Methane action at National Oil Companies:

An opportunity for deep cuts in global methane emissions



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CARBON LIMITS

This research was prepared on behalf of the **Environmental Defense Fund.**

About Carbon Limits

Carbon Limits works with public authorities, private companies, finance institutions and non-governmental organizations to reduce emissions of greenhouse gases from a range of sectors. Projects in the oil and gas sector of developing countries and transition economies are important with emphasis on identification and development of greenhouse gas (GHG) abatement opportunities projects and the monitoring, reporting and verification (MRV) systems needed to ensure that emissions and emission reductions are adequately quantified and reported.

Carbon Limits has actively worked on issues related to methane emission management with many national oil and gas companies and governments in three continents.

Methodology

For the development of this study, an initial review of available international databases regarding National Oil Companies (NOCs) was carried out, including publications from the World Bank, the International Energy Agency and the Natural Resource Governance Institute. The majority of insights are informed by a series of workshops and interviews with over 20 internal Carbon Limits experts and external industry stakeholders. In total, these experts have worked on oil and gas methane emission mitigation in close to 30 National Oil Company (NOC) countries, including all of the 15 NOC countries with the highest methane emission levels. The results of such activities were assessed and organized for the purpose of this paper.

Lead Authors

Stephanie Saunier, Managing Director
Torleif Haugland, Senior Partner

Note
This paper does not necessarily reflect the participants' views and opinions provided during their interviews, nor show the official policy or position of the organization/company they represent.

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Executive Summary

In the first two decades after its release, methane is 84 times more potent than carbon dioxide, making methane action an urgent and time sensitive area for climate action. Alongside CO2 emissions, global methane emissions pose a significant challenge to the oil and gas industry and to the role of natural gas in a decarbonizing energy transition. Despite being one of the largest sources of methane emissions, the oil and gas sector has ample cost-efficient opportunities to deeply reduce methane emissions in the near term. As the largest producers of oil and gas globally, NOCs are critical stakeholders to achieve deep cuts in global methane emissions. However, most NOCs, with a few exceptions, have not yet started or are early in the process of developing robust methane management programs. NOCs' critical importance to future methane emission reduction comes from two facts:

This paper examines the essential role of NOCs to accelerate methane reduction, addresses current challenges and offers potential solutions for governments, members of industry, civil society and the financial sector to motivate NOC action on methane management.

NOCs' critical importance to future methane emission reduction comes from two facts:

- Countries where NOCs dominate account for 75% of all oil and gas sector methane emissions, representing a large share of emissions that can be eliminated profitably or at low cost.
- NOCs have close ties with government institutions in their home countries and are typically actively involved in decisions on the broader direction of oil and gas sector policies. They are key implementing institutions of policy objectives and targets, including measures to address climate change.

NOCs are a heterogenous group, covering a broad range of corporate structures, governance models, and national commercial and social mandates. This diversity must be carefully considered when proposing a set of actions for active NOC methane management. A strategic methane roadmap, attuned to national circumstances, should be informed by a thorough understanding of the local situation. Understanding the current barriers to action and the potential solutions to address these barriers can help drive progress on NOC methane management. Three types of barriers and solutions are highlighted:

- Limited awareness of, and focus on, methane emission. As an invisible and odorless gas, methane has historically been difficult to detect and quantify. Consequently, there is often a limited awareness of the scale and scope of a company's methane emissions at the political, executive and operational level. Technological progress opens new opportunities for improved monitoring and quantification in order to build company knowledge and further management prioritization on methane reduction efforts.
- Legal and structural issues. Existing structural processes, such as existing joint venture contracts and regulations, can inhibit effective methane management and discourage transparency and mitigation. NOCs can support government-led reforms to remove these barriers. A common understanding among NOC senior management and government institutions on the need for robust methane reductions can greatly facilitate reform processes.
- Challenging economic incentive. Despite global abatement studies indicating significant opportunity for no net cost mitigation in NOC countries, the economics of local methane mitigation efforts may not

always be favorable enough to trigger action from a corporate perspective due to the small scale of individual projects, low local gas prices and demand constraints. Nevertheless, methane emission mitigation is often still one of the most cost-efficient options to reduce GHG emissions and should be among the first options to reduce emissions.

Despite these initial challenges, there are other external drivers (co-benefits for NOCs) which together with the factors mentioned above make a strong case for NOCs to initiate broad-based methane management programs.

- International capital markets. Verified methane emission reductions and disclosure of GHG emissions from operations are increasingly viewed favorably in international capital markets and among equity investors.

- International oil and gas markets. Credible low oil and gas sector value chain emissions increasingly matter for NOCs to protect their access to key oil and gas markets (e.g., European Union).

- NOC country contributions under the Paris Agreement. NOC-led methane mitigation can significantly support their countries' contributions to the objective of the Paris Agreement. Methane emission reduction projects are particularly effective at demonstrating progress against climate goals because they are relatively inexpensive, have a short lead time (mostly less than two years) and offer near-term climate results

This should represent a strong rationale for establishing a roadmap for methane management.

While there is not one roadmap suitable for all NOCs, this report outlines key activities that are essential to building a robust methane management strategy.

1. **Measure.** Emissions detection and measurement campaigns are critical to take stock of current emissions levels and to build internal awareness and knowledge.

2. **Quantify.** Inventories at the company and national levels are essential as a basis for the design and implementation of an active and cost-efficient strategy for methane emissions management.

3. **Opportunize.** Cost/benefit assessments of mitigation actions are needed as support for identification of the highest-impact opportunities.

4. **Test.** Pilot projects will test and demonstrate economic and environmental benefits.

5. **Plan.** A comprehensive plan for methane management with prioritized action to quantify and reduce emissions.

6. **Target.** Setting targets for management is directly linked to comprehensive methane management. It aims at deep cuts in methane emissions and it is the final step of the roadmap. It must be accompanied by a robust methodology and plan for monitoring and reporting of progress.

While the activities listed above are NOC-internal, collaboration with other institutions can greatly enhance the effectiveness and endurance of a NOCs' methane management system. When methane is established as a company and national priority, there are often favourable conditions for forceful coordinated actions with government institutions and NOCs, given their close ties. NOCs are increasingly becoming active in international methane initiatives, but there is a considerable

unexploited potential to scale-up these ties, with considerable mutual benefits to NOCs and global methane emission reduction efforts. Related to this, closer collaboration between NOCs and international oil and gas companies in NOC countries can accelerate methane measurement and best practice sharing.

Building and maintaining momentum for a robust methane management process requires constant attention from senior management in NOCs, particularly during the first phase to ensure that motivation, awareness and operational capabilities are well established at all organizational levels. Setting reduction targets and establishing sound methods and procedures to monitor progress are essential to ensuring durable success.

As essential stakeholders in the oil and gas industry's methane challenge, NOCs should actively prioritize methane mitigation. **Based on extensive industry expertise and research, this report provides an overview of key considerations for NOCs and relevant partners as they work to mitigate methane emissions.**



1.

National Oil Companies are essential to solving the global methane challenge

Reducing methane emissions presents an important near-term opportunity to address climate change. Methane's ability to trap heat in the atmosphere is 84 times higher than CO2 over a 20-year horizon and recent research shows that human-induced methane emissions are responsible for at least one fourth of the global warming we experience today. After agriculture, the oil and gas sector is the second largest source of "manmade" methane emissions, causing as much as a quarter of total global methane emissions. Unlike agriculture, where methane abatement solutions are typically high cost, the oil and gas sector offers significant potential for near-term and cost-efficient emission reductions. With increased awareness on the severity of and opportunity to address oil and gas emissions, reducing methane emissions is a growing global priority. Engagement from and collaboration among all stakeholders — including industry, policymakers, international institutions and non-government organizations — is essential to achieve deep cuts in global methane emissions in line with the Paris Agreement.

