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Assessment of Opportunities for Implementing a Methane Import Standard in South Korea

This report was prepared by Carbon Limits AS for Solutions for Our Climate (SFOC).

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Assessment of Opportunities for Implementing a Methane Import Standard in South Korea

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The report provides a comprehensive analysis of the methane import standard landscape and outlines the opportunities for introducing a methane import standard in South Korea.

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Carbon Limits works with public authorities, private companies, finance institutions and non-governmental organizations to reduce greenhouse gas emissions from a range of sectors. Our team supports clients in the identification, development, and financing of projects that mitigate climate change and generate economic value, in addition to providing advice on the design and implementation of climate and energy policies and regulations.

Disclaimer

This report outlines potential approaches to designing a methane import standard in South Korea. It does not aim to identify the best approach or combination of approaches but rather to highlight the opportunities and methane reduction potential offered by each method. This report is not intended to be an exhaustive document, and alternative approaches to developing and implementing a methane import standard may exist. The results presented are based on the data and assumptions used in the analysis and may not fully reflect real-world conditions.

Part of this work is derived by Carbon Limits from International Energy Agency material. The report is not endorsed by the IEA in any manner.

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Abbreviations

APG	Associated petroleum gas
BOE	Barrel of oil equivalent
CBAM	Carbon Border Adjustment Mechanism
CH_4	Methane
CO_2	Carbon dioxide
ETS	Emission Trading System
EU	European Union
GWP	Global Warming Potential
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
kg	Kilogram
LDAR	Leak Detection and Repair
LNG	Liquefied Natural Gas
MMBtu	Million British Thermal Units
MJ	Megajoule
MRV	Monitoring, reporting and verification
$MtCH_4$	Mega-ton of methane
OCI+	Oil Climate Index plus Gas
OGCI	Oil and Gas Climate Initiative
OGMP	Oil and Gas Methane Partnership
VRU	Vapour recovery unit
USD	United States Dollar

Introduction

Having signed the Global Methane Pledge in 2021, South Korea has committed to reducing its methane emissions by 30% in 2030 compared to 2020 emission levels. In November 2023, the Korean government released a methane reduction roadmap, "demonstrating alignment with global methane reduction initiatives".[1] The roadmap establishes a 30% methane reduction target by 2030 from 2020 levels, with sector-specific reduction targets across waste (49% reduction), agriculture and livestock (34.2% reduction), and energy (22.7% reduction) to ensure the achievement of the country's methane reduction commitments.[2]

About 98% of oil and gas consumed in South Korea in 2023 was imported.[3] Given that a significant portion of methane emissions in oil and gas supply chains happen during up- and midstream operations, most of the methane emissions due to the consumption of oil and gas in South Korea occur outside of the country's border. As a significant player in the global energy market, South Korea can extend its efforts beyond its borders and leverage its influence by introducing a methane import standard. Such a standard could drive the adoption of methane emission mitigation solutions in exporting countries, similar to the methane regulation recently adopted in the EU (hereafter "EU Methane Regulation").[4]

Focusing on oil and gas imports, this report provides a comprehensive analysis of existing approaches to introducing a methane import standard and explores opportunities for implementing such a standard in South Korea. The report discusses four approaches to implementing a methane import standard: information-based, prescriptive, performance- and market-based. It quantitively evaluates the potential impact of imposing a standard on methane abatement potential and cost in major oil and gas exporters to South Korea. It also provides an estimate of the methane tax size required to achieve a target methane intensity in the case of a market-based approach. The implications of introducing a methane import standard for the oil and gas market and the security of supply are beyond the scope of this analysis.

The report is divided into three chapters. The first chapter provides an overview of approaches to calculating methane intensity and assesses the methane intensity of oil and gas imports to South Korea. The second chapter reviews different approaches to setting up a methane import standard and discusses the essential components of designing an effective import standard regulation. Finally, the third chapter assesses the impact of different approaches on methane abatement potential and producer costs. The analysis aims to support informed discussions on designing a methane import standard in South Korea. It however does not aim at identifying the best approach and does not claim to be exhaustive regarding the possible approaches to methane import standard. The study can be scaled and provide insights for a methane import standard design for coal. It can also be extended to other geographies such as China and Japan. Together with the EU these key markets represent a substantial share of the global fossil fuel imports and hold significant potential to influence global methane emission reductions.

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[1] SFOC (2024) Korea's 2030 Methane Emissions Reduction Roadmap: A Suitable Pathway to 1.5°C? Retrieved from: https://forourclimate.org/research/547

[2] SFOC (2024) Korea's 2030 Methane Emissions Reduction Roadmap: A Suitable Pathway to 1.5°C? Retrieved from: https://forourclimate.org/research/547

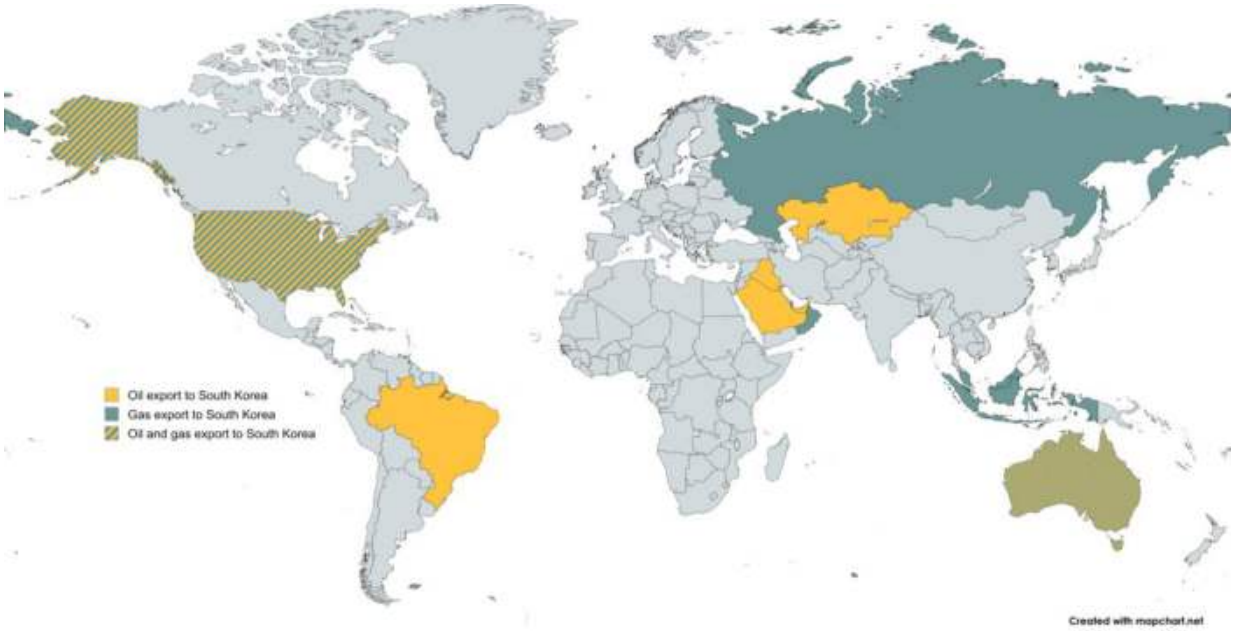
[3] Energy Institute (2024) Statistical Review of World Energy. Retrieved from: https://www.energyinst.org/statistical-review; Petronet (2024) Oil Import Statistics. Retrieved from: https://www.petronet.co.kr/v4/main.jsp; Korea Energy Economics Institute (2024) Korea Energy Statistical Information System: Monthly Energy Statistics. Retrieved from: https://www.kesis.net/sub/sub_0003_eng.jsp?M_MENU_ID=M_M_002&S_MENU_ID=S_M_011

[4] European Commission (2024) New EU Methane Regulation to reduce harmful emissions from fossil fuels in Europe and abroad. Retrieved from: https://energy.ec.europa.eu/news/new-eu-methane-regulation-reduce-harmful-emissions-fossil-fuels-europe-and-abroad-2024-05-27_en

1. Overview of the methane intensity of oil and gas imported to South Korea

In 2023, about 98% of oil and gas consumed in South Korea was imported. Based on Korean energy import statistics, major oil and gas exporting countries were identified.[5,6] Figure 1-1 shows the top nine oil exporters (United States, Iraq, Saudi Arabia, Brazil, United Arab Emirates, Kazakhstan, Kuwait, Qatar, Australia) and top seven gas exporters (United States, Russia, Qatar, Indonesia, Malaysia, Australia, Oman) to South Korea, which together accounted for more than 90% of South Korea's oil and gas imports in 2023.

Figure 1-1 – Major oil and gas exporters to South Korea in 2023

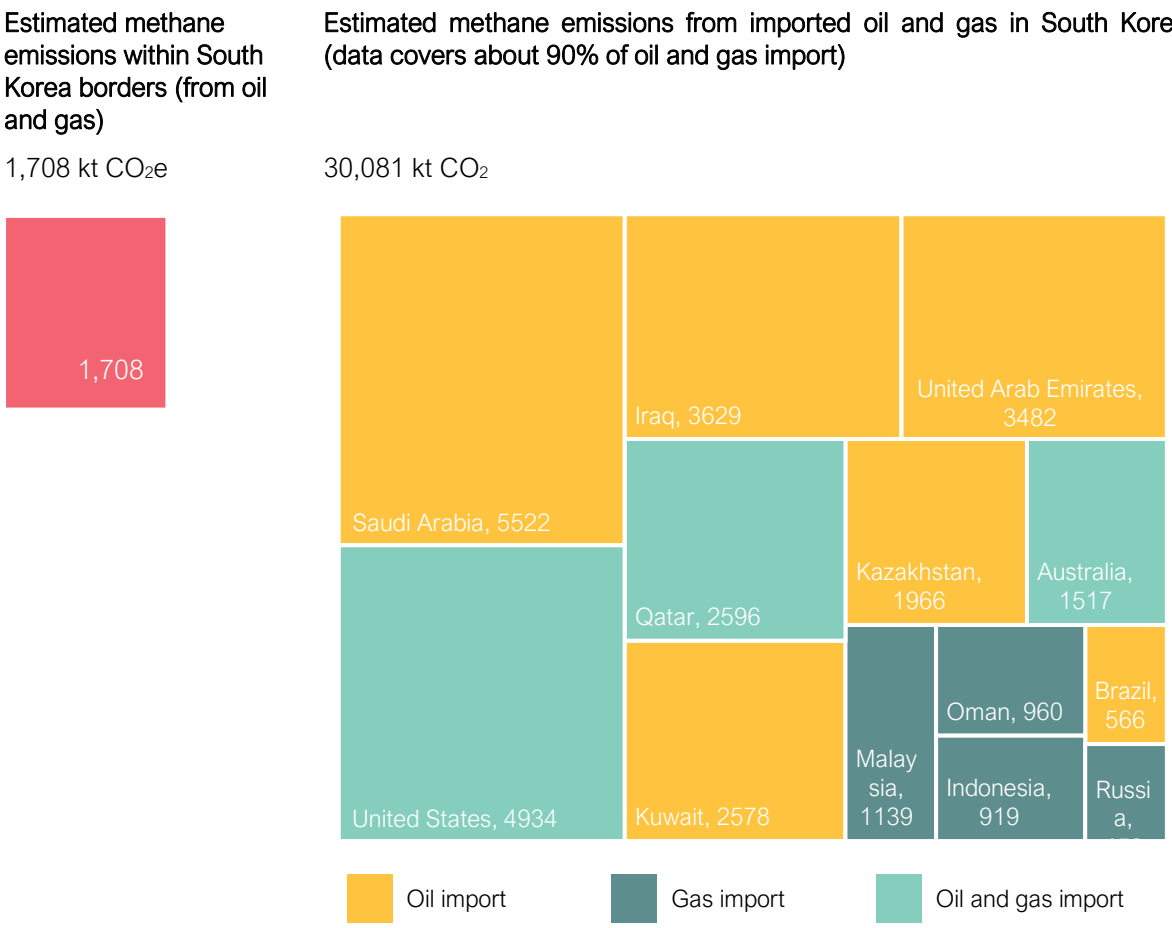


Source: Carbon Limits, based on data from the Internation Energy Agency (for oil) and the Korea Energy Economics Institute (for gas), 2025

Methane emissions from the oil and gas sector within South Korea's borders were 1,708 kt CO_2e.[7] This represents less than 6% of supply chain methane emissions from production and transportation that occur outside its borders, in the countries listed above. Figure 1-2 shows methane emissions within South Korea, represented by the pink box, compared to supply chain emissions from imported oil and gas, represented by the yellow (oil), blue-green (gas) and teal (oil and gas) boxes.

[5] Petronet (2024). *Oil Import Statistics*. Retrieved from: https://www.petronet.co.kr/v4/main.jsp
[6] Korea Energy Economics Institute (2024). *Korea Energy Statistical Information System: Monthly Energy Statistics*. Retrieved from: https://www.kesis.net/sub/sub_0003_eng.jsp?M_MENU_ID=M_M_002&S_MENU_ID=S_M_011
[7] International Energy Agency (2024). Global Methane Tracker 2024. Retrieved from: https://www.iea.org/reports/global-methane-tracker-2024

Figure 1-2 – Estimated methane emissions from oil and gas within South Korea and from imported products



Given the significant up- and midstream emissions in the oil and gas sector, it is essential to address methane emissions from a value-chain perspective. An importing country can influence its suppliers by imposing a methane import standard that could drive methane mitigation in exporting countries. Understanding the potential impact of such a standard requires a clear assessment of current methane emissions associated with energy imports.

