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Methane Reduction Alliance

Proposal for an international agreement to cap methane emissions in the gas supply chain

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Executive Summary

This proposal outlines how an alliance between the world's largest gas importing countries could create strong incentives in the global gas market to cut methane emissions across the supply chain. Such a policy would reduce global warming while bringing to market the significant quantities of gas that are currently wasted.

The methane alliance would be a trade-based measure in which climate-ambitious countries that import large amounts of gas, such as the European Union (**EU**), Japan, South Korea, the United Kingdom and China, introduce or strengthen methane regulations domestically, while agreeing to prioritise the purchase of gas from countries with similar regulations in place. This would increase incentives for gas-producing countries to strengthen their methane regulation, and for gas production companies to support emissions regulation.

The paper first outlines the context for the proposal, highlighting that while methane has historically been sidelined as a climate pollutant, abating this greenhouse gas is now considered the single fastest means of reducing global warming.

Second, the paper highlights how evolutions in emissions tracking technology are increasing governments' ability to regulate the gas industry's methane emissions. It explains that the onus is on governments to shift regulatory incentives for methane abatement because existing incentives have not been strong enough to deal with the problem.

The third part of the paper explains some of the government and industry responses to methane emissions in the gas supply chain. It describes how the existing methane regulatory landscape is inconsistent across countries and even within countries, which is creating an unequal playing field for gas operators and governments. It also summarises some of the more and less useful voluntary methane initiatives, emphasising the need for verifiable emissions reductions mechanisms.

Fourth, the paper sets out a proposed design of a methane reduction alliance to address the above issues. The design is intended to ensure compatibility with trade law requirements, by ensuring that alliance countries establish consistent domestic methane regulation which is then applied to imports in an equivalent way. This would be done through a performance standard that caps and gradually reduces the volume of emissions associated with a particular supply chain, with a fee applied for emissions exceeding the standard. This section also explains that, in order to have their exports credentialed as compliant with the standard, governments of gas exporting countries would be incentivised to regulate all methane emissions within their jurisdiction rather than only those associated with exported gas.

The fifth and final section explains how the proposal would work in the current trade context. It notes that as Russia's invasion of Ukraine and other factors constrain global gas markets, countries reliant on gas imports are looking to sign new supply contracts, many of which would require expanded gas production. This overlooks the role that capturing currently-wasted methane could play in bolstering gas supply while still ensuring an orderly phase-down and then phase-out of gas in line with climate targets.

1 Context: the value of coordinated action to cut methane emissions

As the world faces the dual and urgent problems of curbing greenhouse gas emissions while managing constraints on gas supply, coordinated action is needed to stop methane being wasted in energy supply chains.

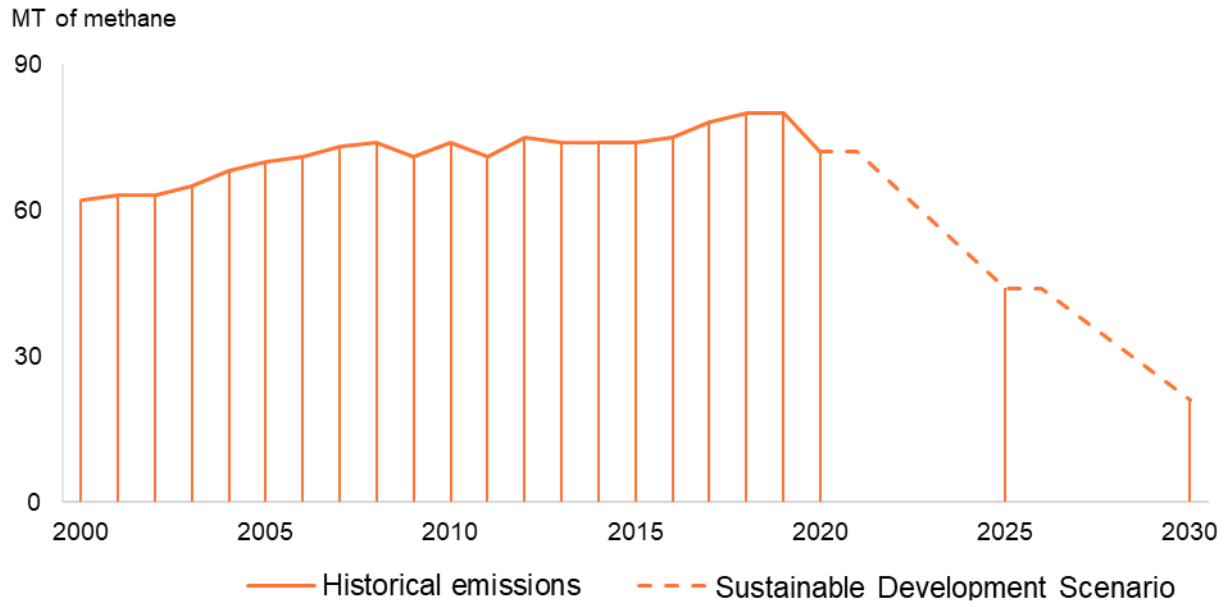
To avoid the worst effects of global warming, we need higher ambition for decarbonisation, and accelerated implementation of decarbonisation policies. Country-level emissions reduction targets outlined in Nationally Determined Contributions under the Paris Agreement have helped to set expectations around climate goals, but attention is now turning to the pressing need to design and implement effective policies. One such policy that could be adopted is a limit on methane emissions from the gas supply chain prescribed in the domestic legislation of major gas importing countries, coordinated through an international agreement. This would help reduce emissions while limiting the need for more gas extraction, and so could be aligned with scientifically-determined timelines for the phase-down and eventual phase-out of gas.

