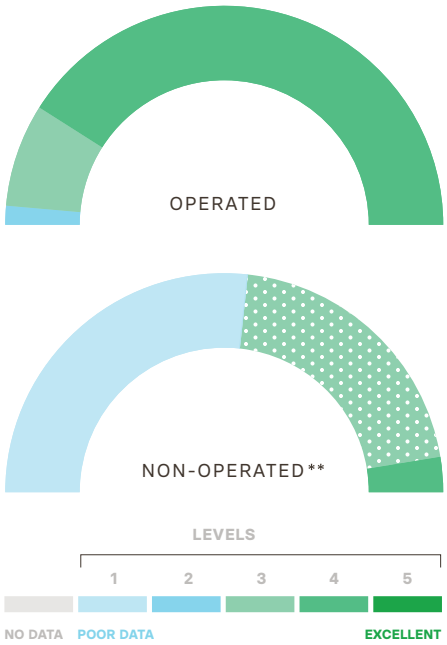
UPSTREAM

wintershall dea

2025 TARGET (intensity*)

*maximum amount of annual methane emissions by 2025 as a percentage of marketed gas on operational base

DATA QUALITY



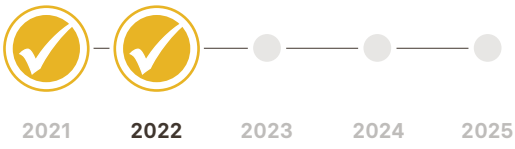
2021 METHANE ESTIMATES (kt)

0.86

Data not available for **14** out of **23** non-operated assets reported

**dotted pattern = incomplete data

GOLD STANDARD



implementation plan approved for data quality improvement

WINTERSHALL DEA

Wintershall Dea is committed to be a leading company in carbon-efficient gas and oil production. We strongly support the EU`s 2050 carbon-neutrality target. To play our part in this commitment, we have set ourselves ambitious targets.

We want to be net zero across our upstream operations – both operated and non-operated — by 2030. This includes Scope 1 and Scope 2 greenhouse gas emissions on equity share basis.

As a member of the Methane Guiding Principles, we are working towards a continual reduction in methane emissions. We have committed to achieve a methane emissions intensity of below 0.1 % by 2025 and beyond. Our approach to reach these targets is focused on four pillars:

1: Steering of our gas dominant portfolio towards lower emissions, by considering GHG emissions as a key metric and by using carbon pricing when making investment decisions.

2: Continuous implementation of energy efficiency and emission reduction measures, e.g. by using renewable energy in our operations. During 2022 and 2023 we will run a global measurement campaign to cover all material methane emission sources of our operated assets. Non operated assets to follow. Further we closely work with our partners to reduce methane emissions through repair programmes, stop flaring and optimize energy efficiency.

3: Investment in nature-based solutions to compensate for unavoidable emissions

4: Investing in carbon capture and storage and hydrogen to deliver our goal to control and reduce our net carbon intensity.

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SEGMENT

UPSTREAM

BAHÍA DE BIZKAIA GAS (BBG)

Bahía de Bizkaia Gas (BBG) is the owner of a Liquefied Natural Gas (LNG) Regasification Plant in the port of Bilbao. We get LNG from tankers from all over the world and transform it into natural gas for domestic, commercial and industrial consumption and for the generation of electric power.

Our reception, storage and regasification operations are key to the supply of energy in the Basque Country and to support the Spanish and European gas systems.
Our storage capacity amounts to 450,000m^3 in three tanks (150,000m^3 each), while our send out rate is 800,000Nm^3/h. Finally, our jetty has a capacity up to vessels of 270,000m^3 storage capacity.

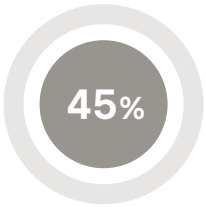
We also have a truck tank loading station to deliver LNG to satellite plants by road and the necessary facilities for LNG carrier load.

Our partners:
Enagás Transporte S.A.U owns a 50% share in BBG. The Basque energy (EVE) owns the remaining 50% share in BBG.

Mission and vision:
Our mission is to ensure the supply of natural gas in the Basque Country and the surrounding areas, contribute to the diversification of supply sources in the Spanish gas system and strengthen the position of the Basque Country and Spain as strategic players in the Spanish and European gas systems, respectively.

Our interest in our participation in the O&GMP is to know about the latest technologies to measure the fugitive leaks and being informed about the CH_4 future regulations to allow us to prepare ourselves technically for possible new requirements.

2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

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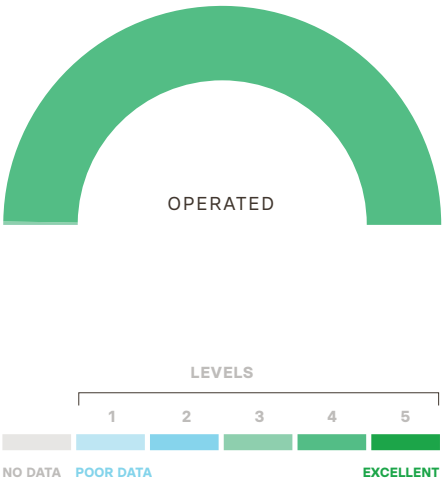
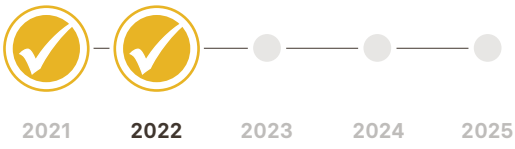


2021 METHANE ESTIMATES (kt)

0.07

GOLD STANDARD



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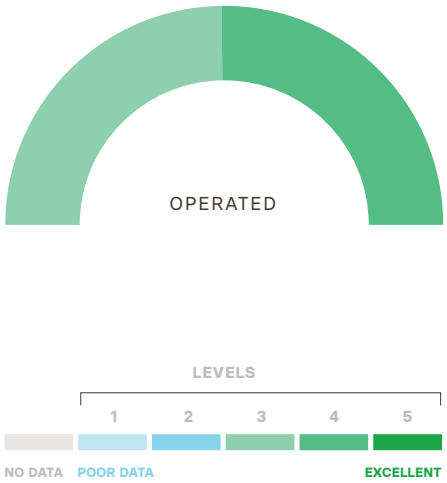
SEGMENT

MIDSTREAM

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

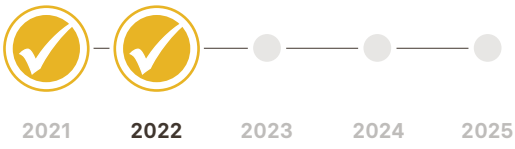
DATA QUALITY



2021 METHANE ESTIMATES (kt)

0.27

GOLD STANDARD



implementation plan approved for data quality improvement

DESFA

DESFA SA, the leading gas infrastructure company in Greece, is responsible for the operation, management, utilization and development of the national gas grid and its interconnections, in a technically sound and economically efficient way, in order to best serve its users with safety, reliability and adequacy. DESFA operates 1466 km of Gas network, 49 Metering and/or Regulating Stations, 68 Valve Stations, 56 Scrapper Stations, 4 Entry Point Stations, 1 Compressor Station and 1 LNG terminal of useful storage capacity 225000 m^3 LNG. Currently, DESFA has no non-operated assets.

DESFA is committed to manage all its activities for ensuring protection of the environment, taking into account the principles of sustainability and maximum preservation of natural wealth. In line with the EU energy and climate goals, DESFA is contributing to the net-zero decarbonisation by 2050. The reduction of the direct and indirect emissions of greenhouse gases is our distinct and strong commitment. Focusing on methane emissions, DESFA set an absolute performance target of 20 % methane emissions reduction from the company's activities until 2025, in comparison with the base year 2015, in line with the UN Global Methane Alliance initiative. To achieve this target, DESFA implements several best available techniques (minimize venting by optimizing operations, intense leak detection and repair programs, boil off recovery in LNG terminal etc). Recently, DESFA optimized specific preventive maintenance operations leading to significant methane emissions reduction. DESFA's new projects are designed predominantly to minimize methane emissions. Moreover, DESFA participates in associations, workshops and R&D projects to share knowledge and adopt novel techniques on methane emissions reduction.

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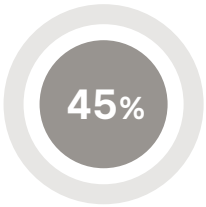
SEGMENT

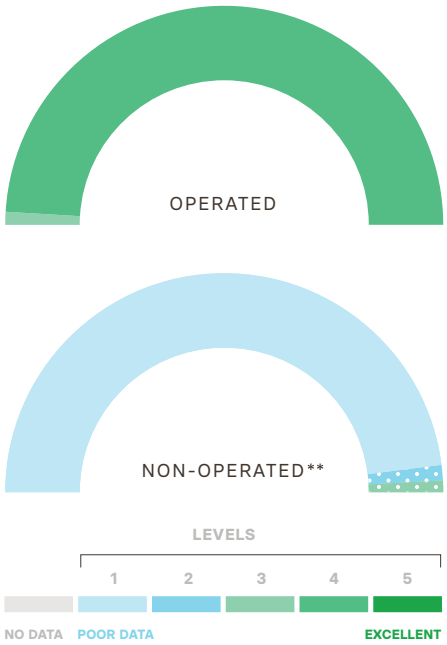
MIDSTREAM

2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

DATA QUALITY



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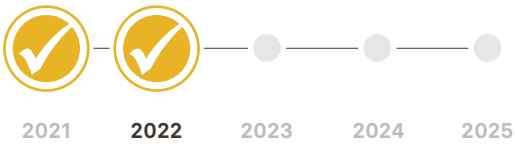
2021 METHANE ESTIMATES (kt)

2.34

GOLD STANDARD



implementation plan approved for data quality improvement

ENAGÁS

Enagás is the leading gas infrastructure company in Spain. Enagás operates more than 12,000 km of gas pipelines, 19 compressor stations, 493 regulation and metering stations, three underground storages and four LNG terminals. Enagás also has non-operated facilities holding stakes in assets in Spain* (two LNG Terminals); México (LNG Terminal, transmission network and one compressor station); Chile (LNG Terminal); Peru (transmission network); Greece* (Greek gas operator) and the US (company that owns, among others, 11,000 km of transmission pipelines). Enagás also holds a stake in the Trans Adriatic Pipeline linking Greece, Albania and Italy.

Enagás is committed to reach carbon neutrality by 2040. To achieve this, Enagás has set out an ambitious Decarbonisation Strategy setting short-medium-long intermediate targets. The reduction of methane emissions is a cornerstone of our Decarbonisation Strategy. Enagás' efforts to reduce these emissions are based on the following pillars:

- Improvement of data accuracy: Quantification according to the most accurate methods.
- Mitigation measures: Implementation of the best available techniques to minimise the emissions.
- Targets: in 2019 Enagás committed to reduce its methane emissions by 45% in 2025 and 60% in 2030 vs 2015 figures in line with the UN Global Methane Alliance initiative.
- Science and R&D efforts: collaboration with academia and leading innovation projects
- Industry Leadership: participation in associations, workshops, training sessions, reports and studies to share knowledge and raise awareness (e.g. signatory of the Methane Guiding Principles; involvement in MARCOGAZ, GIE, GERG, IGU, GIIGNL, ...).

* Non operated assets in Spain (i.e. Saggas and BBG LNG terminals) and Greece (i.e. Desfa) are operated by OGMP 2.0 members and hence their data is not included in the non-operated graph to minimize reporting burden and the risk of reporting potentially misaligned numbers. There are specific company factsheets for each one.

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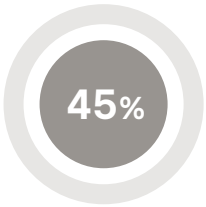
SEGMENT

MIDSTREAM

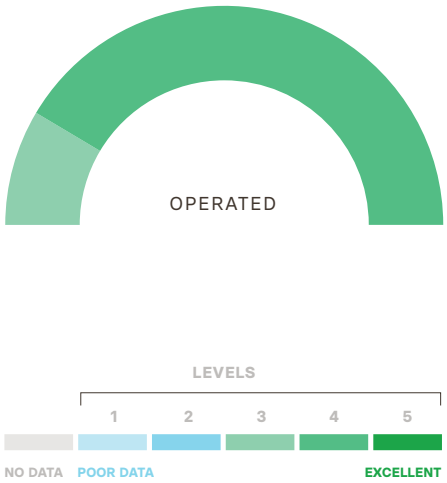
eustream
SLOVAK GAS TSO

2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

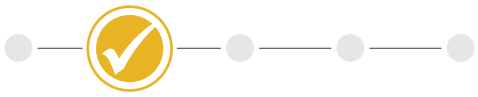
DATA QUALITY



2021 METHANE ESTIMATES (kt)

2.57

GOLD STANDARD



implementation plan approved for data quality improvement

EUSTREAM

Eustream is the operator of the large-scale high-pressure gas transmission system in the territory of Slovakia. It is an important energy connection:
- east to west, providing transit backbone
- west to east, supplying gas from European Union to Ukraine
- north to south, enabling access to LNG terminals in Poland and Croatia

Since 1972 nearly 3 000 billion cubic meters of gas has been transmitted.

The transmission system is comprised of four to five parallel pipelines, 1200 or 1400 mm in diameter. The energy necessary for continuous gas flow is provided by five compressor stations with an installed power of almost 550 MW.

Eustream is responsibly taking steps to be prepared for future challenges and tasks in the transport of low-carbon and recoverable gases. Eustream develops numerous green hydrogen projects, among which outstanding is the Central European Hydrogen Corridor Project connecting Ukraine with EU and the IPCEI project on pipeline hydrogen transport research and development.

Methane reduction in Eustream is very efficient as a result of targeted and coordinated effort of Eustream in various fields:
- Significant modernization of the network
- Minimizing venting in operations
- Implementation of detailed and coordinated LDAR system

These three sets contributed to significant and gradual reduction of methane emissions in Eustream. Eustream continues to work significantly to reduce methane emissions and increase reporting accuracy.

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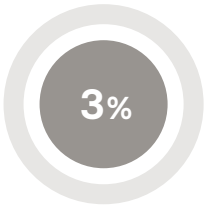
SEGMENT

MIDSTREAM

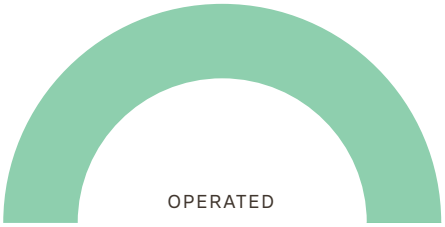
EWE

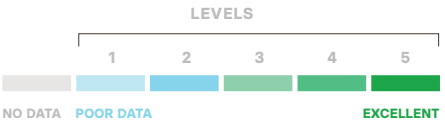
2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2020 estimates

DATA QUALITY

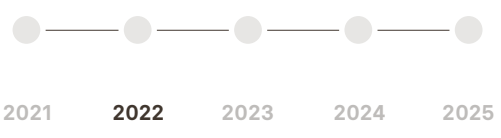




2021 METHANE ESTIMATES (kt)

0.19

GOLD STANDARD



EWE GASSPEICHER

Since the seventies of the past century EWE GASSPEICHER GmbH (EWE) plans, builds and operates cavern storages for natural gas in northern Germany. Until now, EWE owns four locations with a total number of 38 caverns.

