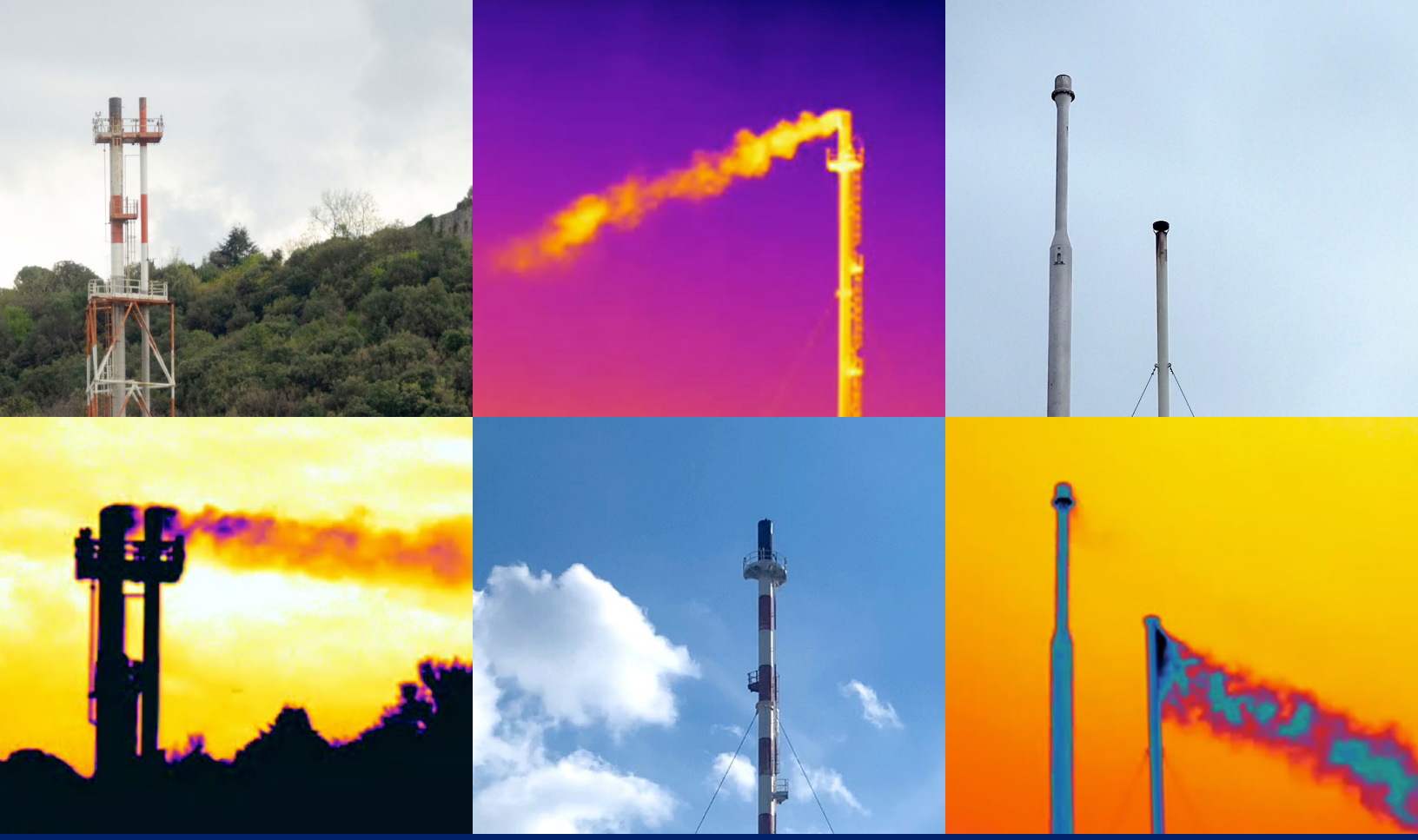
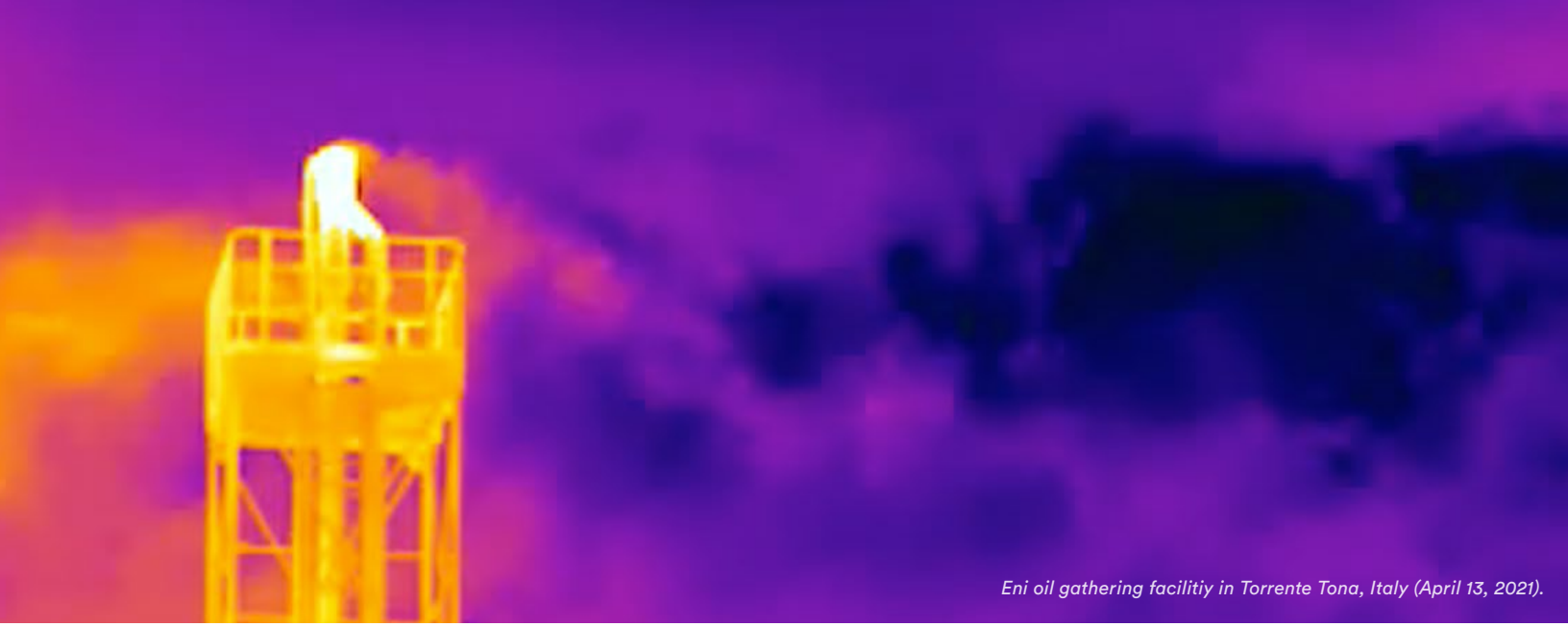


It Happens Here Too:
Methane Pollution in Europe's Oil and Gas Network

Updated May 2023

Photo credits (left to right): SNAM-GNL LNG regasification terminal in La Spezia, Italy (April 6, 2021); SNAM-Stogit underground gas storage facility in Minerbio, Italy (April 17, 2021); OMV Petrom compressor station in Pitesti, Romania (June 12, 2021)

CLEAN AIR TASK FORCE



Eni oil gathering facilitiy in Torrente Tona, Italy (April 13, 2021).

Executive Summary

After many years of slipping under the radar, the crisis of methane pollution has become a climate priority at the highest levels.

In 2021, the European Commission put out its first ever EU-wide proposal to deal with methane emissions. It was a part of a breakthrough moment for methane campaigners, coming just a few weeks after methane had made it to the mainstage at COP26 in Glasgow and more than 100 world leaders committed to the Global Methane Pledge that set a collaborative international target for methane, the long overlooked 'other' greenhouse gas.

Now, that moment has turned into momentum.

At COP27 in Egypt, we saw a plethora of announcements. Over 150 countries now support the pledge and 95% of nationally determined contributions include methane in their greenhouse gas target or will by their next revision. More than 50 countries have National Methane Action Plans or are working to develop one. Canada, Nigeria, and the United States announced far-reaching regulations or regulatory pathways that include ambitious new plans like monthly leak detection and repair inspections at all oil and gas facilities, replacing vent-by-design equipment within a few years, and a fee on methane emissions.

A new bar has been set for methane action. Now it is up to the EU institutions to rise to the occasion.

In the past 18 months, the EU Methane regulation has faced a lot of adversity. It was first pushed off the radar as crises in Ukraine and the global energy market took priority, but it re-emerged as a key component of the Commission's RePowerEU plan. With Europe's need to diversify oil and gas supply to the fore, methane emerged as a major energy security consideration. Reducing methane leaks around the world could help make up near-term shortfalls in energy for Europe while reducing global emissions – a win-win for the planet. As part of its response to the energy crisis, the Commission announced a program called "you collect, we buy" that could be harnessed to reduce the 210 billion cubic metres of gas that is wasted globally through flaring, venting and fugitive emissions.

Despite high-profile promises made on the global stage, European leaders have not stepped up to make passing strong methane legislation a priority and, as a result, industry interests have successfully weakened, delayed, and eroded many of the measures in the Commission's original proposal. The recommendations presented by Council of the European Union was considerably weaker than the original proposal, putting the EU at threat of falling behind on methane action.

Measures put in place by Canada, the United States, Nigeria and others have made the original Commission proposal look average; the vision outlined by the Council was several steps back from even that. But there are signs of hope. The version agreed on by the relevant committees within the European Parliament on April 26 was a major step forward. It included requirements for companies to detect and repair leaks in their operations, ban venting and flaring, as well as introduce performance standards for the sector, and a total emission reduction target to be set before 2026. Crucially, they also introduced the world's first import standard, which would expand the scope of regulations to oil and gas being imported into the EU, and required the Commission to adopt a methane intensity standard for domestic and imported gas following an impact assessment.

Now the onus is on Parliament as a whole to back those recommendations and come into the trilogues on the front foot, ready to push for bloc-wide methane mitigation measures that are truly world-leading. The world is looking to Brussels for leadership on this issue, and ending up with EU legislation that is just "okay" isn't good enough.

There is widespread public support for strong regulations to reduce methane pollution in the oil and gas industry in Europe. A representative survey CATF conducted with YouGov in August 2022 of 6,251 voting-age respondents from four countries (France, Italy, Germany, and Poland) showed at least 90% of respondents support regulations to reduce methane emissions in the oil and gas industry by targeting methane leaks (90%), establishing equipment standards (91%), and applying regulatory measures to EU suppliers (90%).[1]

Since 2021, Clean Air Task Force has continued to travel around the bloc, documenting methane emissions throughout Europe's oil and gas network.