International trade-based measures to promote decarbonisation have not been widely deployed but present a powerful means of building momentum across countries. Under the UN's international climate law regime – the Framework Convention on Climate Change (**UNFCCC**) – reporting has focused on emissions occurring within the boundaries of each reporting country, and countries have been slow to develop effective international emissions pricing mechanisms. There are, however, signs of progress towards such measures: the European Commission is planning to introduce a carbon border adjustment mechanism to encourage trading partners to develop their own carbon pricing systems, and German government officials have mooted the idea of an international carbon club to drive internationally-coordinated climate action. Such measures would serve the dual objectives of (a) creating a more equal market between countries which price emissions and those that don't; and (b) encouraging trading partners to accelerate their domestic decarbonisation.

The majority of climate mitigation policies, including trade-based measures, are focused on mitigating emissions of carbon dioxide (**CO2**), even though there is great potential to stem global warming caused by a more potent greenhouse gas – methane. Methane emissions are responsible for around a third of observed global warming to date, and the UN Environment Programme's 2021 Global Methane Assessment showed that strong action to mitigate methane emissions in the next 5-10 years is the single biggest and fastest form of emissions mitigation. This is because over a 20-year period methane is around 80 times more greenhouse-damaging than equivalent emissions of carbon dioxide.[i]

While the main anthropogenic sources of methane are fossil fuels, agriculture and waste, there is a particularly important opportunity to reduce methane emissions from fossil fuels, where emissions reductions can be achieved at low cost and with existing technology. The fossil fuel industry is responsible for one-third of anthropogenic methane emissions, and rapid reductions of methane from fossil fuels would slow atmospheric build-up of greenhouse gases in the crucial near-term. The International Energy Agency (**IEA**) estimates that in order to achieve net zero emissions by 2050, methane emissions from fossil fuel use must decrease from their 2020 baseline by over 70% by 2030 – see **Figure 1**.

Figure 1: Oil and gas sector methane emissions, historical and in the IEA's Sustainable Development Scenario[ii]