Within industry, large international oil companies have led the way on methane mitigation by setting reduction targets and implementing best-management practices. NOCs, with a few exceptions, have given methane management less attention. Yet as stewards of over half of oil and gas production and nearly two-thirds of oil and gas reserves, NOCs are critical stakeholders in reducing global methane emissions.[2]

While data for individual NOCs is limited, according to the International Energy Agency (IEA), countries where NOCs have an important or dominant role in oil and gas operations (NOC countries) account for approximately 75% of global oil and gas methane emissions, with 66% of emissions coming from only 15 NOC countries (NOC15 countries). The IEA estimates that NOC countries have an even larger share of low-cost methane mitigation opportunities, with 83% of no net cost abatement options concentrated in NOC countries, of which 75% is concentrated in NOC15 countries.[3]

Figure 1

Share of methane emissions and abatement potential at no cost in NOC countries — IEA Methane Tracker 2020[4]



Share of methane emissions

66%
NOC 15

9%
Other NOC

25%
Non-NOC Countries



Global no net cost potential

75%
NOC 15

8%
Other NOC

17%
Non-NOC Countries

NOC15-countries
Top 15 countries with highest methane emission levels among NOC-countries: Russia, Iraq. Libya, Iran, Turkmenistan, Venezuela, China, Saudi Arabia, Algeria, Uzbekistan, Nigeria, UAE, Kuwait, Kazakhstan, Egypt

Other NOC-countries
Includes other 45 countries, most importantly: Argentina, Indonesia, Mexico, Angola, Oman, Qatar and India (combined 6% of global emissions)

Non-NOC countries
Includes the rest of the World, most importantly: US, Canada, EU (combined 19% of global emissions)

Along with being cost-effective, methane mitigation is an attractive opportunity for near-term action and results. The lead time for simple but effective methane measures, such as repairing existing or installing new equipment pieces, is typically less than two years.

Given the scale of the NOC methane opportunity and the availability of cost-effective, near-term solutions, NOCs and their home governments have a clear opportunity to drive meaningful methane reductions globally.

As discussed in Box 1 below, NOCs mostly have a dominant position in their home country, but their strategic and operational priorities, corporate structures and governance models vary widely and have evolved over time.

Consequently, the ability and motivation of NOCs to engage actively in methane management will vary. This is already evident with some NOCs, such as Equinor, Saudi Aramco and the China National Petroleum Corporation (CNPC), who are actively engaged in international methane initiatives (see Box 2). At the same time, NOCs have one thing in common: they have close ties with the government institutions in their countries, and as such they have considerable influence on the broader direction of oil and gas sector investments and operations in their home countries.



[1] IPCC fifth assessment reports, Chapter 8. https://www.ipcc.ch/report/ar5/wg1/mindex.shtml

[2] https://www.iea.org/reports/the-oil-and-gas-industry-in-energy-transitions

[3] Emissions data in this paper are from IEA Methane Tracker (https://www.iea.org/reports/methane-tracker-2020/interactive-country-and-regional-estimates) since it offers a consistent data set with the required country and supply segment breakdown. As also highlighted by the IEA, estimates in the Methane Tracker are uncertain and the data can diverge considerably from other sources.

[4] Please refer to assumptions and methodology: https://www.iea.org/reports/methane-tracker-2020

[5] Based on Carbon Limits experience, important mitigation measures are repairs of existing components such as valves and flanges, replacement and installations of equipment such as compressors and vapour recovery units. The lead time for relevant equipment is typically low and some of the measures can typically be undertaken independently and consecutively at installation without elaborate planning processes and without major disruption to production.

Box 1: Overview of National Oil Companies

A National Oil Company (NOC) is a corporation that owns and operates oil and gas sector assets and is fully or majority-owned by a national government. A database launched in 2019 by the National Resources Governance Institute (NRGI) covers information on 71 NOCs with headquarters in 61 countries (NOC countries). The database includes information on production, revenues, spending and transfers to governments. At least 25 of the 61 NOC countries are "oil-dependent," meaning that revenues from the oil and gas sector account for more than 20% of all government revenues.

Companies other than NOCs are here named in two categories: **"Majors,"** large companies with a broad international portfolio of oil and gas sector assets. The IEA counts as Majors: BP, Chevron, ExxonMobil, Shell, Total, ConocoPhillips and Eni and **"Independents,"** all other private companies which own and/or operate oil and gas sector assets.

NOCs are responsible for 55% of global oil and gas production, while the shares for Independents and Majors are 30% and 15% respectively. NOCs own an even larger share of global reserves (about 67%), which are generally "low cost" relative to Independents and Majors' reserves. This implies that NOCs' share of production will likely increase over time as their assets are increasingly cost competitive.

The majority of NOCs' oil and gas production (65%) is from operated assets — assets where the NOC has operational control. The remaining production (35%) is from non-operated assets — assets where the NOC owns an equity stake but does not have operational control. This means that NOCs have direct operational control over a significant portion of global assets, further highlighting the opportunity for NOCs to contribute to dramatic cuts in global methane emissions if methane management is implemented at the assets operated by NOCs. Curtailing methane emissions from NOCs' non-operated production will require collaboration with joint venture partners, including private companies (see Section 3).

NOCs cover a broad range of corporate structures and governance models. Most companies operate only domestically but some large NOCs have assets and operations abroad, including Gazprom, Equinor, Petronas and several Chinese NOCs. Most NOCs are 100% state-owned, but there has been a number of companies seeking private co-owners through listing at international stock exchanges. Petrobras, China Petroleum & Chemical Corporation (Sinopec), PetroChina, China National Petroleum Corporation (CNOOC), Equinor, and Oil and Natural Gas Corporation Limited (ONGC, India) were listed during the period 2000 to 2004. Saudi Aramco concluded an IPO in 2019, while KazMunayGaz's IPO originally scheduled for the same year was deferred. There has also been progress towards a clearer and more confined commercial focus for NOCs. Still, many NOCs continue to have complex mandates, including sometimes regulatory functions and other tasks which elsewhere are conducted by governmental institutions.

Some 25 NOCs are currently part of international industry associations (such as IPIECA and IOGP) and climate change-specific initiatives (see Box 2). These are increasingly focusing on methane management and as such help spur action on methane quantification, reporting and mitigation within NOCs.

Given their mixed mandates, NOCs have three arenas for contributing to active and effective methane management:

1.

Through the assets they directly operate and control.

2.

Through cooperation with private companies within the framework of Production Sharing Agreements (PSAs) and Technical Service Agreements (TSAs) and through other channels of communication and collaboration with private companies.

3.

Through influence on broader national reforms to improve the transparency and efficiency of the oil and gas sector and NOC operations, including enhancing methane management programs.