Fundamentally, nothing has changed: **the issue of methane pollution remains ever present across the entire oil and gas network in Europe.**

In this report, Clean Air Task Force (CATF) outlines our observations of methane pollution from oil and gas infrastructure within the EU. This report is based on trips to over 430 and gas sites spread across 15 European countries, including the United Kingdom between February 2021 and March 2023, utilizing special optical gas imaging (OGI) technology that allows us to make invisible methane pollution visible. This is the first multi-country survey of oil and gas facilities in Europe, and the takeaway is clear: methane pollution is widespread. We found evidence of methane emissions in a large majority (289) of the sites we visited, showing that this is a common problem across Europe.

Our documentation shows emissions at every stage, including in areas near population centers. In total, we observed 881 sources of emissions. The emissions we observed predominantly came from storage tanks, emergency relief stacks, unlit flares, and other miscellaneous leaks from piping equipment. We also observed various types of failures resulting in methane pollution directly from the wellhead in nine oil and gas producing countries (Austria, France, Italy, the Netherlands, Romania, Slovakia, Spain, Germany, and UK), with Romania illustrating a significant problem.

While several of the oil and gas operators that own these assets are part of the Oil and Gas Methane Partnership 2.0 (OGMP 2.0) and/or have made commitments to address methane pollution, rhetoric does not always match action on the ground. Currently, companies can voluntarily report methane emissions, but there is no clear legal obligation to reduce emissions. EU oil and gas companies often deflect responsibility by raising the issue of methane emissions from global oil and gas producers and exporters. While upstream methane released from oil and gas imported into Europe is a major problem, and one that must be addressed with a strong import standard, the industry will not address problems within the EU at anywhere near the scale that is necessary if there is no policy framework to compel them, more importantly, nor can the EU impose standards on imported fuels if it fails to impose domestic measures.

In this decade, we will need to make significant progress cutting emissions across all three major methane emitting sectors – energy, agriculture, and waste – but some of the biggest and most immediate opportunities are in the energy sector. The International Energy Agency (IEA) estimates that we can eliminate nearly 75 percent of the methane emissions from the oil and gas industry globally using the tools we have today at little to no cost to industry. This is based on the average price of gas from 2017 to 2021, which is merely a fraction

[1] Clean Air Task Force, *Public Opinion of EU Methane Regulation*, 2022, https://www.catf.us/2023/04/european-citizens-from-france-italy-germany-and-poland-strongly-support-tough-regulations-to-reduce-methane-emissions/

of the prices we are seeing today. At today's prices, the IEA estimates every reduction that is technically feasible to cut can be cut at zero cost or at a profit.

For the EU's regulation to be seen as a global example of leadership, it must resist the efforts that are being exerted to weaken them. The EU should back the recommendations taken by the relevant committees in the European Parliament, especially the expansion of measures to imported oil and gas.

As the large majority of emissions due to EU gas consumption actually take place outside of the EU borders, this extension of mitigation measures could have a major impact into cleaning up the value-chain and cutting methane globally. The EU's gas imports market touches on over 51% of global production.

Optical Gas Imaging

Optical gas imaging uses an infrared camera to visualise otherwise invisible gases. CATF's camera, a FLIR GF320, has been calibrated to visualise methane and other volatile organic compounds. This process was recommended by the US EPA as a best available technology for leak detection and repair at oil and gas sites in 2016.

LEARN MORE

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Gas flare in Romania (June 11, 2021)

SECTION 1

Introduction

Methane is a powerful greenhouse gas, with more than 80 times the global warming potential of carbon dioxide over a twenty-year period (more than 30 times over a hundred-year period). The Sixth Assessment Report of the IPCC found methane to be responsible for 0.5C of the 1.1C rise in global warming, making it the second biggest contributor to anthropogenic climate change after carbon dioxide. Atmospheric concentrations of methane continue to rise.[2] The U.S. National Oceanic and Atmospheric Administration reported that methane concentrations in the atmosphere in 2022 were at the highest level ever recorded.[3] In addition to its global warming effects, methane is the biggest contributor to ground-level ozone pollution and it is emitted along with other harmful compounds, thus, emissions mitigation presents significant public health and economic impacts.

Due to its short lifespan (10-15 years), immediate reductions in methane emissions can lead to a noticeable slowing of warming within a few decades. In fact, the Global Methane Assessment determined that 0.3C of warming can be averted by 2050 with a 45 percent reduction of methane emissions by 2030.[4] This would prevent 255,000 premature deaths, 775,000 asthma-related hospital visits, 73 billion hours of lost labour, and 26 million tons of crop losses globally.

About 60% of the world's methane emissions are caused by human activity (anthropogenic).[5] In the EU, around 53% of anthropogenic methane emissions come from agriculture, 26% from waste, and 19% from energy, which includes oil, gas and coal.[6] Of these sources, tackling methane emissions in the oil and gas industry is the lowest hanging fruit. According to the IEA, 78% of

2 https://www.ipcc.ch/assessment-report/ar6/

3 https://gml.noaa.gov/ccgg/trends_ch4/

4 UNEP and Climate and Clean Air Coalitions. (2021). *Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions.* https://www.unep.org/resources/report/global-methane-assessment-benefits-and-costs-mitigating-methane-emissions

5 https://www.iea.org/reports/global-methane-tracker-2023/understanding-methane-emissions

6 European Commission. (2020a). *EU Methane Strategy.* Retrieved from: https://ec.europa.eu/energy/sites/ener/files/eu_methane_strategy.pdf . However, based on our research, official inventories may be significantly underestimating methane emissions from the energy sector.

Types of Methane Emissions From the Oil and Gas Supply Chain

- **Venting** is the controlled release of greenhouse gases that are part of routine and emergency operations from the gas and oil sector.
- **Flaring** refers to the controlled combustion of fossil gas as part of routine or emergency operations. Most gas is combusted when it is sent to a flare, but flares do not always burn efficiently and sometimes the flare goes out entirely which can result in a significant amount of methane emissions.
- **Fugitive emissions or leaks** refer to the escape of gas from static components (open pipes, connectors, valves, regulators, and hatches). They are due to many causes like thermal or mechanical stresses, human error, or worn-out equipment.

methane emissions can be abated at marginal or negative costs to companies. Yet, the Methane Regulation of the European Union (EU) faces high risk of missing its emissions reduction objectives and commitments without stricter rules to mitigate methane emissions.

Methane is a highly flammable gas and the primary component (between 80-95%) of fossil (natural) gas. As it is transported from production areas to consumers, methane can be emitted from many points along the supply chain. (The graphic on the next page shows points along the oil and gas supply chain where methane emissions are commonly found.) While some emissions are accidental leaks, others are intentional, such as venting, which is done to release pressure or for maintenance activities. Methane may be leaked or vented from pipelines, production and transmission equipment, and combustion sources throughout the value chain. Extensive research has shown that methane emissions from the oil and gas industry are highly underestimated.[7] Most scientific research on methane emissions in the oil and gas industry has focused on the United States, given the large share of its contribution to global oil and gas production. While there has been some research on fossil gas emissions in Europe, more research is currently underway.

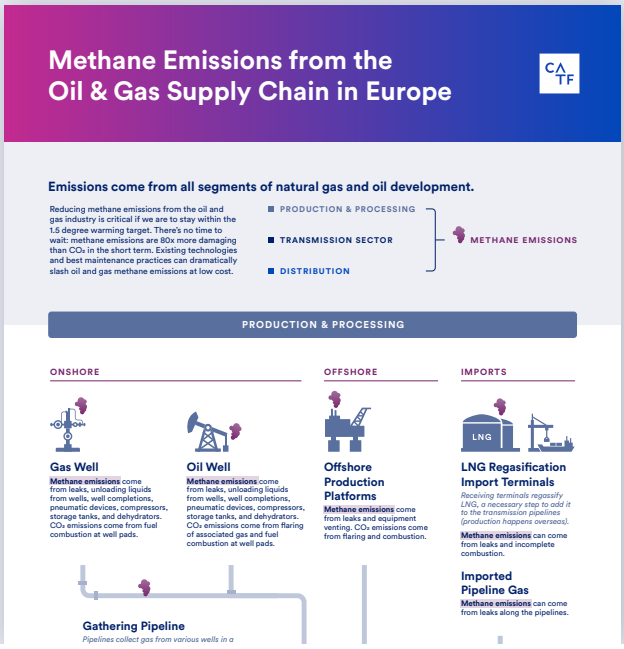
In this report, Clean Air Task Force (CATF) has prepared a snapshot of the widespread issue of methane pollution within Europe. The #CutMethaneEU campaign, launched by CATF along with several partner organizations including 2Celsius (2C), Deutsche Umwelthilfe (DUH), Legambiente, Ecologistas en Accion, and the Environmental Investigation Agency (EIA), is meant to highlight the widespread issue of methane pollution across the oil and gas sector in the EU and the need for the European Commission to issue strong legislation in response. The evidence from more than 430 oil and gas sites across fifteen countries is stark – methane pollution is happening all around us. We found fugitive emissions in every country we visited, at every type of site we visited, at every company we visited, and from numerous types of components and equipment. Of the 430 sites visited, we documented emissions at 289 of them.

Policy context

This report comes at a time when global attention on methane is intensifying, starting with the report from the IPCC released in August 2021.[8] In the landmark report, scientists at the IPCC argued that cutting methane emissions is key to achieving global climate goals. A few weeks after this IPCC report was released, on September

[7] See, for instance: Alvarez, R. A. et al. (2018). Assessment of methane emissions from the U.S. oil and gas supply chain. *Science,* 361(6398), 186-188; and Zavala-Araiza, D. (2021). A tale of two regions: methane emissions from oil and gas production in offshore/onshore Mexico. *Environmental Research Letters*, 16(2). https://doi.org/10.1088/1748-9326/abceeb

[8] IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change[Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, In press, doi:10.1017/9781009157896.



Methan Emissions Supply Chain in Europe Infographic

Learn more about the sources of methane emissions throughout the oil and gas supply chain and see where methane leaks occur.

VIEW INFOGRAPHIC

View in Appendix

18th 2021, the EU and the United State (U.S.) announced the Global Methane Pledge, an agreement to collectively slash economy-wide methane emissions by at least 30% below 2020 levels by 2030.[9] At the time of writing, more than 151 countries have joined the Global Methane Pledge, including half of the top 30 methane emitters worldwide. Countries that have joined the pledge currently account for 55% of total methane emissions from human activities.