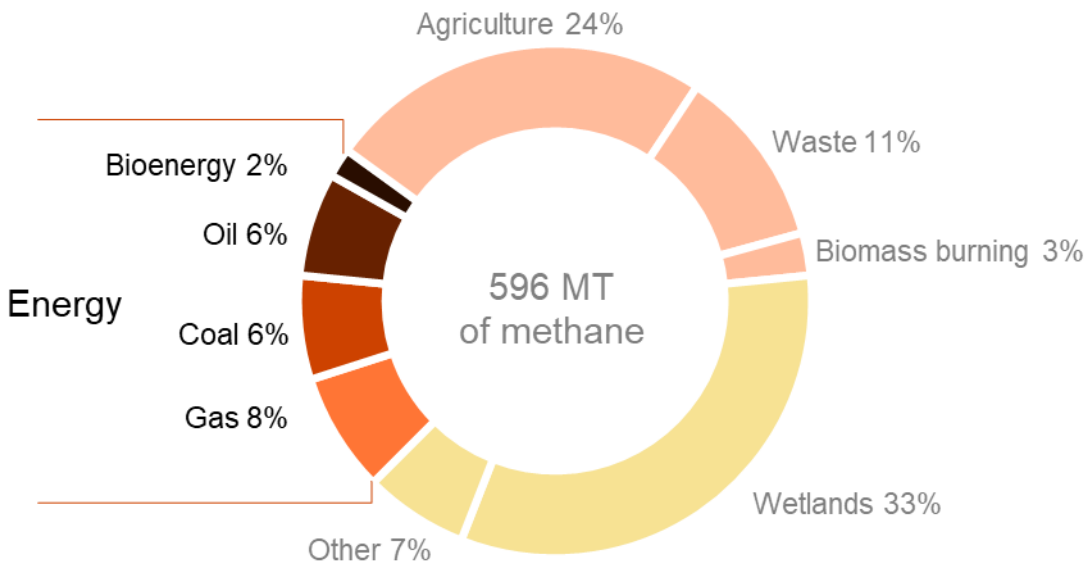
A methane reduction alliance is a trade-based measure to limit methane emissions from one of the main fossil fuel sources emitting methane – the gas supply chain. It would involve climate-ambitious countries that import large amounts of gas, such as the European Union (**EU**), Japan, South Korea, the United Kingdom and China introducing or strengthening methane regulations domestically, while agreeing to prioritise the purchase of gas from countries with similar regulations in place. This would increase incentives for gas-producing countries to strengthen their methane emissions regulation, and for gas production companies to support emissions regulation.

While this proposal focuses on the international trade of gas, the concept could be extended to methane emissions from the oil and coal industries as well. In particular, coalmines are the biggest source of energy sector methane emissions globally, but there is a concerning lack of incentives for mine owners and operators to address the issue.[iii]

2 Innovations enabling better methane regulation

Energy sector methane emissions are a crucial 'low-hanging fruit' in the battle to stop global warming. While methane emissions estimates are subject to a high degree of uncertainty, the IEA estimates that the fossil fuel supply chain contributes around 123 MT of methane annually. This is only slightly less than agriculture, which is the largest source of anthropogenic methane (**Figure 2**). Methane emissions occur throughout the extraction, processing and transportation of gas through 'fugitive' leaks, 'venting' (intentional releases of methane) and 'flaring' (where gas is ignited at incomplete combustion rates, leading to residual methane emissions). Much of the methane emitted through the fossil fuel supply chain can be avoided using existing technology, and in the gas sector, much of that technology could be deployed at no or low net cost.[iv]

Figure 2: Sources of methane emissions[v]



However, in many of the major gas exporting countries, gas companies have not invested in effective methane emissions abatement, due to:

(a) **Information issues**: there may be information gaps about methane in some companies, and in many jurisdictions there are disincentives to discovering new methane leaks (for example, if methane emissions attract a fee through emissions pricing schemes, or could otherwise attract more rigorous regulation).[vi]

(b) **Infrastructure**: new infrastructure may be needed to bring to market methane that is currently wasted (although this is a bigger problem for methane wasted in oil and coal extraction, where methane capture equipment might be totally absent).[vii]

(c) **Investment incentives**: even where methane abatement is cost effective, companies might prefer to use their limited capital for investments offering higher returns. Also, the gas supply chain can create 'split incentives' whereby, for example, pipeline operators that invest in methane leak repair see the benefit of that repair accrue to the owners of gas, by enabling more throughput.[viii]