Over last 50 years of operation, EWE has continuously improved the operating procedures and has modernized the existing constructions and installations. Beside commercial interests, these measurements served the environmental protection, especially when it comes to the mitigation of methane emissions. Examples of measures introduced include thermal use of vapors in gas drying facilities, reverse compression of seal leakages by reciprocating compressors or flaring of operational gas releases.

Currently, with highly developed mature and complex facilities and by using innovative procedures EWE ensures a state-of-the-art emissions management, which is considered to be above the industry average. In addition to this, EWE strives to make further improvements.

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SEGMENT

MIDSTREAM

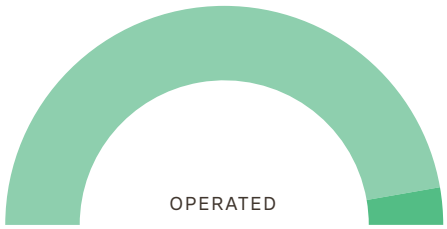
FGSZ

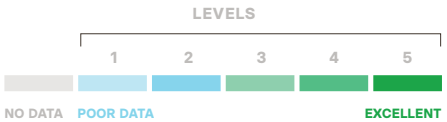
MEMBER OF MOL GROUP

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

DATA QUALITY

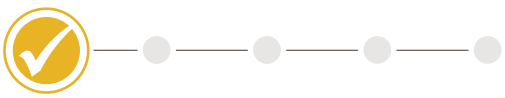




2021 METHANE ESTIMATES (kt)

1.3

GOLD STANDARD



implementation plan approved for data quality improvement

FGSZ

FGSZ Ltd is the owner and operator of the Hungarian high-pressure natural gas pipeline system servicing gas distribution companies, power plants and large industrial consumers.

FGSZ is the only transmission system operator (TSO) in Hungary, conducting its activities in a regulated market environment. We operate in accordance with the applicable Hungarian and EU laws at all times, and FGSZ is one of the first European independent TSOs to hold an ITO certificate. In addition to its domestic gas transmission activity, FGSZ transmits gas from Austria to Hungary, and it also engaged in bi-directional deliveries with Romania, Croatia, Ukraine, Serbia and Slovakia, while we constantly examine the interconnection possibilities with Slovenia.

Physical properties:
- ~5.900 km of pipelines, looped system
- 6 cross-border interconnections
- 10 compressor stations with 243 MW built-in capacity
- ~400 delivery facilities
- Based in Siófok + 6 operation centers

Partners:
- 7 adjacent TSOs
- 1 dominant and several smaller producers
- 2 storage operators
- 5 large and 5 smaller DSOs
- 45 shippers
- 80+ wholesale shippers

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SEGMENT

MIDSTREAM

fluxys

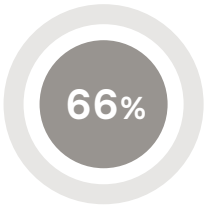
FLUXYS BELGIUM

Fluxys Belgium is an independent energy infrastructure company with no interests in the generation or sale of energy. In 2012, CREG, the Belgian federal regular, certified Fluxys Belgium as a transmission system operator that works entirely separately from natural gas suppliers and producers. The company has more than 90 years' experience in the development, financing, construction, operation and maintenance of gas infrastructure.

With 900 employees, the company operates 4,000 km of high pressure transmission pipelines and associated infrastructure (4 compressor stations and 192 pressure reduction stations), a liquified natural gas terminalling totalling a yearly regasification capacity of 104 TWh and an underground storage facility with a total capacity of 8.7 TWh.

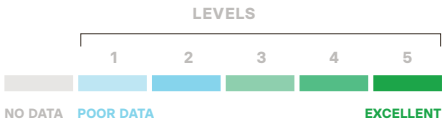
As a purpose-led company, Fluxys Belgium together with its stakeholders contributes to a better society by shaping a bright energy future. Building on the unique assets of gas infrastructure and its commercial and technical expertise, Fluxys Belgium is committed to transporting hydrogen, biomethane or any other carbon-neutral energy carrier as well as CO_2, accommodating the capture, usage and storage of the latter.

2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2017 estimates

DATA QUALITY

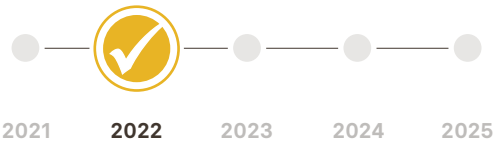


**dotted pattern = incomplete data

2021 METHANE ESTIMATES (kt)

3.66

GOLD STANDARD



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SEGMENT

MIDSTREAM

GA-MA JSC SKOPJE, TSO - NORTH MACEDONIA

Ga-MA is the only one transmission system operator (TSO) on territory of Republic of North Macedonia. GA-MA AD Skopje is joint stock company with 100 % shares of the Government of North Macedonia.

- High pressure 54 bar pipeline 130km
- Mid pressure 12 bar pipeline 80km
- Design pressure 54 bar
- Working pressure 40 bar
- DN 500
- No current offtakes
- No underground gas storage
- No compressor
- Current gas consumption 340 million Nm^3/year
- Current supply source is from border with Bulgaria (MK/BG) 40bar DN500.
- Three metering lines (ultrasonic meters), each of 100 000 Nm^3/h. Designed capacity is 800 mil. Nm^3/year with the possibility of increasing to 1200 mil. Nm^3/year.

Sum of all facilities and pipeline network 100% operated by TSO GA-MA

Facilities:

- 1 launching station on the high-pressure pipeline Ø 500 mm
- 1 receiving station on the high-pressure pipeline Ø 500 mm
- 16 valve stations on the high pressure (54 bar)
- 40 valve stations on the mid pressure (12 bar)
- 7 high pressure 54bar metering and regulating stations
- 60 mid pressure 12 bar metering and regulating stations of which 50 are in the Skopje region
- 1 main high pressure (max 54 bar) cross-border station MK/BG

Supply options:

- Current supply source is from Russian origin on the border with Bulgaria (MK/BG) 40bar DN500.
- Intake point is "Zidilovo" after 4,3km from border between MK/ BG

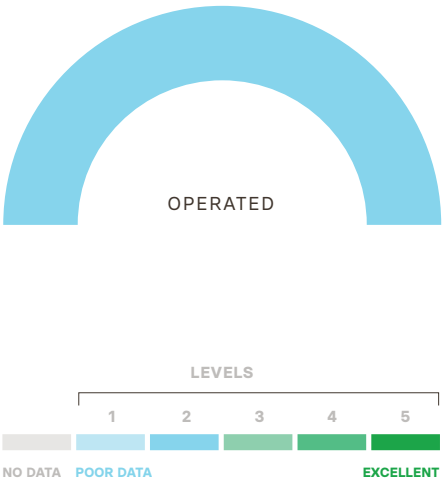
Current demand:

- Current gas consumption is **426 million Nm^3/year**
- Main consumers are industry and power generation plant TE-TO Skopje. Main consumers are in the Skopje area.

2025 TARGET (intensity*)

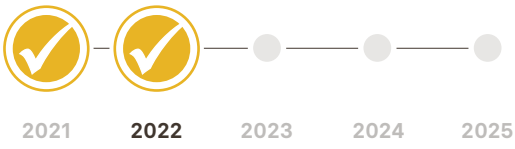
* maximum amount of annual methane emissions by 2025 as a percentage of marketed gas

DATA QUALITY



2021 METHANE ESTIMATES (kt)

GOLD STANDARD



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SEGMENT

MIDSTREAM

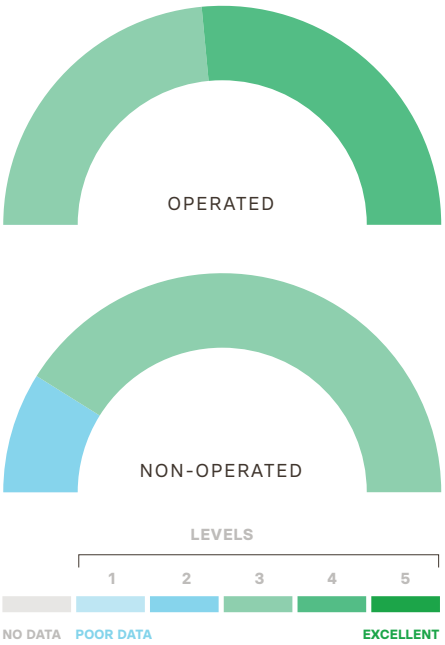
GASCADE Gastransport GmbH

The global climate concerns all of us. The OGMP 2.0 is an excellent initiative to work together on the issue of reducing methane emissions. We at GASCADE are glad to contribute. We are determined to further reduce methane emissions and play our part in achieving the common goals. GASCADE aims to reduce its methane emissions till 2025 by 50 % compared to 2015 and we are putting every effort into achieving this objective. We pursue high quality standards and plan maintenance measures with foresight. We regularly check our facilities regarding possible leaks. In addition, we use mobile compressors during the maintenance work to minimize gas losses. Existing operational processes are also being optimized to reduce the methane emissions.

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

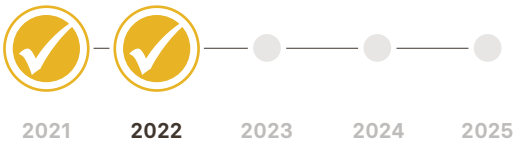
DATA QUALITY



2021 METHANE ESTIMATES (kt)

1.87

GOLD STANDARD



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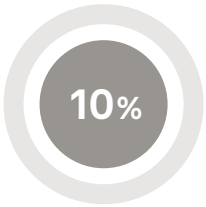
SEGMENT

MIDSTREAM

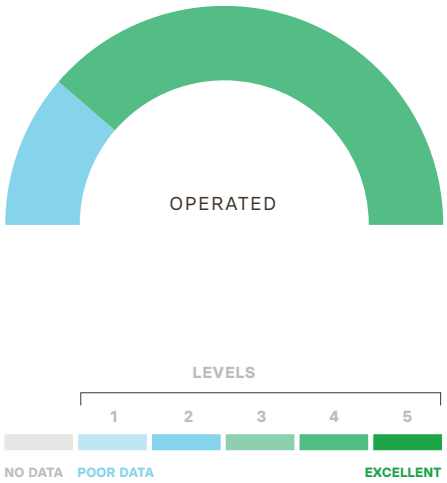
GAS CONNECT AUSTRIA

2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

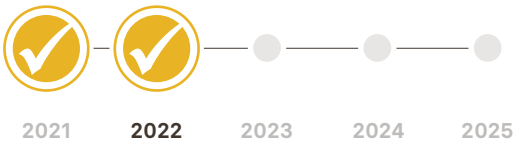
DATA QUALITY



2021 METHANE ESTIMATES (kt)

0.64

GOLD STANDARD



implementation plan approved for data quality improvement

GAS CONNECT AUSTRIA

Gas Connect Austria is an Austrian gas network operator with a high-pressure natural gas pipeline network of around 900 km. It is clear from our mission statement that we take sustainable account of the impact on people and the environment. We therefore focus also on the reduction of me-thane emissions. We use established management systems to reduce and avoid environmental pollution.

The following management systems are operated and practised:

ISO 9001: Quality management system

ISO 14001: Environment management system

ISO 50001: Energy management system

ISO 45001: Occupational health and safety management system

ISO 27001: Information security management system

These management systems are continuously monitored and audited by external certified inspec-tion bodies.

In the past we did a lot of initiatives to avoid and reduce methane emissions. We are generally sub-ject to a continuous improvement process, which we naturally also apply to our environmental per-formance. This approach is confirmed, for example, by our participation in OGMP 2.0. In the course of this participation, we have refined our reporting system with regard to methane emissions and, among other things, initiated new reduction and avoidance measures. Of course, we are striving to achieve the Gold Standard by implementing the requirements resulting from our participation in OGMP 2.0 to the best of our ability and within the specified timeframe. In general the decarbonisa-tion requirements to net zero is a major challenge for us. To meet this challenge, we have devel-oped reduction targets for CO_2 and CH_4 to be achieved through the implementation of planned reduction measures.

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SEGMENT

MIDSTREAM

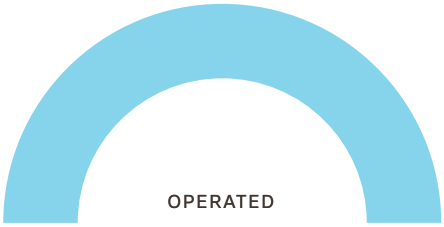
GAS TRANSMISSION OPERATOR GAZ-SYSTEM

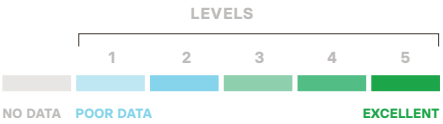
GAZ-SYSTEM plays a strategic role in the Polish economy. The company is responsible for the natural gas transmission, manages the most important gas pipelines in Poland and is the owner of the President Lech Kaczyński LNG Terminal in Świnoujście. As part of the six-year investment program, in 2022 GAZ-SYSTEM completed strategic projects that increase energy security of Poland and Central and Eastern Europe. The most important of them are: the Baltic Pipe, the North-South Gas Corridor and gas interconnectors with Lithuania and Slovakia.
In the following years, GAZ-SYSTEM will also expand the LNG Terminal in Świnoujście and plans to build an FSRU terminal in the Gulf of Gdańsk.

2025 TARGET (intensity*)

* maximum amount of annual methane emissions by 2025 as a percentage of transmitted gas

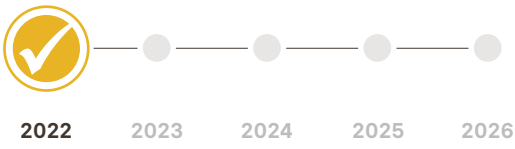
DATA QUALITY





2021 METHANE ESTIMATES (kt)

GOLD STANDARD



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SEGMENT

MIDSTREAM

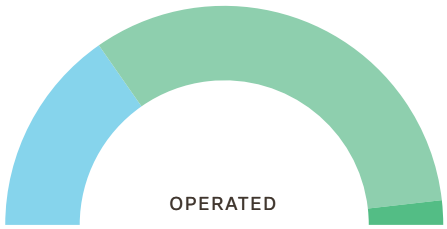
GASUNIE DE

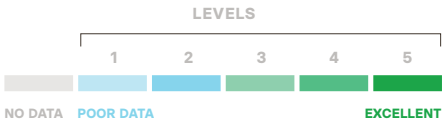
Gasunie is a European energy infrastructure company. Gasunie's network is one of the largest high-pressure pipeline networks in Europe and consists of over 17,000 kilometers of pipelines in the Netherlands and Germany. Gasunie is helping to accelerate the transition to a CO_2-neutral energy supply. The company believes that innovations in the gas sector can make an important contribution to this, for example in the form of renewable gases such as hydrogen and green gas. When it comes to hydrogen, scale and an integrated approach to the entire hydrogen chain are important. Gasunie is therefore investing in innovative partnerships and a hydrogen backbone for transport and storage. Both existing and new gas infrastructure are important in this context. Gasunie, as a founding member of the European Green Gas Initiative, has set itself the goal of achieving a 100% climate-neutral gas transport infrastructure by 2050. The transport of hydrogen, synthetic methane or biogas are the decisive steps to achieve this goal.