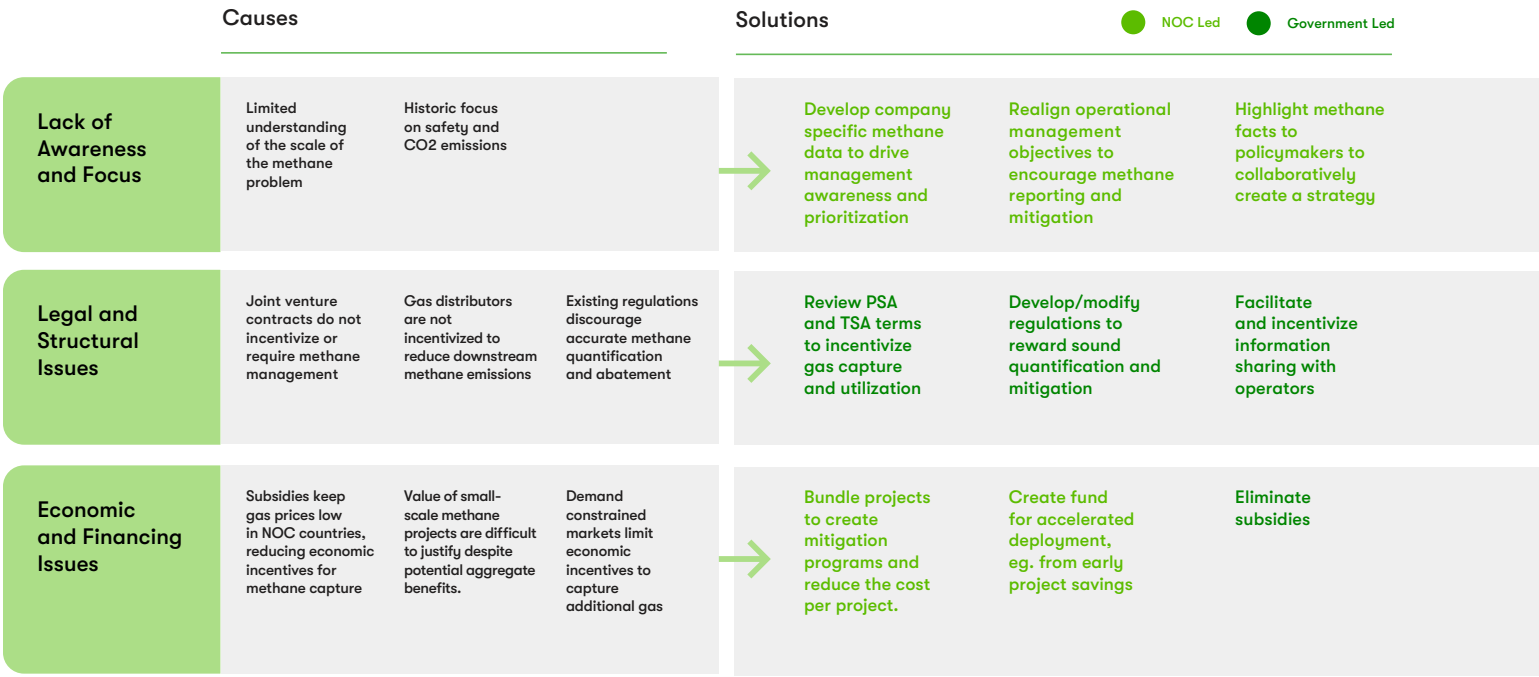
The engagement of NOCs at each of the three arenas will depend on national circumstances and their mandates. A methane management roadmap must be based on a thorough understanding of the causes of the current situation. Understanding the barriers to action with potential solutions to address these barriers can help drive progress on NOC methane management, as discussed in Section 2 below. In Section 3, drivers for action by NOCs are discussed and a roadmap, attuned to national circumstances, is suggested to accelerate NOC methane mitigation.



2.
Challenges and solutions for NOCs

The scale of seemingly profitable but unexploited methane abatement opportunities suggests that there are large challenges or barriers to action. Barriers typical of NOC and NOC countries and their causes and possible solutions are summarized in Figure 2 and further explained below. Some causes are internal to NOCs and can be corrected by NOC management, while others are more deeply rooted in legal conditions and institutional structures which require broader reform processes. Solutions are normally found through a combination of NOC internal changes and national reforms. Their impacts are more powerful if implemented in a coordinated manner.

Figure 2
Causes of, and solutions to, key barriers to methane management



a) Lack of awareness and focus:

Although companies differ greatly, most senior corporate executives recognize the importance and risks of climate change policies for NOCs' development and operations. The significance of methane as a potent GHG is less known; methane is often considered merely a potential safety hazard. As a result, only a limited number of sources of emissions which present a hazard risk are addressed. Despite its near-term climate warming impact, methane is an invisible gas that has traditionally received less attention than observable issues like gas flaring. Methane emissions are often inadequately monitored and quantified, leading to an underreporting of emissions and exacerbating the lack of corporate and political awareness of the magnitude of the problem. While not an issue unique to NOCs, the practical complications of monitoring and the uncertainty of estimates also represents a hindrance to building awareness and knowledge.

At most NOCs, methane management is typically the responsibility of the Health, Safety and Environment (HSE) department. While there may be individual local champions who have the knowledge and motivation to address methane emissions, HSE departments largely lack influence and the power to set priorities for "new problems" like methane emissions. Environmental protection is harder to sell than health and safety, the latter of which presents major challenges for many companies. When environmental protections are considered, the focus is naturally on local impacts and large resource waste or more easily demonstratable projects such as renewables or carbon capture and storage. Gas lost through methane emissions may not be perceived as a large resource loss, and the environmental impacts not understood or considered important.

Three broad groups of solutions are important to overcome these barriers:

- **Use company/country specific methane data to drive management awareness and prioritization.** A clear solution to improve awareness and knowledge is to conduct local measurement campaigns using rigorous methods of quantification to reveal the scale and nature of the problem as well as undertake analysis to demonstrate the operational, economic and environmental benefits of action.[6] This requires active support from both high-level executives and operational managers in NOCs. Technological progress in emission detection and measurement, including remote sensing, opens new opportunities for building awareness and knowledge both internally in NOCs and with the public at large. Methane information is increasingly available for anyone to see. TROPOMI methane satellite data is freely available today (and has been used to spot a large emission source in Turkmenistan), and data from the MethaneSAT satellite, which will show methane emissions on a 200 km view path, will be freely available following its launch on SpaceX's Falcon 9 rocket, estimated for late 2022.[7,8,9] From the ground level, infrared videos can easily reveal the severity of fugitive methane emissions to garner public attention. In Colombia, for example, infrared footage was broadly shared with media, which, along with other factors, helped build support for a stringent new Colombian methane reduction target.[10] Such information can be used to prioritize methane emissions in NOC corporate and national climate policy strategies.

- **Realign operational management objectives to encourage methane reporting and mitigation.** Robust methane management requires a specific mandate from the NOC executive and/or political level. Without sufficient governance and prioritization from a higher level, HSE managers and operational staff often lack the resources, technical knowledge and focus needed to address methane. Depending on company culture and policies, operational staff may also have a concern that spotting environmental problems can have negative impacts on their job appraisals. To address these constraints, executive action is especially critical to allocate sufficient resources and change the operating culture to encourage methane mitigation.

- **Present methane facts to policymakers to collaboratively create a strategy.** A common understanding by NOC executives and policymakers about the nature and scale of methane emissions is essential in order to build an effective and durable methane management strategy. Facts on emissions and mitigation potentials and costs will clarify the extent to which methane management should be prioritized from a NOC corporate perspective and as part of national reporting of emissions and mitigation efforts under the Paris Agreement.