The Global Methane Pledge provides additional impetus to existing international initiatives aiming to tackle energy-related methane emissions, including the Oil and Gas Methane Partnership (OGMP); the Climate and Clean Air Coalition (CCAC); and the World Bank's Zero Routine Flaring by 2030 and Global Gas Flaring Reduction initiatives.

There is currently no legal framework to reduce methane emissions at the European level. This is despite its huge gas infrastructure network, the fact that some member states are actively producing oil and gas, and that the bloc is the world's largest importer of fossil gas. Fugitive emissions and intentional venting throughout the supply chain have long been overlooked.

On December 15th, 2021, the European Commission proposed its EU Methane regulation,[10] aiming at setting a policy framework to tackle methane emissions from the energy sector. In the proposal, the Commission sets requirements for the compulsory monitoring, reporting, and verification (MRV) of all energy-related methane emissions, and comprehensive leak detection and repair (LDAR). The proposal also put under the spotlight the global dimension of this issue, arguing that external methane emissions associated with the bloc's fossil gas consumption – i.e. emissions derived from gas consumed in EU but produced externally – are between three to eight times the quantity of emissions released within the EU.

9 European Commission. (2021). *Joint EU-US Press Release on the Global Methane Pledge*. Retrieved from: https://ec.europa.eu/commission/presscorner/detail/en/IP_21_4785

10 European Commission. (2020a). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2021%3A805%3AFIN&qid=1639665806476

CATF Campaign Manager in Brandenburg, Germany (June 7, 2021)

SECTION 2

Methodology

The findings from CATF's #CutMethaneEU campaign are based on fieldwork conducted by CATF between February 2021 and March 2023. This report summarises the findings of more than 430 trips to oil and gas sites across Europe.

Methane is invisible to the naked eye. To document methane emissions, we used a special type of infrared camera (specifically a FLIR GF320) that can detect methane, propane, ethane, and butane, all commonly found in fossil gas, in addition to other gases and gas compounds. The optical gas camera is one of many instruments used by oil and gas regulators and companies to detect emissions caused by leaky or broken equipment as well as process venting. Gas Infrastructure Europe and MarcoGaz, two industry association groups, have praised optical gas imaging's ability to quickly and effectively detect fossil gas, saying that "[Infrared] cameras play an increasingly relevant and important role in complementing existing leak identification and control methods; moreover, they also allow us to identify big emitters that are often indiscernible with traditional devices (e.g., remote and not accessible equipment)."[11]

The GF320 camera can detect multiple types of gas: in oil and gas infrastructure, between 80-95% of the gases observed will likely be methane, while the presence of other gases will depend on the proximity of the facility to the production process. CATF's OGI experts are certified thermographers, and all videos are reviewed by internal and external experts before publication, including petroleum engineers and other thermographic experts.

The optimal gas imaging camera detects the presence of methane emissions; however, it cannot quantify emissions from a sources. Any reference to emission size in this report is qualitative, not quantitative, and is on a comparative basis of all the emissions documented across Europe. Additionally, the camera has detection limits, so only leaks above a certain size can be detected. The minimum detection threshold is determined by distance to the emissions source and the difference

[11] Gas Infrastructure Europe & Marcogaz. (2019). *Potential ways the gas industry can contribute to the reduction of methane emissions.* https://ec.europa.eu/info/sites/default/files/gie-marcogaz_-_report_-_reduction_of_methane_emissions.pdf

Oil storage tanks at a gathering facility in Videle Est, Romania (June 8, 2021)

in temperature between the gas and the background objects. The minimum detection limit reported by FLIR for the GF320 optical gas camera is 0.8 grams per hour. Additional research has been conducted to determine minimum detection limits as a function of distance and temperature differentials.[12]

We used a variety of research methods to identify individual sites to visit. Gas Infrastructure Europe[13] provides significant documentation of gas storage facilities; some countries (Germany, Italy, the Netherlands) have individual databases of hydrocarbon production; and gas company websites provide information about the location of their compressor stations and other infrastructure on the network. In addition, local knowledge from environmental groups and individual actors has been instrumental to the identification of smaller production sites. In some cases, we reviewed Google Maps satellite view to find and identify sites. We also made use of a valuable resource map of the EU's midstream gas facilities, which was produced and published in early 2021 by a research group at the German Aerospace Center (DLR).[14]

Specific site selection was based on an attempt to document a representative sample of the infrastructure in each country but does not reflect any scientific methodology. In some cases, we were asked by local environmental groups to visit specific sites. In some instances, we revisited sites where we found significant methane emissions several days, weeks, or months later to determine if emissions from these facilities had continued.

The sites we visited included active and inactive oil and gas wells, gathering and processing stations, oil storage facilities, gas storage facilities, gas transmission compressor stations, gas pipelines, gas regulation and metering stations, gas depressurization stations (also known as city gates), liquefied natural gas (LNG) regasification terminals, and LNG refueling stations.

We did not have access to go inside the fence line at sites, so filming was done from public spaces and access roads. *All videos were taken from locations outside of the facility and therefore our ability to detect fugitive emissions was limited to what we could see from the fence line.* For well sites, the average distance from the emissions source was between 2 to 15 meters, for gathering storage and processing facilities, the average distance was 5 to 50 meters, for compressor stations and storage facilities, the average distance was 5 to 150 meters, and for LNG terminals, the average distance was about 300-600 meters. Given this method, the failure to document emissions at a site should not be interpreted as the lack of emissions at a site.

CATF Campaign Manager in Faro, Italy (April 15, 2021)

12 Zeng, Y., & Morris, J. (2018). Detection limits of optical gas imagers as a function of temperature differential and distance. *Journal of the Air & Waste Management Association*, 69(3), 351–361. https://doi.org/10.1080/10962247.2018.1540366

13 Gas Infrastructure Europe. (n.d.). Data Retrieved November 14, 2021, from https://www.gie.eu/transparency/databases/

14 SciGRID_gas. (n.d.). *Motivation and Approach*. Retrieved November 14, 2021, from https://www.gas.scigrid.de/pages/motivation-and-approach.html

SNAM-GNL LNG regasification terminal in La Spezia, Italy (April 6, 2021)

SECTION 3

Findings

CATF surveyed over 430 sites across Europe, documenting methane emissions at 289 sites in 14 Member states of the EU and the UK. This report does not present a quantitative estimate of emissions from oil and gas infrastructure in these countries nor in Europe; rather it demonstrates that leaks and venting from these sites are ubiquitous and occurring from sites in each member state we visited and from sites of every type. We believe these sites are generally representative of the oil and gas industry in a given country, where the national context varies significantly – some countries are oil and gas producers, other countries are importers or transit countries with a vast midstream infrastructure, and some countries have both. As such, we did not spend an equal amount of time in each country.

Due to these limitations, this report **does not intend to provide a 'scorecard'** for countries or make any conclusion that some countries are doing better to reduce methane emissions and to detect and repair leaks. Furthermore, we are not providing quantitative estimates about the inventory of reported methane emissions per country or reported emissions from a particular site.

Each emissions source presented below could represent a small emissions source or a large emissions source; however, qualitative descriptions of some sources are provided in the description of findings below.

3.1 Emissions by Source

Although we have not attempted to sample equipment systematically, it is notable that at the installations we surveyed, **storage tanks** were the most common source of methane emissions, accounting for 185 out of the 881 emissions sources. These storage tanks were primarily located at oil and gas production areas in UK, Romania and Italy. 92 of these leaking tanks were in Romania, 31 were in UK, and 21 were in Italy. Storage tanks emitting methane emissions were also identified in France and Germany. Tank emissions occurred for several reasons: in some cases, it was clear that gas was being vented to reduce pressure on the system; in other cases, thief hatches were left open, or pressure relief valves had failed; and finally, in some cases in Romania, we observed large rusted out holes in the sides of active storage tanks, where gas could freely escape.

Storage tanks can vent large volumes of gas, particularly in the production segment of the industry. According to the U.S. Environmental Protection Agency (EPA), storage tank batteries can vent 0.14 to 14,158 cubic meters of fossil gas[15] and light hydrocarbon vapours to the atmosphere each day – and therefore, emit significant volumes of methane.

The Methane Guiding Principles initiative says that strategies to reduce emissions from storage tanks depend on the venting causes for each location, but installing vapor-recovery systems, decommissioning old tanks at production sites, adding tank-pressure monitors, and including tanks in routine Leak Detection and Repair (LDAR) programmes could make a significant difference.[16] In the US, tanks installed since 2011 that exceed a potential to emit of six tons per year of non- methane VOCs (Volatile Organic Compounds) are subject to emissions standards, with significantly more stringent rules in several US states.

Venting from equipment, vent **stacks** and **unlit flares**, was observed 453 times. Vent stacks are commonly found throughout the gas storage and transmission system. This equipment is not designed to combust gas because environmental plans assumed gas would not be continuously emitted from these sources. Our research shows that gas is often being emitted from these sources, which is likely the result of malfunctioning equipment along the piping infrastructure at the facility. In several locations CATF detected methane being released from **partial** combustion – a flare or compressor turbine burning inefficiently and releasing a large amount of methane.

Another common source of emissions (404 observations) was **miscellaneous leaks related to facility piping.** This includes the piping network within a facility and valves that connect the various equipment on a site. In our classification, it could include rusted holes in pipes, small vent pipes on metering boxes, pig traps, gas analysers, or other equipment. From outside the facility, it is sometimes difficult to identify the specific type of equipment or its purpose. These have been common in all countries visited – and we have detected continuous releases from vent pipes at compressor stations, refuelling stations, and metering sites. In many cases, venting was frequent or continuous. Leaks from **valves**, venting from **separators** and **metering boxes** were also observed frequently, indicating that emissions occur across the entire value chain, and not necessarily only on the exploration and production phases.

We also detected many leaks from **oil and gas wells**, the majority of which were documented at wells in Romania. Romania's wells have not been properly maintained. We visited 110 well sites, the majority in Romania, Austria, Germany, and Italy, and found gas leaking from open valves and casing heads. In addition, we observed casing gas being released in Germany and Spain. In some cases, these could be fixed simply by tightening nuts and bolts, whereas other cases might require additional measures. There are numerous options to utilise fossil gas from oil wells. Estimates suggest that rules banning gas venting could easily reduce emissions by 95%.[17]

OMV oil production well in Prottes, Austria (July 4, 2021)

3.2 Emissions by Country

Austria

Austria's oil and gas production is relatively small and has declined over the last ten years by about a third, according to data from the IEA.[18] In 2018, oil made up 40% of Austria's final energy consumption, and natural gas made up 18%. Austria is a transit country for fossil gas entering western Europe, as it is home to the Central European Gas Hub in Baumgarten, so the amount of gas

[15] US Environmental Protection Agency. (2010, March). *Reducing Methane Emission with Vapor Recovery on Storage Tanks: Lessons Learned from the Natural Gas STAR Program.* https://www.epa.gov/sites/default/files/2017-07/documents/06_vrus_vernal_2010.pdf

[16] Methane Guiding Principles. (2019). *Reducing methane emissions: Venting.* https://methaneguidingprinciples.org/best-practice-guides/venting/

[17] Clean Air Task Force. (n.d.). *Oil and Gas Methane Mitigation Program.* https://www.catf.us/methane/mitigation-program/

[18] https://iea.blob.core.windows.net/assets/ea419c67-4847-0.7%20Mtoe%20Mtoe2-905a-d3ef66b848ba/Austria_2020_Energy_Policy_Review.pdf

OMV gas production facility in Stockerau, Austria (July 7, 2021)

flowing through the system in Austria is greater than the amount consumed by the country.