To assess the feasibility of establishing a methane import standard in Korea, the initial step of the study involves estimating the methane emission intensity of the country's energy imports. This chapter offers a methodology for calculating the methane intensity of imported oil and gas covering supply chain emissions from production to the import point.

Methane intensity is a metric representing the amount of methane emissions relative to a specific unit of activity in oil and gas operations. It therefore allows to compare the performance of different supply chains in terms of methane emissions.

Various methodologies exist for calculating the methane intensity of oil and gas supply chains. Each existing framework employs unique choices for the numerator, denominator, scope, and output units, making comparisons challenging. For instance, members of the Oil and Gas Climate Initiative (OGCI) calculate their methane intensity at the corporate level as the ratio between the volume of methane emitted and the volume

of gas marketed. The result is expressed as a percentage.[8] On the other hand, the Oil Climate Index plus Gas (OCI+) calculates the intensity of oil and gas supply chains as the ratio between the mass of methane emitted and the total energy produced. The result is expressed in Mt CH_4 / MJ.[9] A similar unit (kg CH_4 / GJ) is also used by the International Energy Agency (IEA) in some publications.[10]

Because some countries only export oil or gas to South Korea, this paper presents separately methane intensity numbers for oil and for gas. The metric used is the ratio between the mass of methane emitted and the total energy produced. This metric is expressed as kilograms of carbon dioxide equivalent of methane emissions per barrels of oil equivalent of energy produced, which is relevant for both products and requires limited conversion factors. This type of metric has been favoured in this study for its applicability to oil and gas separately. However, a further comparative analysis of different metrics might prove that other metrics present more advantages depending on the intended use. In any case, an alignment of methodology for methane intensity calculation in the industry and across jurisdictions would increase reporting consistency and better inform regulatory decisions.

The formulas used and the methane intensities of oil and gas exporters to South Korea are detailed in the following sections.

1.1. Methane intensity of imported oil

Methane emissions in the oil value chain occur mainly during production (upstream) and less so during transportation and shipping (midstream): emissions from oil transport are considered minor compared to production, with the IPCC estimating them at 3% of production emissions.[11] Therefore, this analysis only focuses on emissions from oil production.

To calculate the methane intensity of oil production by an exporting country, the total methane emissions from upstream oil production are divided by the total oil production expressed in the energy unit.

$$Methane\ intensity\ \left[\frac{kg\ CO_2e}{BOE}\right] = \frac{Total\ methane\ emissions\ from\ upstream\ oil\ production\ [kg\ CH_4] \times Methane\ GWP\text{-}100}{Total\ volume\ of\ oil\ production\ [Sm^3] \times Energy\ content\ of\ oil\ \left[\frac{GJ}{Sm^3}\right] \times Conversion\ factor\ \left[\frac{BOE}{GJ}\right]}$$

Where:

- The total mass of methane emissions from upstream oil production in each country is retrieved from the Global Methane Tracker provided by the IEA.[12] IEA estimates methane emissions from global oil and gas operations by generating emission intensities specific to each country and production type, and then applying these to country-specific production and consumption data.[13] Emissions from three production sources are aggregated: onshore conventional oil, offshore oil and unconventional oil

[8] Oil & Gas Climate Initiative (OGCI), *Reporting Framework*, October 2023, https://www.ogci.com/wp-content/uploads/2023/11/OGCI_Reporting_Framework_2023_-_FINAL_FINAL.pdf
[9] Rocky Mountain Institute, *Oil Climate Index + Gas Methodology*, 2024, https://ociplus.rmi.org/methodology#introducing
[10] International Energy Agency (2024). *Methane emissions from oil and gas production and methane intensity for selected producers, 2023*. Retrieved from: https://www.iea.org/data-and-statistics/charts/methane-emissions-from-oil-and-gas-production-and-methane-intensity-for-selected-producers-2023
[11] Boettcher et al. (2019). *Chapter 4: Fugitive Emissions. 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy.* Accessible online: https://www.ipcc-nggip.iges.or.jp/public/2019rf/vol2.html
[12] International Energy Agency (2024). *Global Methane Tracker 2024*. Retrieved from: https://www.iea.org/reports/global-methane-tracker-2024
[13] International Energy Agency (2024). Global Methane Tracker Documentation 2024 Version. Retrieved from:https://iea.blob.core.windows.net/assets/d42fc095-f706-422a-9008-6b9e4e1ee616/GlobalMethaneTracker_Documentation.pdf

- The total volume of oil production in each country is provided by the IEA[14]
- The average energy content of oil is assumed to be 36 GJ / Sm^3 crude oil[15]
- The global warming potential over 100 years (GWP-100) of methane is 28[16]
- The conversion factor from GJ to BOE is assumed to be 0.18 BOE / GJ[17]

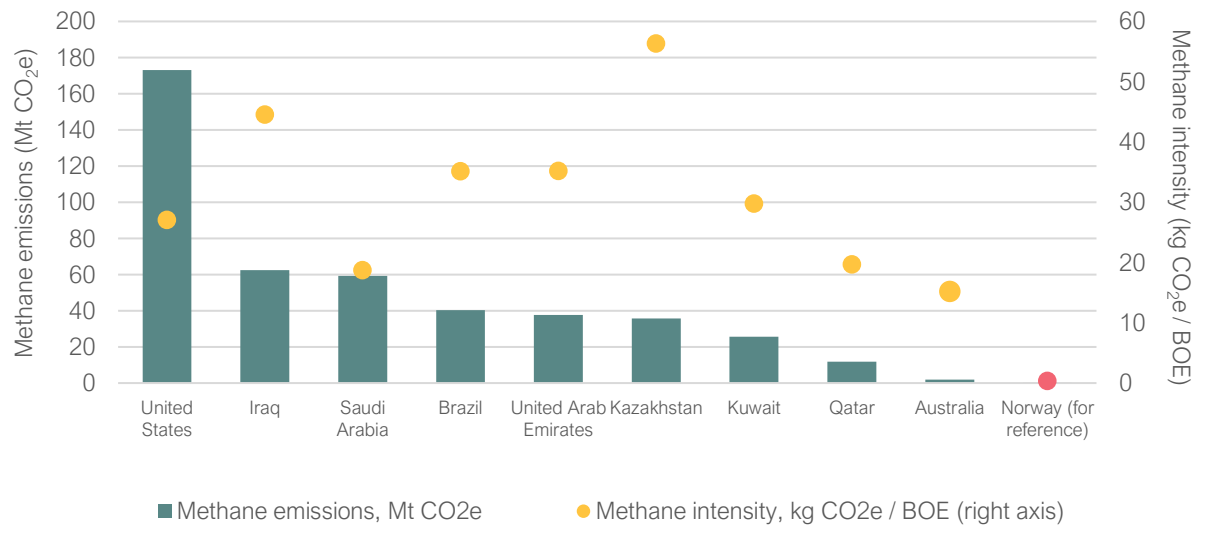
The results obtained are presented in Table 1-1. The intensity of oil imported to South Korea ranges from 15.2 kg CO_2e/BOE (Australia) to 56.3 kg CO_2e/BOE (Kazakhstan). Considering the volume imported in 2023 from each country, the weighted average methane intensity of the top nine oil exporters to South Korea is 27.6 kg CO_2e/BOE. For comparison, Norway has a methane intensity of 0.3 kg CO_2e/BOE for oil.

To put these numbers in perspective, the industry-wide target of OGCI is 0.2% (of gas volume emitted). This value has been used as the threshold for the upstream segment in the Waste Emissions Charge (WEC) in the United States.[18] Assuming an average methane content of 90%, this threshold is equivalent to 5.9 kg CO_2e/BOE. Thus, the average intensity of oil exported to South Korea is about 4.7 times higher than this threshold.

At 90% methane content in gas, OGCI's 0.2% methane intensity target corresponds to 5.9 kg CO_2e per BOE

Figure 1-3 illustrates methane emissions associated with oil exported to South Korea.

Figure 1-3 – Methane emissions and methane intensity associated with oil exported to South Korea in 2023



[14] International Energy Agency (2024). *Oil Market Report*. Retrieved from: https://iea.blob.core.windows.net/assets/9780437d-2467-427d-a1a5-fb710cdfd0a1/-15MAY2024_OilMarketReport.pdf
[15] Norwegian Offshore Directorate (2025). *Energy calculator*. Accessible online at: https://www.norskpetroleum.no/en/calculator/about-energy-calculator/
[16] Greenhouse Gas Protocol (2016). *Global Warming Potential Values from IPCC Fifth Assessment Report (AR5)*. Accessible online at: https://ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf
[17] Equinor ASA (2025). *Natural Gas Converter*. Accessible online at: https://ngc.equinor.com/
[18] US Environmental Protection Agency (2024). *Waste Emissions Charge for Petroleum and Natural Gas Systems: Procedures for Facilitating Compliance, Including Netting and Exemptions.* Accessible online at: https://www.epa.gov/inflation-reduction-act/waste-emissions-charge

Table 1-1 – Methane intensity of oil exported to South Korea

Country	Methane intensity (kg CO_2e/BOE)
Australia	15.2
Brazil	35.2
Iraq	44.6
Kazakhstan	56.3
Kuwait	29.8
Qatar	19.7
Saudi Arabia	18.7
United Arab Emirates	35.2
United States	27.1

Source: Carbon Limits analysis (2025), based on data from International Energy Agency (2023) Methane Tracker Database

1.2. Methane intensity of imported gas

Gas is imported to South Korea by sea as liquefied natural gas (LNG). Methane emissions occur at every stage of the value chain before entering South Korea's territory: during production (upstream), inland transportation (relevant not for all locations), processing and liquefaction, loading and shipping.

In this assessment, methane emissions associated with gas imported to South Korea thus result from the sum of emissions occurring:

- During production (upstream): the mass of methane emissions for each country is obtained by aggregating emissions from "onshore conventional gas", "offshore gas" and "unconventional gas" from the Global Methane Tracker provided by the IEA.[19] The share of emissions allocated to gas exported to South Korea is assumed to be equal to the ratio between the volume of gas exported to South Korea and the volume of gas produced in the country.
- During inland transportation, liquefaction and loading (midstream): the mass of methane emissions for each country is derived from the "downstream gas" emissions from the Global Methane Tracker provided by the IEA.[20-21] The share of emissions allocated to gas exported to South Korea is assumed to be equal to the ratio between the volume of gas exported to South Korea and the volume of gas produced in the country.
- During shipping: the mass of methane emissions for each country is derived from a record of LNG shipping in 2023 provided by SFOC based on Kpler. For each shipment in 2023, the volume of the LNG cargo at departure and arrival is extracted from the dataset. Emissions are calculated from the

[19] International Energy Agency (2024). *Global Methane Tracker 2024*. Retrieved from: https://www.iea.org/reports/global-methane-tracker-2024

[20] International Energy Agency (2024). *Global Methane Tracker 2024*. Retrieved from: https://www.iea.org/reports/global-methane-tracker-2024

[21] This method relies on the assumption that emissions due to the downstream activities for local consumption (*e.g.*, distribution) are equivalent to the ones dedicated to export (*e.g.*, liquefaction). This assumption was made to obtain a conservative estimate of intensity rather than excluding the inland transportation and liquefaction activities by lack of data.

difference of volume by applying a factor representing the methane slip of the vessel. The methane factor depends on the type of vessel and is retrieved from Howarth 2024.[22]

$$\text{Methane intensity}\left[\frac{kg\ CO_2e}{BOE}\right] = \frac{\text{Methane emissions}_{upstream}[kg\ CO_2e] + \text{Methane emissions}_{midstream}[kg\ CO_2e] + \text{Methane emissions}_{shipping}[kg\ CO_2e]}{\text{Total volume of gas exported}\ [Sm^3] \times \text{Average gross calorific value of natural gas}\ \left[\frac{GJ}{Sm^3}\right] \times \text{Conversion factor}\left[\frac{BOE}{GJ}\right]}$$

Where:

$$\text{Methane emissions}_{upstream}[kg\ CO_2e] = \text{Total methane emissions from upstream gas production}\ [kg\ CH_4] \times \frac{\text{Total volume of gas exported}\ [Sm^3]}{\text{Total volume of gas production}\ [Sm^3]} \times \text{Methane GWP-100}$$

$$\text{Methane emissions}_{midstream}[kg\ CO_2e] = \text{Total methane emissions from}\ \frac{mid}{downstream}\ \text{gas production}\ [kg\ CH_4] \times \frac{\text{Total volume of gas exported}\ [Sm^3]}{\text{Total volume of gas production}\ [Sm^3]} \times\ \text{Methane GWP-100}$$

$$\text{Methane emissions}_{shipping}[kg\ CO_2e] = \sum_{Shipments} \left(Cargo_{origin}[kg\ CH_4] - Cargo_{destination}[kg\ CH_4]\right) \times \frac{\text{Methane slip}\ [\%]}{1 + \text{Methane slip}[\%]} \times \text{Methane GWP-100}$$

Where:

- The total volume of gas production in each country is retrieved from the Energy Institute[23]
- The total volume of gas imported from each country is retrieved from the Korea Energy Economics Institute[24]
- The average gross calorific value of gas exports by country is retrieved from the International Energy Agency[25]
- The global warming potential over 100 years (GWP-100) of methane is 28[26]
- The conversion factor from GJ to BOE is assumed to be 0.18 BOE / GJ[27]

The results are presented in Table 1-2. The intensity of gas imported to South Korea ranges from 12.9 kg CO_2e/BOE (Australia) to 36.3 kg CO_2e/BOE (Indonesia). Considering the volume imported in 2023 from each country, the weighted average methane intensity of the top seven gas exporters to South Korea was 22.3 kg CO_2e/BOE. For comparison, Norway has a methane intensity of 0.02 kg CO_2e/BOE for gas.