[6] For a detailed overview of robust quantification protocol, see: Mogstad, Isabel. "Hitting the Mark: Improving the Credibility of Industry Methane Data." Environmental Defense Fund, February 2020.

[7] See, for example, a recent study on methane emissions for the Permian Basin using satellite data: Zhang, Y, et al., "Quantifying methane emissions from the largest oil-producing basin in the United States from space." ScienceAdvances, April 22, 2020.

[8] Varon, D.J., et al. "Satellite Discovery of Anomalously Large Methane Point Sources from Oil/Gas Production." GeoPhysical Research Letters, Nov. 22, 2019.

[9] MethaneSAT, a subsidiary of Environmental Defense Fund.

[10] "Media Coverage of FLIR Camera Emissions Registration in Colombia." Youtube, Sept. 2, 2019. The Colombian government has recently announced a 45% reduction target and commitments to have draft regulations by the end of the year.

b) Legal and structural issues

This is a broad category covering institutional challenges within NOCs as well as factors largely outside the remit of NOCs.

Institutionally, NOC administrative units and company structures can inhibit methane mitigation efforts, which often require coordinated measures and present opportunities for technology sharing across company infrastructure. For example, two subsidiaries of a NOC could not share an infrared methane camera due to administrative restrictions.

Regarding broader structural and regulatory features, which can be influenced by NOC managers to a varying degree, three are highlighted here

- **Joint venture contracts do not incentivize or require methane management.** Joint venture contracts — PSAs and TSAs — between private oil companies and NOCs may not foster active and effective management of gas resources. For example, it is quite common for Majors and Independents to be field operators of an oil asset, but not have ownership to the associated gas (except for gas volumes used on-site). Therefore, PSAs and TSAs often lack incentives for the operator to manage the gas productively, leading to large volumes of flared or vented gas.

- **Gas distributors are not incentivized to reduce downstream methane emissions.** Downstream distributors typically do not own the gas and are paid for distribution services independent of losses. Payment from NOCs to gas distributors are typically based on the quantity of gas measured at the inlet to the distribution system and not based on quantities delivered to end users. In such cases, distribution companies are not sufficiently incentivized to maintain a high standard of their networks. As an example, the current CIS system with emission factor-based fee offers weak, if any, incentives to reduce emissions and seems primarily to serve fiscal purposes.[11]

- **Existing regulations discourage accurate methane quantification and abatement.** Although regulations of methane as a pollutant are not very common, some NOC countries have regulatory schemes that are counterproductive to emissions reduction.[12] For example, in CIS countries where several NOCs operate, methane emissions exceeding a certain threshold are heavily fined. Emissions are normally reported based on standard indirect calculation methods rather than direct measurement of actual emissions. These regulations can discourage robust direct measurement campaigns since there may be a risk of detecting emissions higher than the threshold or than in previous reports.[13]

Many of the structural and regulatory barriers described above are harmful for NOCs and NOC countries at large, but solutions exist.

- ✓ **Review PSA and TSA terms to incentivize gas capture and utilization:** To address contractual challenges in joint ventures, PSAs could be revised to establish equal ownership of oil and gas between NOCs and joint venture partners and to require specific methane management practices (e.g., robust leak detection and repair programs).

- ✓ **Develop/modify regulations to reward sound quantification and mitigation:** Gas distribution companies, in particular, should be incentivized to avoid gas losses, which can reduce emissions while increasing gas volume sales for NOCs.

- ✓ **Facilitate and incentivize information sharing with operators:** Across these barriers, it is in the economic, operational and environmental interest of NOCs to have these contracts and regulations changed. Given the close collaboration that often exists between NOCs

[11] Commonwealth of Independent States (CIS), the former republic of the Soviet Union.

[12] Maslova E., et al., 2017. "Analysis of the requirements of the Russian and international legislation in the field of norming, reporting and setting fees for methane emissions to the atmosphere."

[13] Haugland, Torlief. "Regulatory reforms to incentivize methane emission reduction in Kazakhstan." UNECE.

and NOC country governments, there is a favorable opportunity to impose reforms to eliminate these barriers, but it requires a concerted view that methane emission reduction is a priority. When there is a shared understanding at all levels of the importance of methane mitigation (in the same way as the focus on safety, for example), significant changes can be performed effectively.

c) Challenging economics from a company perspective

According to IEA abatement cost estimates (see Figure 1), there should be a compelling economic argument for methane abatement. NOC countries have a larger share of methane which can be eliminated at no net costs than the global average, respectively 46% and 40%. While the underlying techno-economic analysis for such assertions can be sound and valid, there are factors which explain why a simplistic, conventional economic argument from a company perspective are not always quite as convincing.

- **Gas prices in NOC countries are often low due to subsidies, reducing the economic benefit of mitigating methane to increase sales volumes.** In NOC countries, the actual price paid for gas is often a major barrier. The IEA's Methane Tracker, which is the source of abatement potential shown in this paper, does not account for subsidies when estimating the market value of gas and hence may overestimate the economic benefits of abatement at a company level.[14]

- **Value of small-scale methane projects are difficult to justify despite potential aggregate benefits.** Even if the aggregate economic losses caused by methane emissions are significant, individual methane abatement measures are often small and quite labor intensive. The potential sales benefit from a methane abatement project may be perceived as uncertain and/or small, especially when compared to the significant gas capture which often follows a gas flare reduction project, for example. Further, even if a mitigation solution has a high long-term economic return (i.e., IRR), the actual short-term monetary benefit (i.e., NPV) is typically low and might not be sufficient in capital ranking for the NOC to prioritize relative to other planned projects.

- **Demand constrained markets limit economic incentives to capture additional gas through methane mitigation.** A NOC's national gas market may be "demand constrained," which implies that the additional gas volumes brought about by methane capture does not lead to increased gas sales but rather results in less non-associated gas production. In such a case, the abatement measure does not offer revenues in the form of additional gas sales from the captured methane.

Nevertheless, methane emission reductions are some of the most cost-efficient options if NOCs are setting GHG emissions reduction targets. When, and if, NOCs embark on an ambitious GHG reduction strategy, methane emissions sources should be in focus and cost-efficient measures will depend critically on the preparation of field-specific abatement cost studies set within the context of a holistic assessment of the aggregate, longer-term value of abatement. Methane mitigation also has indirect benefits such as job creation, reliability improvement and increased safety.[15]

[14] The IEA Methane Tracker estimates gas prices as "the monetary value attached to captured methane…viewed from a global, societal perspective."

[15] "Find and Fix: Job Creation in the Emerging Methane Leak Detection and Repair Industry." Datu Research, March 2017.

The economic incentives for mitigation actions can be greatly improved if NOCs and NOC country governments undertake measures such as:

- **Bundle projects:** Mitigation projects can be designed to address one specific issue at a broad scale to leverage the learning from pilots and reduce the cost per project (e.g., address all the wet seal compressors in a company or a region).