CATF visited 25 facilities in Austria on May 11-13, 2021 and June 30-July 7, 2021. The sites include locations involved in oil and gas production and gas transmission owned or operated by adx Energy, GasConnect, OMV, RAG, TAG, and Uniper. We documented methane emissions at 17 sites in Austria. The most concerning sites, in terms of volume of emissions, types of emissions events, and recurrence of emissions, are owned by state-controlled OMV and by Rohöl Aufsuchungs AG (RAG).

Many of the observed incidents of methane emissions came from oil and gas wells and fossil gas processing sites. For instance, at the V-001 oil well owned by RAG, we found significant venting from the pressure relief valve of the storage tank on site and observed a large cloud of emissions blow towards a house 100 meters downwind. We documented a number of leaks at well heads across Austria. We visited ten wells in an oil field outside of Prottes, a small town approximately 30 kilometers north of Vienna in the heart of Austria's main oil production region. Of the 10 wells we visited, we found fossil gases leaking from three of these wells. All three wells were located within 15 meters of residential houses. We also found three wells in the Hochleithen forest, another oil field in the Weinviertel region, and observed emissions at these wells over the course of two months, from our initial visit in May to our second visit in July 2021.

Several of the sites were releasing methane from more than one source. In the gas processing plant in Stockerau (owned by OMV), we detected two sources of methane emissions on our first visit. When we returned to the site one and a half months later, we found that the two sources of emissions had continued, and we also found two additional emissions sources. Other sources of emissions in Austria included vent pipes at compressor stations and gas storage and processing facilities.

Belgium

Natural gas is the second-largest energy source of Belgium after nuclear, making up around 27% of its annual energy consumption and 34.4% of its power mix in 2019,[19] according to data from its gas transmission system operator Elia. Belgium does not have any production sites and imports all of its gas from the Netherlands, Norway, Germany, the United Kingdom (UK) – through undersea pipelines – and LNG mainly from Qatar through its Zeebrugge terminal, in operation since 1987.

Fluxys gas compressor station in Zelzate, Belgium (August 15, 2021)

In August 2021, CATF visited eight sites in Belgium, and found emissions at seven of the sites, with the results of one of the sites inconclusive.[20] We visited three transmission compressor stations, three LNG refuelling stations, the LNG regassification terminal in Zeebrugge, and the Zeebrugge interconnection terminal where gas enters Belgium from the UK. At the interconnector

[19] https://www.comparateur-energie.be/blog/mix-energetique-en-belgique/

[20] The LNG regasification terminal in Zeebrugge is a large facility with high security. The closest one can get to the facility from public roads and access points is approximately 800 meters. At that range, the camera is almost ineffective unless there was a very large emissions event. We observed a lit flare at the site, but could not make a proper assessment of the facility.

terminal in Zeebrugge, we found a total of 11 different sources of methane emissions. Most of these emissions came from open-ended lines, but also included vents on the compressor building rooftop, and emissions from the emergency vent stack.[21]

We observed emissions at each of the compressor stations we visited. In Winksele, we found emissions coming from the emergency blowout stacks as well as leaks from several valves and open-ended lines. In Zelzate, we found small, but continuous emissions come from three of the vents on the emergency blowout stacks. And, in Ravels, we observed significant methane slippage, where uncombusted or partially combusted methane is released from the exhaust stack.

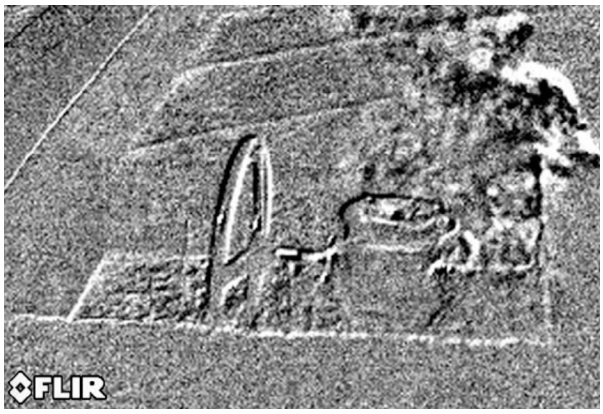
LNG refuelling stations, which are used by LNG-powered heavy-goods vehicles (HGVs), are small but under-scrutinized sites. We detected several different sources of emissions at three sites which we visited:

- continuous venting from the blowout pipe at the LNG storage tank at the Berg fuelling station;
- large emissions purges from the blow out pipe on the LNG tank each time a truck refuelled their tank at a station in Veurne; and,
- a leaky pump handle at the fuel station and continuous emissions from the blowout pipe and the engine of one of the LNG trucks.

Bulgaria

Bulgaria aims at becoming the new Balkan Gas Hub, linking Southeastern Europe with the rest of the European Union. The new Gas Interconnector Greece-Bulgaria (IGB), inaugurated in 2022 is one example of the growing role of Bulgaria in building a European gas network. For this reason, visiting the gas transmission system in Bulgaria was important to collect evidence for stricter rules.

In April 2022, CATF visited seven regulation and metering stations operated by Bulgartransgaz. All the sites were situated on the main pipeline, from Plovdiv to the Black Sea. Regulation (GRS) and metering (GMS) stations are the most common facilities across



Bulgartransgaz metering station on the main gas pipeline in South-Eastern Bulgaria (April 4, 2022)

a pipeline, distant of few kilometers each to ensure good operation, control the quantity of gas going through, and for maintenance. At each of them, CATF documented methane emissions, some being very significant. At most of them (GMS Rosen, GMS Plovdiv North Stara Zagora,GRS Stara Zagora, GRS Novi Pazar, GRS Dimitrovgrad), CATF observed poorly closed or malfunctioning valves and leaky pipe connectors.

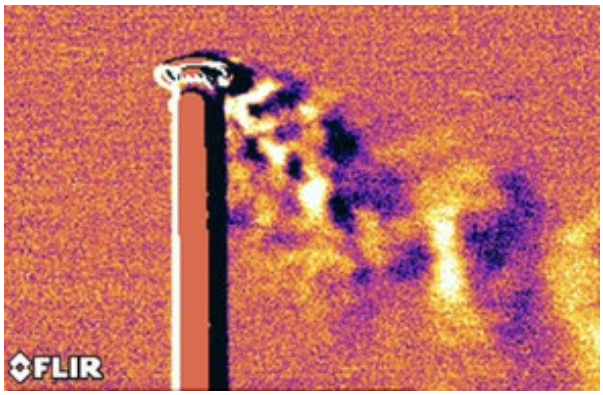
The sites visited along the pipeline were small in size, yet, at the regulation and metering stations of GMS Rosen and GMS Plovdiv North, CATF identified more than eight leaks and venting events. At the other facilities, more than three sources of emissions were identified each time.

Czech Republic

The Czech Republic is a historic coal producer, with the fuel accounting for one-third of its total energy supply in 2019. It produces only around 3% of its crude oil and 1% of its fossil gas consumed. However, the country has significant gas storage capacity, amounting to about 33 billion cubic metres (bcm), and with plans to expand current capacity to 4 bcm by 2022 – about half of the country's annual gas consumption.

For this reason, most sites in the Czech Republic CATF visited are gas storage facilities. In May 2021, CATF visited seven sites and found emissions at six of those

[21] Methane slip from hot emissions stacks occurs when a compressor turbine is not running efficiently. It can be difficult to capture these emissions with an optical gas camera due to the presence of heated vapors. A trained and experienced thermographer can discern methane slip from hot gas by panning the camera and following the emissions plume as it moves across the sky. Proper measurements are always necessary to determine the quantity of slippage, but a camera can provide initial information that there might be a problem. CATF does not often publish videos of methane slip because the heated emissions source might concern a non-trained viewer.



MND gas compressor station in southern Czech Republic (May 10, 2021)

sites: four gas storage fields and two transmission compressor stations. The largest apparent emissions sources we detected were located at the underground gas storage facility, PZP Uhrice owned by MND. At this site, we detected six emissions sources: two main flares that were unlit and venting, a compressor station vent pipe, a tank at the well storage site, and two large storage tanks. At the MND-owned Damborice plant, we detected significant continuous venting from one storage tank and smaller amounts of intermittent venting from another tank. At the storage facility in Dolní Bojanovice, two unlit flares were venting significant emissions.

France

France is Europe's second largest consumer of energy, behind Germany. Even though its energy mix is dominated by nuclear power, France is still among the EU's largest gas consumers and importers, with total consumption of gas in 2020 amounting to about 40 bcm per year.[22] France has significant gas infrastructure in the midstream sector to support the transmission of gas into and around the country. In 2022 GRTgaz, France's main transmission operator, had 26 compressor stations, seven interconnection terminals, and four LNG regasification terminals.[23]

In August 2021, we visited four sites, and found emissions at three of the sites, with results from one of the sites being inconclusive. These sites included two compressor stations, the LNG regasification terminal in Dunkirk, and an LNG refuelling station.

At both compressor stations we visited, we found moderately sized venting from the emergency blowout stacks. At the compressor station in the Region Nord-Est, we observed emissions releases from two sets of emergency relief vents. Emissions were continuous and substantial at the compressor station in Pitgam we found two sources of emissions: venting from the emergency relief stacks and a small leak from a pressure relief valve.

We also visited an LNG refuelling station operated by V-GAS/Proviridis outside the city of Lens. At this site, we observed small but continuous emissions from the vent stack on the LNG storage tank. Given the amount of gas infrastructure in France, additional work looking at emissions in the gas sector would be advisable.

CATF organized a second fieldwork in France early 2022. In addition to the two compressor stations visited during our previous trip, we traveled to eight other compressor stations operated by GRTgaz and found emissions at four of them (les Voisines, Bourgogne Auvergne, la Begude de Mazenc, Courthezon). These compressor stations were using highly polluting venting techniques from their emergency blowout vents and other vent stacks.

We also visited several oil wells and storage facilities in the historical producing regions of Alsace and Île-de-France and found emissions at six of them, all emitting gas from their storage and separator tanks.