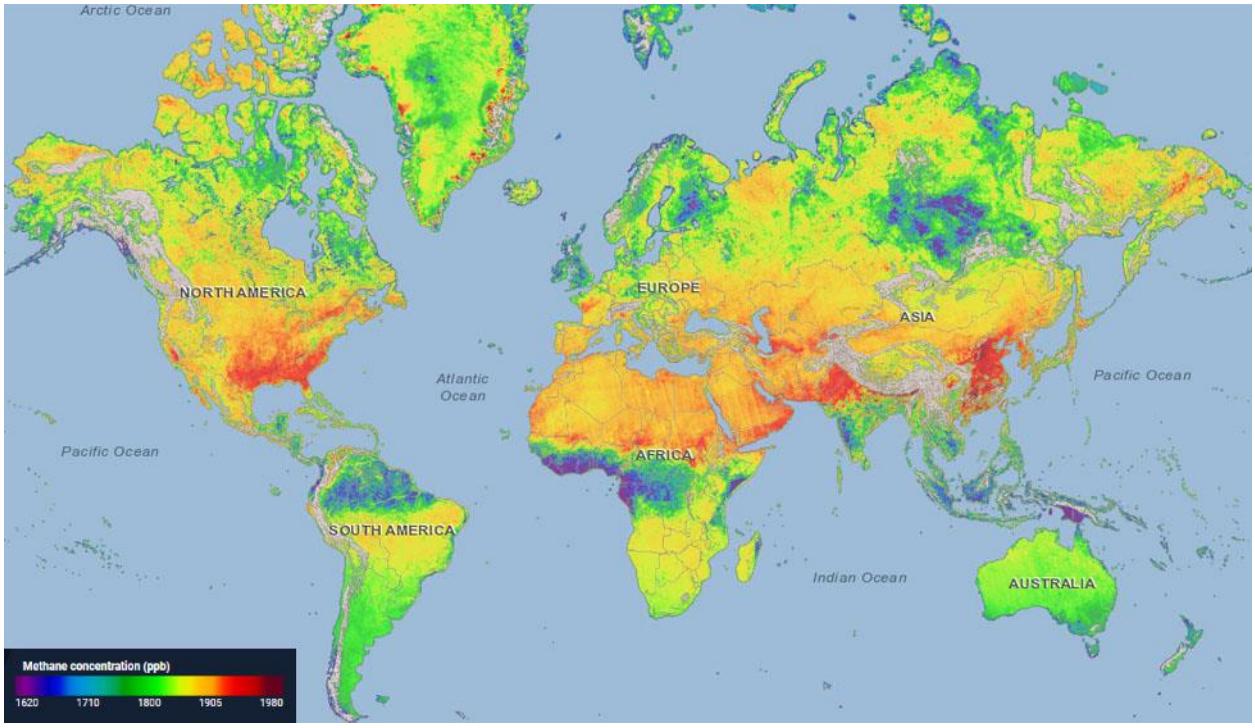
In the absence of strong industry action to cut methane emissions, governments have a crucial role in shifting incentives so that companies make the necessary investments to stop wasting methane.

There is a lot of 'low-hanging fruit' in methane regulation, as it has been neglected relative to CO2. Historically, climate policies have targeted combustion-level (rather than supply chain) emissions of fossil fuels, particularly coal, and the main component of those emissions is CO2. Measuring CO2 from end-point combustion is straightforward, and so phasing down or phasing out coal has provided governments with tangible emissions reductions data. Consequently, regulation and emissions pricing schemes have predominantly focused on CO2 abatement rather than cutting methane.

However, while combustion-point data is tangible, it does not provide a complete picture of the lifecycle emissions associated with the use of a particular fossil fuel. For example, Turkmenistan is estimated to have released more than a million tonnes of methane from its pipelines between 2019 and 2020, which is equivalent to the annual emissions of 5.4 million petrol-fuelled cars.[ix] Supply chain emissions, being more diffuse than a single combustion point, have historically been more difficult to measure, and therefore difficult to regulate.

This is changing, though, with the development of new technologies and public access to emissions data. A new frontier of methane tracking technologies, especially satellites with higher resolution and better coverage, is revealing not just that the fossil fuel industry is vastly understating the extent of its methane problems, but also which sites and companies are responsible for those emissions. As the public becomes more aware of the dangers of methane and the benefits of abating its release, pressure is building for governments to fix regulation and for companies to act.

Figure 3: World map showing satellite-detected methane concentrations in April 2020[x]



3 Government regulation and voluntary methane schemes

The ability to attribute emissions to a particular source provides an evidence base for governments to regulate methane emissions and exposes derelict companies to reputational risks. While some governments are responding to clearer evidence with improved regulation, there is currently a lack of regulatory coherence across jurisdictions. At the same time, companies are using voluntary schemes to promote the impression of being climate-conscious without actually making binding and verifiable commitments to reduce methane emissions. A

methane reduction alliance could both address this lack of regulatory coherence and bring substance to voluntary industry commitments.