To put these numbers in perspective, the threshold set up by the Waste Emissions Charge (WEC) in the United States for the upstream segment is equivalent to 5.9 kg CO_2e/BOE. Thus, the average intensity of gas exported to South Korea is about 3.8 times higher than this threshold.

Figure 1-4 illustrates methane emissions associated with gas exported to South Korea.

[22] Howarth, R.W. (2024). The greenhouse gas footprint of liquefied natural gas (LNG) exported from the United States. *Energy Science & Engineering*.
[23] Energy Institute (2024). *Statistical Review of World Energy 2024*. Retrieved from: https://www.energyinst.org/statistical-review
[24] Korea Energy Statistical Information System (2024). *Monthly Energy Trends, Gas*. Retrieved from: https://www.kesis.net/sub/sub_0001_eng.jsp
[25] International Energy Agency (2024). *Annual Gas Statistics Database Documentation*. Retrieved from: https://wds.iea.org/wds/pdf/Gas_documentation.pdf
[26] Greenhouse Gas Protocol (2016). *Global Warming Potential Values from IPCC Fifth Assessment Report (AR5)*. Retrieved from: https://ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf
[27] Equinor ASA (2025). *Natural Gas Converter*. Retrieved from: https://ngc.equinor.com/

Figure 1-4 – Methane emissions and methane intensity associated with gas exported to South Korea in 2023

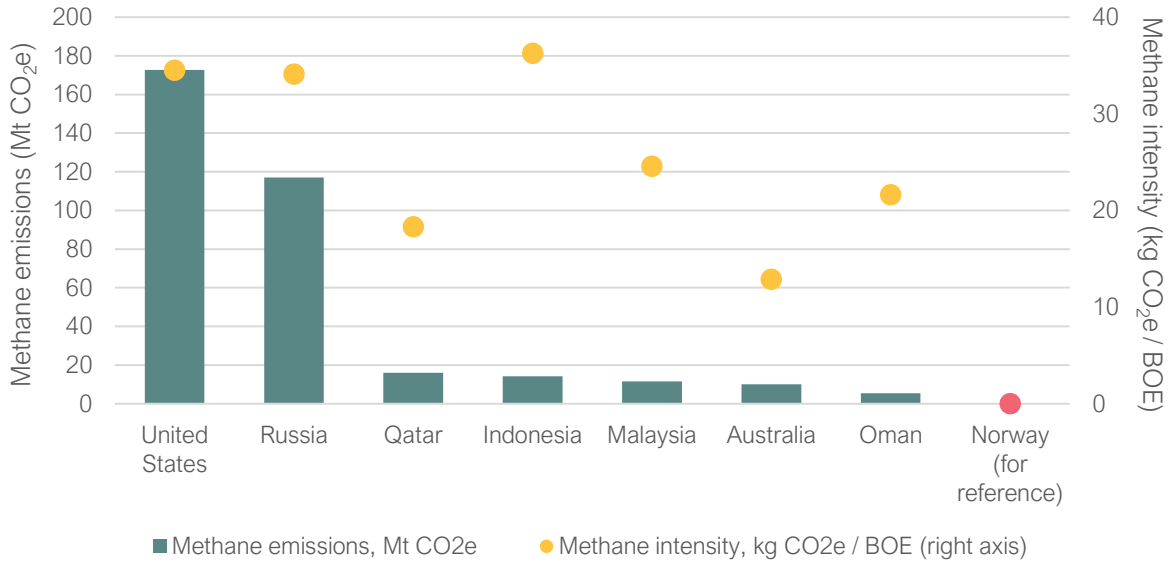


Table 1-2 – Methane intensity of gas exported to South Korea

Country	Methane intensity (kg CO2e/BOE)
Australia	12.9
Indonesia	36.3
Malaysia	24.6
Oman	21.6
Qatar	18.3
Russia	34.1
United States	34.5

Source: Carbon Limits analysis (2025), based on data from International Energy Agency (2023) Methane Tracker Database

1.3. Key takeaways

There are several methodologies for calculating the methane intensity of oil and gas, such as those suggested by OGCI, OCI+, and IEA. This report considers the methane intensity of oil and gas separately, based on the total methane emissions from production divided by the volume of production expressed in kg CO2e/BOE.

The analysis focuses on the top-nine oil (United States, Iraq, Saudi Arabia, Brazil, United Arab Emirates, Kazakhstan, Kuwait, Qatar, Australia) and top-seven gas (United States, Russia, Qatar, Indonesia, Malaysia, Australia, and Oman) exporters to South Korea. The results show that the weighted average

methane intensity of imported oil is 27.6 kg CO_2e/BOE and of imported gas is 22.3 kg CO_2e/BOE. These numbers are significantly higher than 5.9 kg CO_2e/BOE, which corresponds to the industry-wide accepted target of 0.2%.

Given the significant share of imported fossil fuels in the country's consumption and the fact that the majority of methane emissions occur in the up- and midstream segments, it is important for South Korea to address methane emissions in the oil and gas supply chains. This highlights the relevance of methane regulation and the introduction of a methane import standard in Korea. Understanding the current methane intensity provides a foundation for subsequent analysis of different approaches to implementing a methane import standard, which will be explored in the following chapters of the report

2. Review of approaches to methane import standard

Chapter 2 presents different approaches to designing a methane import standard. It considers methane-specific regulatory approaches while demonstrating how these approaches can be applied to methane import standard and highlights essential regulatory elements for developing such a standard.

2.1. Approaches to setting up a methane import standard

IEA categorizes methane-focused policies in the energy sector into four regulatory approaches: prescriptive, performance-, market- and information-based.[28] Even though this categorization applies to policies mostly targeting national or subnational methane emissions (the EU Methane Regulation being the first one to target emissions beyond the jurisdiction's borders), those approaches can be used to design an import standard. These approaches can be applied separately or in combination.

1. Information-based: This type of policy is designed to improve the process of collecting, quantifying and reporting information about emissions. When applied to an import standard, this approach can consist of requiring that information regarding emissions associated with the imported products is submitted and obtained following defined monitoring, reporting and verification (MRV) requirements.

2. Prescriptive: This type of policy is intended to achieve emission reductions by mandating specific requirements regarding technologies, equipment, procedures, and practices. For instance, policies can impose a ban on venting and flaring, set requirements for periodic Leak Detection and Repair (LDAR), or prohibit gas-driven devices. When applied to an import standard, this approach can require that the imported product was produced (and, depending on the scope, processed and transported) following certain practices or using certain technologies.

3. Performance-based: This type of policy establishes a mandatory performance standard expressed as a methane emissions intensity target, without specifying how the target must be achieved. When applied to an import standard, this approach can typically take the form of a maximum allowable methane intensity of a product.

4. Market-based: This type of policy imposes a cost on methane emissions to create an economic incentive for producers to reduce their emissions. This instrument can take the form of a fee or tax or be integrated into an existing emission trading system (ETS). When applied to an import standard, it can be imposed in several ways: based on the amount of oil and gas imported (assuming an importer has a defined methane intensity for a product), or according to a reported methane intensity of a product (cargo intensity or producer's intensity) in full or in part that exceeds a certain threshold (can be linked to the performance-based standard). Other approaches are possible, such as a system based on the ETS and a border adjustment mechanism[29], but these are not analyzed further in this report.

[28] International Energy Agency (2021) Driving Down Methane Leaks from the Oil and Gas Industry: A Regulatory Roadmap and Toolkit. Retrieved from: https://www.iea.org/reports/driving-down-methane-leaks-from-the-oil-and-gas-industry

[29] The relevance of a system similar to the EU Carbon Border Adjustment Mechanism (CBAM) is not within the scope of the current analysis as upstream oil and gas is not covered by the existing Korean ETS.

2.2. Elements of an import standard policy design

This section outlines some key elements to be defined as part of an import standard, depending on the chosen approach, and focuses on three main aspects:

- Stringency: Defines the strictness of the standard.
- Methodologies: Ensures the standard is applied consistently.
- Proof and Verification: Guarantees the standard is enforced.

Additionally, this section highlights the challenges and opportunities for synergies with existing frameworks. The elements presented are based on Carbon Limits' analysis of the IEA Regulatory Roadmap[30], the EU Methane Regulation, and the Clean Air Task Force's roadmap for the development of an import standard (hereafter referred to as "CATF's roadmap")[31].

Information-based

Stringency: The required quality of methane emissions estimates must be characterized across several dimensions:

Type of information to be reported: In addition to methane emissions numbers, complementary information may be required, such as the identification of the locations and/or operators involved in the value chain (production facility, processing facility, *etc*.) or, in the case of methane intensity, the throughput of the different facilities along the value chain.

Accepted methods to quantify emissions: These can range from generic and aggregate emission factors to measurements or measurement-informed specific emissions factors. Methane emissions inventories are considered more robust when emissions are quantified for each individual emission source (e.g., for each compressor). However, this approach may also be complemented by site-level quantification (referred to as "top-down" quantification) using methods such as drones or planes.

Granularity of reporting: At the level of production, methane emissions estimates may be communicated for each emission source or aggregated by source categories, by facility or group of facilities, or by an operator. Looking at the entire value chain, it should be specified which stages are included in the reporting and if and how they can be aggregated.

Frequency of quantification and reporting: Emissions numbers may be updated at a set frequency.

Methodologies: As part of the reporting methodology, the accepted methods for quantification must be defined. This includes specifying which sets of detection and quantification technologies are accepted, and which standards and sources may be used for calculations or emission factors. Reporting templates may be laid out or re-used from existing frameworks to facilitate reporting aligned with the targeted granularity. Additionally, when considering all emissions along a product value chain, the different stages at which emissions must be reported (i.e., the number of actors that must report) should also be specified.

Proof and verification: The design of the import standard may define if and how methane emissions reports are to be verified. Specifically, the standard may specify who is entitled to carry out the verification (typically

[30] International Energy Agency (2021) Driving Down Methane Leaks from the Oil and Gas Industry: A regulatory roadmap and toolkit, Driving Down Methane Leaks from the Oil and Gas Industry – Analysis - IEA , License: CC BY 4.0

[31] Carbon Limits (2023) Roadmap for the Development of an EU Methane Import Standard. Retrieved from: https://www.catf.us/resource/roadmap-development-eu-methane-import-standard/

an entity independent from oil and gas producers), what the scope of the reporting activities is (desktop methodology verification and/or site audits), and which standard(s) the information is checked against.

Challenges and opportunities: The Oil and Gas Methane Partnership (OGMP2.0) framework can serve as a basis for the information-based standard. This reporting framework recommends quantification methods for each source category, provides reporting templates, defines reporting levels and proposes a pathway to improving the reporting. The highest reporting level relies on a combination of source-level quantifications based on measurements or engineering calculations and site-level measurements. A "gold standard" is attributed to companies that report a defined share of their emissions and assets at the highest level. This voluntary initiative covered 140 companies globally in 2024. Therefore, even though information collection and analysis can represent a significant effort for operators, an import standard based on OGMP2.0 may only represent a marginal increase in effort for those companies that have already joined it (see Section 3.1). In addition, the EU Methane Regulation also contains an information-based import standard (through the concept of MRV equivalence defined in Article 28 of the EU Methane Regulation), which builds upon the OGMP2.0 gold standard.

The OGMP2.0 framework does not involve verification. Verification beyond desktop checks may be challenging. Collaboration with private or public organizations in the producing or exporting country may be required for on-site verification. This could be developed in synergy with the EU import standard, which includes verification by an independent third party. Additionally, some certification frameworks exist or are being developed for gas, such as the MiQ[32] and the Measurement, Monitoring, Reporting, and Verification (MMRV)[33] frameworks, and could be leveraged to track emissions along value chains. Independent data sets (in particular through the International Methane Emissions Observatory) including but not limited to satellite data may be used as a complement to evaluate the quality of the received information.

Prescriptive

Stringency and methodologies: The import standard may specify which practices and technologies must be implemented, and which ones are prohibited. The stringency of the standard depends, in the first place, on which emission sources are targeted: leaks, flaring, compressors, tanks, etc. In the second, it depends on what requirements are set for each targeted emission source. For instance:

LDAR: The standard can include details about the frequency of LDAR campaigns, the accepted types of detection technologies (e.g., through the definition of a detection threshold and probability of detection), the minimum leak rate above which leaks must be fixed, and the allowed delay for completing the repair.

Ban on venting and flaring: The standard can specify the edge cases and exemptions in which flaring or venting is allowed.