Geopetrol oil well in France (January 24, 2022)

22 https://www.statista.com/statistics/703653/natural-gas-consumption-france/

23 GRTgaz, https://www.grtgaz.com/sites/default/files/2021-03/Essentiel-plaquette-institutionnelle-EN-2019.pdf

Germany

Germany is one the world's largest importers of natural gas. In 2020, the country imported 102 billion cubic meters, almost one quarter of all the gas imported into the EU. A large percent of this gas comes from Norway and the Netherlands after significantly reducing imports from Russia. Germany has the largest underground gas storage supplies in Europe and more than 30 transmission compressor stations along its pipeline network. Germany has also historically produced oil and natural gas for domestic consumption (both offshore and in Lower Saxony), but both industries have been steadily declining for the last two decades.

CATF visited compressor stations, a few underground storage sites, some oil and gas wells, gas processing facilities, and oil refineries. In February-June 2021, CATF visited 33 sites in Germany and found emissions at 16 of them. Some of these sites we have visited on multiple occasions. We observed emissions from vents on compressor station buildings, methane slip from gas turbine units, leaks in the piping network, and venting from emergency blowout stacks.

On several occasions, we visited the Gascade Mallnow compressor station near the German-Polish border, connecting the two sections of the Yamal- Europe pipeline connecting Russia to the Germany. We found several sources of methane, most prominently, the emergency blowout stack released a continuous stream of gas following numerous visits spanning February, April, June (2021), and again in March 2023. CATF detected methane emissions from emergency blowout stacks at other compressor stations across the country. At two compressor stations (Siedenburg Ost and Erdölwerk Barenburg) substantial emissions from methane slip, the first coming from three compressor units, and in the latter through three hot exhaust pipes.

In November and December 2022, CATF traveled twice to Hamburg to investigate methane emissions at the Neptune Energy oil gathering and processing facility. We identified four sources of significant emissions coming from storage tank roofs as well as large venting of gas from an annex across the road. In February 2023, CATF traveled to the oil field of Landau an der Pfalz, operated by ONEO, in Rhineland-Palatinate and found three cases of casing gas venting from piping next to the wellheads.

Greece

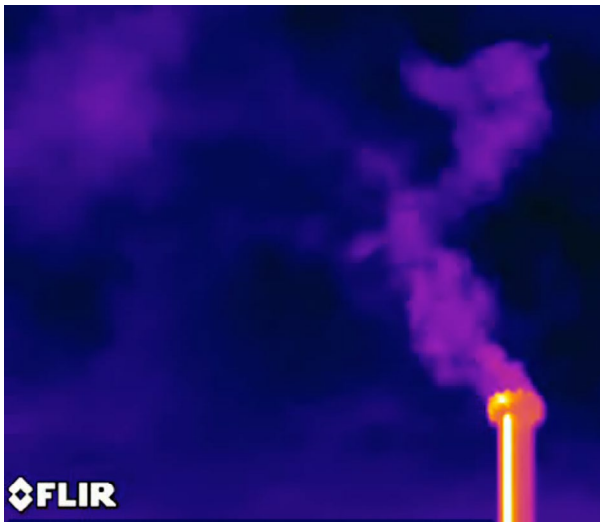
Except in the Prinos and Epsilon offshore oil fields, Greece is not a production country. Yet, the country plays a significant role in the Southeastern Europe gas network by connecting producing countries in the Caucasus and Eastern Mediterranean with Italy and the Central and Eastern European market. For this reason, CATF visited sites in the midstream sector, between Athens and Thessaloniki where the main gas pipeline is situated. It ranges from Revithoussa, Greece main LNG terminal to Thessaloniki where it is interconnected with the Bulgarian network through the newly operational Interconnector Greece-Bulgaria and Trans Adriatic Pipeline.

CATF focused its survey on transmission facilities operated by DESFA. Regulation and metering stations are the most common infrastructure along a pipeline, placed periodically along. They participate in monitoring the gas flow, work as gateways, either to allow freely gas to flow or stop it among certain section of pipe, for example during maintenance operations.

DESFA regulation station in Ano Liosa, in the suburb of Athens (March 14, 2023)

Out of the 12 gas transmission facilities (metering and regulation stations and the Compressor Station of Nea Mesimvria), CATF documented emissions at 8 of them. The largest apparent emissions sources we detected were located at the Compressor Station of Nea Mesimvria. Despite being a new infrastructure operational since 2020, we detected significant and continuous leaks from malfunctioning equipment.

In March 2023, CATF surveyed two city gate stations in Athens, and identified emissions from venting. One of the stations was located at the core of the Gazi entertainment district, in the city center. CATF also documented large emissions from vent stacks at the regulation station operated by DESFA in Ano Liosa.



MOL processing facility in southern Hungary (May 15, 2021)

Hungary

In March 2021, Hungary announced that it intends to bring its coal phaseout forward by five years to 2025, and replace its 884MW lignite-fired Matra power plant with low-carbon energy generation technologies. The plan is to be achieved primarily with renewables, but Hungary also sees a role for gas in its energy transition. Fossil gas generates about a third of Hungary's primary energy supply, with a similar percentage for oil products. The country plans to begin importing more gas from a planned LNG terminal in Krk, Croatia.[24]

In May 2021, CATF visited nine sites in Hungary, and detected methane emissions from eight of them. At these sites we mainly found emissions coming from malfunctioning valves and emergency blowout vents. The highest apparent volumes were observed at two oil and gas gathering facilities: Szank 4 Gyüjtöállomäs, owned by MOL,) and SZBT-3, owned by Hexum Földgäz Zrt. In the former, we observed considerable venting to release pressure within three oil and gas separators, while in SZBT-3 we observed continuous emissions from the central relief vent. We also detected venting from numerous large storage tanks at one of Hungary's refineries (Mol Nyrt. KTD Algyoi Gáztechnológia, owned by MOL) and leaks in Gyüjtöállomäs 3, a gas processing station, through valves and a rusted hole.

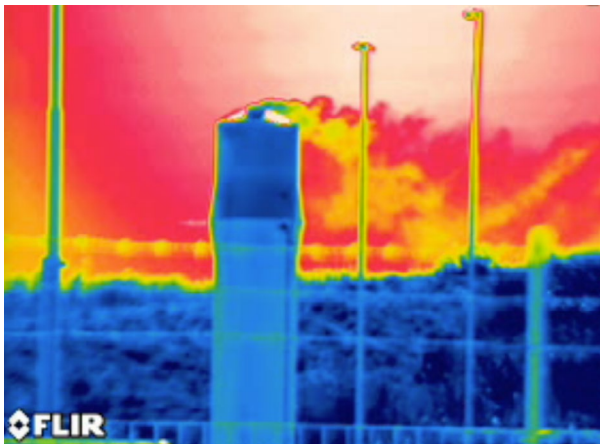
Italy

Italy is the second largest consumer of fossil gas in Europe and one of the top gas importers in the world. As such, it has an extensive pipeline network and several gas interconnections with neighbouring countries in the EU and North Africa. In the last two decades, it has increased its gas storage capacity to stabilize availability and access. The country is also home to three LNG terminals – Adriatic LNG in Rovigo, Panigaglia, and Toscana in Livorno – and has a declining oil and gas production industry.

In a series of trips made in April and August 2021, CATF visited 46 sites and detected emissions at 35 sites. The sites ranged from oil and gas wells, gathering facilities, processing stations, compressor stations, and underground gas storage facilities.

We visited the Snam-GNL Panigaglia LNG terminal five times. The first time, in April 2021, we saw two emergency relief vents releasing a continuous stream of methane, and in subsequent visits over the next two weeks they continued to vent. Four months later, in August, we returned to the site and again observed emissions from those two stacks.

Over the two trips to Italy, we visited eight of the nine gas storage facilities operated by Snam-Stogit, and found emissions at all the sites we visited. One of the largest sources of emissions were detected at the storage sites in Minerbio, where we documented a significant emissions event from the emergency blowout stack. When we returned to the site in August, we observed ten sources of



Greenstream Interconnector, Gela, Sicily (October 11, 2022)

[24] https://seenews.com/news/shell-to-supply-gas-to-hungary-via-croatias-krk-lng-terminal-712667

emissions at this site. At every storage site, we observed some emissions from the emergency vent stacks. We also observed many smaller sources of emissions across all the facilities. At the gas storage facility in Cortemaggiore, we found at least nine sources of methane emissions, including continuous emissions from the central relief stack, several metering units that were malfunctioning, and emissions from a smaller vent relief stack.

In October 2022, CATF went to the regions of Sicily and Basilicata to investigate upstream and midstream oil and gas infrastructures in Southern Italy. CATF visited 10 transmission sites operated by SNAM, Italgas and by Greenstream BV and found emissions at each of them. Leaky and faulty equipment, as well as poor operations and maintenance practices were widespread. We identified 54 leaks at various regulation and metering stations: nine leaks at the regulation station of Gela, Sicily, nine at Pisticci, Basilicata, nine at Moliterno, Basilicata, including a ruptured pipeline. On average, CATF documented seven sources of emissions at sites.

On October 11th, 2022, CATF visited the Greenstream interconnector in Gela, operated by Eni-NOC, and found a very significant venting event from a vent stack. The gas emissions were so significant that it made the identification of leaks and other venting events harder. We also documented nine leaks at the facility coming from various pipes, valves, and connectors.

In February 2023, CATF traveled again to the compressor station of Melizzano, Campania and found similar emissions as already observed in September 2021. In addition, seven other vents were releasing continuously gas and 23 leaks were identified from piping, valves, metering boxes and other equipment. In just three sites visited (Melizzano compressor station, an adjacent regulation station, and the regulation station of Maddaloni), CATF documented 69 sources of emissions, including 11 vents and 48 leaks.

Netherlands

The Netherlands has traditionally been among Europe's largest gas producers and exporters, but production has been in steady decline since 2013, falling by 55% in five years.[25] Gas production in the Netherlands will continue to decline once the country shuts down the Groningen gas field, one of the largest in the world, in mid-2022. As of 2018, natural gas provided 42 percent of Netherland's primary energy supply, and the country is becoming increasingly reliant on imports.[26]

In February and August 2021, CATF visited 18 sites in the Netherlands and found methane emissions at 13 of them. We visited gas wells, storage facilities, LNG refuelling stations, compressor stations, and metering stations.

We did not detect any methane emissions released from three inactive gas wells we visited in Groningen, but at the gas storage facility in Norg, we found two underground storage wells, NOR-41 and NOR-43, leaking a small amount of gas. We also saw methane emissions from the thermal combustors at the site, which appeared to be turned off at the time.