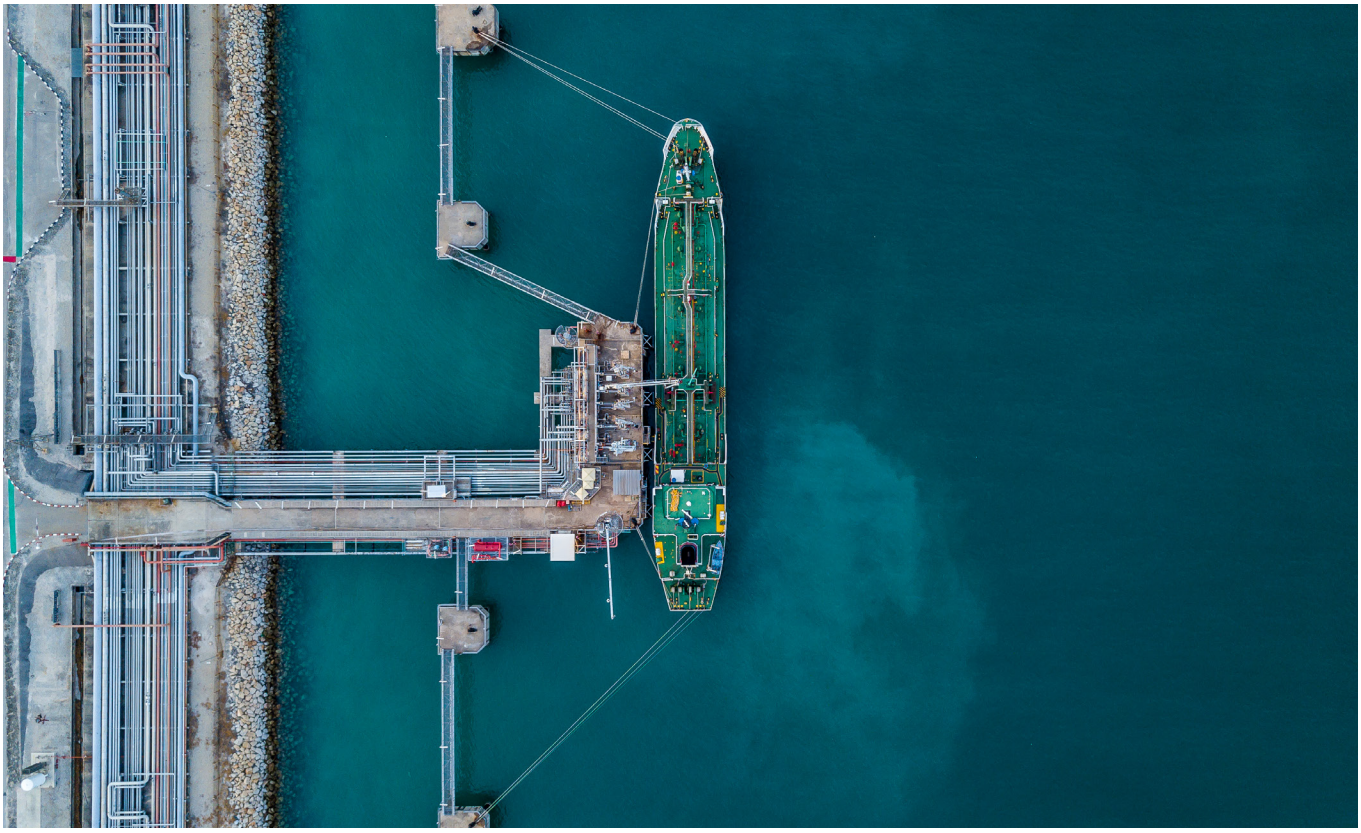
- **Create funds for accelerated deployment:** Design and establish specific funds for methane management (quantification and mitigation) in order to enhance NOC internal action. For example, attractive economic returns on methane mitigation profits and savings can be earmarked for ongoing methane management programs.

- **Take into account the co-benefits of mitigation when assessing and comparing projects:** There are prospects that verified emission reductions gradually will appear as economic benefits for NOCs, either through domestic or international carbon pricing schemes (e.g., trade-in emission allowances or taxation of emissions), broader national economic benefits (e.g., jobs creation) and other economic/financial incentives. This could potentially be a significant boost to the no-cost abatement potential.

- **Eliminate Subsidies:** Bringing the domestic consumer prices of gas in line with cost of supplies will spur sound methane management and reduce emissions. If the environmental costs of methane (e.g., through carbon pricing or other schemes) are added, the economic incentives for action would be further enhanced. Still, it is important to be mindful of, and consider how to mitigate, social impacts of removing subsidies.

This review and analysis show that the causes of barriers are known, and solutions are readily available. NOC leadership can begin addressing these challenges today, working in concert with policymakers to support national action on methane.

Beyond an improved awareness of large inexpensive abatement opportunities, an understanding of the strategic and political importance of methane emission reductions in NOC countries spurs a deeper motivation to act. This deeper motivation, together with an understanding of the key elements of a robust, durable methane management roadmap and of the opportunities to collaborate with external institutions, can drive significant progress on methane within an NOC. This is discussed in the final chapter of this paper.



3.

Strategic drivers and a roadmap for effective methane management

Strategic importance of methane mitigation

Since the Paris Agreement was adopted in 2015, climate change has steadily climbed on the international policy and public agenda. With growing political and public pressure globally, the oil and gas industry has increasingly recognized its own role in affecting climate change and the new commercial risks to the industry. Consequently, oil and gas companies are increasingly integrating climate change issues into their corporate strategies and operations.

For NOCs, methane management can in many cases be particularly important as part of a climate strategy and action plan because large methane emission reductions can be achieved quickly at low or no cost. Three strategic considerations are further compelling arguments for giving priority to methane management as part of a NOC's corporate climate mitigation action:

1. **Pressure from international capital markets.** Financial institutions are increasingly concerned with the investment risks of climate change. This affects NOCs to the extent they seek international debt financing or new equity investors. With growing pressure from financial markets to have the oil and gas industry disclose GHG emissions and address climate risks, NOCs' cost of capital may very well be sensitive to GHG performance.[16] NOCs' share of upstream oil and gas sector investments have increased markedly over the past decade and were reported to be about $220 billion in 2019 (43% of the industry total).[17] Moreover, NOCs listed on international stock exchanges are increasingly exposed to public and shareholder pressure to have a credible corporate strategy to mitigate GHG emissions in place.

2. **Pressure from international oil and gas markets.** With the increased call for transparency on supply chain emissions, high emissions or lack of credible data may increasingly penalize bad performers. For example, the EU is considering implementing a Border Adjustment Mechanism based on the GHG performance of imports, which could restrict NOCs' access to EU markets if they are unable to transparently and robustly illustrate low GHG emissions across their supply chains.[18] In addition, some oil and natural gas purchasers may choose to select (and pay a premium) for low emission products following the model of renewable electricity certificates, for example.[19]

3. **NOC country contributions under the Paris Agreement.** NOC countries are all parties to the Agreement, communicating their nationally determined contributions (NDCs) and outlining how these contributions will be achieved. However, in most NDCs, oil and gas methane emissions are not included in the NOC country's emission reduction pathway despite methane mitigation often representing "low hanging fruit," as explained above. NOC countries would benefit from giving methane abatements a more prominent role in future NDCs since methane reductions are relatively inexpensive, quick to implement and offer near-term climate results.