BATs: The standard can specify which types of pumps and controllers are allowed (e.g., electric, instrument air, or with a limit on the bleed rate) or which types of centrifugal compressors are permitted. It can also impose the installation of vent recovery units on tanks and a minimum destruction efficiency on flares.

Proof and verification system: Operators may be required to report on the practices and technologies in place at their sites. This may include LDAR reports, reports on the volumes of gas flared and vented, and inventories of equipment. The reported information may be verified through site audits. Similar to the

[32]MiQ, MiQ website, Accessible at : https://miq.org/ . Last accessed: February 2025
[33]US department of energy, Greenhouse Gas Supply Chain Emissions Measurement, Monitoring, Reporting, Verification Framework, Accessible at: https://www.energy.gov/fecm/greenhouse-gas-supply-chain-emissions-measurement-monitoring-reporting-verification-framework . Last accessed: February 2025.

information-based standard, the entities entitled to carry out verification and the procedures may be specified.

Challenges and opportunities: The prescriptive standard has a rigid nature, as only the prescribed changes will take place. While there is industry alignment on what constitutes best practices, as referenced in the Methane Guiding Principles' guides[34], not all practices or technologies may be applicable to all situations. For instance, certain detection technologies (for LDAR) or abatement technologies might not be available in certain regions or might not be suitable for specific locations. Therefore, one of the challenges of the prescriptive import standard is to define requirements that are stringent and detailed enough to lead to emission reductions but flexible enough to be applicable to most operators. If not based on a robust marginal abatement cost analysis, this approach can lead to not implementing the most cost-effective solutions. Consequently, complying with the standard can be particularly costly for certain operators and/or can have limited effects on emissions abatement. Another challenge of the prescriptive standard is futureproofing: if the standard is very specific in the designation of the allowed technologies, future emerging abatement technologies might be prohibited from being implemented.

Similar to the information-based standard, this approach may require some cooperation with parties in the producing or exporting countries for site audits. However, due to the nature of the information required (practices in place instead of emission estimates), this type of standard is easier to administrate than information-based or performance-based standards. The information reported might be relatively simple to verify, as it is not prone to variation in reporting methods.

Performance-based

Stringency: The import standard may establish a maximum methane intensity threshold for imported products. Differentiated thresholds can be set for various products, similar to the approach taken in the EU Methane Regulation.

Methodologies: To ensure the standard is consistently applied, the methodology for calculating methane intensity must be unequivocally defined. The standard must thus specify the parameters to be used for the numerator and the denominator, including the units, the scope and the granularity of the information.

Proof and verification system: The quality of the methane intensity number depends on the quality of the methane emissions number. Therefore, an MRV system must be in place to ensure that methane intensity is calculated based on robust emissions estimates. Consequently, all the previously mentioned considerations regarding the information-based metric are also applicable to the performance-based metric. Additionally, the standard could require operators or exporters to report information about the amount of product they produce, process, or sell to document the denominator of the intensity number.

Challenges and opportunities: The performance-based standard offers flexibility for producers and exporters, allowing them to develop their own mitigation strategies and innovate to reduce their methane intensity below the threshold. However, for it to be effective in reducing emissions, an importing country must set the intensity threshold at an appropriate level. To align with the EU's approach, this could involve assessing the baseline intensity of exporting countries based on consolidated emission numbers and then evaluating the impacts of different threshold values. In the EU Methane Regulation, there is a phased implementation of the performance-based standard: importers are initially required to report intensity before the EU Commission determines the maximum admissible intensity values.

[34]Methane Guiding Principles, Best practices guides, Accessible at: https://methaneguidingprinciples.org/resources/best-practices/ . Last accessed: February 2025.

One key element of the performance-based standard is the methodology for calculating methane intensity which must be applied consistently across all operators or exporters. To address this, aligning the methodology with the one defined by the EU or with other existing methodologies may reduce the risk of confusion. The EU methane intensity is defined at the producer level. Should an importing country aim to define a value chain methane intensity metric, additional methodological steps would need to be specified. Methodologies to aggregate intensities from different segments have already been published, for instance by the Natural Gas Sustainability Initiative[35].

Market-based

Stringency: A methane tax on emissions from imported oil and gas can be imposed based on the amount of a product either according to a reported methane intensity of a product or the intensity set in an importer's country regulation. It can be applied to all products, or products with methane intensity above a set threshold.

Methodologies: Methodologies for calculating the tax must be defined, including how emissions and/or methane intensity are estimated. If the tax applies only to products exceeding a certain intensity threshold, a benchmark must be established. The tax rate should be set at a level that discourages high-emission practices and incentivizes mitigation. Therefore, determining this tax rate requires a thorough cost analysis.

Proof and verification system: In line with defined MRV requirements, exporters may be required to submit an emission report detailing methane emissions and methane intensity calculations. Similar to previous approaches, third-party audits can ensure that reported emissions are accurate, and methane intensity is calculated based on a defined or equivalent methodology. If accepted by a regulator, exporters might submit proof of paying the equivalent of a tax in their jurisdiction.

Challenges and opportunities: Similarly to the performance-based standard, the market-based approach offers flexibility to producers and exporters to reduce emissions in the most cost-effective way. However, it also requires a robust understanding of baseline emissions and market dynamics to be designed efficiently. A tax on methane emissions exists in some jurisdictions such as Norway[36] or in the US[37] and might be used as models even though they do not apply to imports.

Example: approach in the EU Methane Regulation

Table 2-1 shows the approach taken by the EU in its Methane Regulation. It outlines the approach taken for each standard and the choices made in terms of the level of stringency, methodologies, proof required, and verification procedures.

[35] Edisson Electric Institute and American Gas Association (2024) NGSI Methane Emissions Intensity Protocol Version 2.0. Retrieved from: https://www.eei.org/issues-and-policy/NGSI

[36] Norwegian Offshore Directorate, Act 21 December 1990 no 72 relating to tax on discharge of CO2 in the petroleum activities on the continental shelf. Accessible at: https://www.sodir.no/en/regulations/acts/co2-discharge-tax/ Last accessed: February 2025.

[37] U.S. Environmental Protection Agency (2025) Waste Emissions Charge. Retrieved from: https://www.epa.gov/inflation-reduction-act/waste-emissions-charge

Table 2-1 – Oil and gas import standards defined in the EU Methane Regulation

Import standard	Policy approach	Stringency	Methodologies	Proof and verification system
MRV Equivalence	Information-based	Monitoring and reporting equivalent to what operators in the EU are subject to or to OGMP 2.0 level 5: • Yearly reporting • Source-level quantification based on measurements. • Site-level quantification based on measurements.	The minimum information to be provided is defined in Article 12: type and location of the emission sources, information on the quantification methodologies, methane emissions on operated and non-operated assets, etc. Reporting templates will be laid out. The latest technical guidance documents and reporting templates of the OGMP may be used in the meantime. Accepted measurements and quantification methods will be defined. In the meantime, the latest OGMP 2.0 technical guidance documents approved before 4 August 2024 may be used.	Importers must provide a copy of the latest report on methane emissions. Reports submitted by importers must be verified by independent third-party verifiers.
Methane intensity	Performance-based	The maximum admissible methane intensity for oil and gas will be defined by 2029 after an assessment of the potential impact of various levels of maximum methane intensity values.	The methodology to calculate methane intensity will be defined by 2027. Operators and importers will report methane intensity starting from 2028. The information reported will support the impact assessment to determine the level of ambition.	The evidence and verification required to support the methane intensity reported are not explicitly mentioned in the EU Regulation text. However, the numbers are expected to be backed by the fact that emissions must be reported and verified following the MRV equivalence.

While this section focuses on the elements to be defined as part of an import standard design, further regulatory and economic considerations may also be analyzed. For example:

> **Responsibility for enforcement:** Who is responsible for enforcing the import standard? In the EU, each Member State's competent authorities receive information from operators and importers and apply penalties in case of infringement.

Entities subject to the standard: Who is the import standard enforced on? In the EU, importers placing products on the EU market must meet the requirements, as well as operators within the EU.

Guaranteeing enforcement: How is enforcement guaranteed? An incentive system must be in place to ensure the entities subject to the standard comply with it. In the EU, each Member State lays down rules on penalties applicable to infringements, ensuring that penalties are effective, proportionate, and dissuasive.

Impact on trade and prices: What are the impacts on trade and final consumer prices?

Legal applicability: Is the standard applicable from a legal perspective? For instance, the CATF's roadmap analysed the conditions necessary for the import standard to be compliant with World Trade Organization (WTO) rules.

These considerations will help in choosing the most suitable type(s) of standard and an appropriate level of stringency.

2.3. Key takeaways

An import standard for South Korea can be defined using different approaches: information-based, prescriptive, performance-based, and market-based. To ensure the standard's applicability, its effectiveness in reducing methane emissions and its cost-effectiveness, several elements must be defined during its design. A robust information-based standard may serve as a prerequisite for other types of standards. To facilitate its design and implementation and avoid duplicating reporting efforts for exporters, a South Korean import standard could draw on existing reporting frameworks (such as OGMP 2.0), certification frameworks, or the forthcoming import standards in the EU. The following section provides a preliminary analysis of the impact these approaches can have on exporters of oil and gas to South Korea. In addition to the analysis of abatement costs, further considerations regarding enforcement, market dynamics and WTO compliance must be evaluated.

3. Assessment of the impact of approaches on abatement potential and producer costs

This chapter presents an assessment of how oil and gas producers' practices, methane abatement cost and abatement potential would be impacted by an import standard that could potentially be introduced in South Korea depending on the approach taken and the level of ambition chosen.

The following sections provide the qualitative assessment of an information-based import standard and quantitative estimates of the impact of prescriptive, performance- and market-based standards on oil and gas exporters to South Korea. The estimates are based on assumptions regarding the scope of a prescriptive standard, the target for a performance standard, and the amount of tax in the case of a market-based standard. These serve as an illustration of potential impact and are not recommendations but rather reflections of the assumptions made. When developing an import standard, South Korea may select different parameters.

The quantitative analysis is based on the Methane Tracker data from the IEA that provides a selection of methane mitigation options in the oil and gas industry and estimates for each mitigation option the associated abatement potential and cost.[38] Each option has a specific capital cost, annualized over its expected lifespan, and added to yearly operational costs like wages and maintenance. Costs are based on US data but adjusted for country-specific factors such as labour costs, equipment origin, and import taxes. To determine the value of the methane captured, well-head prices are used in each country.[39]

The impact of introducing different types of methane import standard on methane abatement potential (and therefore the resulting methane intensity) and the abatement cost for each considered country is estimated according to various parameters, including the type of abatement technology, the product (oil, gas), and the segment (up- or downstream). It should be noted that, according to the Methane Tracker, certain abatement technologies can be deployed at a net negative cost. Indeed, since natural gas is a valuable product, recovered methane can often be sold or used on site. This means that if the net value received for the methane sold or used is greater than the cost of the technology over a project lifetime, the deployment of the abatement technology can result in overall savings.

For the quantitative estimates of the impact of prescriptive, performance- and market-based standards on oil and gas exporters to South Korea, the resulting methane intensity for each country is calculated according to the methodologies presented in Chapter 1.

Disclaimer

This analysis gives a high-level assessment of the impacts of different levels of ambition of the standards under consideration. It is based on countries' averages where different producers in the same country may actually face different impacts depending on their operation conditions and mitigation actions already in place. It is also based on simple assumptions such as the fact that taxes will directly be passed on to producers increasing their costs. In addition, the input data to this analysis, retrieved from the **IEA Methane Tracker is also subject to wide uncertainties, in particular regarding abatement potential and costs**, which are, for the most part, extrapolated from US information.

[38] International Energy Agency (2024) Methane Tracker. Retrieved from: https://www.iea.org/data-and-statistics/data-tools/methane-tracker.

[39] International Energy Agency (2024) Global Methane Tracker Documentation 2024 Version. Retrieved from:https://iea.blob.core.windows.net/assets/d42fc095-f706-422a-9008-6b9e4e1ee616/GlobalMethaneTracker_Documentation.pdf

Therefore, the numerical results in this section should be considered carefully, taking into account the uncertainties of the input data. Once the approach(es) for an import standard are decided, further assessment could be conducted with consolidated data, elaborating on the analysis developed here.

This exercise does not aim to compare and select the best option but rather demonstrate how each of the potential options may impact oil and gas producers in the considered exporting countries.

The market implications of introducing a methane import standard are out of the scope of this analysis. The analysis does not cover the influence of changes in producers' abatement costs on the price of oil and gas for importers, nor does it address potential risks to the security of supply.

3.1. Information-based standard

While emission monitoring is usually an essential first step to implementing mitigation measures, the abatement potential of an information-based policy is indirect and therefore complex to assess. Table 3-1 takes stock of the information-based policies already in place in the considered exporting countries according to the IEA policy database[40] and counts how many of the main oil and gas producing companies in the country are part of the OGMP 2.0 framework. This allows to qualitatively evaluate the level of effort the exporters would need to put into improving their monitoring and reporting should an information-based standard be implemented.