We also visited several locations around the Port of Rotterdam. At one site, we observed a large oil storage tank with a floating roof releasing significant quantities of emissions, most likely non-methane volatile organic compounds. At another site, we observed small emissions from an unlit flare and the pressure release valve of one of the condensate tanks. We also observed significant venting of (presumably mostly non-methane) hydrocarbons from a crude oil tanker as it left the docks.

Poland

Poland's energy mix is mostly driven by coal, and it has nominal oil and natural gas production. Coal contributes almost 70% of the country's energy supply,[27] but this will change as Poland decarbonizes, according to its 2040 Energy Strategy.[28] Poland was previously a conduit for the transmission of Russian gas to Germany through the Yamal pipeline and hosted multiple natural gas facilities to maintain this flow of gas. After Russia halted supply

[25] https://iea.blob.core.windows.net/assets/93f03b36-64a9-4366-9d5f-0261d73d68b3/The_Netherlands_2020_Energy_Policy_Review.pdf

[26] https://www.iea.org/reports/the-netherlands-2020

[27] https://www.forum-energii.eu/en/analizy/transformacja-2021

[28] https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/poland-adopts-2040-energy-policy-plans-to-cut-coal-share-to-56-by-2030-62459745

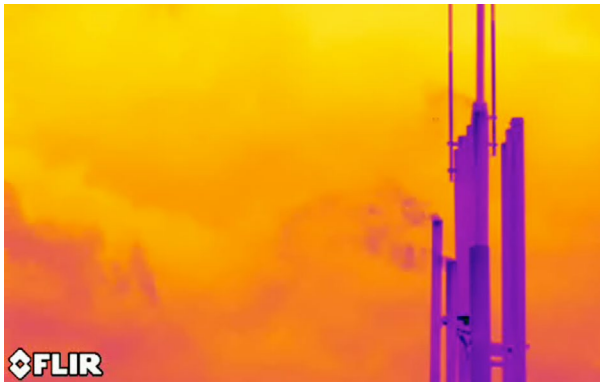
of natural gas to Poland in 2022, the country began importing natural gas as LNG from United States and Qatar via the Swinoujscie LNG terminal with plans to further expand storage and receiving capacity.

In April 2021, CATF visited two gas facilities – the Swinoujscie LNG terminal owned by Gaz-System and the compressor station Tłocznia Gazu Szamotuły owned by EuRoPol Gaz – and detected methane emissions at both sites. At the Swinoujscie facility, we detected emissions from the emergency vent stack, although the amount of gas being released when we were present appeared to be small. Given the size of the facility, we were not able to get close enough to any other equipment. At the compressor station in Szamotuly, owned by EuRoPol Gaz, we found continuous emissions from several emergency relief vents.

Romania

Romania is among the few remaining EU member states with considerable, active oil and gas production sites–and its fossil gas consumption has steadily increased in recent years to become the country's main energy source.[29] Most of Romania's oil fields are located in the southern part of the country, a few hours outside of Bucharest, and some are located close to population areas. In 2017, Romania was estimated to have 13,000 active wells spread across 400 oil fields.

CATF visited Romania twice: from May 16-18, 2021, and for two weeks in June 2021. In total, CATF visited 52 sites–including oil and gas wells, oil storage facilities, compressor stations, gathering facilities, and processing plants–and documented methane emissions at 50 of them. Most of the sites visited were owned by OMV Petrom.



Transgaz compressor station in Sinca, Romania (May 18, 2021)

We observed many open hatches on production tanks allowing methane and other hydrocarbons into the air, vents from separator tanks, and leaking wellheads. The largest point sources of emissions were emergency vent stacks at both processing stations and compressor stations.

At some oil storage facilities, we saw high volumes of methane and other volatile organic compounds being released. For instance, in Barbaresti, we detected large volumes of emissions from three pressure relief valves on top of one large storage tank, which were visible at a distance of about 100 meters. At that distance, the detection limits of the camera increases and therefore the size of the emissions source must be large in order to visualise. We also found several gathering and processing plants venting. At Otesti, for instance, we found four storage tanks emitting: one tank had a large, rusted hole at the top of it, and another tank had rusted holes where the roof joined the side of the tank, which was releasing emissions.

We also detected significant emissions from oil and gas wells.[30] For instance, at Videle, six wells were leaking methane gas and other volatile organic compounds: five of the wells were turned on and pumping, and the sixth was leaking gas despite not being in operation. On another day, we drove around the Schilista oil field for three hours looking at well sites. Out of 16 wells we inspected on that site, methane and other gases were leaking from 15.

In May 2022, CATF traveled again to Romania and found emissions at 14 sites comprising oil production and gas storage and transmission, out of 20 visited. At the nine oil wells, gathering and processing facilities operated by Petrom, we observed highly polluting casing gas venting, from the wellheads, tanks or a vent by the wells. We also monitored emissions at the compressor station of Boldesti where we observed, among other leaks and venting events, gas coming from the ground. The most likely scenario is a ruptured pipeline under the road.

[29] https://www.euractiv.com/section/energy/news/romania-will-phase-out-coal-by-2032/

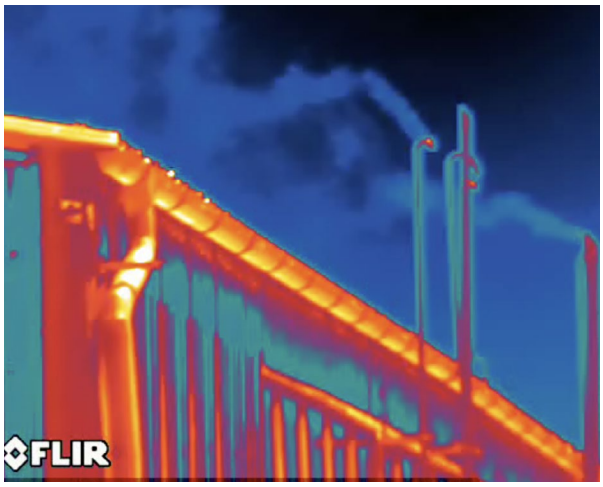
[30] We typically try to inspect well sites in clusters, but we define one site as a cluster of wells based on the area we are surveying. One wellsite, in our records, could be a small group of wells (for example, 2-3 oil wells) or a larger group of 10-15 wells. We keep track of how many wells were inspected within each cluster.

Slovakia

While Slovakia is another EU member state with a large nuclear fleet, accounting for almost 50% of its power mix, the country was previously also an important transitway for Russian gas to the rest of the EU. Therefore, it has a large gas network which includes interconnections and reverse flows from the Czech Republic and Austria, a pipeline connecting with Ukraine, and an interconnection between Slovakia and Hungary. Another interconnection between Poland and Slovakia was recently built to gain infrastructural access to gas sources in bordering regions.

In July 2021, CATF visited five sites, and found emissions at three of the sites: a gas processing plant, and two oil and gas gathering stations. At the Zberné Stredisko - Gajary Báden processing plant, we found methane emissions from four compressor station vent pipes and two separator tanks. At the nearby gathering facility of Zberné Naftivé Stredisko, we also found four sources of emissions: an open tank hatch, a vent pipe from the compressor station, and pressure relief valves from two separators.

Early 2022, CATF traveled along the national transmission pipeline system operated by EUstream. At the compressor stations of Kapusany, Zlievce, Laksarka Nova Ves and Ivankapro Nitre, CATF found significant venting events, either from the emergency blowout vents, metering building vents, and others. In addition, other sources of emissions from valves and piping were leaking gas into the air.



Nafta gas compressor station in Slovakia (July 6, 2021)

Oil well n°4, Ayoluengo, Spain (July 6, 2022)

Spain

Spain is set to play a growing role in connecting Europe to new sources of imported energy as the EU looks to reduce its dependency on Russian oil and gas. The REPowerEU communication of the European Commission (May 2022) highlights Spain as one of the main recipients of LNG and crude oil via both the Mediterranean Sea and the Atlantic Ocean. Spain has six LNG storage terminals, representing just over 35% of the current capacity in the European Union and United Kingdom. Spain also leads Europe in regassification facilities needed to convert LNG into gas used in the energy grid, with 27% of the bloc's overall capacity. Thus, the prevalence of methane emissions in the Iberian Peninsula is an important part of CATF's campaign to document the need for a comprehensive Europe-wide legislation to tackle methane pollution at every level of the supply chain, from LNG terminals and pipeline interconnectors to distribution.

CATF visited nine transmission sites operated by Enagas and found emissions at five of them. At the transmission center of Durango, CATF documented methane emissions from venting. At the transmission centers and metering stations of Cantabria, Vitoria-Gasteiz, Asturias, and Miranda de Ebro, CATF found leaks, some emitting significant amounts of gas.

We also detected emissions from inactive oil wells in the valley of Ayoluengo, the only onshore oil field in the Iberian peninsula. While the historical oil valley was repurposed into an industrial heritage site, some oil wells were still leaking gas into the atmosphere and were not sealed.