3.1 Regulation

As with broader climate policies, the level of methane regulation is highly differentiated between countries and even within countries. For instance, in the US, a number of States have introduced rigorous methane reporting and emissions reductions requirements, while some of the biggest gas-producing States have very weak regulation.[xi] At the federal level, the Biden Administration's Inflation Reduction Act will increase consistency across the US by introducing a fee on methane emissions (reaching USD1500 in 2026) covering various gas production, transport, processing, and storage activities.[xii] Norway applies a greenhouse tax covering methane emissions from fossil fuels,[xiii] and the EU Commission has this year consulted on a strategy that would deliver improved methane regulation within its borders, and with their cooperation, among its trade partners.

On the other hand, some of the countries with the highest levels of gas industry methane emissions have very weak regulation, either because of lax laws (such as Algeria) or because laws are not implemented or enforced (for example, Russia). IEA data shows that the methane emissions intensity among the worst performing countries is over 100 times higher than among the better ones.[xiv] The lack of consistency in methane regulation across jurisdictions, and lack of an international pricing incentive for lower methane-emissions gas, mean that countries with strong emissions controls are not rewarded, and countries which fail to regulate benefit from externalising their environmental costs.

Coordinated action between major gas importing countries could help to increase regulatory cohesion. For an importing country to impose limits on supply chain methane emissions, there would need to be domestic regulation in that country with equivalent limits, thus increasing coherence between trading countries. An methane reduction alliance would also increase cohesion between gas importing countries, as they would need to coordinate appropriate emissions thresholds between themselves.

3.2 Voluntary schemes

As scrutiny of methane emissions has increased, a range of new voluntary oil and gas (**O&G**) methane initiatives has emerged, with varying contributions to the issue of methane emissions reduction. The Oil and Gas Methane Partnership (**OGMP**) is an initiative of the UN Environment Programme's Climate and Clean Air Coalition, in partnership with the European Commission, the UK Government, Environmental Defense Fund, and 62 O&G companies. The OGMP plays an integral role in developing methane reporting methodologies and guiding technology advancement and policy development.

While genuine voluntary efforts such as this are important, when voluntary schemes enter the realm of making claims about emissions reductions, there is a risk of industry co-opting those schemes for greenwashing. The Oil and Gas Climate Initiative (**OGCI**) is a consortium of 12 of the largest O&G companies, with the stated aim of reducing the collective average methane 'intensity' of aggregated upstream gas and oil operations to 0.2% by 2025.[xv] Methane intensity refers to the quantity of methane emitted as a proportion of the total volume of oil and gas that

enters a particular part of the supply chain. The OGCI claims its participating companies had a 2017 baseline of 0.3% emissions intensity for upstream emissions.[xvi] However, while that claimed baseline and those stated objectives might enhance the industry's public image, the OGCI does not offer independent evidence to substantiate the claims, and independent studies indicate that methane intensity is consistently higher.[xvii]

Another issue with relying on voluntary schemes is their limited coverage. Voluntary methane schemes only represent about 30% of total O&G methane emissions, which means that even if all commitments under those schemes were met, they still could not achieve the necessary 70% reduction in energy sector methane emissions required by 2030. This reflects the fact that voluntary schemes are failing to capture a crucial component of the O&G sector – most industry partners engaged in voluntary methane initiatives are large private sector entities, but over half of global gas assets are held by national oil companies (**NOCs**). NOCs generally have far lower transparency and some have been shown to have very high estimated methane emissions.[xviii]

A methane reduction alliance between major gas importing countries could help to build on the positive aspects of voluntary schemes – including by mandating compliance with OGMP's methane reporting standards. At the same time, introducing substantive and verifiable emissions limits as a condition of trade would help prevent voluntary schemes being used to misrepresent emissions levels in gas supply chains, while bringing international pressure to bear on NOCs to cut methane emissions.

4 Design of a methane reduction alliance

This section sets out the key features of a methane reduction partnership between countries to reduce emissions.

4.1 Parties

Parties to the alliance would be the largest global gas importers, such as the EU, Japan, South Korea, the United Kingdom and China (referred to as **Alliance Parties**).

4.2 Setting of methane reduction targets

The Alliance Parties would agree on volume-based thresholds for supply chain methane emissions for all gas consumed within each of their territories each year (**Methane Thresholds**). To determine the Methane Threshold:

1. The government of each Alliance Party would calculate the projected total amount of gas consumed (**TGC**) within each Alliance Party's territory within the target period (e.g. 2025 to 2029).