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

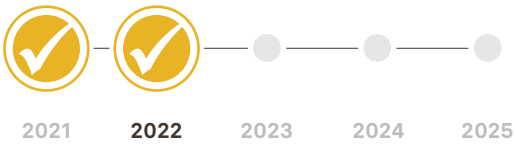
DATA QUALITY





2021 METHANE ESTIMATES (kt)

GOLD STANDARD



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SEGMENT

MIDSTREAM

N.V. NEDERLANDSE GASUNIE

Gasunie is an energy infrastructure company. In the Netherlands and the northern part of Germany, we operate the infrastructure for the large-scale transport, storage and conversion of gas. At the moment, this is mainly natural gas, but the energy transition is increasingly bringing about a shift towards green gas, hydrogen, heat and CO_2 networks.

Gasunie makes an active contribution to reducing methane emissions, wants to continue doing so and is among the frontrunners in Europe in this field. This pioneering role is partly reflected in our aim to reduce our methane emissions in the Netherlands by at least 25% in 2025 relative to 2020, and by more than 50% in 2030.

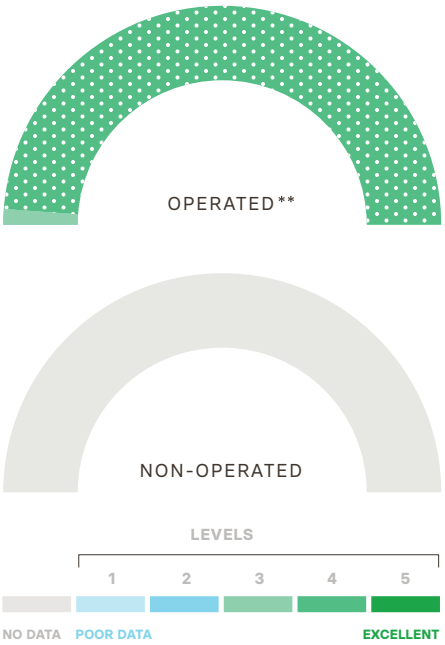
To meet these targets, we are amongst others using mobile recompression units during maintenance work that we use to recompress natural gas and transfer it to another pipeline, avoiding venting the gas. Another measure is to eliminate methane emissions from pneumatic components (by using electricity or air). We have also set up a leak detection and repair (LDAR) programme to reduce our methane emissions caused by leaks.

The data reported in this factsheet only relates to the results of Gasunie in the Netherlands, while Gasunie Deutschland reports its own data separately.

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane emissions by 2025 based on 2020 estimates

DATA QUALITY

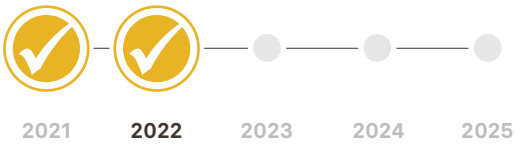


**dotted pattern = incomplete data

2021 METHANE ESTIMATES (kt)

4.07

GOLD STANDARD



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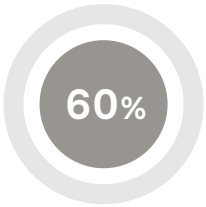
SEGMENT

MIDSTREAM

GRTgaz Deutschland

2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2009 estimates

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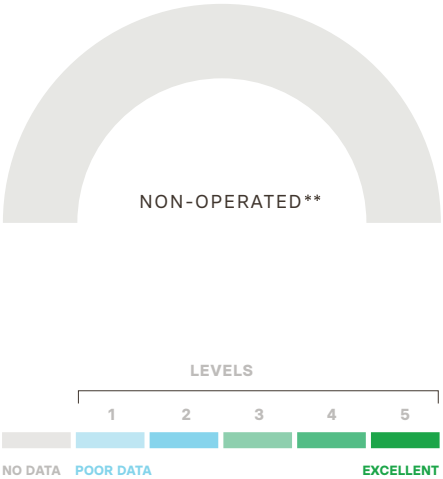
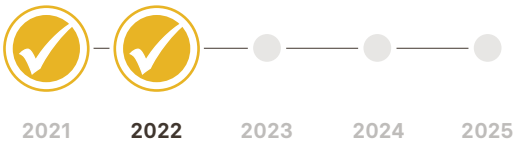


**All non-operated assets reported by OGMP2.0 members

GOLD STANDARD



implementation plan approved for data quality improvement

GRTGAZ DEUTSCHLAND

GRTgaz Deutschland is a shareholder of MEGAL GmbH & Co. KG, the pipeline system of the same name in Germany. The MEGAL pipeline system is a part of the market area THE and offers a bi-directional cross border point at the German-Czech border in Waidhaus, at the German-French border in Medelsheim as well as at the bi-directional cross border point at the German-Austrian border in Oberkappel. The MEGAL pipeline system consists of two pipelines: the MEGAL Nord (North) pipeline and the MEGAL Süd (South) pipeline which are connected via a 40 km-long connection line between Schwandorf and Rothenstadt.

As the main connector of Eastern and Western Europe, GRTgaz Deutschland manages a transport system that moves large amounts of natural gas through Southern Germany. Our network connects the gas infrastruture of Germany with that of our parent company in France as well as the networks of Czechia and Austria. As part of the German and European gas infrastructure, we play a critical role in securing a lasting gas energy supply in German and Europe. As a team, we ensure first-class services, a discrimination-free network access, and maintain close contact with our customers.

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SEGMENT

MIDSTREAM

GRTGAZ

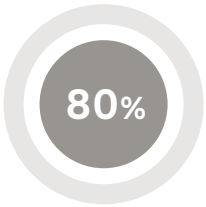
GRTgaz is the main gas transmission system operator in France with more than 32,000 km of pipelines to transport gas from suppliers to consumers connected to its network. GRTgaz has 2 subsidiaries: Elengy, a leader in LNG terminal services in Europe, and GRTgaz Deutschland, a German transport network operator.

In 2016, GRTgaz set an ambitious strategic objective of reducing two-thirds of its methane emissions by 2020. GRTgaz successfully achieved this target through Leak Detection And Repairs programs, extensive quantification campaigns carried out by certified third parties, mobile gas recovery recompression solutions and R&D programs led by the GRTgaz research center (RICE).

In 2020, GRTgaz raised this target to a 80% reduction of its methane emissions by 2025 (from the 2016 baseline) representing a decrease of 16.2 kt CH_4 from 2016 to 2025. An investment program dedicated to methane emission reduction is already ongoing and will be strengthened.

GRTgaz is an active member of the OGMP 2.0 Task Forces, the Methane Guiding Principles, GIE / Marcogaz working groups, and European GERG R&D projects. Among the R&D projects carried out by RICE, GRTgaz participates in the GERG research project on top-down measurements. Within GIE/Marcogaz methane Working Group, GRTgaz is a main contributor to recommendation documents and advocates for better methane management through several presentations in seminars and webinars. In France, GRTgaz works closely with the other gas infrastructure operators to promote methane reduction actions.

2025 TARGET (absolute reduction*)



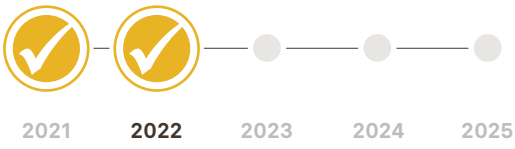
*percentage reduction of annual methane emissions by 2025 based on 2016 estimates

DATA QUALITY

2021 METHANE ESTIMATES (kt)

6.86

GOLD STANDARD



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SEGMENT

MIDSTREAM

medgaz

2025 TARGET (absolute reduction*)

10%

*percentage reduction of annual methane emissions by 2025 based on 2020 estimates

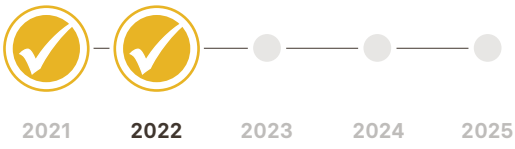
DATA QUALITY

**dotted pattern = incomplete data

2021 METHANE ESTIMATES (kt)

0.79

GOLD STANDARD



implementation plan approved for data quality improvement

MEDGAZ

Medgaz is in charge of operating the direct gas pipeline connecting Algeria and Spain. Medgaz started the activity on April 2011, with a capacity of 8 BCM/year of natural gas and without interruption since then. Expansion project came on stream on 1st July 2022 has increased the capacity up to 10 BCM/year.

Medgaz operates the system comprising a compression station in Beni-Saf, Algeria, an offshore pipeline from Almeria to Spain and a reception terminal in Almería.

With the Expansion project the yearly estimated emissions will be modified according to production (4 turbo compressors installed instead of 3). The marine pipeline technical data is: 210km, 24 inches and maximum depth of 2.165m.

Medgaz, respectful of the environment, is applying best practices and looking for technical and procedure improvements to help to preserve our surroundings. In that sense, Medgaz HSE department reports methane emissions from main emission sources on a monthly basis, both internally and to our shareholders. The reporting involves main equipment depressurization as well as natural gas self-consumed (burned). Yearly targets established have the aim of reducing the impact of Medgaz activity.

Medgaz has been engaged in methane emissions reduction by joining the OGMP and designing a reduction plan for the upcoming years.

Performance target is to reduce emissions up to 10% of reported quantity by 2025.

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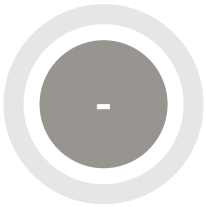
SEGMENT

MIDSTREAM

MOLDOVAGAZ

NO TARGET



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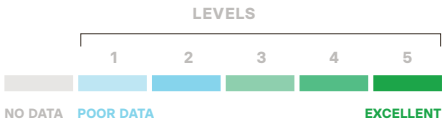
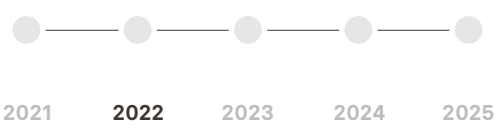


2021 METHANE ESTIMATES (kt)

2.97

GOLD STANDARD



MOLDOVAGAZ

JSC "Moldovagaz" (Moldovagaz) has become a member of OGMP 2.0 from November 2020, when the initiative was launched.

Moldovagaz is one of the largest enterprises of the energy sector of the Republic of Moldova and one of the main gas suppliers in the country. As a gas market participant, Moldovagaz holds the status of a natural gas supplier to fulfil public service obligation and to ensure reliable supply of natural gas to the final consumers (household and industrial consumers).

Moldovagaz is also the founder of other natural gas undertakings providing transmission and distribution services on the natural gas market of Republic of Moldova. The activity of the company including of its dependent undertakings is focused on the provision of quality services for natural gas transmission, supply and distribution for more than 690 thousand consumers on the territory of Republic of Moldova.

Joining OGMP 2.0 initiative, Moldovagaz is intended to follow the OGMP 2.0 targets on the maximum reduction of methane emissions in gas sector, thus increasing the positive environmental impact together with the gas companies' performance criteria within the country as well as at the regional level.

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SEGMENT

MIDSTREAM

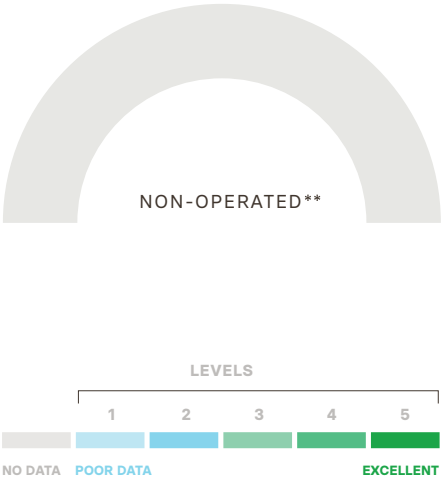
NEL Gastransport GmbH (NGT)

The global climate concerns all of us. The OGMP 2.0 is an excellent initiative to work together on the issue of reducing methane emissions. We at NGT are glad to contribute to this. We are determined to further reduce methane emissions and play our part in achieving the common goals. NGT aims to reduce its methane emissions till 2025 by 50 % compared to 2015 and we are putting every effort into achieving this objective. We pursue high quality standards and plan maintenance measures with foresight. We regularly check our facilities regarding possible leaks. In addition, we use mobile compressors during the maintenance work to minimize gas losses. Existing operational processes are also being optimized to reduce the methane emissions.

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

DATA QUALITY



**All non-operated assets reported by OGMP2.0 members

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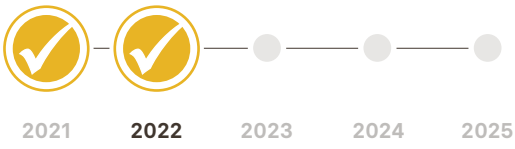

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SEGMENT

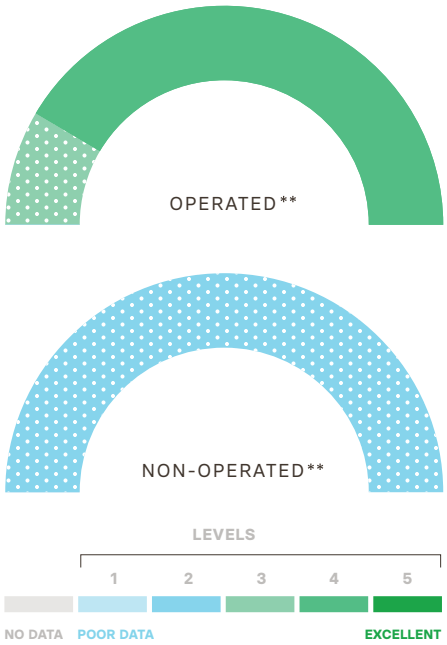
MIDSTREAM

THE NATIONAL GAS COMPANY OF TRINIDAD AND TOBAGO LIMITED

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane emissions by 2025 based on 2021 estimates

DATA QUALITY



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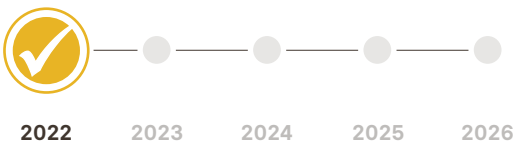
2021 METHANE ESTIMATES (kt)

0.81

GOLD STANDARD



implementation plan approved for data quality improvement

NATIONAL GAS COMPANY OF TRINIDAD AND TOBAGO

The National Gas Company of Trinidad and Tobago Limited (NGC) and its subsidiaries are an integrated group of energy companies operating in Trinidad and Tobago's energy sector, with a growing presence in other jurisdictions. A profitable and high-performing state enterprise, parent company, NGC plays a pivotal role in Trinidad and Tobago's gas-based energy sector and is strategically positioned along the entire natural gas value chain. Through its people, investments, strategic partnerships and pioneering gas pricing model, NGC has secured the profitability of the local gas-based energy sector and catalysed the social and economic development of Trinidad and Tobago for four and a half decades.

NGC's core business is the aggregation, purchase, sale, transportation, and distribution of natural gas in Trinidad and Tobago. Other areas of business include (non-operated) joint venture oil production; marketing and trading of energy commodities; portfolio investments; technical services; engineering; procurement and construction services and activities in the sustainable energy space, including renewable energy and energy efficiency projects and investments.

NGC owns, maintains, and operates most of Trinidad and Tobago's gas pipeline network of approximately 1,000 km, both offshore and onshore. The capacity of the network is 4.4 billion standard cubic feet per day (Bcf/d), supplying power generation, world-scale petrochemical plants, and a wide range of non-petrochemical light manufacturing, industrial and commercial enterprises.