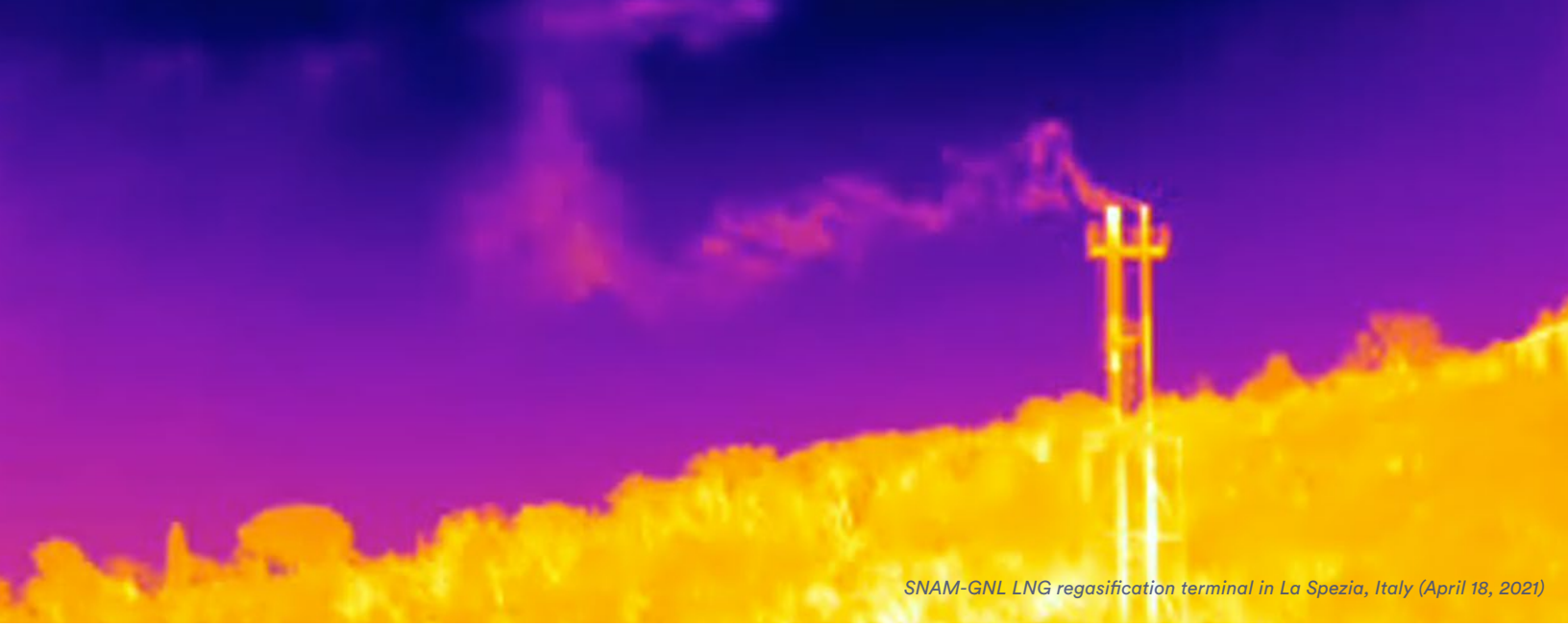
LNG Sites Around Europe

CATF has visited several different types of LNG sites in Europe. These sites were explained in individual country sections, but additional attention should be paid to them given the unique nature of the infrastructure and the continuing growth of LNG supply to Europe. In total, we visited five LNG regassification terminals (across five countries) and eight LNG refueling stations (across four countries). LNG regassification terminals are large facilities that receive shipments of LNG from production countries, such as the Algeria, Norway, Qatar, and the United States, among other countries. Regassification terminals have a variety of infrastructure that may include compressor stations, large LNG storage tanks, LNG refueling stations, and direct connections to the country's gas transmission grid. Given the size of these facilities, it is difficult to measure emissions using the camera outside of the site's property.

We found emissions from two LNG regassification terminals, SNAM-GNL Panagalia and Gaz-System Swinoujscie. At both facilities, we were constrained by the distance from the facilities. However, both installations had cold vent emergency relief stacks that routed the gas out of the system. We did not observe any flares at these facilities, whereas, at the three facilities where our inspections proved to be inconclusive, we observed lit flare units being used to combust fugitive gas.

At the LNG refueling stations, we visited eight sites and found large emissions events from four of the sites. LNG refueling stations, as was briefly explained above, provide fuel for heavy-duty vehicles such as trucks. These are small stations with a 12,000 kilogram LNG storage tank and several fuel pumps. The use of LNG as a fuel source in the trucking industry in Europe is increasing, and so is the number of LNG-powered trucks. Several countries provide subsidies to transport companies and are providing Incentives to increase the number of stations along the highways. According to the Natural and Biogas Vehicle Association, more than 450 of these stations exist throughout Europe.[31]

[31] NGVA, "Stations map." https://www.ngva.eu/stations-map/



SNAM-GNL LNG regasification terminal in La Spezia, Italy (April 18, 2021)

SECTION 4

Key Lessons

CATF's work to survey sites and document methane emissions has made headlines the past two years in many media outlets across Europe. Public pressure on operators resulting from this campaign plays a key role in ensuring ambitious policies are delivered.

First, CATF's findings highlight the fact that regardless of which part of the oil and gas system we look at, or where we look, methane emissions are everywhere. Given that methane leaks are widespread across the value chain, standardising practices to detect and repair them would be a simple and cost-effective solution that would substantially contribute to the mitigation of methane emissions across the EU.

Second, public statements from oil and gas companies do not always match up to observed emission types. In responses to EU public consultations on the EU Methane Strategy released in 2020 and on upcoming plans to put forward legislation on energy-related methane emissions, several European oil and gas companies have made ambitious commitments to reduce methane emissions, but the rhetoric does not match action on the ground.

For instance, Italy's Snam has claimed in several statements and policy submissions that it has successfully worked for many years to reduce methane emissions through voluntary programs and remains strongly committed to minimising methane emissions.

The company said it is implementing an LDAR program for its transmission systems, underground gas storage, and its Panigaglia LNG terminal. But observations at 32 of Snam's installations – including three trips over a two- week period to the Panigaglia terminal, showed emissions coming from 26 of them. In statements to media, Snam said these emissions were due to the temporary mechanical failure of an air compressor and that they were confident about fixing it during the second half of 2021. In eight of the installations, we detected over 10 different sources of emissions, and two with over 20. During two distant trips to the Melizzano compressor station (September 2021 and February 2023), we identified methane emissions at the very same equipment.

In turn, several other energy companies have said in statements to media that the majority of these leaks are unavoidable and needed to avoid pressure building up

on storage plants. Most of the companies interviewed by reporters writing about CATF's infrared footage said that they were aware of the leaks, and many added that these emissions were linked to ongoing repairs.

Although many major oil and gas operators are members of initiatives such as the OGMP 2.0, no company currently has a legal obligation to report methane emissions. Therefore, these companies can set up ambitious targets and self-report with no monitoring or verification of these emissions. This proves that a binding, EU-wide system to monitor, report, and verify emissions from companies across the bloc is a necessary step to address the issue at EU level.

Moreover, several EU oil and gas companies seem to be perpetuating the idea that it is the big global oil and gas exporters who should be paying more attention to methane emissions. In policy submissions to influence the EU Methane Strategy released in October 2020,[32] as well as upcoming rules to tackle energy-related methane emissions,[33] many of the EU's main oil and gas operators highlighted the need to set global standards and put pressure on exporters, rather than toughening compulsory measures. Many of these companies claim the need for voluntary measures and flexibility when implementing some of the proposals the European Commission is considering, such as compulsory MRV systems and a potential ban on routine venting. What we have documented corresponds to just a fraction of the entire emissions from the EU oil and gas sector, and it highlights that many sites across the EU are not following industry best practices.[34] Poor maintenance, the high number of leaking facilities, as well as the often-lackadaisical response from operating companies further reinforces the fact that sectoral self-regulation for methane emissions will not solve this problem.

Finally, the prevalence of venting shows that **we need legislation banning intentional venting and flaring**, except in the event of an emergency. The European Commission said that it would consider such legislation (see *Policy Context* above), and the results from our surveys suggest this is a key pathway to reducing emissions within the next decade. The EU could take inspiration from Norway's ban on venting and flaring, which requires polluters to pay a tax on flaring, to adopt a plan to capture excess and associated gas, to obtain permits to flare, and to report all flared gas on a monthly basis and in public reports (see *Policy recommendations*, for a more detailed explanation on how such a ban could work).

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32 European Commission. (2020b). *Have your say: EU methane strategy.* https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12504-EU-methane-strategy_en

33 European Commission. (2020c). Have your say: *Climate change – new rules to prevent methane leakage in the energy sector.* https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12581-Climate-change-new-rules-to-prevent-methane-leakage-in-the-energy-sector_en

34 IEA (2020), 'Methane Abatement Options,' Methane Tracker 2020, IEA, Paris https://www.iea.org/reports/methane-tracker-2020

SECTION 5

Policy Recommendations

The European Commission's proposal for an EU Methane Regulation in the energy sector is currently under its final discussions. Without an ambitious toolbox to tackle methane emissions, Europe will fall short of its climate commitments. Moreover, as the Commission's own 2020 Methane Strategy mentions, several of the improvements that the oil and gas sector need to implement come at near-zero cost. Since 2021, CATF has been supporting five key policy recommendations based on the findings of our #CutMethaneEU campaign.

A comprehensive Leak Detection and Repair (LDAR) Program

Methane leaks are frequently unpredictable, and the only way to address them is with efficient and robust LDAR requirements. Establishing an LDAR program at the EU level is a first step that would take little time to implement and would be extremely cost-effective.

During our trips we have seen a clear mismatch between rhetoric and action, and therefore strict deadlines to enact these programmes will be crucial.

The EU could implement new LDAR requirements in under two years, as it wouldn't need any data monitoring or new technology. CATF recommends that EU LDAR legislation covers both fugitive emissions and excessive venting from equipment designed to vent gas, including pneumatic controllers, compressor seals, and storage tanks. Detection is based on the same methods and tools CATF uses to record methane emissions.

Efficient EU LDAR legislation would make monthly or quarterly instrument-based leak detection mandatory or push for continuous monitoring with advanced technologies. Based on U.S. EPA data, emissions from leaks can be cut by about 90% with monthly inspections or 80% with quarterly inspections.

Once leaks are detected, legislation should make it mandatory to repair it within a strict timeline: within five days for most leaks, or for critical infrastructure that would require a shutdown to repair, at the next scheduled shutdown. The leaks should then be re-surveyed to check if the repair was successful.

A ban on routine venting and flaring

Throughout the #CutMethaneEU campaign, we have observed that a significant share of the total sources of emissions came from routine venting and flaring. The European Commission proposal for a Methane Regulation and the Parliament compromise include measures to eliminate routine flaring and venting. This is an urgent measure that would drastically reduce methane emissions and improve air quality.

A ban on routine venting and flaring should have defined exceptions, as in the Commission's proposal, for safety reasons, emergency, or circumstances where capture for sale or reinjection would not be technically possible or would be extraordinarily costly. Also, in all circumstances where the only options are either to vent or flare, operators should be required to flare rather than vent.

The ban should cover oil and gas wells, large purposeful releases, and equipment that vents by design. Existing venting equipment should be progressively replaced with zero-emitting alternatives, with clear requirements and timelines, and new facilities should be required to install zero-emitting equipment, when appropriate.

In Norway, for instance, its ban on venting and flaring requires polluters to pay a tax on flaring, to adopt a plan to capture excess and associated gas, to obtain permits to flare, and to report all flared gas on a monthly basis and in public reports.

An obligation to monitor, report, and verify emissions

The EU has a solid and robust monitoring, reporting, and verification (MRV) system to account for CO_2 emissions, but there is no such system for methane emissions at EU levels. CATF strongly welcomes the proposal for a Regulation on methane emissions reduction in the energy sector, which addresses MRV, based on the methodology used by the Oil and Gas Methane Partnership (OGMP 2.0).