At the level of countries or states, six of the main oil and gas exporters have some emission reporting requirements in their regulation and two countries (Australia and the United States) have requirements to measure methane emissions. This means that should the information-based standard incorporate a regulatory MRV equivalence, mirroring Article 28 of the EU Methane Regulation, those countries would have a smaller gap to bridge than countries that do not have any regulatory reporting requirements. However, the size of the gaps for the different countries depends on the level of ambition of the information-based import standard (see the different elements to be defined as presented in Chapter 2). For instance, the OGMP 2.0 framework, which has become a widespread reporting standard in the industry[41], requires for its higher level of reporting a combination and comparison of source-level measurements and site-level measurements (reconciliation). The EU has based its level of ambition on this framework: Article 12 of the EU Methane Regulation requires source-level and site-level measurements and reporting. Yet, the measurement requirements in place in the US and Australia do not include this combination of source and site-level measurements. Therefore, even the most advanced countries in terms of MRV regulatory requirements might not directly align with the requirements of an ambitious information-based import standard.

At the level of individual companies however, the MRV practices might not be limited to the minimum regulatory requirements. For instance, a lot of companies around the world joined the OGMP 2.0 framework, which is a voluntary reporting initiative. As depicted in Table 3-1, in all countries except Iraq and Russia, more than half of the major oil and gas producers are signatories of OGMP 2.0. Therefore, several of the exporters to South Korea might only require limited additional efforts in their MRV practices should the information-based standard be aligned with OGMP 2.0 criteria.[42] However, it should be noted that:

[40] International Energy Agency (IEA) / International Renewable Energy Agency (IRENA) Global Renewable Energy Policies and Measures Database © OECD/IEA and IRENA, Retrieved from: Policy database – Data & Statistics – IEA. Accessed on: November 2024.

[41] United Nations Environment Programme (2024). An Eye on Methane: Invisible but not unseen: How data-driven tools can turn the tide on methane emissions —if we use them. Retrieved from: An Eye on Methane 2024 | UNEP - UN Environment Programme

[42] The name of the producers exporting to South Korea was not part of the data available for this study. Therefore, when not all producers in one country were part of OGMP2.0, it was therefore not possible to determine if the producers specifically exporting to South Korea were or were not part of the framework.

- Participation in OGMP 2.0 does not necessarily imply that best monitoring and reporting practices are in place: this is only guaranteed when the companies are rewarded the "gold standard" after several years of reporting.
- Participation in OGMP 2.0 does not mean that the data reported is verified by an independent third party, which is one of the requirements of the standard imposed by the EU Methane Regulation.

In addition, since some exporters supply oil and/or gas to the EU market, as depicted in Table 3-1, they might already have an incentive to improve their reporting system to comply with the EU information-based import standard.

Table 3-1 – Stocktake of the information-based policies in the countries exporting to South Korea and of the share of OGMP2.0 signatories among the major producers

Country	Does the country have requirements regarding methane emissions…			Was the country a significant exporter of oil and/or gas to the EU in 2023?[43]	Are the country's major producers[44] OGMP 2.0 signatories?
	Quantification	Measurement	Reporting		
Australia	Yes	Yes	Yes	No (<1%)	4/5
Brazil	Yes	No	Yes	Yes (Oil)	2/3
Indonesia	No	No	No	No (<1%)	3/5
Iraq	No	No	Yes	Yes (Oil)	1/5
Kazakhstan	Yes	No	Yes	Yes (Oil)	3/5
Kuwait	No	No	No	No (<1%)	3/5
Malaysia	No	No	No	No (<1%)	4/5
Oman	No	No	No	No (<1%)	5/5
Qatar	No	No	No	Yes (Gas)	3/5
Russia	No	No	No	Yes (Oil and gas)	0/3
Saudi Arabia	No	No	No	Yes (Oil)	3/5
United Arab Emirates	No	No	Yes (state-level only)	Yes (Oil)	3/5
United States	Yes	Yes	Yes	Yes (Oil and gas)	5/5

Source: for policies - IEA policy database[45], for exporters to the - EU Eurostat[46], for OGMP2.0 signatories - Carbon Limits analysis based on the OGMP2.0 fact sheets[47]

In summary, an information-based standard can raise awareness regarding the location and magnitude of emissions and therefore lead jurisdictions and/or operators to take mitigation measures. In addition, as explained in the previous section, obtaining robust information on emissions and/or practices in place is a prerequisite to (1) setting the level of ambition of a prescriptive, performance or market-based standard, (2) ensuring that the standard is really applied. Therefore, as done in the EU Methane Regulation, an

[43] For this table, countries are considered significant exporters to the EU when the quantity exported to the EU is larger than 1% of the total quantity (of oil or of gas) imported to the EU in 2023.
[44] "Major producers" are defined as those representing a significant share of a country's production. When data is available, this includes producers ensuring 75% or more of the total production. In cases where production data is not openly available, the best available assumptions are used.
[45] International Energy Agency (IEA) / International Renewable Energy Agency (IRENA) Global Renewable Energy Policies and Measures Database © OECD/IEA and IRENA, Retrieved from: Policy database – Data & Statistics – IEA. Accessed on: November 2024.
[46] Eurostat, *Imports of oil and petroleum products by partner country* (last updated 03/02/2025) and *Imports of natural gas by partner country* (last updated 29/01/2025). Retrieved from: https://ec.europa.eu/eurostat/databrowser/explore/all/envir?lang=en&subtheme=nrg.nrg_quant.nrg_quanta.nrg_t&display=list&sort=category Accessed on: February 2025.
[47] United Nations Environment Programme (2024). OGMP 2.0 company reporting factsheets. Retrieved from: Reports and briefs – OGMP 2.0

information-based standard can be developed in parallel with another import standard. Should South Korea impose an information-based standard requiring source-level and site-level measurements (as OGMP 2.0 and the EU Methane Regulation), and verification (as the EU Methane Regulation), additional efforts will be imposed on exporters. However, this additional burden may be limited for exporters who are part of the OGMP 2.0 initiative. An information-based standard also has implications for operators and importers in South Korea, who must collect and submit information. Additionally, the entity responsible for administering the standard must determine whether the submissions comply with the requirements.

3.2. Prescriptive standard – Illustrative example

This section assesses the impact of a prescriptive import standard on abatement potential and the resulting methane intensity in the oil and gas exporting countries under consideration. Different levels of ambition can be considered for a prescriptive standard: for example, an LDAR requirement could be more or less stringent depending on the frequency (every two years, up to quarterly) and the type of technology allowed. For this analysis, the level of ambition aims to mirror the prescriptive requirements imposed on operators in the EU by the EU Methane Regulation[48]:

- Article 14 obliges operators to conduct LDAR surveys at defined frequencies, depending on the location and type of equipment. Given the frequencies set out in Annex I of the EU Methane Regulation, it is assumed equivalent to the implementation of annual, biannual and quarterly LDAR in the Methane Tracker.
- Article 15 imposes restrictions on venting and flaring, prohibiting any non-emergency venting or flaring. This is assumed to correspond to the various measures under "Zero Routine Flaring and Venting" in the Methane Tracker.
- Article 15 states that only zero-emitting pneumatic devices, compressors, atmospheric pressure storage tanks, sampling and measuring devices and dry gas seals are installed in new or refurbished sites. In the current analysis, this is considered to be equivalent to the measures under "Zero emitting equipment" in the Methane Tracker.

Hence, the prescriptive standard analysed in this section compiles the different requirements summarized in Table 3-2.

[48] European Parliament and Council of the European Union (2024). Regulation (EU) 2024/1787 of the European Parliament and of the Council of 13 June 2024 on methane emissions reduction in the energy sector and amending Regulation (EU) 2019/942. Official Journal of the European Union, L 202, 1–45. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32024R1787

Table 3-2 – Mitigation options for inclusion in a prescriptive standard

Category	Abatement option
LDAR	Annual LDAR
	Biannual LDAR
	Quarterly LDAR
Zero-emitting equipment	Replace compressor seal or rod*
	Replace pumps
	Replace with electric motor
	Replace with instrument air systems
Zero routine flaring and venting	Blowdown capture
	Improve flaring
	Install plunger
	Vapour recovery units

**IEA does not specify the frequency of rod replacement. According to best practices, rod replacement should occur every 26,000 hours or three years*[49]

The abatement cost and abatement potential of each mitigation option are sourced from the Methane Tracker database. The analysis includes those abatement options from Table 3-2 that are relevant for a country under consideration. Technically feasible abatement potential and corresponding methane intensity are provided in Table 3-3 for oil and Table 3-4 for gas.

The introduction of a prescriptive standard similar to the EU regulation would result in a considerable reduction in methane intensity in each country for both oil and gas. For oil, the weighted average intensity would drop to 10.4 kg CO_2e/BOE (63% reduction) and for gas, to 15.2 kg CO_2e/BOE (32% reduction). However, this does not allow reaching the 5.9 kg CO_2e/BOE threshold that corresponds to the 0.2% intensity target in any of these countries (Figure 3-1, Figure 3-3). A methane intensity threshold is not a part of a prescriptive standard and is provided for reference.

[49] CCAC OGMP (2017) Technical Guidance Document Number 4: Reciprocating Compressors Rod Seal/Packing Vents. Retrieved form: https://www.ccacoalition.org/sites/default/files/resources//2017_OGMP-TGD4-Reciprocating-Compressors_CCAC.pdf

Figure 3-1 – Resulting methane emissions and methane intensity associated with oil exported to South Korea in the case of the application of a prescriptive standard similar to the EU

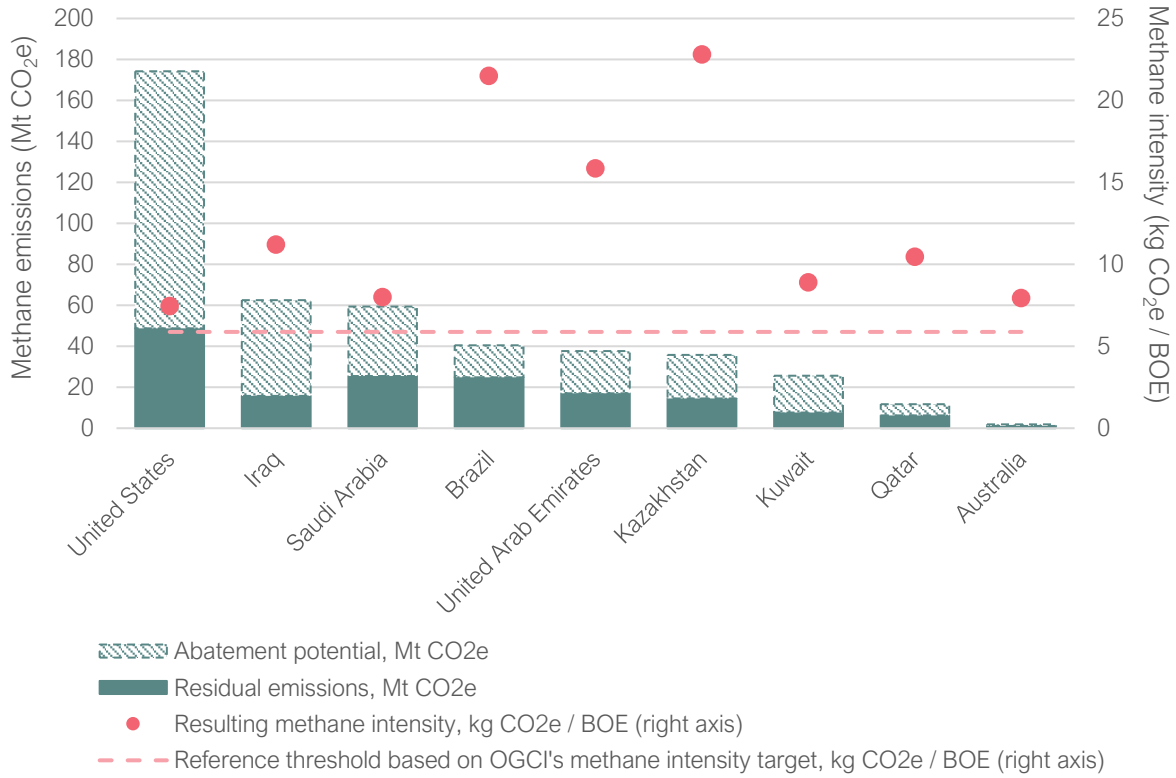


Table 3-3 – Estimated methane intensity of oil exported to South Korea and associated potential and abatement cost in the case of the application of a prescriptive standard similar to the EU

Country	Abatement potential (%)	Weighted average abatement cost (USD/MMBtu)	Methane intensity (kg CO_2e/BOE)	
			Current	Resulting
Australia	47%	-1.6	15.2	8.0
Brazil	39%	-4.8	35.2	21.5
Iraq	75%	-2.2	44.6	11.2
Kazakhstan	59%	-1.4	56.3	22.8
Kuwait	70%	0.4	29.8	8.9
Qatar	47%	-2.1	19.7	10.5
Saudi Arabia	57%	-1.6	18.7	8.0
United Arab Emirates	55%	-1.6	35.2	15.9
United States	72%	4.9	27.1	7.5

Source: Carbon Limits analysis (2025), based on data from the International Energy Agency (2023) Methane Tracker Database

Figure 3-2 – Resulting methane emissions and methane intensity associated with gas exported to South Korea, in the case of the application of a prescriptive standard similar to the EU