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SEGMENT

MIDSTREAM

Wir transportieren Gas.
nowega

NOWEGA

Nowega is a TSO based in Münster with a workforce of over 100. We currently operate and market around 1500 km of high-pressure gas pipelines - from the Dutch border across Lower Saxony and through parts of North Rhine Westphalia. Our network structure has grown historically together with the production activities in the North German region and is unique among its kind in Germany. In our grid network we operate 4 compressor stations with a capacity of 2.5 MW.

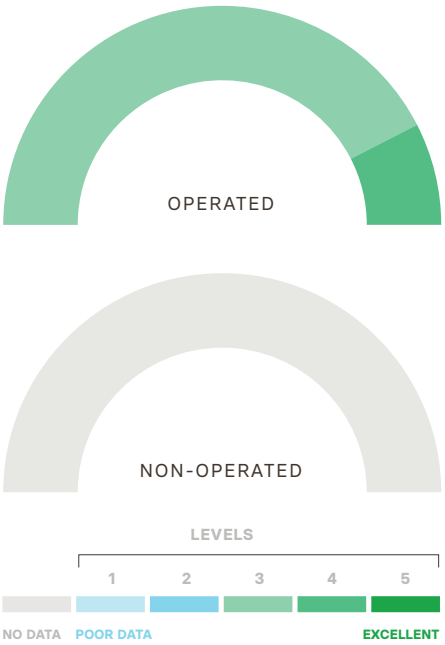
Nowega is acutely aware of its responsibility not only towards its own employees, but towards the environment, the community, and the customers. With the reliable and economic operation of pipeline networks and plants, we make an important contribution to the security of supply. For decades, we have been carrying out maintenance and servicing measures (e.g., LDAR measures), some of which go above and beyond the requirements of the DVGW regulations, with the aim of reducing the impact on the environment. Reducing emissions while maintaining security of supply is of paramount importance to us, which is why we always follow the best practice approach, looking for new technologies and methods, e.g., for gas leak detection.

Nowega is a founding member of the GET H2 Initiative, which aims to establish a Germany-wide hydrogen infrastructure - the basis for the gradual transition from a natural gas grid to a hydrogen infrastructure. In our view, an H_2 infrastructure will make a significant contribution to the CO_2-neutral energy supply of the future.

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

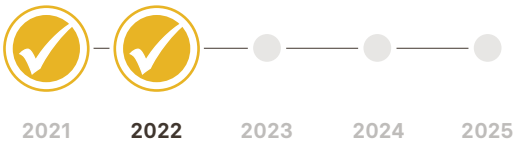
DATA QUALITY



2021 METHANE ESTIMATES (kt)

0.22

GOLD STANDARD



implementation plan approved for data quality improvement

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SEGMENT

MIDSTREAM

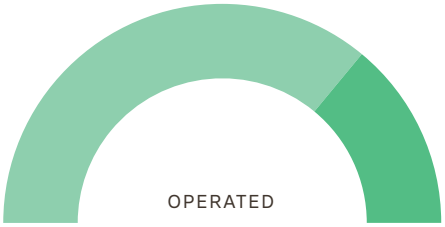
OPAL Gastransport GmbH & Co. KG (OGT)

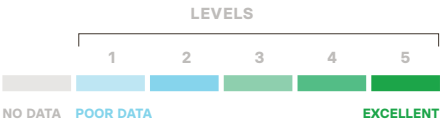
The global climate concerns all of us – and we at OPAL want to make our contribution. The OGMP 2.0 is a great initiative, and we are proud to be part of it. We are committed to lower methane emissions and hence play our part in achieving the common goals. OPAL aims to reduce its methane emissions till 2025 by 50 % compared to 2015, and we are putting every effort into achieving this objective. In detail, this means that we are consistently checking all our facilities for methane leaks, using state-of-the-art methods to reduce methane emissions, developing our high-quality operational processes and standards further, and plan our maintenance with foresight. To expend our efforts even further, we have launched our sustainability campaign which also goes beyond methane.

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

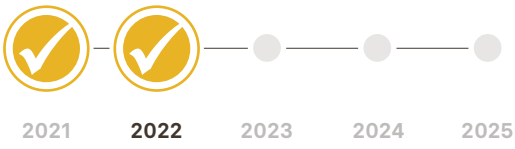
DATA QUALITY





2021 METHANE ESTIMATES (kt)

GOLD STANDARD



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SEGMENT

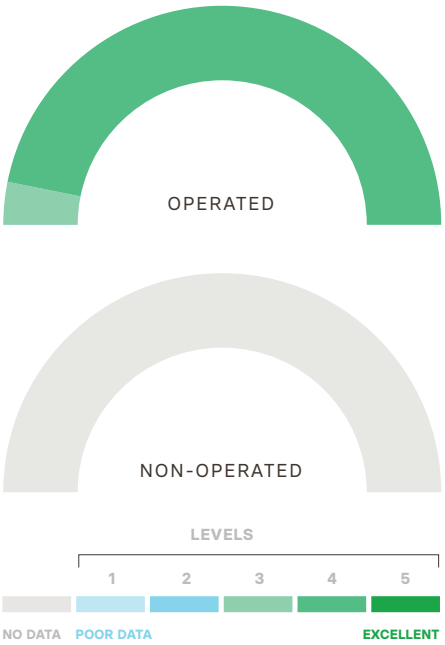
MIDSTREAM

OGE

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane emissions by 2025 based on 2009 estimates

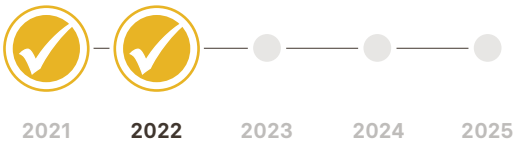
DATA QUALITY



2021 METHANE ESTIMATES (kt)

3.04

GOLD STANDARD



implementation plan approved for data quality improvement

OPEN GRID EUROPE

OGE is one of Europe´s leading gas transmission system operators. We operate the longest pipeline network of all German TSOs and play a key role in ensuring safe and reliable transport of gaseous energy carriers throughout Europe. We continue to further develop the infrastructure to move natural gas today and green gases in the future. We want to make a significant contribution to climate protection in Germany and Europe. Hence, we are actively working on the transformation of natural gas to green gases. Furthermore, we are engaged in efforts to increase the security and quality of our natural gas transmission services. That includes tackling the issue of methane emissions within our pipeline network.

OGE is actively working to reduce methane emissions from the transmission of natural gas. We have long been taking various measures to reduce methane emissions in our part of the value chain and we are striving for more. To further reduce our methane emissions and continue to take the lead on this issue, we have set ourselves the goal of achieving a 55% reduction by 2025 compared to 2009.

To this end, we have identified and are applying meaningful new technical measures to curb emissions. These include, for example, the use of mobile compressors, a technology which we will continue to develop and strengthen.

We are a committed member of several initiatives and associations to work alongside our public and private partners to tackle the issue of methane emissions throughout the gas industry.

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SEGMENT

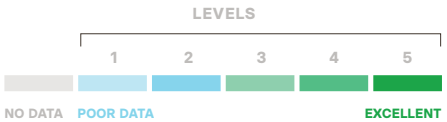
MIDSTREAM

ONTRAS

2025 TARGET (intensity*)

*maximum amount of annual methane emissions by 2025 as a percentage of marketed gas

DATA QUALITY



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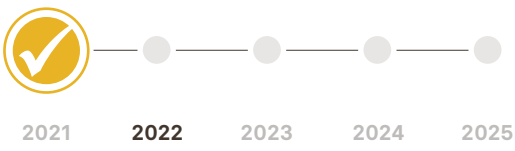
2021 METHANE ESTIMATES (kt)

3.70

GOLD STANDARD



implementation plan approved for data quality improvement

ONTRAS

ONTRAS Gastransport operates the 7,700 kilometre gas transmission system in eastern Germany and is responsible for the reliable and efficient transport of gaseous energy - today and in the future. We are actively shaping the energy market of the future, contributing ideas and developing sustainable solutions for our infrastructure. In doing so, we rely on reliable technology, many years of experience and a dedicated team. Our gas infrastructure is compatible with renewable gases and thus also supports a variety of use cases for hydrogen, such as material applications, mobility and heat.

As part of this effort we are constantly working on making our infrastructure ready for the integration of renewable gases such as hydrogen and biomethane and strengthening our efforts in reducing the carbon-footprint of our activities. We are therefore delighted to be part of the OGMP 2.0 initiative enabling us to work together with renowned partners from across the entire value chain supporting us to monitor, report and reduce verifiably the methane emissions of our operations and thereby contribute to the decarbonisation of our energy system.

With the ONTRAS H2-Startnetz, we want to lay the foundation for the hydrogen infrastructure in eastern Germany. By 2030, a network of more than 900 kilometres of pipelines is to be created.

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SEGMENT

MIDSTREAM

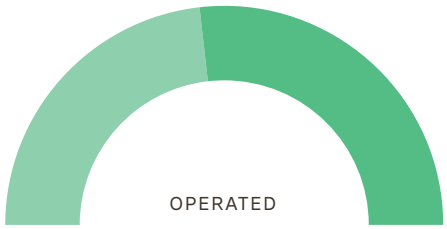
REN
Redes Energéticas Nacionais

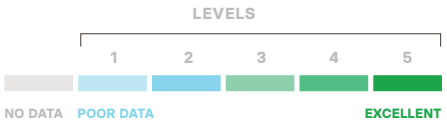
2025 TARGET (absolute reduction*)

30%

*percentage reduction of annual methane emissions by 2025 based on 2018 estimates

DATA QUALITY

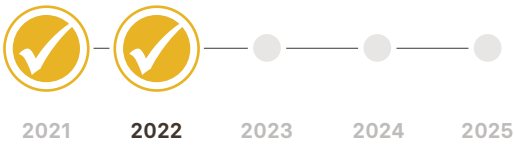




2021 METHANE ESTIMATES (kt)

0.11

GOLD STANDARD



implementation plan approved for data quality improvement

REN

REN is the Portuguese high pressure natural gas transmission system operator, and very high voltage electricity transmission system operator, and undertakes the global system management of both national electric and natural gas systems under the framework of public service concessions. REN is additionally the concession holder for the Portuguese LNG plant in Sines and the Underground Storage facility in Carriço.

Along with its ambition of maintaining one of Europe's leading position, when it comes to renewable energy sources integration and as a leading player in operational performance, REN is committed to UN's sustainable development goals, engaging in several initiatives in the environmental, social and governance area, such as reforestation, global warming limitation or gender equality.

Sustainable development is thus one of REN's core values and present throughout all its activities. Motivated by the overarching goal of becoming carbon neutral by 2040, REN participates in the Oil & Gas Methane Partnership as part of the United Nations Environmental Program, which aims at systematically and responsibly reduce methane emissions. By implementing best practices in the natural gas sector, REN seeks to actively contribute to the improvement of the quality of life of citizens and to fighting climate changes by cutting down noxious gas emissions and setting the stage for a transformational change that will help preserve and restore nature and biodiversity.

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SEGMENT

MIDSTREAM

RETRAGAS

RETRAGAS

Retragas srl, a company of A2A S.p.A. Group, is a regional natural gas transport company operating in northern Italy whose network is located downstream of the regional network of the largest transport company and is directly interconnected to the latter.

Retragas efficiently manages the service through its regional transport system, handling more than 420 million cubic meters of natural gas per year.

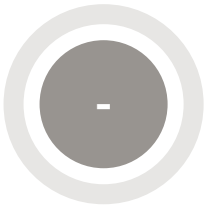
We are present with our networks (over 400 km) and plants (9 primary interconnection cabins) in Lombardy, Trentino-Alto-Adige and Piedmont.

Basic service provided is the continuous and interruptible transport of natural gas on the regional network to accredited sector operators (shippers, traders).

Gas is received at the delivery points of a network scope and transported to the redelivery points of the same scope. Service is subject to transport tariffs determined according to the indications of the Regulatory Authority for Energy, Networks and Environment.

To manage the provision of the basic service in conditions of safety and economy, Retragas makes available ancillary services such as, by way of example, the management of transport data, the transfer of capacity, transfers and transfers of capacity, the operational balancing of the transport system, administrative balancing, compliance with the minimum pressure values at the redelivery points and the permissible gas quality intervals, the planning and management of maintenance, invoicing and management of service emergencies.

NO TARGET



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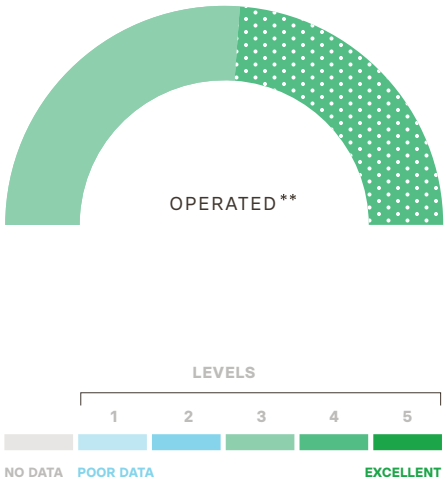

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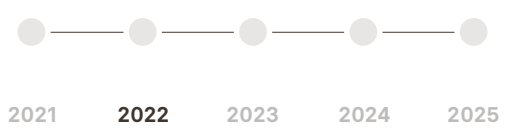
2021 METHANE ESTIMATES (kt)

0.12

GOLD STANDARD



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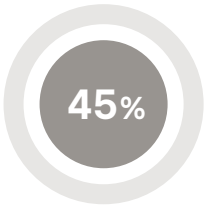
SEGMENT

MIDSTREAM

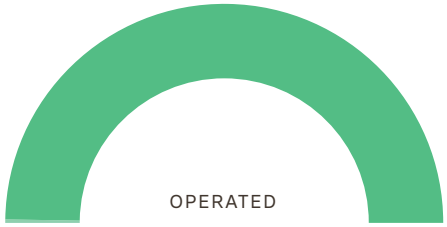
saggas

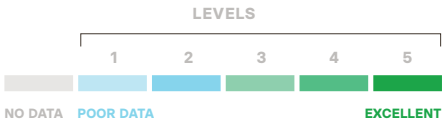
2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

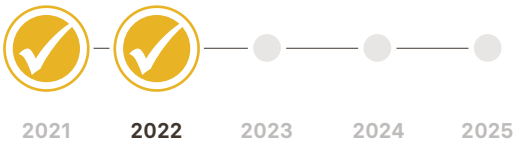
DATA QUALITY





2021 METHANE ESTIMATES (kt)

GOLD STANDARD



implementation plan approved for data quality improvement

SAGGAS

The Saggas Company owns the regasification plant located in the port of Sagunto, a key infrastructure of the Spanish energy sector. Saggas provides greater security and efficiency to the national gas system by diversifying the natural gas entry points and placing ourselves close to the final consumption points. The proximity to the main producing countries in Africa and the Middle East means that Sagunto plant is strategically located.

Liquefied natural gas (LNG) arrives at Saggas facilities by LNG vessels; it is changed the liquid to a gas and place it into the basic network of gas pipelines. Saggas services includes: vessel unloading, storage of LNG, regasification, loading of road tankers, reloading of methane tankers, loading of LNG to small-scale vessels, and in 2022 LNG bunkering according to the deployment of the European Union alternative fuels infrastructure Directive. All processes use state-of-the-art technologies and are carried out under the strictest safety and quality controls.

As a member of the energy sector, Saggas aims to improve its global performance and provide a solid base in order to develop initiatives in the areas of Sustainable Development, Energy and Climate Change. Saggas guarantees the development and use of efficient technologies. Saggas Carbon Strategy Plan 2014 – 2020 was our first goal, so that, we are on the verge of being more ambitious in our second Carbon Strategy Plan 2021 - 2026. We move forward together.