CATF recommends the following measures to make the system accurate, robust, and designed for achieving the EU's methane reduction objectives:

On measurement

Based on the current frameworks available as well as on existing jurisdictions already verifying methane emissions – such as the Canadian federal and provincial regulations, U.S. state and federal regulations, Norwegian regulations, and Mexican regulations – **CATF recommends a gradual two-step approach:**

1. First, the EU should implement emissions monitoring that relies on a comprehensive equipment survey, granular reports, and application of the most up-to-date emission factors on the whole EU oil and gas supply chain. This could be achieved at limited costs and with the scientific tools and methods already available, and therefore it should be enforced as soon as possible and no later than 6 months after the adoption of the MRV legislation.
2. Second, the EU must make measurement data in emissions monitoring compulsory. With the rapid development of methodologies and technologies, emissions measurement at facility level, using satellite, aerial, and ground-based technologies, should be implemented within two years.

On reporting

The ultimate objective of measuring methane emissions is to ensure that we have detailed and accurate data, and that information is made publicly available. Without accurate reporting, measures to reduce methane emissions will not contribute to the EU's wider climate goals.

Reporting should include detailed emissions information and not just overall aggregate emissions at the country or asset level. Granular data is critical for assessing accurate emissions, mitigation measures, and to ensure third-party verification. To ensure transparency, and inform interested parties, the data should be made available to the public.

On verification

Third-party verification will be needed on emissions from fossil gas in the EU. Independent verification should ensure the reported emissions match the emissions measured, that the reporting method is accurate, and that the measurement data are based on an accurate methodology. When satellite data becomes available both regulators and third parties should incorporate that data into their assessments of emissions and compliance by reconciling satellite data with ground-based measurements, reporting, and emissions estimates.

Tough Import Standards from Production Regions Outside the EU

As the world's largest fossil fuel importer, the EU can leverage its position to require third-party countries – most notably, the world's main oil and gas exporters – to enact tough methane standards.

Requirements on imports could significantly contribute to emission reductions and could help spread methane mitigation around the globe, increasing the impact of European action and reflecting the EU's commitment to promoting strong environmental policies internationally. As the largest importer of fossil fuels in the world, the EU is in a unique position to lead on methane requirements on fossil fuels and to help ensure global methane mitigation.

Dealing with Abandoned and Unused Oil and Gas Wells

With an oil and gas industry dating back to the 1850s, the EU needs to pay close attention to its abandoned gas wells, which can be significant sources of methane, even when nominally plugged.

Wells that have been improperly plugged have been found emitting continuous streams of methane. The issue of abandoned and inadequately plugged wells is complicated by the difficulty in identifying which companies own them or were responsible for them. In some cases, due to the way these wells were decommissioned, no owner can be identified and held accountable for the emissions and the measures needed to properly remediate them.

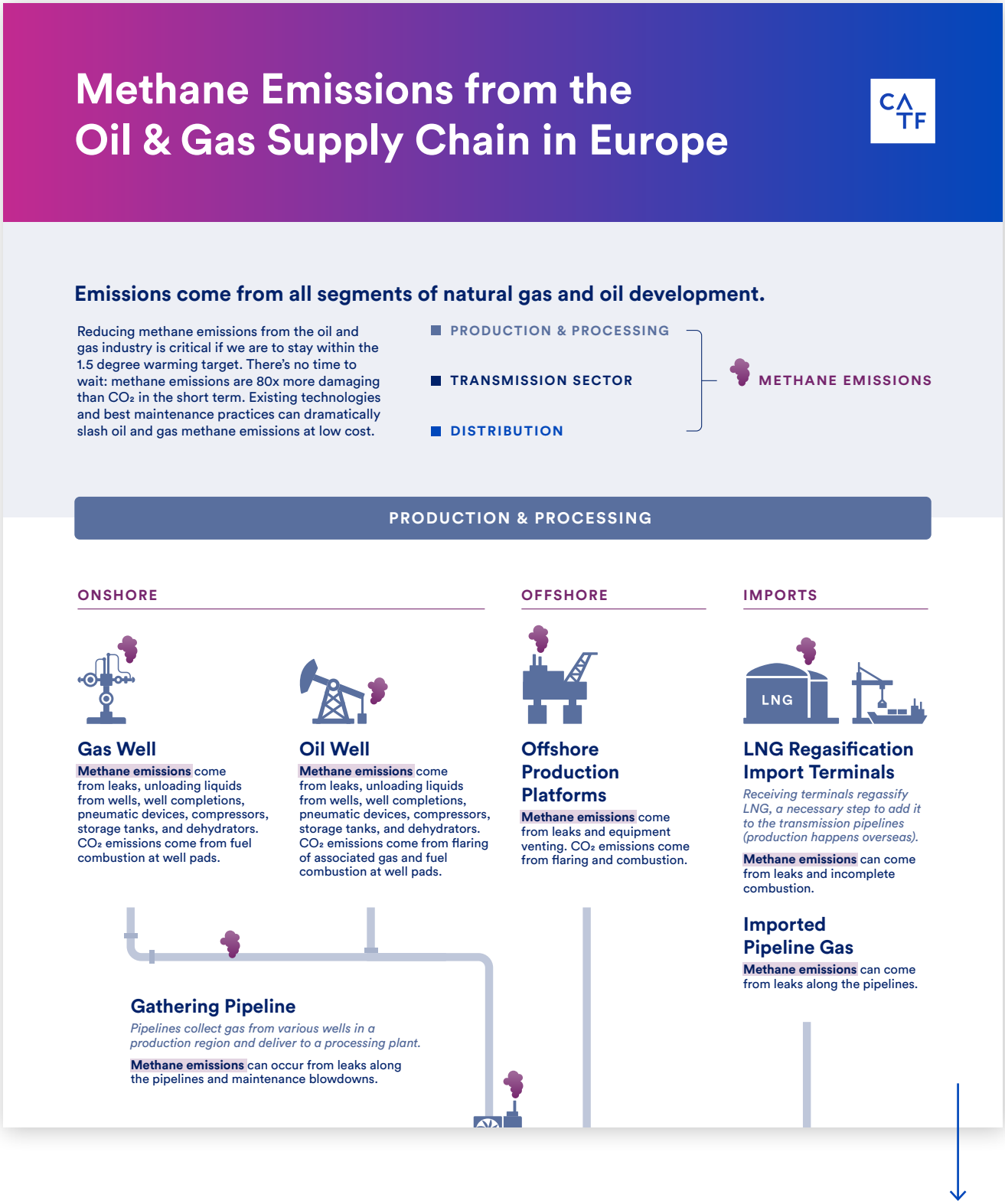
The EU should establish a separate program on methane mitigation for abandoned wells to ensure these wells are found, registered, properly plugged, and remediated. Such a program could lead to substantial reductions in methane emissions from abandoned wells as well as employment opportunities. For this programme, the Commission should provide funding for the identification, monitoring, and proper plugging and abandonment of wells without legal ownership. A public dataset with the information of these wells should be made available. Lastly, proper signalization and buffer zone rules should be put in place.

As a potential precedent, the Canadian federal government is dedicating $1.7 billion (Canadian) to help clean up abandoned and orphaned wells and to provide employment as part of the COVID-19 economic recovery efforts.

Appendix

Methan Emissions Supply Chain in Europe Infographic

View the full suppy chain here.



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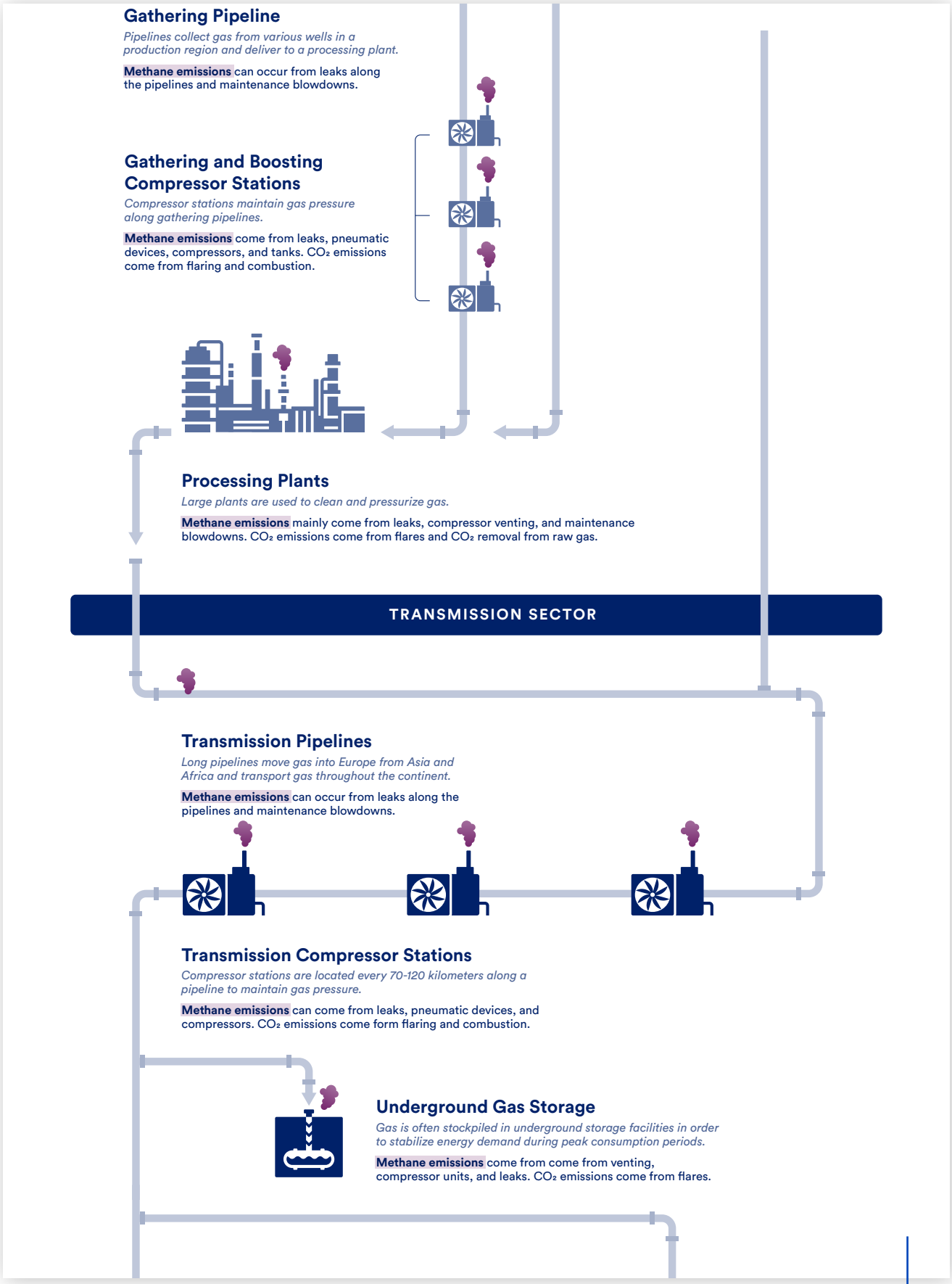

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