2. A percentage methane emissions intensity target (**MEIT**) would be calculated across the Alliance Parties for the given period, based on (a) the need to reduce energy sector methane emissions from 2020 levels by 70% by 2030 (per IEA's guidance); (b) evidence from experts about feasible reductions in methane emissions intensity; and (c) representations from the gas industry (for example, European gas companies reported a

distribution-level emissions intensity of 0.12% in 2019 and OGCI companies have a stated goal of achieving 0.2% methane emissions intensity for upstream operations by 2025).[xix]

3. The MEIT would then be converted to a volume-based methane emissions reduction target for each Alliance Party (the **Methane Threshold**) for all gas consumed within their territory (covering the whole supply chain both within and outside of their borders). Conversion to a volume-based reduction would help ensure that achieving the MEIT is not offset by an Alliance Party increasing overall gas consumption.

4. The Methane Threshold would be evenly distributed across the period to which the target applies, providing the **Annual Methane Threshold**.

Methane Threshold (bcmCH4) = TGC x MEIT

Where:

- TGC is the projected total gas consumed within the relevant Alliance Party in a given year
- MEIT is the % targeted methane emissions-intensity of the supply chain
- bcmCH4 is the unit billion cubic metres of methane

$$\textbf{Annual Methane Threshold (bcmCH4)} = \textbf{MT} \times \frac{\textbf{1}}{\textbf{YTP}}$$

Where:

- MT is the Methane Threshold
- YTP is the number of years in the target period (e.g. there are five years of reductions in the target period 2025-2029 inclusive)

Worked example:

If the EU's TGC for 2025-2029 is 1,300bcm, and the MEIT is 0.15%, then:

$$\textbf{Methane Threshold} = 1300 \times \frac{0.15}{100} = 1.95\text{bcmCH4}$$

For a linear reduction in methane:

$$\textbf{Annual Methane Threshold} = 1.95 \times \frac{1}{5} = 0.39\text{bcmCH4}$$

Note: the Annual Methane Threshold is based on a linear reduction in emissions; this could be adjusted to give weighting to particular years if accelerating methane reductions are anticipated over the target period.

5. Once the Alliance Parties agree on Methane Thresholds and Annual Methane Thresholds, each Party would allocate a proportion of those amounts to gas supply chains within their jurisdictions (covering all supply chains including those without imported gas). This could be done by allocating quotas to the operators at a specified point in the supply chain for all methane emissions upstream of that operator (the **Methane Threshold Quota**). For example, a gas importing company would need to ensure that any gas they import complies with the allocation of the Annual Methane Threshold applied to the upstream segment up to and including the import segment, and a distribution company would be required to do the same for their segment of the supply chain. The relevant gas companies (or operators)

within each supply chain would need to provide evidence that all gas held at specified times complies with the Methane Threshold Quota. The Methane Threshold Quota would therefore act as a performance standard with which all gas molecules within the importing jurisdiction must comply.[xx]

6. Where a gas company or operator is not able to verify that their gas meets the Methane Threshold Quota, the Alliance Party would impose a methane fee or tax on the gas in that supply chain (or use other methane pricing mechanisms).[1] Crucially for trade law compliance as well as fairness and effectiveness, the performance standard would be applied to all gas produced within the Alliance Party's jurisdiction as well as imported gas.[2]

The alliance will have a greater impact if it incentivises methane reductions across the whole gas industry of importing and exporting countries, regardless of whether the gas is for export or domestic consumption. The above design would clearly incentivise the governments of gas exporting countries to introduce compatible legislation (such as a performance standard) to control methane emissions for their export supply chains, as this would simplify export processes. For some exporting countries there could also be advantages in regulating non-export supply chains in the same way, so as to avoid separate regulatory regimes. In addition to those incentives, Alliance Parties could promote ambitious methane abatement through an accreditation system for those gas exporting countries which regulate all gas industry methane leaks, including from abandoned wells. This would be predicated on the Alliance Parties having equivalent measures in place domestically (such as the EU's proposed rules for addressing abandoned well methane leaks).[xxi]

4.3 Verification

To simplify emissions monitoring, reporting and verification (**MRV**), gas companies would be allowed to rely on supply chain methane emissions reporting that complies with the latest OGMP guidance (currently OGMP 2.0). Alliance Parties would be responsible for ensuring that all gas consumed within their boundaries is subject to this MRV for the whole supply chain. This will be relatively straightforward for the components of the supply chain within their territories. To verify emissions for the parts of supply chains outside their territories, one of the following options could apply:

1. If the gas exporting country demonstrates that it has MRV systems in place across its whole gas industry that are at least as strong as OGMP, that country can be classified as a **Certified MRV Exporting Partner**. This would allow the exporting country to benefit from having their emissions monitoring system credited with a greater level of reliance from the Alliance Parties, thereby increasing the efficiency of the whole MRV scheme. A jurisdiction being classified as a Certified MRV Exporting Partner would not mean its supply chains are

[1] For example, the California Public Utilities Commission requires utilities to absorb the value of methane they emit, which incentivises them to prevent leaks – see Devashree Saha, 'As U.S. Government Retreats on Reducing Climate-warming Methane, 4 States Step Up' (18 September 2022) https://www.wri.org/insights/us-government-retreats-reducing-climate-warming-methane-4-states-step.

[2] Liability for any exceedance or failure to verify would be contractually attributed between gas trading companies.

deemed compliant with Methane Threshold Quotas, but would streamline the process for determining that compliance.

2. For non-MRV Certified Exporting Partners, a methane emissions intensity factor could be applied to each gas exporter, based on the most up-to-date independent scientific studies of their supply chain emissions. This would encourage emissions abatement across the gas industry, while incentivising governments of gas exporting countries to reform their MRV and emissions reductions programmes.

This design draws on features of the Kimberley Process Certification Scheme (**KPCS**) and the Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (**Kigali Amendment**). The KPCS was designed to ban the trade of conflict diamonds, and provides a useful example of a non- treaty-based approach to international regulation of supply chains. The 56 members of the KPCS (including the EU counting as one member) represent almost all countries involved in the diamond trade worldwide. The regime requires that member parties enact and enforce domestic legislation to criminalise the trade of conflict diamonds.[xxii] The Kigali Amendment, and the wider UNFCCC regime under which it sits, provide a useful example of how an international agreement can be implemented that includes a detailed phase-out path with differentiated obligations for the relevant parties.[xxiii]

4.4 Trade law compliance

With the increasing threat of climate breakdown, governments with higher climate ambition are looking to ensure that their own emissions reductions policies do not disadvantage local industry, while also encouraging other countries to increase their ambition. An example of this is the EU's proposed carbon border adjustment mechanism, which would allow trade-exposed EU industries to compete on the global market without being heavily subsidised domestically. Such mechanisms also incentivise government-level action in exporting countries to cut greenhouse gas emissions, because demonstrating that an export is compatible with an importer's emissions controls is more straightforward where an exporter can show it has similarly rigorous regulation. ClientEarth has commissioned analysis from leading trade law experts showing that, with careful design, countries can impose trade law restrictions for climate and environmental purposes, including using performance standards for methane emissions intensity as a means to adjust the price of imported gas.[3]

A methane reduction alliance could build on the bilateral cooperation mechanisms already in place between major gas importing countries. Various memoranda of understanding (**MoU**) have been signed between LNG importing counties, including between Japan and the UE,[xxiv] Japan and India,[xxv] and Japan, China and South Korea.[xxvi] While the objective of those agreements is primarily to improve market conditions for LNG buyers, they have established a framework of cooperation between key gas importers. The EU-Japan MoU already contains methane-related provisions in which the parties declare their intention to '[support] international

[3] For example, in June 2021, trade law expert Professor Robert Howse of New York University provided an opinion to ClientEarth on a proposal for an international performance standard applied to EU gas imports, which found that, with proper design, such a standard could be trade law compatible; see also ClientEarth's analysis of trade law compatibility of environmental restrictions (October 2020) available here: https://www.clientearth.org/latest/latest-updates/news/how-trade-policy-can-support-good-environmental-practice/.

efforts addressing environmental and social impacts across the whole LNG value chain, including through minimising fugitive methane emissions.'[xxvii] Such statements could be given effect through the development of binding measures to change incentives for gas exporting countries.

4.5 Funding emissions abatement

Many, but not all, of the major gas exporters have adequate resources and technical capacity to properly regulate the gas industry. Qatar, the US and Australia, for example, are well-positioned to regulate methane emissions from gas used internally and exported, as they have functioning rule of law, well-resourced public administrations, and resources to access the best technology. In developing countries, some of the NOCs are enjoying extraordinary profits in the current market and, with proper incentives, could be using some of those profits to invest in emissions abatement technologies. However where there are significant financial constraints on developing countries making the necessary investments for methane abatement, importing country governments could consider offering financial assistance (including from the distribution of revenues collected from excess methane emissions fees under the alliance) to capture wasted methane.