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SEGMENT

MIDSTREAM

SNAM

Snam is one of the world's leading energy infrastructure operators, focused on transmission, storage and regasification of natural gas in Italy and on new energy transition initiatives (hydrogen, biomethane, sustainable mobility, energy efficiency).

During 2021 Snam increased its absolute methane reduction target from -45% to -55% by 2025 vs. 2015 related to the operated business, a more ambitious target than that indicated by OGMP 2.0. Methane reduction is part of a strategy to achieve carbon neutrality (scope 1 and 2) at 2040. In 2021 natural gas emissions decreased by 29% vs. 2015, avoiding approximately 171,000 tons of CO_2 eq of emissions, implementing best practices that include in-line gas recompression, hot tapping, LDAR etc.

To account methane emissions, Snam developed an international methodology in collaboration with GRI - US EPA for over 20 years, integrated with emission factors based on field measurements carried out by external companies. Over the last years, emission factors for fugitive emissions have been updated, based on measurement campaign in representative facilities, in accordance with EN 15446.

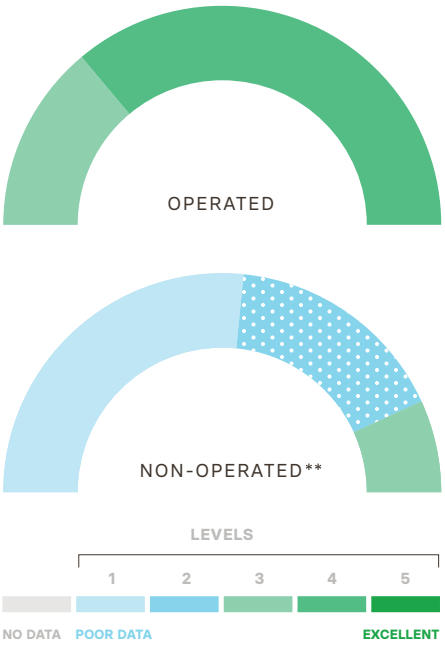
Snam is also actively participating in different Working Groups and Task Forces at EU / international level (IGU, Marcogaz, GIE, CEN, GERG, MGP and others), including CDP activities reaching "Climate Change A- List".

Snam's targets and activities to reduce emissions are disclosed in the Sustainability/Climate Change Reports (https://www.snam.it/en/Investor_Relations/Reports/Annual_Reports/index.html)

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

DATA QUALITY



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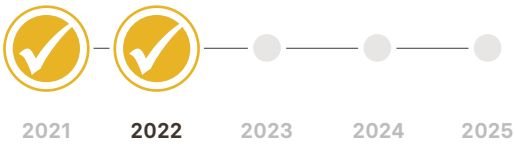
2021 METHANE ESTIMATES (kt)

22.08

GOLD STANDARD



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SEGMENT

MIDSTREAM

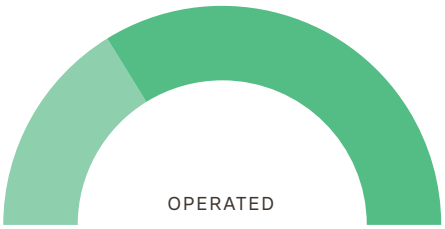
storengy
A company of ENGIE

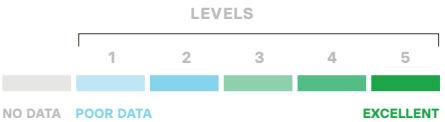
2025 TARGET (absolute reduction*)

35%

*percentage reduction of annual methane emissions by 2025 based on 2016 estimates

DATA QUALITY

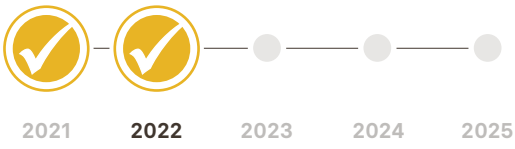




2021 METHANE ESTIMATES (kt)

0.16

GOLD STANDARD



implementation plan approved for data quality improvement

STORENGY DEUTSCHLAND

Storengy Deutschland GmbH bundles the ENGIE group's gas storage activities in Germany. Its core business includes planning, construction and operation of storage facilities and marketing of gas storage capacities. Storengy operates six gas storage facilities across Germany and offers storage services for third parties: technical operations management, technical dispatching, and maintenance.

Already below the "near zero" emissions intensity threshold (as defined by the OGCI), Storengy Deutschland GmbH engages itself, through its participation to OGMP 2.0, to continue its efforts to reduce its environmental impact, especially in term of methane emission. Storengy Deutschland GmbH wants to act on all the possible sources of methane emissions in its processes.

The first goal is to identify and reduce fugitive emissions of its sites. The use of innovative technologies to point out, measure and remedy those kinds of emissions is one of the priorities for Storengy Deutschland in the years to come.

Another key topic for Storengy Deutschland's methane emissions reduction is activities related to maintenance works and venting operations. In a first step, Storengy Deutschland invested in a mobile hot flare, to avoid venting to the greatest possible extent during main planned maintenance activities. Then the focus will be set on emissions through compressors' seals.

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SEGMENT

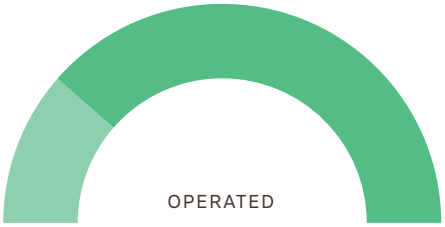
MIDSTREAM

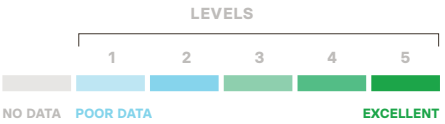
storengy
A company of ENGIE

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane emissions by 2025 based on 2016 estimates

DATA QUALITY

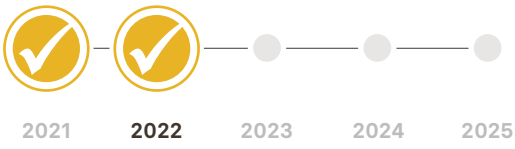




2021 METHANE ESTIMATES (kt)

2.22

GOLD STANDARD



implementation plan approved for data quality improvement

STORENGY FRANCE

Storengy France, an ENGIE subsidiary, is a key player in underground gas storage. Drawing on 60 years of experience, the company develops and operates 14 storage facilities in France and offers its customers innovative products.

Its mission is to provide flexibility to gas markets and to contribute to the security of energy. Storengy France's storage facilities represent 10 billion m^3.

And if today we store natural gas, tomorrow it will be renewable (biomethane, hydrogen, etc.).

As a committed actor to energy transition, limiting methane emissions of energy-related activities, and more specifically of the underground gas storage activity, has become a major strategic challenge for Storengy France. In that purpose, Storengy France has committed on reducing methane emissions by at least 25% by 2025 (compared to 2016 emissions) on all storage sites in operation. A first objective of this action plan is to monitor the various sources and to quantify methane emissions according to OGMP 2.0 standards. Then, the target is both to avoid and reduce methane emissions due to underground storage facilities activity.

In compliance with ENGIE's strategy and the European Commission challenge to combat global warming and in particular methane emissions, the reduction of our environmental footprint shall continue until we reach NET ZERO. Methane emissions reduction program will strongly contribute to this ambition and all operational teams are mobilized for this topic.

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SEGMENT

MIDSTREAM

storengy
A company of ENGIE

STORENGY UK

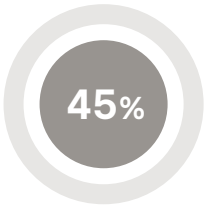
Storengy UK is the UKs largest fast cycle natural gas storage facility. Operating the Stublach Gas Storage Project, a salt cavern storage facility in Cheshire, Northwich since 2007. Enhancing the security of supply to the UK gas market. Stublach comprises 20 underground salt caverns, created between 2009 and 2018. Each of these caverns stores natural gas over 500 metres below the surface.

Storengy UK's 4.4 TWh storage capacity is equivalent to the energy consumption of 0.6% UK (300,000) households.

At Storengy UK we are passionate about actively supporting the transition to Net Zero carbon emissions. We have set ourselves an ambitious target of being net zero by 2025. We intend to deliver net zero through a range of projects including:

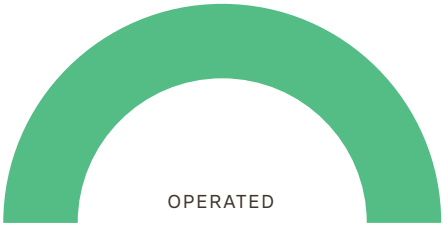
- Providing Hydrogen Refuelling Stations to facilitate the move away from diesel powered vehicles
- Hydrogen storage instead of natural gas
- Investing in the development of biogas plants using farm and food waste to create net zero gas
- Geothermal Energy opportunities

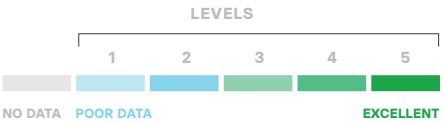
2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2016 estimates

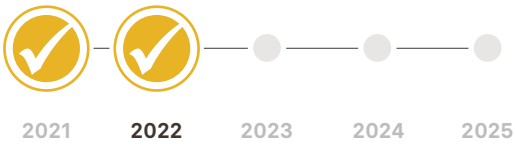
DATA QUALITY





2021 METHANE ESTIMATES (kt)

GOLD STANDARD



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SEGMENT

MIDSTREAM

TRANS AUSTRIA GASLEITUNG

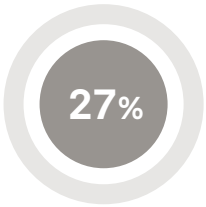
Trans Austria Gasleitung GmbH with its approximately 1,140 km long pipeline system and 5 compressor stations (approx. 420 MW of power installed) is a certified Austrian Independent Transmission Operator with its main activities in the transport of gas and the operation and maintenance of high-pressure gas pipelines and facilities for the reliable and secure supply of energy to Austria, Slovenia and Italy.

We are aware of the common challenges to tackle climate change and considerable efforts have been made in the past to continuously reduce emissions with a positive impact on environment (reduction of GHG emissions). The company aims to reduce its absolute methane emissions by 27% by 2025 and is therefore particularly keen to be an active partner in the Oil and Gas Methane Partnership.

The TAG Pipeline System is continuously being adapted to the state of the art and operated in compliance with the strict legal requirements. In addition, we implement measures to achieve a continuous and sustainable reduction of GHG emissions. For example, ten heavy duty gas-operated compressor units were decommissioned and replaced by four electric driven compressors within the last five years.

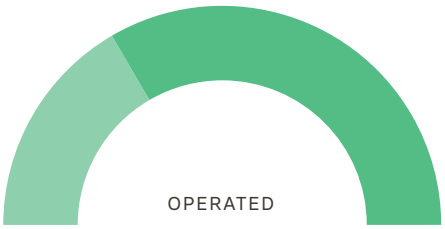
The harmonized recording and reporting of emissions and the professional exchange within OGMP make it possible to identify further potentials in the prevention of methane emissions in gas transportation. The company is also a member of the European Hydrogen Backbone (EHB), to actively contribute future steps towards a carbon-free society.

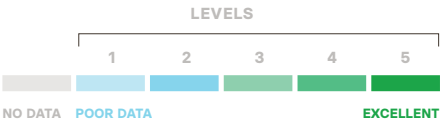
2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2015-2020 estimates

DATA QUALITY

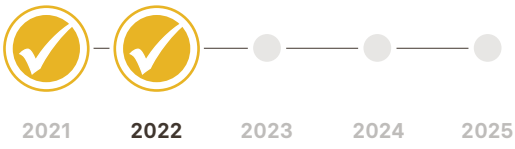




2021 METHANE ESTIMATES (kt)

1.34

GOLD STANDARD



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SEGMENT

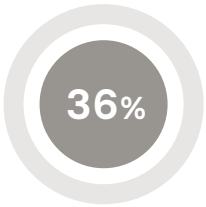
MIDSTREAM

TEREGA

As a crucial regional, national and European actor in the energy market, Teréga has, for more than 75 years, been bringing its expertise to bear on the development and operation of gas transport and storage infrastructures. Committed to the development of its sector and representing around 15% of the french natural gas transport grid and 25% of french storage capacity, Teréga is invested in the safety, maintenance and enhancement of its infrastructures, to provide everyone with an ever safer, ever more efficient, and ever more environmentally integrated network.

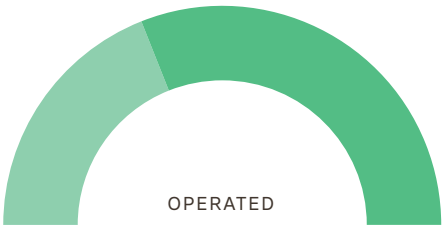
As a responsible actor in the energy sector and fully aware of the challenges of environmental and energy transition, Teréga has been committed for several years to projects reducing its carbon footprint, through its internal strategy relying on the "Avoid - Reduce - Offset" approach.
The engagement of Teréga in the OGMP initiative was natural evidence, supporting the fact that the MRV (Measure - Reporting - Verification) process is the first key to a strong reduction path of CH_4 emissions.

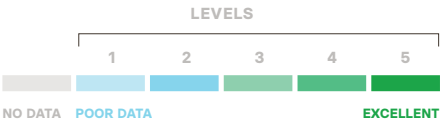
2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2017 estimates

DATA QUALITY

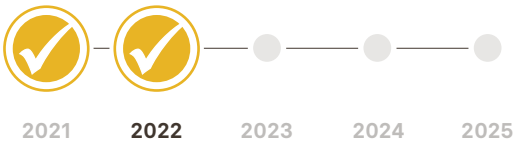




2021 METHANE ESTIMATES (kt)

2.03

GOLD STANDARD



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SEGMENT

MIDSTREAM

Thyssengas

THYSSENGAS

Founded in 1921, Dortmund (Germany) based Thyssengas GmbH has more than 100 years of experience in the operation, service and maintenance of gas networks.

Our infrastructure mainly extends to the territory of North Rhine-Westphalia (North West of Germany). and transmits aprrox. 6 billion cubic metres of gas through 4400 km of underground transmission network. At more than 1000 exit points the gas is safely being served to downstream networks, industrial customers and power plants.

We are part of the well-integrated European gas transmission grid forming the basis for an internal energy market.

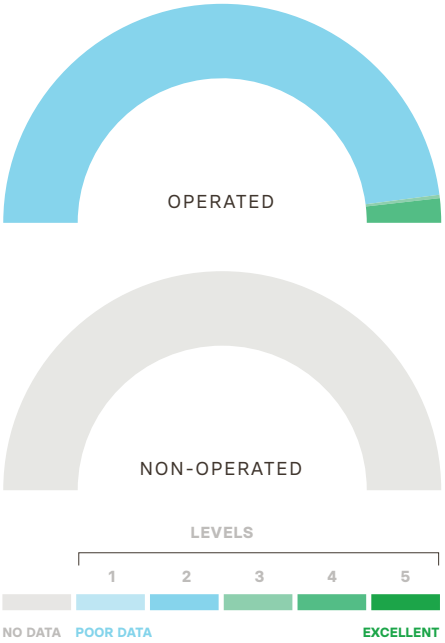
In addition, we are taking the need for the energy transition seriously and our objective is to take an active part in its implementation. While we are convinced that our gas infrastructure can be the building block for a safe, cost-effective and eco-friendly energy supply in the future, we are fully aware that this will only work if we do our job responsibly. Therefore, we are constantly working on the improvement of our processes using new technology and innovation. The identification and reduction of methane emissions is one of our essential tasks.