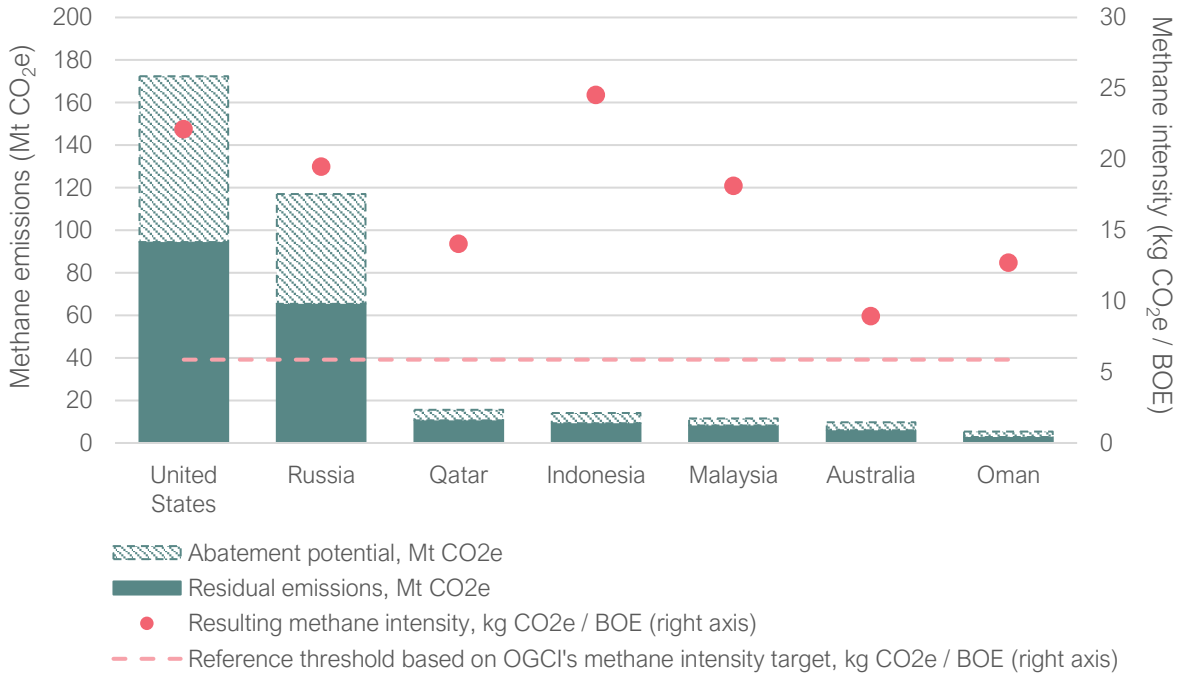


Table 3-4 – Estimated methane intensity of gas exported to South Korea and associated potential and abatement cost, in the case of the application of a prescriptive standard similar to the EU

Country	Abatement potential (%)	Weighted average abatement cost (USD/MMBtu)	Methane intensity (kg CO_2e/BOE)	
			Current	Resulting
Australia	40%	-1.2	12.9	9.0
Indonesia	34%	-4.3	36.3	24.5
Malaysia	28%	-4.6	24.6	18.1
Oman	47%	-3.5	21.6	12.7
Qatar	32%	-1. 9	18.3	14.1
Russia	44%	1.0	34.1	19.5
United States	45%	3.2	34.5	22.1

Source: Carbon Limits analysis (2025), based on data from the International Energy Agency (2023) Methane Tracker Database

The cross-country analysis showed that the mitigation option that is relevant for all the considered countries and can ensure between 10 and 36% of emission reduction in the oil sector depending on the country and between 5 and 16% in the gas sector is an instalment of vapour recovery units (VRUs). A VRU captures and recovers vapours from storage tanks or other equipment, preventing their release into the atmosphere. Based on the IEA Methane Tracker information, its abatement cost ranges between -5.2 to 5.2 USD/MMBtu depending on the county, sector, and segment. It is worth noting that the abatement cost for the US is significantly higher compared to other countries. This is due to a range of underlying reasons

including the sector's structure, characterized by multiple small operators and decentralized operations, which does not allow for the benefits of economies of scale. The introduction of such a prescriptive standard can lead to substantial reductions in emissions by setting requirements to use certain mitigation technologies. The analysis performed for the countries exporting oil and gas to South Korea showed however, that despite bringing down the emissions and ensuring reaching methane intensity close to the industry standard of 0.2% (5.9 kg CO_2e/BOE), none of the countries reaches this target level. This is because setting requirements for using a specific set of mitigation options may not be equally efficient for different regions and operators' practices. This approach provides less flexibility to operators and does not incentivize them to implement other mitigation options that might be more cost-efficient and more suitable for their specific circumstances. It is worth highlighting that the estimates of abatement potential and abatement cost may vary significantly depending on the assumptions made when developing a marginal abatement cost curve for a specific country. The actual emission reduction achieved can be higher or lower than anticipated based on the accuracy of these assumptions.

3.3. Performance standard – Illustrative example

The analysis in this section assesses the impact of a performance-based standard that could potentially be introduced by South Korea on exporting countries depending on different levels of maximum allowable methane intensity (intensity threshold). It is assumed that abatement options are implemented according to their cost-effectiveness until the defined methane intensity threshold is reached, meaning that cost-effective solutions are implemented first and that no mitigation occurs beyond what is required to meet the threshold. The analysis includes all abatement options for the upstream segment presented in the IEA's Methane Tracker.

The methane intensity threshold analysed in this paper is based on the industry-wide target of OGCI set at 0.2% methane emissions per volume of gas marketed.[50] Assuming an average methane content of 90%, this threshold is equivalent to 5.9 kg CO_2e/BOE.

Disclaimer

The analysis takes the OGCI target as a reference point because it is, at the time of publication of this report, the only widely communicated intensity target. It has also been used in a regulatory context as the Waste Emissions Charge (WEC) in the United States bases its threshold for the upstream segment on it.

However, other thresholds could be defined. For instance, as mentioned in Chapter 2, the threshold for the EU Methane Regulation will be determined later based on an impact assessment. The type of analysis conducted in this section, with consolidated data, may help in selecting the right level of stringency.

Table 3-5 and Table 3-6 provide, respectively for oil and gas, the resulting methane intensity, the associated abatement potential and the abatement cost for each country under a performance standard with a methane intensity threshold of 5.9 kg CO2e/BOE.

Under the performance standard analysed, most of the countries studied wouldn't reach the methane intensity threshold set at 5.9 kg CO_2e/BOE. However, the full implementation of all available abatement technologies in the upstream segment would still result in significant emission reductions for these countries. For oil, the weighted average intensity would drop to 6.4 kg CO_2e/BOE (77% reduction) and for gas – to 10.8 kg CO_2e/BOE (52% reduction), considering the volume imported in 2023 from each country. It should

[50] US Environmental Protection Agency (2024). Waste Emissions Charge for Petroleum and Natural Gas Systems: Procedures for Facilitating Compliance, Including Netting and Exemptions. Accessible at: https://www.epa.gov/inflation-reduction-act/waste-emissions-charge

be noted that the analysis only focuses on mitigation measures implemented in the upstream segment, but for gas, the methane intensity is calculated for the gas value chain as explained in Chapter 1. Therefore, the intensity threshold may be reached in several countries if abatement options are also implemented in the midstream segment (e.g., loading and shipping).

The costs associated with these abatement efforts vary widely: the average cost to approach the threshold is negative for most oil exporting countries but positive for most gas exporting countries.

Figure 3-3 and Figure 3-4 illustrate the resulting methane emissions and methane intensity associated respectively with oil and gas exported to South Korea, in the case of the application of a performance standard with a methane intensity threshold of 5.9 kg CO_2e/BOE.

Figure 3-3 – Resulting methane emissions and methane intensity associated with oil exported to South Korea, under a performance standard with a methane intensity threshold of 5.9 kg CO_2e/BOE

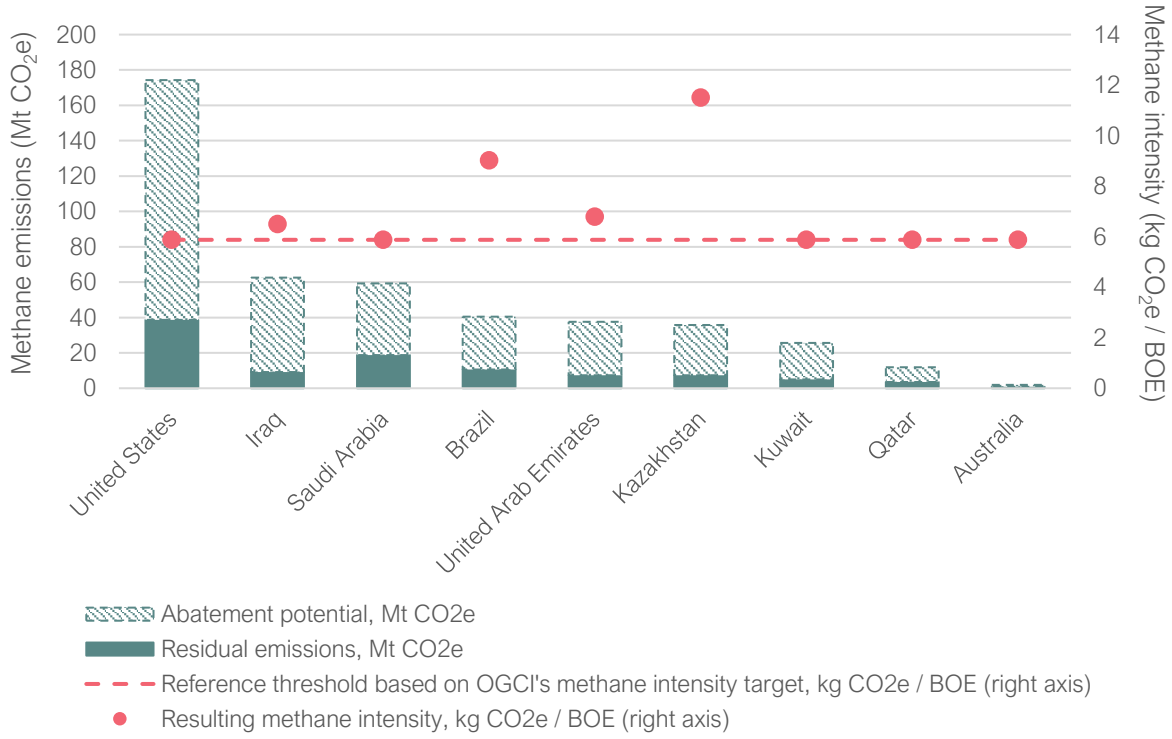


Table 3-5 – Estimated methane intensity of oil exported to South Korea and associated abatement potential and abatement cost, under a performance standard with a methane intensity threshold of 5.9 kg CO_2e/BOE

Country	Abatement potential (%)	Weighted average abatement cost (USD/MMBtu)	Methane intensity (kg CO_2e/BOE)	
			Current	Resulting
Australia	60%	-2.7	15.2	5.9
Brazil	74%	-5.5	35.2	9.0
Iraq	85%	-2.4	44.6	6.5
Kazakhstan	80%	-1.8	56.3	11.5
Kuwait	80%	-0.6	29.8	5.9
Qatar	70%	-3.1	19.7	5.9
Saudi Arabia	69%	-2.7	18.7	5.9
United Arab Emirates	81%	-2.3	35.2	6.8
United States	78%	4.3	27.1	5.9

Source: Carbon Limits analysis (2025), based on data from the International Energy Agency (2023) Methane Tracker Database

Legend: Green cells indicate countries where methane intensity has reached the threshold, while red cells indicate countries where it has not

Figure 3-4 – Resulting methane emissions and methane intensity associated with gas exported to South Korea, under a performance standard with a methane intensity threshold of 5.9 kg CO_2e/BOE

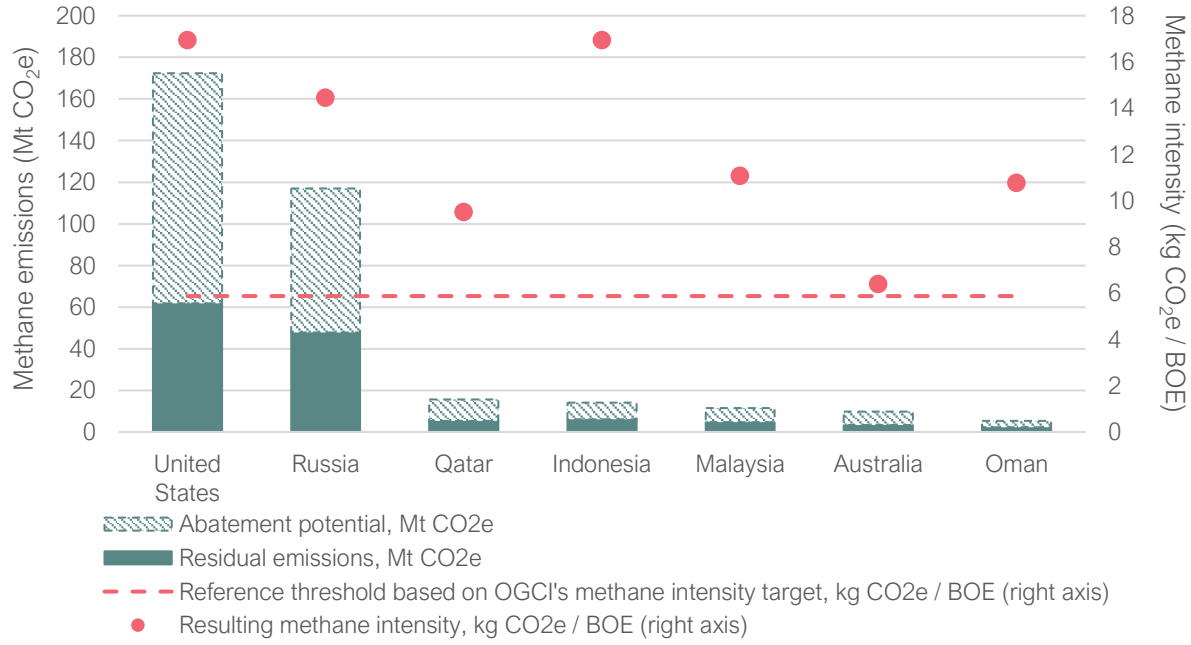


Table 3-6 – Estimated methane intensity of gas exported to South Korea and associated abatement potential and abatement cost, under a performance standard with a methane intensity threshold of 5.9 kg CO_2e/BOE