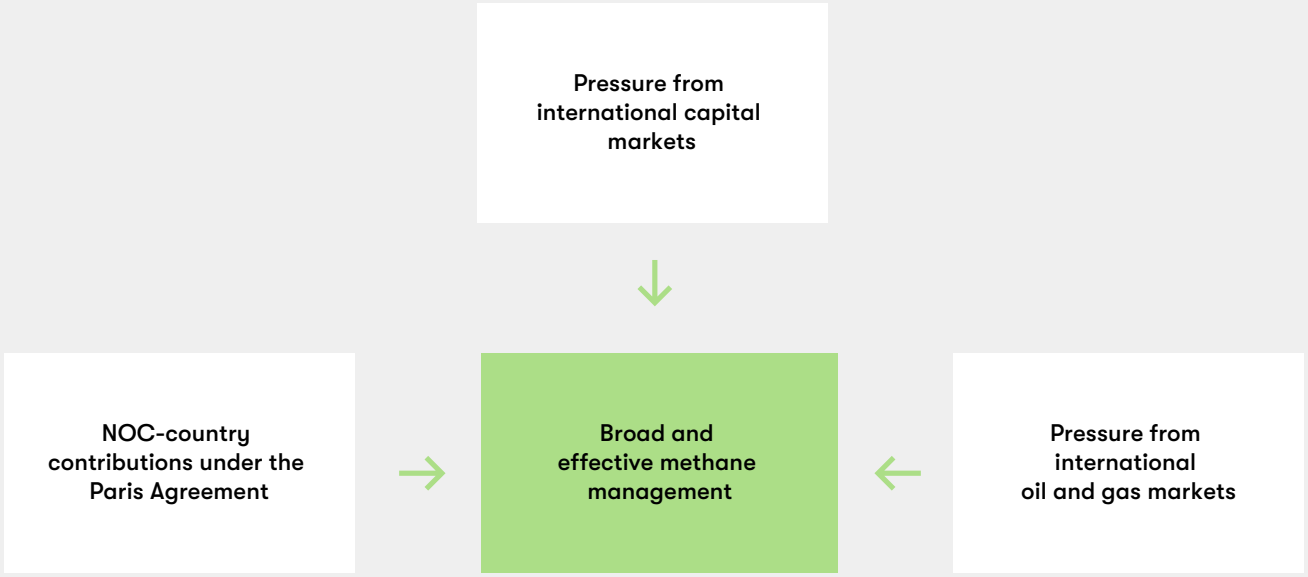
[16] "Implementing Tcfd Recommendations For Oil And Gas Methane Disclosure." Principles for Responsible Investing, Oct. 25, 2018. Other relevant references are https://www.sasb.org/ (SASB), Climate Action 100+; Climate Disclosure Standards Board (CDSB) and Global Reporting Initiative (GRI).

[17] "The Oil and Gas Industry in Energy Transitions." International Energy Agency, January 2020.

[18] "EU Green Deal (carbon border adjustment mechanism)." EU Commission, March 2020.

[19] "CNOOC to Receive Chinese Mainland's First Carbon Neutral LNG Cargoes from Shell." Shell, June 22, 2020.

Figure 3
Main drivers for active methane management



The drivers for methane management, illustrated in Figure 3, represent a strong rationale for establishing a roadmap for methane management and are only expected to accelerate in scale, as evidenced by recent developments in the EU policy arena and increasingly climate-conscious financial markets. This is particularly true for NOC countries that are "oil dependent" (greater than 20% of revenues come from the oil and gas sector), are exposed and may attain co-benefits from a high impact methane management program.

These processes are also directly linked to the prospects of carbon pricing which increasingly can provide a direct economic stimulus to methane mitigation efforts. The impacts of carbon pricing are particularly powerful due to methane's high global warming potential. For example, if carbon pricing policy is implemented and emission reductions are remunerated at $10/CO2 equivalents, this roughly equates to $5.5/MMBtu of gas, close to the import price for natural gas into Europe.[20] In comparison, typical scenario analysis suggests that a carbon price above $75/CO2 equivalents would be required in typical NOC countries to achieve the Paris Agreement objectives.[21]

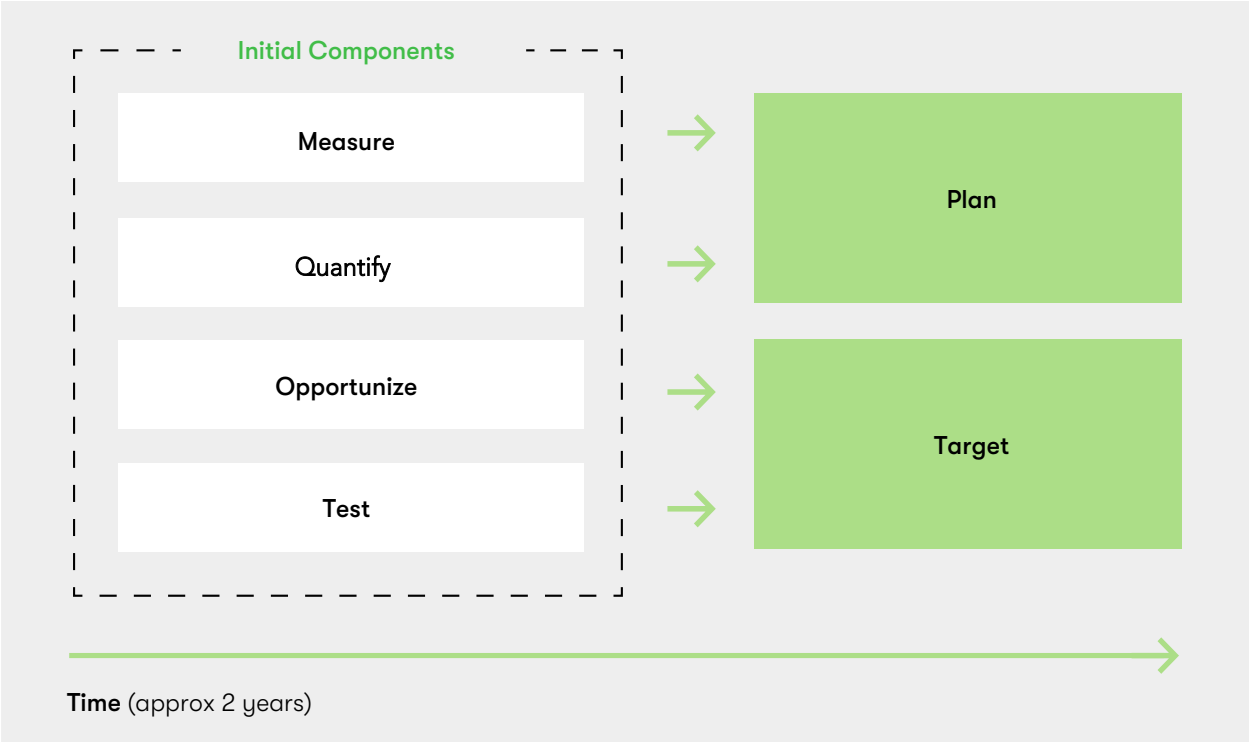
[20] Average price import gas price for gas to Germany was $5.25/MMBtu in 2019 according to BP Statistical Review 2020.Change font of note #24
[17] "The Oil and Gas Industry in Energy Transitions." International Energy Agency, January 2020.

[21] See for example, the IEA World Energy Outlook 2019 which in their "Sustainable Development Scenario" has a carbon price for developing economies at $75/CO2 equivalents in 2030 and $100/CO2 equivalents in 2040.

Key elements of a roadmap

Differences in national circumstances and framework conditions means that NOCs' approaches to methane management should and will differ. While there is not one roadmap suitable for all NOCs, there are key activities that are typically essential features for most NOC methane management programs.

Figure 4
Activities of a roadmap for effective methane management



The activities should advance partly in parallel and partly in sequence. They are thematically connected; for example, measurements are necessary inputs to establish an inventory, and the inventory is an essential input for the abatement cost studies that help set priorities for emission reduction measures. The approach should build awareness and support at all levels of the organization. For instance, documenting positive results from pilot projects can inform the design of a broader methane management program. Through thorough measurements, inventory and abatement costs, studies can inform executive decisions on methane targets.