Furthermore, we strongly believe in the potential of hydrogen as a future energy carrier diminishing greenhouse gas emissions. Accordingly, we are one of the key drivers behind the discussion to establish a hydrogen-based energy system in Germany.

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

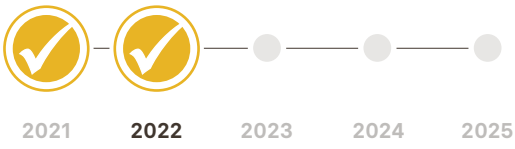
DATA QUALITY



2021 METHANE ESTIMATES (kt)

2.14

GOLD STANDARD



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SEGMENT

MIDSTREAM

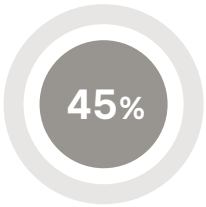
UNIPER ENERGY STORAGE

Uniper Energy Storage operates underground gas storage facilities and holds interests in non-operated facilities in Germany, Austria and the UK. Providing an overall storage capacity of around 83 TWh – around 7% of all Europe's gas storage capacity - the company is one of the top 5 storage operators in Europe in terms of capacity.

Based on its solid operating experience, acquired over several decades through its predecessor companies, Uniper Energy Storage identified the importance of methane emission reductions early on and became a launching member of the Oil and Gas Methane Partnership (OGMP) 2.0 in 2020. Uniper Energy Storage reported in 2020 and 2021 the majority of its methane emissions from operated assets on a level 4 reporting standard, received Gold Standard in both years and has already successfully achieved substantial emission reductions compared to the base year 2015.

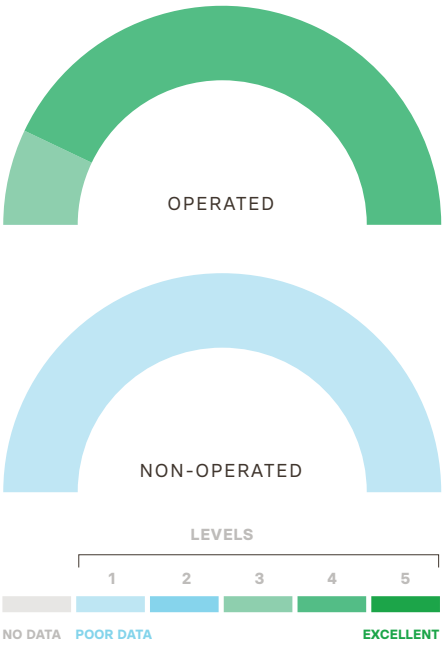
Uniper Energy Storage is committed to monitor closely its methane emissions, to record them in accordance with aligned, reliable and comparable methodologies and is actively promoting the OGMP 2.0 reporting framework with its Joint Venture partners for non-operated assets.

2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

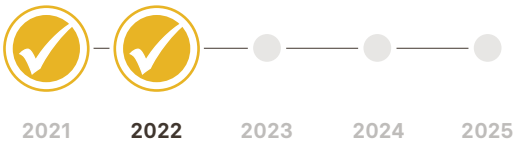
DATA QUALITY



2021 METHANE ESTIMATES (kt)

0.25

GOLD STANDARD



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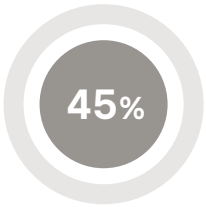
SEGMENT

MIDSTREAM

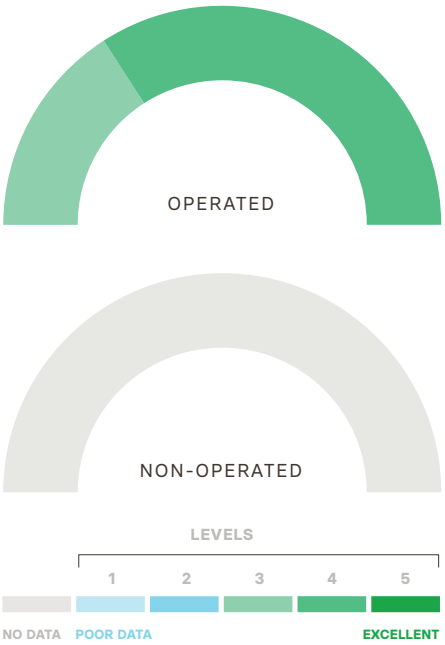
VNG Gasspeicher

2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2020 estimates

DATA QUALITY



2021 METHANE ESTIMATES (kt)

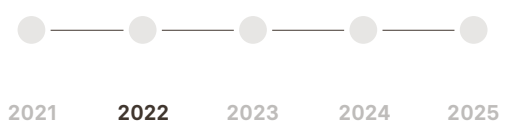
0.12

VNG GASSPEICHER

VNG Gasspeicher GmbH is a company that has been storing natural gas in underground caverns for half a century, constructing these caverns itself and also operating them technically. We are the third largest storage operator in Germany with a storage capacity of 2.2 billion m³.

Our society is undergoing a far-reaching transformation, with secure energy supplies and effective climate protection being key issues in the process - also or especially for us as a gas storage company. To enable us to make a contribution to the change within our means, we have become an OGMP member on a voluntary basis and are focusing on tracking down and reducing methane emissions that are harmful to the climate.

GOLD STANDARD



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SEGMENT

MIDSTREAM

ADRIGAS

2025 TARGET (absolute reduction*)

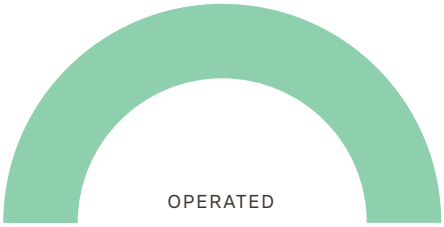
30%

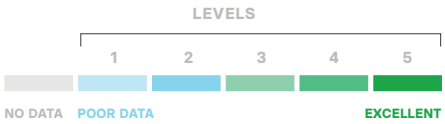
*percentage reduction of annual methane emissions by 2025 based on 2020 estimates

DATA QUALITY

2021 METHANE ESTIMATES (kt)

0.08





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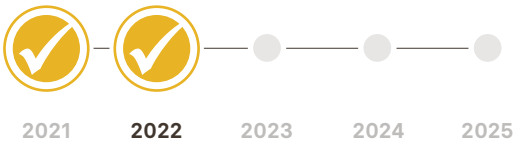

implementation plan approved for data quality improvement

ADRIGAS

ADRIGAS S.p.A., a company belonging to the SGR Group, is an industrial reality active in the natural gas distribution sector, in which it boasts excellent skills in terms of safety and quality of services. Since 1959 it has been designing, building, and managing a network of gas pipelines mainly located in the Emilia Romagna and Marche regions which today measures over 2,700 kilometers and which has over 800 reduction plants and about 175,000 meters.

The head office is located in Rimini. The activity of ADRIGAS S.p.A. is expressed in a constant commitment to citizens and its 175,000 end customers. Although we are an energy and infrastructure company linked to tradition, we strongly believe in the need to actively operate in the energy transition and our investments are oriented in this direction. In 2020 Adrigas achieved energy efficiency certificates which led to savings of over 30,000 TOE. Furthermore, the activities of the entire SGR Group have led to savings in CO_2 emissions of over 8,000 tons.

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SEGMENT

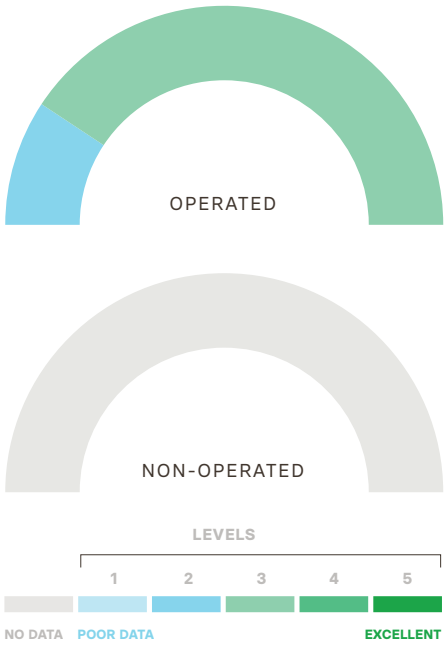
DOWNSTREAM

CHINAGAS 中國燃氣

2025 TARGET (intensity*)

* maximum amount of annual methane emissions by 2025 as a percentage of marketed gas

DATA QUALITY



2021 METHANE ESTIMATES (kt)

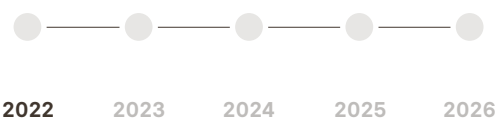
27.73

CHINA GAS HOLDINGS LIMITED

China Gas Holdings Limited (the "Company") and its subsidiaries (the"Group" or"China Gas") are primarily engaged in the investment, construction and operation of city and town gas pipeline infrastructure facilities, gas terminals, storage and transportation facilities, and gas logistics systems, transmission of natural gas and liquefied petroleum gas ("LPG") to residential, industrial and commercial customers, construction and operation of compressed natural gas ("CNG")/liquefied natural gas ("LNG") refilling stations as well as development and application of technologies related to natural gas and LPG in China.

In addition, the Group has drawn on its extensive consumer base to form a comprehensive business portfolio of value-added services, urban heating, new energy, electricity distribution and charging stations.

GOLD STANDARD



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SEGMENT

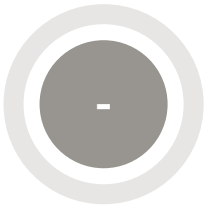
DOWNSTREAM

COTEQ NETBEHEER

Since 1966, the Cogas group has provided energy in the form of electricity, heat and gas to the eastern part of the Netherlands and is situated in Almelo. Coteq Netbeheer is a DSO and one of the three business subsidiaries of the Cogas group. Coteq owns a gas distribution grid with a total length of 4426.7 km that provides gas to 143,512 consumers. Coteq strives to be an excellent DSO by providing a safe and reliable energy infrastructure.

The company also aims to support the energy transition in the region and to reduce the impact of the business operations on the environment. In the Netherlands, all grid operators (TSOs and DSOs) are regulated by the government. Coteq Netbeheer is one of the six DSOs in the Netherlands. These DSOs combine their efforts in the sector association Netbeheer Nederland to learn from each other's experiences and to continuously improve the safety and reliability of the combined networks. Coteq Netbeheer has always put much effort into reducing the amount of gas leakage from a safety perspective. Nevertheless, the obtained insights in the environmental impact of methane emissions combined with the climate goals, make the environmental impact the main argument to reduce the emissions even further to levels that can reasonably be obtained. Coteq is researching appropriate additional reduction targets. A first impact analysis on implementing additional feasible and effective reduction targets for the methane emission source: "leaks systematic review" is realized and the first measures are implemented.

NO TARGET



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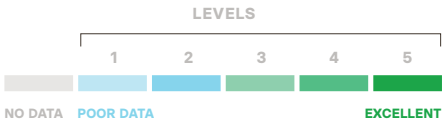
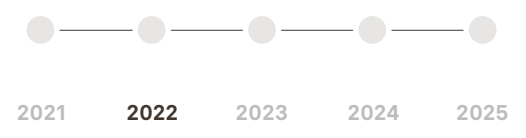


**dotted pattern = incomplete data

2021 METHANE ESTIMATES (kt)

0.18

GOLD STANDARD



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SEGMENT

DOWNSTREAM

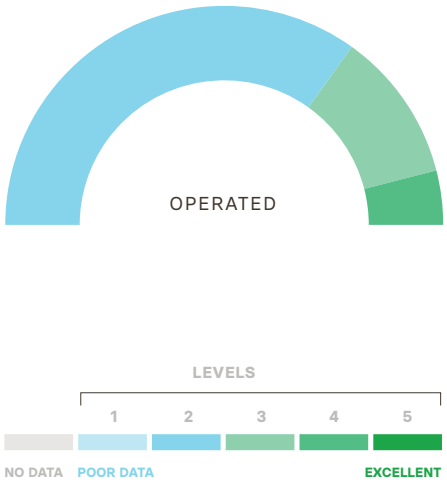
Energienetze Bayern

2025 TARGET (absolute reduction*)

0.74%

*percentage reduction of annual methane emissions by 2025 based on 2019 estimates

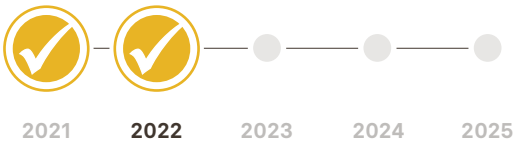
DATA QUALITY



2021 METHANE ESTIMATES (kt)

0.44

GOLD STANDARD



implementation plan approved for data quality improvement

ENERGIENETZE BAYERN

Energienetze Bayern GmbH &Co.KG (ENB) is a gas distribution company, active in the south of Germany in upper and lower Bavaria. ENB is a 100 % subsidiary of Energie Südbayern GmbH with its seat in Munich. We distribute 21 TWh of natural gas and biomethane to 155.000 residential, commercial and industrial endusers and connected distribution grids.

ENB operates 10.500 km of local and regional gas grids, all assets are operated by ENB. All cast-iron pipes were substituted in the past years.

Due to the high investment of over the last 20 years, 75 % of the grid is made of polyethylene, all steel pipes are for 100% equipped with cathodic protection and ENB notice a permanent extremely low rate of methane emissions in its pipeline network.

Joining the OGMP 2.0 in October 2020 is a logical next step in our efforts to measure and quantify our already small proportion of emissions in greater detail and find ways to further reduce them. We are committed to follow the path for gold standard.

Due to this excellent technical status, the methane intensity has already been reduced to 0,03 %.

In 2021 and 2022 ENB has increased the measurement efforts especially in the pressure regulations stations and the small local compressors, for which a new German DVGW-lead program has been initiated with several DSO. In addition new measures have been taken to lower operational emissions by venting and flaring during the construction and repair of distribution grids.

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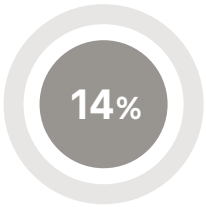
SEGMENT

DOWNSTREAM

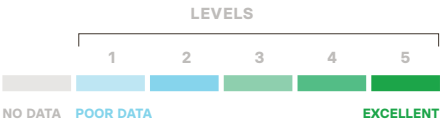
ENEXIS
ENERGIE IN GOEDE BANEN

2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

DATA QUALITY



**dotted pattern = incomplete data

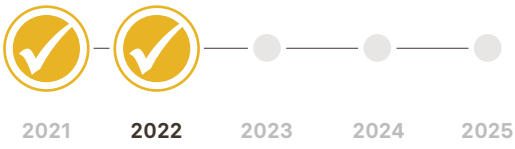
2021 METHANE ESTIMATES (kt)

2.03

ENEXIS

Enexis is a grid operator. We ensure that millions of customers in five provinces in the Netherlands (Groningen, Drenthe, Overijssel, Noord-Brabant and Limburg) have access to electricity and gas every day. 4.947 employees work at Enexis. Beside a safe and reliable energy supply, we are working on increasing the sustainability of the energy system in the Netherlands. On the one hand, by connecting wind farms, solar farms, district heating and charging points for electric mobility and, on the other hand, by working on building the energy system of the future together with our stakeholders. Enexis Netbeheer plays a central role in the energy chain. We distribute energy safely to customers. We work every day for the construction, maintenance, development and operation of the electricity and gas grids. We work together with many parties on innovations to make the energy supply more efficient and sustainable. Besides technological innovations, such as energy storage or congestion management, data also plays an important role.
We facilitate an open electricity market by making energy data available to suppliers and market parties in a safe manner. As a result, administrative processes, such as switching energy supplier, can take place seamlessly for customers. Our ambition is clear: we realize the energy transition in our service area. We do this in close cooperation with our stakeholders. In order to succeed in this task, we need to focus on our core activities.