Country	Abatement potential (%)	Weighted average abatement cost (USD/MMBtu)	Methane intensity (kg CO_2e/BOE)	
			Current	Resulting
Australia	65%	4.7	12.9	6.4
Indonesia	56%	0.6	36.3	17.0
Malaysia	59%	-5.6	24.6	11.1
Oman	57%	8.0	21.6	10.8
Qatar	66%	-2.8	18.3	9.5
Russia	59%	13.8	34.1	14.5
United States	64%	12.1	34.5	17.0

Source: Carbon Limits analysis (2025), based on data from the International Energy Agency (2023) Methane Tracker Database

Legend: Green cells indicate countries where methane intensity has reached the threshold, while red cells indicate countries where it has not

In summary, a performance standard can induce significant emissions reductions, by incentivizing procedures to bring the intensity of their product at the level of, or close to the level of the defined threshold. Based on the Methane Tracker's data, the methane intensity threshold of 5.9 kg CO_2e/BOE can be reached by most exporting countries for oil, and can only be reached for gas if actions are also taken in the midstream segment. Assuming most cost-efficient measures are implemented first, the average cost to reach the threshold is negative for most oil exporting countries. However, a strong incentive system would be required to ensure the most expensive options are implemented. Those results must be considered carefully because the analysis is only based on country averages while companies within each country may have different practices and therefore different methane intensities.

3.4. Market-based standard – Illustrative examples

The analysis in this section assesses the impact of a market-based standard that can potentially be introduced by South Korea on exporting countries depending on different levels of tax. As presented in Chapter 2, various tax models exist. This section considers a fixed tax per tonne of methane emitted, applied to all methane emissions. The impact of a tax is demonstrated as a change in abatement potential at no net cost compared with the current potential. On a marginal abatement cost curve, this would look like a shift of the intersection point to the right as more abatement options would become available if a tax was introduced. The analysis includes all abatement options for the upstream segment presented in the Methane Tracker.

Two options of the tax level were analysed, based on the allowance price of the South Korean ETS and the EU ETS. The assumptions used to calculate the tax amount options are presented in Table 3-7. Thus, the first tax amount option is set at 7 USD/tCO_2e, and the second tax amount option is set at 70 USD/tCO_2e.

Table 3-7 - Assumptions used to define the two tax options analysed

	Tax option 1	Tax option 2
ETS of reference	South Korean ETS	EU ETS
Allowance price (average in 2024)	9,543.78 KWR / tCO_2e	64.94 EUR / tCO_2e
Exchange rate (average in 2024)	0.00073 USD / KRW	1.078 USD / EUR
Resulting tax amount considered	7.0 USD / tCO_2e	70.0 USD / tCO_2e

Source: International Carbon Action Partnership (2024)[51] (allowance price and exchange rate)

The expected abatement cost of each abatement option is calculated by subtracting the amount of tax from the current abatement cost provided in the IEA's Methane Tracker.

The analysis focuses on the impact of implementing all abatement options at no net cost, currently and according to the different tax options presented in Table 3-7. Estimated methane intensity, associated abatement potential and abatement cost are provided in Table 3-8 for oil and Table 3-9 for gas.

Implementing all existing abatement options at no net cost would drop the weighted average intensity to 12.1 kg CO_2e/BOE (56% reduction) for oil and to 13.5 kg CO_2e/BOE (40% reduction) for gas, considering the volume imported in 2023 from each country. This significant reduction in methane emissions underlines that many of the abatement options could already be implemented at no net cost but are not implemented yet for various reasons. The introduction of a market-based standard tax could therefore encourage operators to implement these abatement options.

Under a market-based standard using the first tax option (tax set at 7 USD/tCO_2e), implementing all abatement options at no net cost would reduce the weighted average intensity to 7.8 kg CO_2e/BOE (72% reduction compared to the current methane intensity) for oil and to 11.8 kg CO_2e/BOE (47% reduction) for gas. Compared to the abatement options that can already be implemented at no net cost, this represents an increase in emission reductions for most countries (more or less significant depending on the country). However, there would be no change for four gas-exporting countries, indicating that a substantial portion of the abatement potential is already available at no net cost in these countries without a tax and that the remaining abatement options are relatively costly.

Under a market-based standard using the second tax option (tax set at 70 USD/tCO_2e), implementing all abatement options at no net cost would drop the weighted average intensity to 4.9 kg CO_2e/BOE (83% reduction compared to the current methane intensity) for oil and to 11.0 kg CO_2e/BOE (51% reduction) for gas. In comparison with the first option, this would significantly increase emission reductions for the United States (51% reduction for oil, 22% reduction for gas) and for Kuwait (22% reduction for oil) but would have little to no effect in other countries. Thus, higher taxes might not lead to significantly higher abatement potential.

Figure 3-5 and Figure 3-6 illustrate the percentage of total current emissions that can be abated at no net cost, respectively for oil and gas exported to South Korea, currently and under the different market-based standard options.

[51] International Carbon Action Partnership (2024). *ICAP Allowance Price Explorer*. Retrieved from: https://icapcarbonaction.com/en/ets-prices

Figure 3-5 – Percentage of emissions that can be abated at no net cost regarding oil exported to South Korea, currently and according to the different market-based standard options

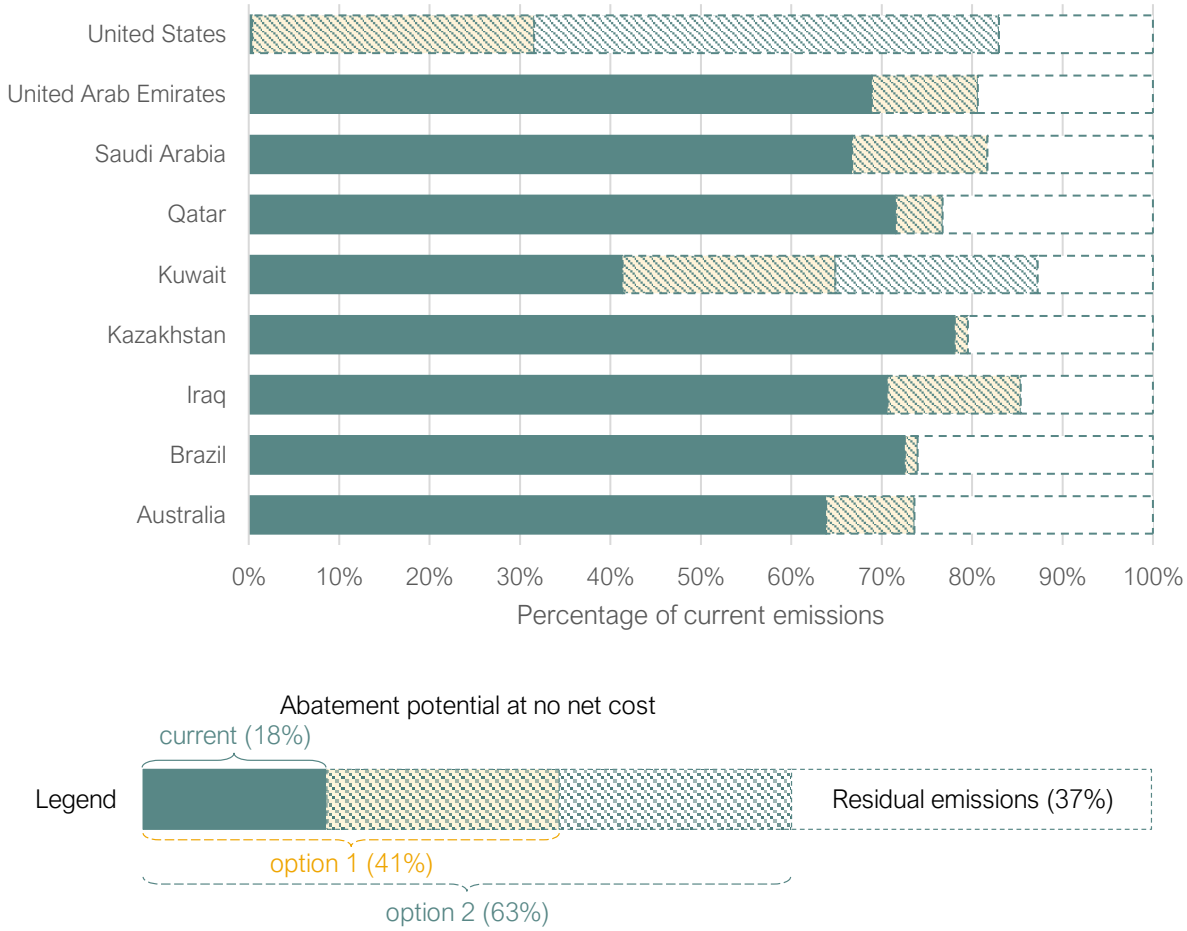


Table 3-8 – Estimated methane intensity of oil exported to South Korea and associated abatement potential and abatement cost, in the case of the implementation of all abatement options at no net cost, currently and according to the different tax options

Country	Abatement potential at no net cost (%)			Weighted average abatement cost of all abatement options at no net cost (USD/MMBtu)			Resulting methane intensity if implementation of all abatement options at no net cost (kg CO_2e/BOE)		
	Current	Tax 1 (7 USD/tCO_2e)	Tax 2 (70 USD/tCO_2e)	Current	Tax 1 (7 USD/tCO_2e)	Tax 2 (70 USD/tCO_2e)	Current	Tax 1 (7 USD/tCO_2e)	Tax 2 (70 USD/tCO_2e)
Australia	64%	74%	74%	-2.6	-5.5	-36.7	5.3	3.8	3.8
Brazil	73%	74%	74%	-5.6	-8.9	-40.2	9.5	9.1	9.0
Iraq	71%	85%	85%	-2.9	-5.9	-37.1	13.1	6.5	6.5
Kazakhstan	78%	80%	80%	-1.8	-5.2	-36.5	12.3	11.5	11.5
Kuwait	41%	65%	87%	-2.7	-5.1	-35.0	17.5	10.4	3.8
Qatar	72%	77%	77%	-3.0	-6.2	-37.5	5.6	4.6	4.6
Saudi Arabia	67%	82%	82%	-2.8	-5.7	-36.9	6.2	3.4	3.4
United Arab Emirates	69%	81%	81%	-2.7	-5.8	-37.0	10.9	6.8	6.8
United States	0.4%	32%	83%	-0.4	-1.1	-30.1	27.0	18.5	4.5

Source: Carbon Limits analysis (2025), based on data from the International Energy Agency (2023) Methane Tracker Database

Legend: Yellow cells indicate that the abatement potential at no net cost (and hence the methane intensity) is the same under both tax options

Figure 3-6 – Percentage of emissions that can be abated at no net cost regarding gas exported to South Korea, currently and according to the different market-based standard options