The content of each element and references on how they can be put into practice is further described below.

Measure

"Seeing is believing." Detection and measurement campaigns are critical to take stock of current emissions levels and to build internal awareness and knowledge. It is the first step in the process towards establishing a company-wide inventory and mitigation plan. Emission reduction measures can follow directly after, or even parallel to, measurement campaigns.

For example, a NOC in East Europe approved a large renovation program on a facility after witnessing significant methane emissions with an infrared camera.

Opportunize

Building on the inventory work, and possibly as an integral part of it, conduct cost/benefit assessments of mitigation actions to support identification of the highest-impact opportunities and inform investment and operational decision making. A number of guideline documents are publicly available to support companies in this process, including the Methane Guiding Principles Cost Model and Gap Assessment Tool and the Oil & Gas Methane Partnership's technical guidance documents. This can help set a baseline for mitigation actions to be deployed on site.

Examples of these are referenced in Mexico's regulation on methane emissions, where mitigation actions are cited for the most common emission sources in the sector.

Quantify

Initial inventory work could be based on estimated emissions from default calculation factors, but this should quickly evolve to include more detailed and local data using a combination of direct measurement technologies. The inventory will be a principal building block in the design and implementation of an active and cost-efficient strategy for methane emissions management. It will also help to disseminate to the public information about environmental performance and progress in emission reduction efforts, such as by reporting credible methane reductions to the UNFCC to illustrate progress against countries' NDCs under the Paris Agreement.

SOCAR in Azerbaijan has recently embarked on a process to establish a high-quality methane emissions inventory which is expected to serve the methane strategy and NDC purposes mentioned above. Colombia is developing a bottom-up methane fugitive emission inventory, led by its Ministry of Mines and Energy and the Universidad Nacional de Colombia, to improve its methane measurement and quantification methodology as well as to inform feasibility assessments of methane mitigation projects at scale.

Test

Undertake investments to test and demonstrate economic and environmental benefits of methane mitigation on a small scale to inform an effective management program company-wide. Pilot projects will also provide input to inventory and abatement cost studies. For example, installing vapor recovery unity (VRU) installations or replacing compressor seals are good initial equipment improvement opportunities. Implementing a systematic leak detection and repair (LDAR) program at a representative selection of pilot sites is a natural first step for all operators and leads to early success.

Since 2018, Kaztransgas (Kazakhstan) has deployed several sets of Pergam laser detectors installed on vehicles to monitor its transmission and distribution networks. In 2019, this pilot program detected 235 leaks, which would otherwise likely have gone undetected.

Plan

Develop and prepare for a comprehensive program aimed at deep cuts in methane emissions. Such a plan will include several important elements such as an inventory improvement plan; a periodic leak-detection and repair program; procedures to ensure that methane emissions are minimized when new installations are engineered; and guidance to minimise emissions during repairs and maintenance. It will also include set projects focusing on the relevant sources of emissions for each NOC, which may include components with low capital expenditures, including changes to operational practices, and larger refurbishments and installation of new equipment. For example, compressor replacements, installation of vapor recovery units at tank farms and deployment of mobile compressor units are capital-intensive but high impact investments in many countries.

The Methane guiding principles provides a set of eight Best Practice Guides which have been designed to provide concrete steps for those responsible for developing methane management plans.

Target

Targets for methane management can take the form of emission reductions (volume or intensity) and/or other metrics such as capital expenditure commitments, coverage of specific company assets or emission sources. Targets and commitments can also evolve over time. Monitoring progress is essential both for internal management and for public communication. Monitoring of company-wide emission reductions is much more demanding than tracking progress on specific and clearly defined mitigation activities. Formulation of targets and methodologies for monitoring may therefore progress over time. Industry-led international initiatives on methane management have different approaches to commitments and targets (see Box 2). Oil and Gas Climate Initiative (OGCI), having the NOCs CNPC, Equinor, Petrobras, Saudi Aramco and eight of the largest international private companies as partners, has collectively set an ambitious target to bring methane intensity to 0.25% by 2025 (see Box 2).

As mentioned above, there is not one roadmap suitable for all NOCs, and the journey to methane management typically include several iterations of all the elements mentioned above. However, the following section provides possible practical first steps for a company wishing to engage on the methane journey:

1. Measure

Start with one or a few detection and measurement campaigns, which have proven to be an effective approach to raise awareness at all levels in the company. The campaign can initially focus on large and/or old installations to maximize the chance of identifying important emission reduction projects.

2. Quantify

Develop a framework and a software tool for quantification and accounting of methane emissions. Based on the results of measurement campaigns and on existing available information on the different facilities, an initial corporate inventory can then be developed. This inventory will need to be refined over time but will provide a basis to focus the effort.

3. Opportunize

Use data from the inventory and relevant economic data to calculate costs, revenues and GHG impacts of mitigation actions. Rank the mitigation alternatives according to economic return and impact opportunities.

4. Test

Possibly in conjunction with measurement campaigns, one or several pilot projects can be implemented and assessed. Emission reduction projects will likely have been identified during the campaign, and the local operator having witnessed the emissions, can be an ally in the project implementation.

5. Plan

Based on results from the activities described above a comprehensive methane management plan should be developed with the aim to achieve deep cuts in emissions. It should include a plan of action both related to identification and quantification of emissions sources and prioritized mitigation measures.

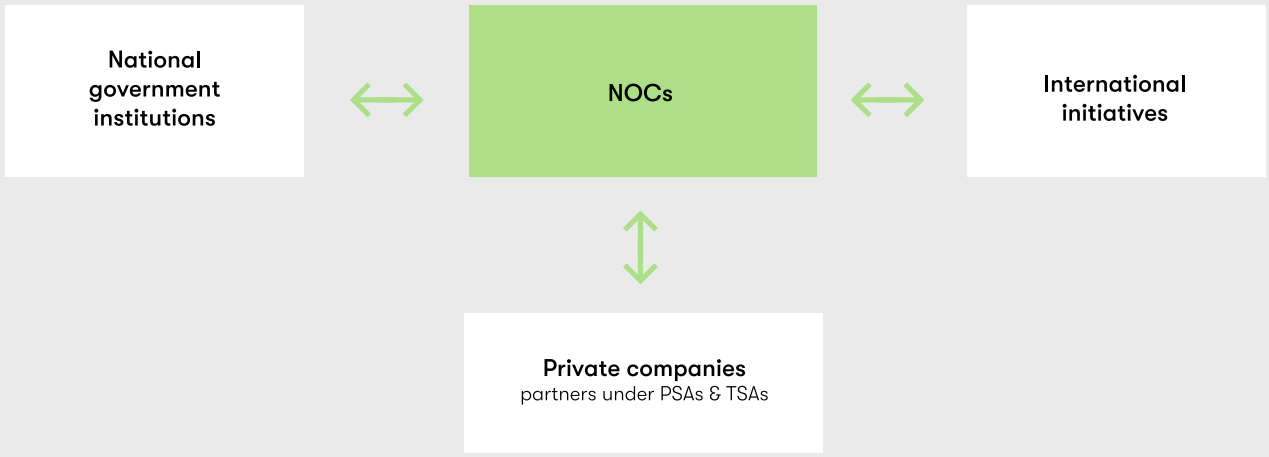
6. Target

Setting targets is directly related to planning work. Targets should be quantifiable and verifiable and would typically evolve over time. They must be accompanied by a robust methodology and plan for monitoring and reporting of progress.