GOLD STANDARD



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SEGMENT

DOWNSTREAM

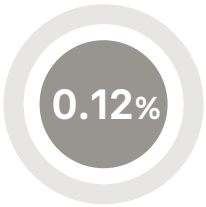
EWE NETZ

EWE NETZ GmbH is an OGMP member with different assets in the downstream sector. EWE NETZ operates the largest natural gas distribution grid in Germany with a total length of over 57,000 km in the regions of Lower Saxony, Brandenburg and Rügen. The entire supplied area covers more than 2,800 km² and more than 786,000 households and companies.

The distribution grid including main and service gas lines are operated in the pressure level of low pressure, medium pressure and high pressure. The high-pressure distribution grid covers a total network length of approx. 3,800 km and has an operating pressure of up to 70 bar. In order to distribute the gas in such a large area and between different network pressure levels, there are over 3,200 gas pressure regulating and/or metering stations with different capacities and operating pressures. These also include stations to upstream and downstream operators like transmission/transport grids (withdrawal stations) as well as stations for (light) industrial consumer supply and injection stations for biogas.

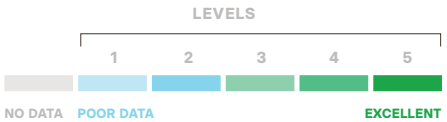
EWE NETZ has been certified an energy management system according to DIN ISO 50001 since 2016 to systematically and sustainably reduce energy consumption. In addition, EWE NETZ demonstrates secure network operations and a high level of security of supply through the Technical Security Management (TSM). EWE NETZ has been repeatedly TSM-tested by the German Association of Gas and Water Professionals (DVGW) in the field of natural gas since 2002.

2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

DATA QUALITY



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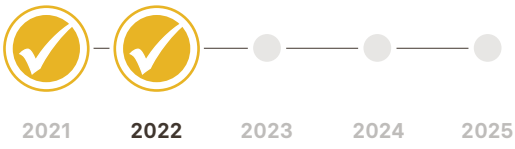
2021 METHANE ESTIMATES (kt)

0.89

GOLD STANDARD



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SEGMENT

DOWNSTREAM

FLUVIUS

Fluvius is the Flemish utility company responsible for building, managing and maintaining distribution grids for electricity, gas, sewerage, cable TV, district heating and public lighting. Fluvius manages over 7 million utility connections.

The key mission as a natural gas distribution company is to ensure the delivery of gas to our residential, commercial and industrial customers with high standards of quality, security and affordability and find and implement innovative solutions.

- The gas distribution assets consist of 57.000 km of gas distribution grid.
- The gas distribution grid connects about 2,3 million customers. The majority are residential customers connected to the low pressure grid.

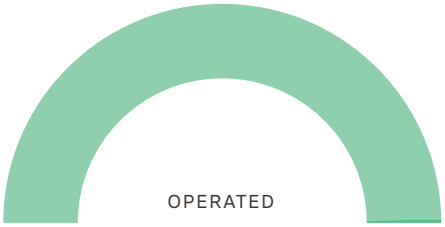
During the past decades, Fluvius has taken several measures such as substituting grey cast iron with modern materials and reducing operational and incident methane emissions in the distribution grid.

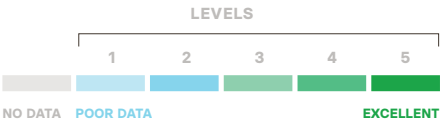
As an ambitious OGMP member Fluvius strengthens its efforts to further reduce methane emissions and collect more data via specific measurements to reach a reporting Level 4/5 by 2024.

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

DATA QUALITY

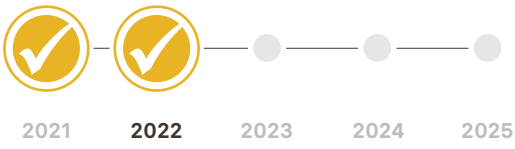




2021 METHANE ESTIMATES (kt)

4.43

GOLD STANDARD



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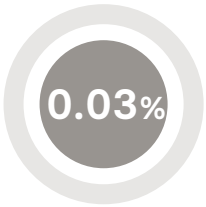
SEGMENT

DOWNSTREAM

GEI

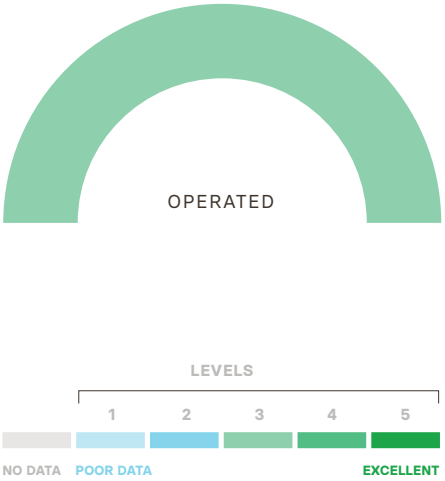
GEI is an Italian gas distribution company operating for 70 years in the north of Italy. We manage 2500 km of network delivering energy from the producer to the final customer with a strong focus on people's safety and environmental sustainability.

2025 TARGET (intensity*)



* maximum amount of annual methane emissions by 2025 as a percentage of marketed gas

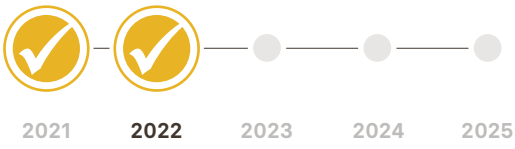
DATA QUALITY



2021 METHANE ESTIMATES (kt)

0.11

GOLD STANDARD



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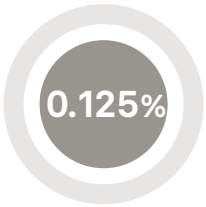
SEGMENT

DOWNSTREAM

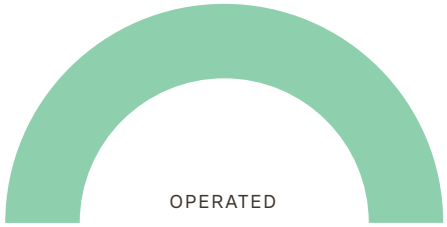
GAZ RÉSEAU DISTRIBUTION FRANCE

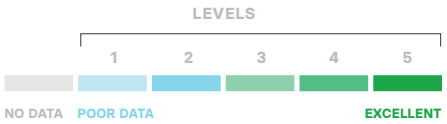
2025 TARGET (intensity*)



* maximum amount of annual methane emissions by 2025 as a percentage of marketed gas

DATA QUALITY

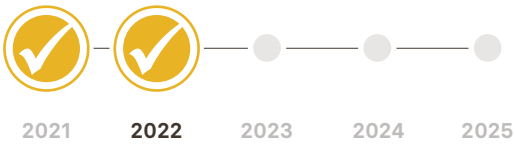




2021 METHANE ESTIMATES (kt)

18.61

GOLD STANDARD



implementation plan approved for data quality improvement

GRDF

GRDF is France's main gas distribution system operator, distributing natural gas to more than 11 million customers for different uses - heating, cooking, mobility, and industrial processes - regardless of their supplier.

GRDF works in close contact with local and regional authorities, the owners of gas distribution networks. We also interact with other stakeholders in the energy world, from public organizations to economic and social operators.

Performing a public service mission, we build, operate, and maintain the largest gas distribution network in Europe (204,200 km). We guarantee that gas is supplied under the best conditions of quality, safety, performance and cost, and we give all gas suppliers access to the network with complete impartiality. Our role as a distributor is to deliver gas to our customers, maintain and develop the gas distribution network with innovative solutions. GRDF has strong CSR commitments and is especially involved to reduce the environmental impact of its activities. Concerning methane emissions issues, we have developed a bottom-up methodology to evaluate periodically the methane emissions of gas distribution network. Beyond this quantification, this tool is used to measure the efficiency of the mitigation action plan we carry out to decrease methane emissions.

Furthermore, GRDF is convinced that the future of energy goes with renewable gas, operating a gas network already well developed and flexible to distribute and store renewable gas in gas network by 2050.

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SEGMENT

DOWNSTREAM

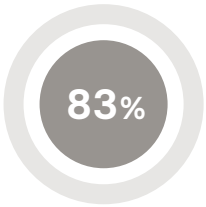
ITALGAS

Italgas is the first Italian gas DSO and third in Europe, serving around 7.75 million residential and industrial customers through 75,000 km of network, in 1,899 municipalities. Italgas is strongly committed to reducing methane emissions, contributing to the achievement of European climate goals.

Italgas' commitment in addressing methane emissions reduction is twofold: on one hand, the company is working to reduce direct emissions and those of its subsidiaries. Using Picarro's Cavity Ring-down Spectroscopy, a laser-based leak detection technology with a higher accuracy and speed than traditional methodologies (1 ppb CH4 concentration in atmosphere versus 1 ppm), Italgas is able to check its entire network in less than a year.

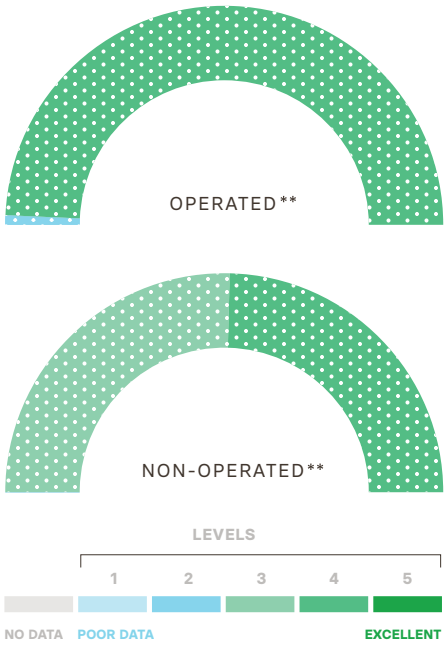
Furthermore, thanks to a proprietary algorithm capable of calculating annual emissions based on the effective loss rate of each material or network component under "real" conditions, Italgas is able to measure the authentic emissions along its network. At the same time, specific asset replacement and maintenance programs have been implemented to reduce the possibility of future leaks. Secondly, Italgas has a recognized leadership role in the gas distribution sector, having joined OGMP 2.0 initiative from the outset and encouraging a proactive behavior to reduce emissions among the other operators. Several initiatives have been undertaken, including the promotion of a common approach to the abatment of emissions among the members of various European associations.

2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

DATA QUALITY



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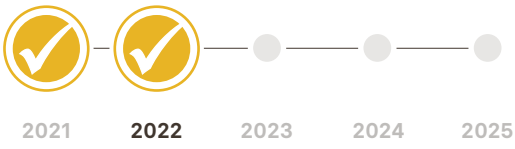
2021 METHANE ESTIMATES (kt)

4.68

GOLD STANDARD



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SEGMENT

DOWNSTREAM

LIANDER

In the Netherlands the gas distribution grid operator function has been separated from the energy supply side since the Dutch Gas Law in the year 2000.
The grid distribution operations under the name of Continuon were separated from the NUON company and resulted in the Network company Alliander.

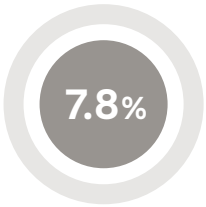
Network operator Liander, which is an Alliander subsidiary, has been tasked with managing and developing the gas and electricity network. The other Alliander units facilitate markets by providing products and services that help create a future-proof energy network. Alliander's shares are held by Dutch provinces and municipalities.

Liander distributes gas to over 3,2 million private households and commercial businesses and operates over 42,000 km gas distribution grid. The operating pressure ranges from 30 mbar up to 8 bar in the gas distribution grid.

Methane emission reduction goals at Liander are currently solely based on the replacement of cast iron pipes. Furthermore the main focus in reducing gas leaks is safety. By reducing gas leaks indirecty also methane emission is reduced at Liander.

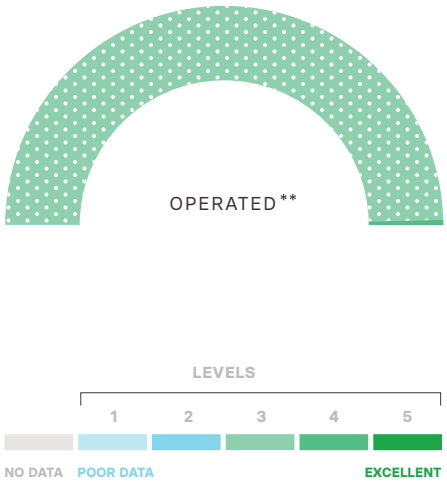
Allianders stands for an energy supply system where everyone has access to reliable, affordable and renewable energy on equal terms. Our strategy comprises four pillars, excellent network management, support for customers in making choices, investing in new open networks and digitalization. The strategy stands firmly on a solid and future-proof foundation: a safe, cost-conscious, sustainable and inclusive organization.

2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

DATA QUALITY



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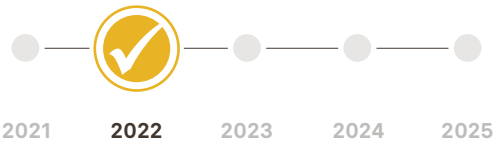
2021 METHANE ESTIMATES (kt)

1.98

GOLD STANDARD



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SEGMENT

DOWNSTREAM

NEDGIA

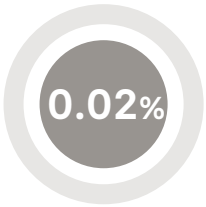
Nedgia, part of Naturgy Group, is the leading company in the natural gas distribution activity in Spain, supplying natural gas to 70% of consumers. With a long history of more than 175 years, Nedgia is currently operating in 11 autonomous communities with around 6 million of supply points.

Its main asset is more than 54,000km of infrastructures allowing the energy supply of natural gas to be delivered safely and efficiently today, and also the distribution of renewable natural gas (like biomethane) and hydrogen in the future.

Nedgia has a longstanding commitment on network innovation to enhance operations, improve safety and minimize impact of our activity on the environment. The company works to develop innovative and efficient solutions to minimize methane emissions, as part of its Sustainability Plan, and contributing to build a carbon-free energy system to fight climate change. In the last years, we have been working in a proactive way to mitigate our methane emissions through voluntary programs and by driving research initiatives together with some of the main European gas associations and organizations, highlighting the fact that we remain strongly committed to tackle this issue and contribute to achieve the EU's climate neutrality objective.