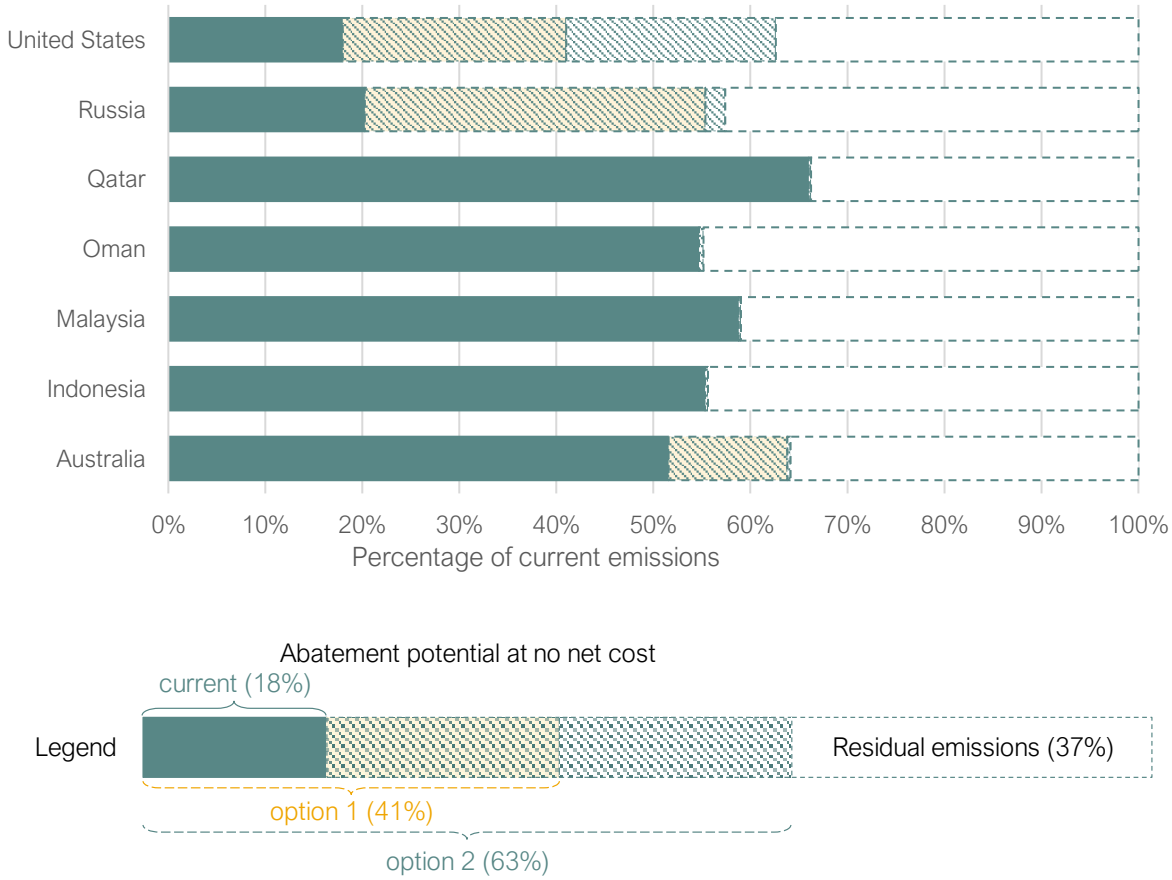


Table 3-9 – Estimated methane intensity of gas exported to South Korea and associated abatement potential and abatement cost, in the case of the implementation of all abatement options at no net cost, currently and according to the different market-based standard options

Country	Abatement potential at no net cost (%)			Weighted average abatement cost of all abatement options at no net cost (USD/MMBtu)			Resulting methane intensity if implementation of all abatement options at no net cost (kg CO_2e/BOE)		
	Current	Tax 1 (7 USD/tCO_2e)	Tax 2 (70 USD/tCO_2e)	Current	Tax 1 (7 USD/tCO_2e)	Tax 2 (70 USD/tCO_2e)	Current	Tax 1 (7 USD/tCO_2e)	Tax 2 (70 USD/tCO_2e)
Australia	52%	64%	64%	-3.0	-5. 7	-36.9	7.8	6.5	6.5
Indonesia	55%	55%	56%	-5.0	-8.5	-39.6	17.3	17.3	17.2
Malaysia	59%	59%	59%	-5.6	-9.1	-40.3	11.1	11.1	11.1
Oman	55%	55%	55%	-4.0	-7.5	-38.6	11.3	11.3	11.2
Qatar	66%	66%	66%	-3.1	-6.5	-37.7	9. 6	9.6	9.5
Russia	20%	55%	57%	-1.5	-3.4	-34.4	27.4	15.8	15.1
United States	18%	41%	63%	-0.8	-2.6	-32.7	29.6	23.3	17.4

Source: Carbon Limits analysis (2025), based on data from the International Energy Agency (2023) Methane Tracker Database

Legend: Yellow cells indicate that the abatement potential at no net cost (and hence the methane intensity) is the same between the current situation and the implementation of a market-based standard with tax 1

In summary, a market-based standard introduced in the form of a methane tax can enable the implementation of new and more costly mitigation options compared to the existing abatement potential. This is particularly relevant for countries with higher mitigation costs, where the current abatement potential at no net cost is relatively limited. With the tax levels assessed, the analysis suggests that the higher tax does not lead to significantly higher abatement potential, as a large share of the abatement potential is already at a relatively low cost. However, these results must be considered carefully because the net cost is not the only factor determining the implementation of technologies and practices. Investment costs or technology availability, for example, can prevent the implementation of abatement options that have a negative net cost.

3.5. Key takeaways

Different approaches to setting up a methane import standard have varying impacts on abatement potential and costs for exporters. An information-based standard, while not leading directly to methane emission reduction, is crucial for setting a level of ambition for other standards and ensuring their application.

A prescriptive standard, which mandates the use of certain mitigation technologies, has the potential to contribute to significant emissions reductions, depending on its stringency and the effectiveness of implementation. It may not be equally cost and emission reduction efficient across different regions and operators, as it provides less flexibility to operators. Without a robust marginal abatement cost analysis, this approach may result in the selection of less cost-effective solutions, leading to higher compliance costs for certain operators and limited emissions reduction impact.

A performance standard that incentivizes reducing methane intensity to a defined threshold can be an effective driver of emissions reductions. In most of the countries analyzed, the average cost of achieving this threshold is negative. However, incentives may still be needed to support the implementation of higher-cost abatement measures. The effectiveness of such a standard largely depends on the robustness of its implementation and the ability to monitor and enforce MRV compliance.

Lastly, a market-based standard in the form of a methane tax can enable the implementation of no net cost mitigation options as well as more costly mitigation options. While higher taxes do not necessarily lead to significantly higher abatement potential, even lower taxes can incentivize the adoption of abatement options that are currently not pursued, despite their negative abatement costs.

The figures below illustrate how the methane intensity of oil (Figure 3-7) and gas (Figure 3-8) changes under different import standards.[52] Each of these approaches can potentially lead to a substantial reduction in methane emission intensity. The graphs below reflect the impact of the assumptions made in the analysis (see Chapter 3) and may present a different picture for the same approaches under different assumptions. Due to the selective nature of the prescriptive standard, it results in a less significant reduction in methane intensity. In contrast, performance- and market-based standards deliver a more substantial reduction as they require the implementation of the most of available mitigation options.

[52] Quantitative estimates are not available for an information-based approach.

Figure 3-7 – Current methane intensity of oil exported to South Korea and estimated methane intensity based on the application of different standards

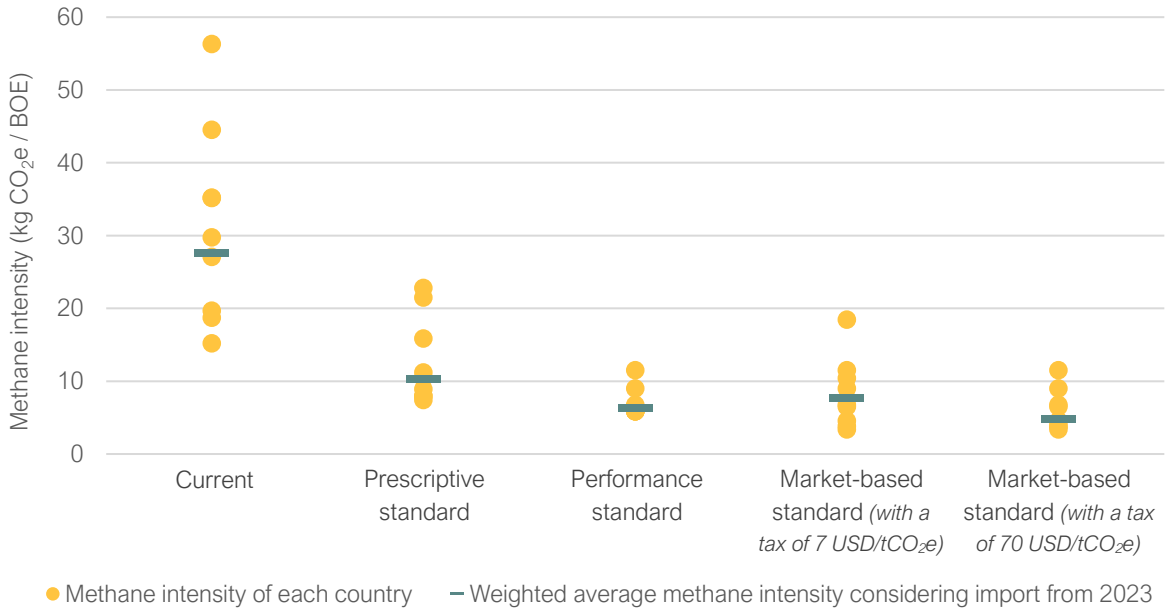
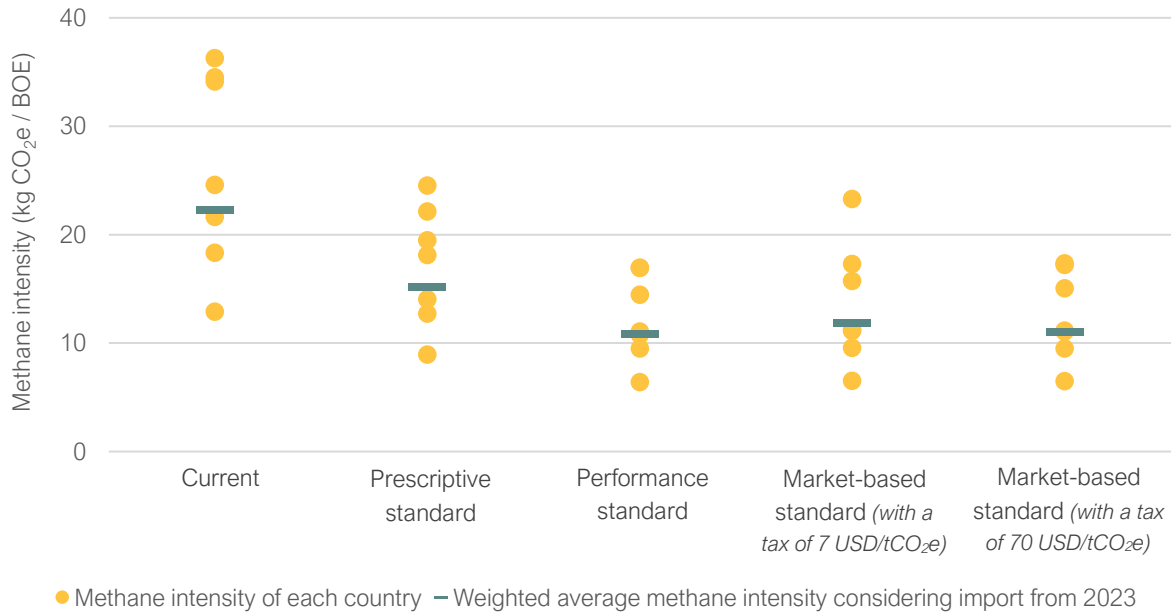


Figure 3-8 – Current methane intensity of gas exported to South Korea and estimated methane intensity based on the application of different standards



Disclaimer

The figures do not aim to compare the impact of different approaches on methane intensity. They illustrate the results of the analysis in Chapter 3 and may show different outcomes under varying assumptions.

Conclusion

In conclusion, South Korea's commitment to reducing methane emissions by 30% by 2030, as outlined in its methane reduction roadmap, highlights the importance of addressing methane emissions from imported oil and gas. Given that a significant portion of South Korea's oil and gas consumption is imported, the country has a unique opportunity to influence global methane emissions through the introduction of a methane import standard.

This report has explored different approaches to implementing such a standard, including information-based, prescriptive, performance-based, and market-based. Impact of each of the potential approaches varies depending on the exporting countries practices. An information-based standard is essential for setting the level of ambition and ensuring compliance. A prescriptive standard mandates the deployment of specific abatement options, and its impact depends on the applicability of these options to operating conditions and oil and gas companies' practices. A performance standard incentivizes reducing methane intensity to a defined threshold, allowing operators to choose the most relevant and cost-effective options. A market-based standard, such as a methane tax, can incentivize producers to implement abatement options that are currently not being implemented, despite their negative abatement costs, as well as to drive the adoption of more costly mitigation options. The potential impact of introducing a methane import standard on oil and gas prices and supply security is not covered within the scope of this analysis.

The analysis provided in this report aims to support informed discussions on designing a methane import standard in South Korea. By leveraging its position in the global energy market, South Korea can drive the adoption of methane emission mitigation solutions in exporting countries, contributing to global efforts in methane mitigation. The insights gained from this study could be relevant to other major oil and gas importers, such as China and Japan. However, their applicability may depend on country-specific factors, including market structures, regulatory frameworks, and trade patterns, which would require further consideration.

Whether one or a combination of these approaches is introduced depends on the existing or planned methane regulations within South Korea, the available time, and the desired outcomes. Policymakers should consider the level of stringency, methodologies, proof, and verification procedures when developing an import standard to ensure its effectiveness. Additionally, it is important to note that some exporters to South Korea also supply other markets, including the EU. In this context, regulations introduced in one jurisdiction may positively impact other major importers but also pose certain risks if producers with higher methane intensity seek alternative markets. While this report does not explore it in depth, aligning regulatory approaches across oil and gas importing countries could help mitigate the risk of market shifts driven by methane intensity. Regulators may benefit from dialogue and collaboration with other jurisdictions to harmonize standards and identify synergies, contributing to a more consistent global approach to methane reduction.

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Assessment of Opportunities for Implementing a Methane Import Standard in South Korea

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Solutions for Our Climate (SFOC) is an independent policy research and advocacy group that aims to make emissions trajectories across Asia compatible with the Paris Agreement 1.5°C warming target.