Engaging with other institutions

While the specific elements and activities of a roadmap as described above are NOC-internal, climate change-motivated methane management is entrenched with international processes. Interaction with external institutions and initiatives is therefore an important part of a roadmap. It can take different forms, but typically includes contact with three groups of institutions, as shown in Figure 5.

Figure 5
NOC links to other institutions



Engaging with these institutions can be an essential part of building momentum for an effective NOC methane management system.

1.

NOC – National government institutions: Given the close ties between government institutions and NOC management as well as the complex commercial and social mandate for many NOCs, NOCs have an important and powerful opportunity to work with governments to drive methane mitigation prioritization and policy. Provided there is a common understanding that

methane emissions should be given priority, there will be good prospects for NOCs to engage with policymakers to address the barriers discussed in section 2 above. The strategic importance of oil and gas in many NOC countries also implies that NOC management is involved in climate change policy formulation and international negotiations under the United Nations Framework Convention on Climate Change (UNFCCC). Often NOC staff are part of the official delegation to UNFCCC meetings. Further, as actions and reporting requirements under the Paris Agreement are being stepped up, the call for additional NOC expertise and involvement may increase. This can be a very good occasion to bring methane to the center of NOC countries' contribution under the Paris Agreement.

2.

NOC – International initiatives and actors: A number of international initiatives, formed by industry associations and public-private partnerships, are engaged in various aspects of methane management. These efforts have different objectives, levels of commitments and membership profiles, with the Majors currently being most active but NOCs increasingly taking part (see Box 2). Participating in these initiatives as well as collaborating with other institutions — such as environmental non-governmental organizations, multilateral development banks and research institutions — can offer important impetus activities of the roadmap referred to above. As international methane initiatives often focus on practical operational issues and delivery of verifiable results, they are an effective path for NOCs to begin and/or advance their methane journey. Moreover, methane initiatives open up opportunities for improved collaboration between NOCs and international private companies.

3.

NOC – Private companies. As NOCs adopt active methane management strategies and operations, collaboration between international companies, NOCs and NOC country government institutions will become a more important and powerful means to achieve quick and significant results. The Majors, in particular, are important NOC joint venture partners, operating 28% of production from assets where NOCs have an equity stake but are not the operator.[23] The Majors, and a few NOCs, have led the oil and gas industry on prioritizing and advancing methane management, evidenced by individual methane reduction targets and participation in global methane initiatives (see Box 2). Several of the Majors are increasing their focus on methane emissions at non-operated assets, including assets owned and operated by NOCs. For example, in 2019, Chevron included all assets in its GHG reduction targets, regardless of whether Chevron had operational control.[24] In 2020, BP announced an aim to influence their joint-venture partners "to establish their own 0.2% methane intensity target."[25] There is considerable scope for improved collaboration and exchange of information between NOCs and private companies. Addressing existing challenges to improve data and best practice sharing should be a mutual priority for NOCs and their private company partners, whether that requires eliminating structural barriers vested in legal agreements (e.g., restructuring PSAs and TSAs to account for gas/methane) or changing regulations. Improving transparency and collaboration between NOCs and private companies can accelerate methane management at NOC-operated and non-operated assets by increasing data availability of methane emissions at jointly owned assets and by sharing operational and technology best practices.

[23] Rystad Energy UCube Database (2018).

[24] "Chevron Sets New Greenhouse Gas Reduction Goals." Chevron, Oct. 3, 2019.

[25] "Reimagining energy, reinventing BP." BP, Feb. 12, 2020.

Box 2: International industry initiatives covering methane management

A number of new initiatives have been launched over the past few years to deal with methane management, including public-private and new industry partnerships. Existing oil and gas industry associations as well as international organizations, multilateral development banks and non-governmental organizations are also active. Three initiatives are particularly relevant for the issues covered in this paper:

Oil and Gas Methane Partnership (OGMP) is a multi-sector partnership under the United Nations Environmental Programme's Climate and Clean Air Coalition comprising 10 oil and gas companies, of which four are NOCs: Ecopetrol, Equinor, Pemex and PTT, as well as governments, inter-governmental organizations and civil society.

Launched in 2014, OGMP requires companies to report annual progress on methane mitigation, providing detailed reporting methodologies and results for its member companies. In 2020, OGMP extended the scope of its reporting framework to include methane emissions from non-operated assets across the oil and gas value chain, which will affect member NOCs directly as well as NOCs with joint ventures with member companies.

As a multi-stakeholder partnership focused on robust methane measurement and reporting, OGMP represents one important opportunity for NOCs to build trust and credibility in their methane mitigation programs.

Oil and Gas Climate Initiative (OGCI) is is an industry initiative comprising 12 large oil companies, of which five are NOCs: CNPC, Equinor, Pemex, Petrobras and Saudi Aramco. OGCI members have set a target to collectively reduce their average methane intensity at upstream gas and oil operations to 0.25% by 2025. The specific quantitative target and ambition set by OGCI requires companies to have in place rigorous methodologies and practical steps to monitor and reduce emissions.

Methane Guiding Principles (MGP) aim to reduce methane emissions across the natural gas value chain. Six large NOCs are signatories to MGP: Equinor, Gazprom, Petronas, Rosneft, Socar and Qatar Petroleum. Under these guiding principles, signatories commit to continually reduce emissions, improve the accuracy and transparency of methane data, report progress and challenges of methane mitigation, and advocate for sound methane policy and regulation.

In addition, there are international oil and gas industry associations working on a broad set of environmental issues and increasingly covering methane. The most relevant for NOCs are the International Association of Oil & Gas Producers (IOGP) with 14 NOC members and the International Petroleum Industry Environmental Conservation Association (IPIECA) with 10 NOC members.



4.
Conclusion

NOCs and governments of their home countries can significantly contribute to deep cuts in global methane emissions, with a significant portion of oil and gas sector methane emissions that can be eliminated at low cost. Some barriers have hindered this potential from being exploited, but, as explained in this paper, there are readily available solutions to overcome these challenges. The steady rise of climate change on global and national policy agendas should motivate NOCs, as well as other parts of the oil and gas industry, to prioritize methane emission reductions. Methane offers the largest potential for low cost and quick direct emission reductions.

NOCs as a group are heterogenous and this diversity must be carefully considered when proposing a set of actions for effective methane management. A methane management roadmap as briefly outlined in this paper must be based on a thorough understanding of the current barriers. Consequently, there is not one roadmap suitable for all NOCs, but there are key activities that are typically essential features for most NOC methane management programs which should advance partly in parallel and partly in sequence. The approach should build awareness and support at all levels of the organization.

While the specific elements and activities of a roadmap are NOC-internal, climate change-motivated methane management is entrenched with international processes. Interaction with external institutions and coalitions is therefore an important part of a roadmap. It can take different forms, but typically includes contact with government institutions in their home countries, with international initiatives and actors, and with private operators. Given the close ties between government institutions and NOC management, this alliance can be a powerful force for establishing an effective NOC strategy and for national measures in support of the objectives of the Paris Agreement. Collaboration with companies and other partners of international initiatives can offer important impetus activities for NOCs' methane roadmap. And finally, cooperation with private companies operating in NOC countries will enhance the effectiveness of methane mitigation and be of mutual interest.