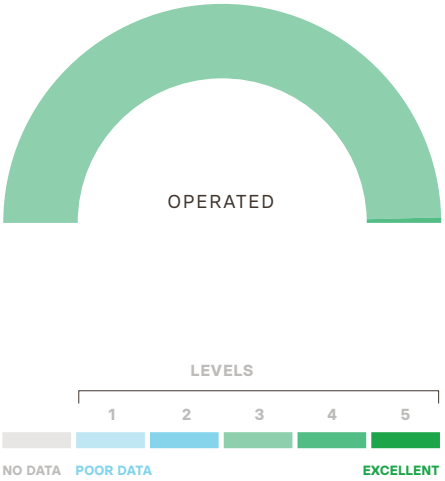
We also work on a coordinated basis with Naturgy companies around the world in an effort to minimize methane emissions. This is part of our Sustainability Plan to reduce GHG emissions, aligned with the European Green Deal.

2025 TARGET (intensity*)



* maximum amount of annual methane emissions by 2025 as a percentage of marketed gas

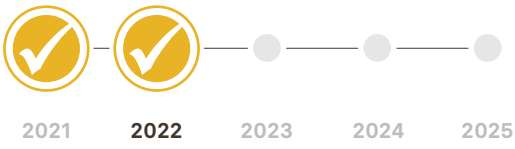
DATA QUALITY



2021 METHANE ESTIMATES (kt)

2.14

GOLD STANDARD



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SEGMENT

DOWNSTREAM

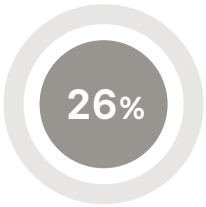
Netze Südwest

NETZE GESELLSCHAFT SÜDWEST

Netze-Gesellschaft Südwest mbH (Netze Südwest) and its predecessor companies can look back on a history of more than 30 years of natural gas supply in Baden-Württemberg. Netze Südwest is regulated by the state regulatory authority of Baden-Württemberg, where it is the largest gas network operator supervised by the authority.

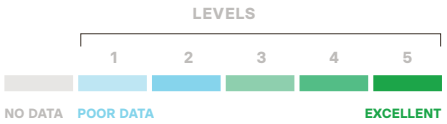
Our core tasks include the reliable and secure supply of gas to network customers. This includes the construction, operation and maintenance of distribution networks, including network connections. However, our tasks as a network operator also include community support through concession management as well as regulatory and network access and energy data management as defined by the Energy Industry Act (EnWG).

2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2020 estimates

DATA QUALITY



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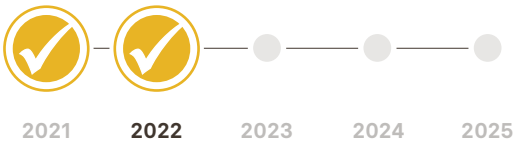
2021 METHANE ESTIMATES (kt)

0.03

GOLD STANDARD



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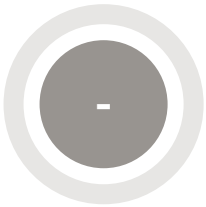
SEGMENT

DOWNSTREAM

NO TARGET



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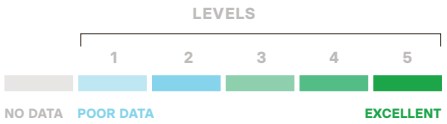

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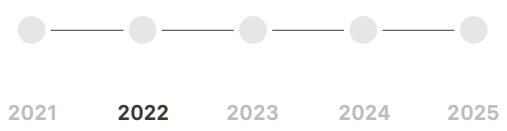
2021 METHANE ESTIMATES (kt)

0.15

GOLD STANDARD



RENDO NETBEHEER

N.V. RENDO is a local grid operator, responsible for an adequate distribution of gas and electricity in South Drenthe and North Overijssel. N.V. RENDO strives to continuously improve its current strong position as a grid operator. N.V. RENDO wants to be active as a grid operator in facilitating new developments in the field of sustainable use of energy and the transition to a sustainable energy supply. Important company values are in addition to a safe, high-quality, reliable and affordable energy network: customer focus, flexibility and sustainable entrepreneurship. N.V. RENDO has three important stakeholders: Customers/public, Staff and The ultimate shareholders For customers/public, N.V. RENDO offers: - A safe, reliable and efficient energy network. - Good service at relatively low cost. - Attractive (sustainable) products and services for the free market. For employees, N.V. RENDO is: - A good company for committed employees, which acts on the basis of respect and mutual responsibility. - A company with a good working climate.

For the ultimate shareholders, N.V. RENDO is: - A well-organized and transparent company. - A company that always realizes positive value development in a broad sense. N.V. RENDO distributes gas to over 100,000 private households and commercial businesses and operates over 3,500 kilometers gas distribution grid. Around 2,700 kilometer of the grid is known as a low pressure network with a pressure of 100 millibar. The other 800 kilometer is a high pressure network with pressures of 1, 4 and 8 bar.

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SEGMENT

DOWNSTREAM

schwaben netz

SCHWABEN NETZ

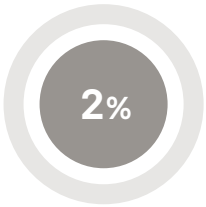
Schwaben netz GmbH is a gas distribution company operational in the south of Germany in western Bavaria. Schwaben netz is a 100 % subsidiary of erdgas schwaben GmbH and is part of the Thüga group, an alliance of 100 local and regional utility companies. The Thüga group wants to expand its expertise in the measurement, quantification and mitigation of methane emissions, therefore 3 gas distribution companies have joined OGMP 2.0 in October 2020.

Schwaben netz operates 7.000 km of gas grids in a 200 villages and smaller cities. The pressure levels range from low pressure up to 80 bar. Schwaben netz also operates 2 small emergency compressors, 5 gas conditioning plants and 8 CNG fuelling stations.

The weighted average age of the service lines is 18 years and of the main grid between 22 and 36 years. In the past 30 years all grey cast and ductile iron have been substituted with polyethylene pipes and steel with cathodic protection. In 2021 100 % of all steel pipes were equipped with cathodic protection. Every new steel pipe is insulated with polyethylene and has cathodic protection. Since joining the OGMP 2.0 schwaben netz has conducted several detailed measurements on leakages in the grids, pressure reduction stations and in 2022 several compressors. The quantification of methane emissions is becoming more detailed each year, new technologies for LDAR and top down measurements are tested.

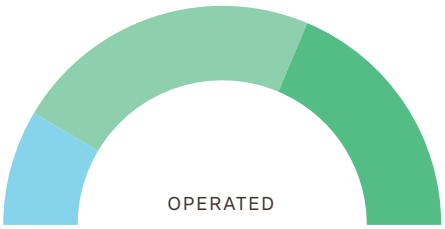
Schwaben netz has implemented in 2016 voluntarily the ISO 14001 environmental management system and is audited regularly every 3 years.

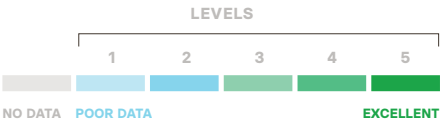
2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2019 estimates

DATA QUALITY

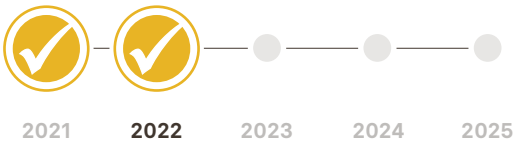




2021 METHANE ESTIMATES (kt)

0.09

GOLD STANDARD



implementation plan approved for data quality improvement

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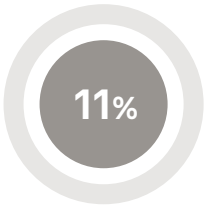
SEGMENT

DOWNSTREAM

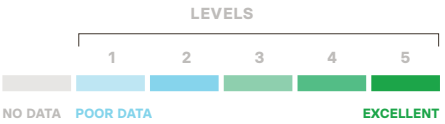
STEDIN GROEP

2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

DATA QUALITY

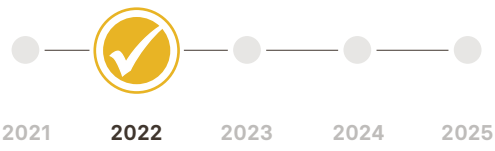


**dotted pattern = incomplete data

2021 METHANE ESTIMATES (kt)

1.36

GOLD STANDARD



implementation plan approved for data quality improvement

STEDIN

Stedin Group is a public organization whose shares are held by 44 municipalities. With our shareholders and other stakeholders, we work together to realize the energy transition. As a grid operator we carry out regulated activities. And as group some non-regulated activities with a strong relationship to the energy infrastructure. As a grid operator for gas and electricity, we provide a vital infrastructure.

With just under 5,000 colleagues, we are faced with the task of investing in the energy transition and maintaining the quality of our grids in the longer term. Stedin Group distributes gas to over 2.1 million gas customers (private households and commercial businesses) and operates over 28,160 km of gas distribution grid. The operating pressure ranges from 30 mbar up to 8 bar.

Until 31 December 2021, Stedin and Enduris are the two independent grid operators within Stedin Group. They operate alongside five other regional grid operators in a regulated market. Working together to create a living world full of new energy. That is our mission. We are convinced that we can make the energy transition possible by focusing on our core tasks for (future) grid management and by providing excellent services to our, in total, 2.3 million customers. We focus on the following three strategic spearheads: better grid management, enabling energy transition and sustainable business operations.

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SEGMENT

DOWNSTREAM

THÜGA ENERGIENETZE

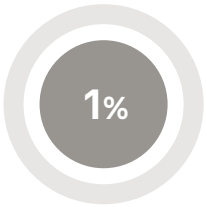
Thüga Energienetze GmbH (THEN) in Schifferstadt is a distribution company operating gas and electricity grids in the south and southwest of Germany. We are a 100 % subsidiary of Thüga AG in Munich. We distribute 6 TWh of natural gas and biomethane through our regional and local gas grid of 4.800 km in in a multitude of communities to 101.000 residential, commercial, industrial end-users and 4 independent DSO. All assets are operated.

For 30 years major reconstruction works were carried out in the grid which led to a constant decrease of the emissions. 72 % of the grid is made of polyethylene, 72 % of steel pipes are equipped with cathodic protection. All cast- and ductile-iron pipes were substituted, now older steel pipes are under renovation.

Joining the OGMP 2.0 in October 2020 is a logical next step in our efforts to measure and quantify our already small proportion of emissions in greater detail and find ways to further reduce them. We are committed to follow the path for gold standard. As we have already reached a very low methane intensity of < 0,007 % we consider our target for 2025 as a challenging endeavour.

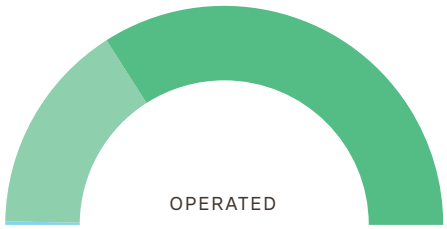
THEN is actively involved in the work of OGMP and explore new ways. In 2021 a first 600 km trial with vehicle-based LDAR was done. All measurements and experiences feed into the large German measurement program - organized by the DVGW - to update and expand the official emissions factors of the German Environmental Agency.

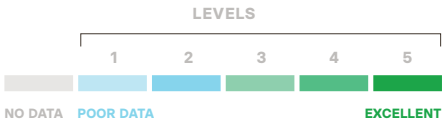
2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2019 estimates

DATA QUALITY

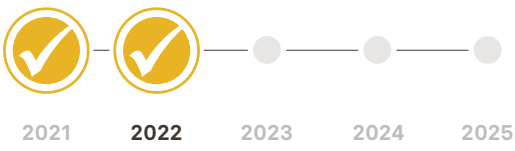




2021 METHANE ESTIMATES (kt)

0.03

GOLD STANDARD



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SEGMENT

DOWNSTREAM

UNARETI

Unareti is involved in gas distribution in different regions of Italy. Conditions of networks are very different plant to plant. The company provides more than 480 million of smc each year to one million of users along more than 6.500 km of grids.

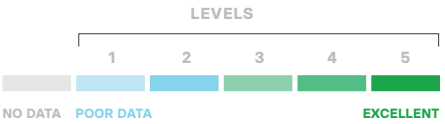
About volume of gas dispersed in atmosphere, generally speaking main way to reduce leakages is supersedes pipes, especially those which have bigger number of leaks, but this is often difficult to do in a short time i.e. in historical center of towns, where pipe conditions are usually worse. The detection of leakages along the grid is carried out through the usage of Picarro technology during periodical surveys. We are intensifying and improving survey of network and of other parts of distribution plants, like branches (buried and air branches) and meters, using instruments capable of detecting very little volume of dispersed gas. In this way, we are able to detect any kind of leakages as soon as possible after it has taken place, reducing the volume of dispersed gas.

Moreover, it is a normal way of working avoid purging or venting releasing gas in atmosphere but burning it by torch. About level of information, for several years Unareti has been publishing its sustainability report, where you can find the reduction of dispersed gas. To do this, we utilise the identical way to calculate the volume of dispersed gas planned by OGMP for Level 4. Only for limited parts of the plant's leakages are calculated as at Level 3, and this will be improved to Level 4 in the next years.

2025 TARGET (absolute reduction*)

*percentage reduction of annual methane emissions by 2025 based on 2019 estimates

DATA QUALITY

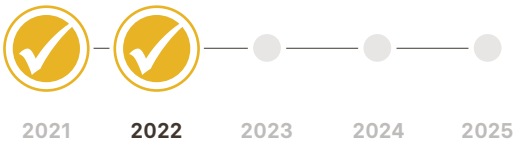


**dotted pattern = incomplete data

2021 METHANE ESTIMATES (kt)

1.79

GOLD STANDARD



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SEGMENT

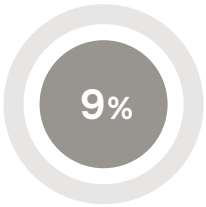
DOWNSTREAM

WESTLAND INFRA NETBEHEER

As a network company, including a grid operator, we work towards a livable and sustainable society for everyone. We believe in powering innovation and collaboration to achieve our goals and taking care for availability for energy, as well now as in the future. Transforming the current energy supply systems into a sustainable energy system in the coming decades are seen as our biggest challenge. Specialized in transport of energy and related products and services, within the legal frameworks, we take the initiative by seeking connections with all stakeholders.

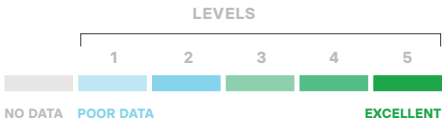
By working together we arrive at the best solutions. We see the transformation of the current energy supply into a sustainable, reliable and cost-efficient energy system as the greatest challenge for the coming decades. For the inhabitants of the Westland and Midden-Delfland regions, for the greenhouse horticulture sector and for our customers in industry, business services and other sectors. The goal is clearer and at the same time more challenging than ever. Global, European, Nationwide, Regional. And as N.V. Juva, we have one common goal: To reduce CO_2 and methane emissions to virtually zero by 2050. We are intrinsically motivated and have a strong intention of contributing to the climate objectives. It also applies to our organisation that there are still steps to be taken in business operations in order to realise our impact. This means that we must constantly adjust our choices and considerations.

2025 TARGET (absolute reduction*)



*percentage reduction of annual methane emissions by 2025 based on 2015 estimates

DATA QUALITY



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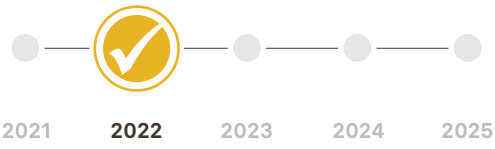
2021 METHANE ESTIMATES (kt)

0.11

GOLD STANDARD



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ANNEX 2.

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