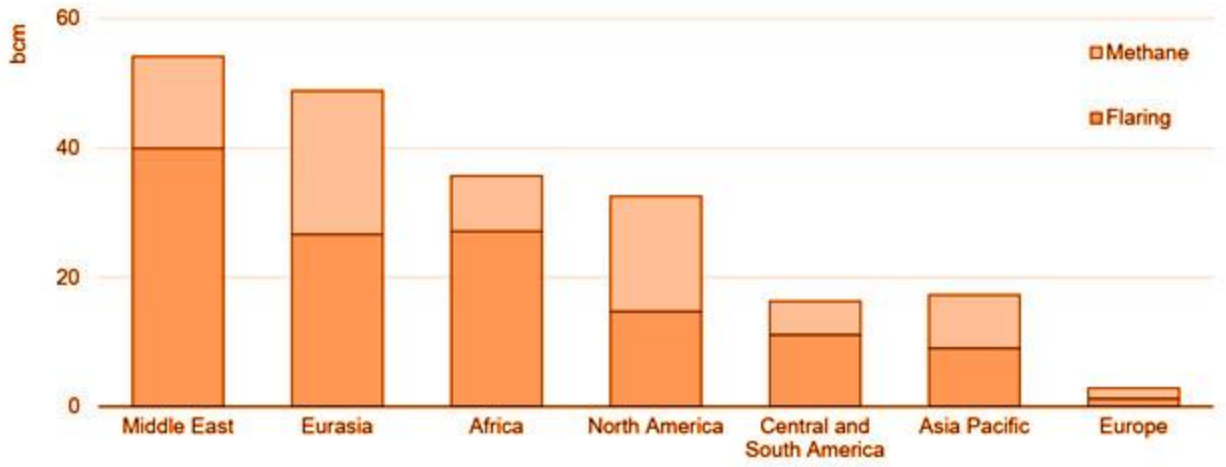
5 Trade context

The EU, Japan, South Korea, the United Kingdom and China are influential actors in the global gas market. These jurisdictions are major gas traders, accounting for over 70% of global gas imports.[xxviii] Four are also committed to achieving net zero emissions by 2050 (China's commitment is by 2060).

Despite their national emissions reductions commitments and evidence of significant differences in the levels of methane emitted from their imported gas supply chains, these countries do not distinguish between the most methane emissions-intensive gas and cleaner alternatives. For example, the EU does not use any pricing or other regulation to distinguish between gas from Algeria (a major EU supplier) which emits 140 times more methane per unit of gas than Norway.[xxix] The same goes for the main exporters into Japan and South Korea – US gas is estimated to emit nearly three times the methane of Malaysian gas.

As Russia's invasion of Ukraine, and OPEC decisions to limit gas supply, constrain global gas markets, countries reliant on gas imports are looking to new contracts to lock in supply, many of which would require expanded gas production and associated new infrastructure. This overlooks the role that methane regulation could play in bolstering gas supply. Analysis from the IEA suggests that capturing currently-wasted methane from O&G operations could provide nearly 210 billion cubic metres of gas (see Figure 4), and a report from Capterio and Columbia University shows that capturing methane which is currently wasted just in the North African gas supply chain could provide 15% of the gas currently imported into the EU from Russia, making use of underutilised pipelines and LNG infrastructure.[xxx] Such measures would help avoid significant expansion of gas fields and the consequent risks of asset stranding and emissions overshoot.

Figure 4: Gas volumes from eliminating non-emergency flaring and curtailing methane emissions[xxxi]



6 Conclusion

Measures to capture methane that would otherwise be wasted are now more important than ever, as gas-reliant countries scramble to find gas supplies and make rushed decisions that could lock them into long-term ongoing gas dependence. This proposal responds to the pressing need to address methane leaks while avoiding massive increases in gas production, showing that a trade-based mechanism could help to shift the incentives for recalcitrant governments and gas operators to capture methane. A methane reduction alliance is a reasonably nimble measure that could be expanded out promptly, starting with the largest gas importers, and avoiding the need for protracted international treaty negotiations. At a time when the world is already suffering from the impacts of global warming, it is incumbent on climate-ambitious governments to look for innovative mechanisms to rapidly stem emissions of this highly-potent greenhouse gas.

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