Research report

Reducing oil & gas methane emissions in Malaysia: progress and workforce implications

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May 2025
1st edition

Institute of Strategic & International Studies (ISIS) Malaysia

ISIS Malaysia

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Acknowledgements

ISIS Malaysia thanks the Environmental Defense Fund for supporting this project with a research grant. The authors also thank all the stakeholders who contributed to the study during the discussions, interviews, survey and roundtable.

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Supported by

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Zayana Zaikariah, Kieran Li Nair and Calvin Cheng (ISIS Malaysia)
Ahmad Afandi Nor Azmi and Emily Oi Yen Tse (independent consultants)

Foreword

The imperative to reduce greenhouse gas emissions in the face of climate change is reflected in Malaysia's resolute commitment to achieving net-zero emissions by 2050. In this pathway, the focus on emission reduction beyond carbon dioxide cannot be understated. Because of methane's potent short-term warming potential, the United Nations Environment Programme identifies its reduction as the fastest and most cost-effective lever to curb global warming, making it essential to averting worsening climate impacts.

Fittingly, Malaysia's dedication to methane abatement as part of its broader sustainability initiatives and transition to a low-carbon economy was demonstrated when the country became a signatory to the Global Methane Pledge in 2021, aiming to cut methane emissions by 30% by 2030 compared with 2020 levels. The Madani government has reaffirmed this commitment with an ever-growing suite of initiatives, such as the National Energy Transition Roadmap and National Climate Change Policy 2.0, aimed at keeping the Paris Agreement's critical north star of 1.5°C in view by placing emissions mitigation at the heart of our climate strategy.

Equally crucial is the concept of a "just transition", which holds relevance to Malaysia as a nation on the cusp of developed status, dependent on oil and gas production as a source of revenue. A just transition aims to ensure that the shift to a sustainable future is equitable and accounts for the livelihoods and wellbeing of workers, communities and industries affected by this transformation. It is essential for Malaysia to adopt a holistic approach towards this emerging challenge.

This timely and pertinent report, produced in collaboration with the Environmental Defense Fund, explores the workforce implications of methane abatement on the oil and gas industry and sheds light on the opportunities and challenges ahead. The report illuminates the need for a robust approach to methane abatement, with enhanced targets and transparent reporting frameworks. Ultimately, it embodies the spirit of a whole-of-nation strategy indispensable in charting a sustainable path through Malaysia's climate ambitions and beyond.

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Abbreviations

AR	Assessment Report
ASEAN	Association of Southeast Asian Nations
BTR	Biennial Transparency Report
BUR	Biennial Update Report
CCUS	carbon capture, utilisation, and storage
CO_2	carbon dioxide
EDF	Environmental Defense Fund
ESG	environmental, social and governance
GHG	greenhouse gas
GMP	Global Methane Pledge
GWP	global warming potential
IPCC	Intergovernmental Panel on Climate Change
ISIS	Institute of Strategic & International Studies Malaysia
kt	kilotonne (one thousand tonnes)
LDAR	leak detection and repair
MGA	Malaysian Gas Association
MGP	Methane Guiding Principles
MLP	Methane Leadership Programme
MMRV	measurement, monitoring, reporting and verification
MOGSC	Malaysian Oil, Gas and Energy Services Council
MOGEC	Malaysian Oil, Gas and Energy Engineering Council
MPM	Malaysia Petroleum Management
N_2O	nitrous oxide
NETR	National Energy Transition Roadmap
NGR	National Gas Roadmap
NRES	Ministry of Natural Resources and Environmental Sustainability
NZCE-2050	Net-Zero Carbon Emissions 2050
O&G	oil and gas
OGMP 2.0	Oil and Gas Methane Partnership 2.0
OGSE	oil and gas services and equipment
PAC	petroleum arrangement contractors
Petronas	Petroliam National Berhad
PIR	Petronas Integrated Report
RUUPIN	Rang Undang-Undang Perubahan Iklim Negara
SUTS	Swinburne University of Technology Sarawak
tCO_2e	tonnes of carbon dioxide equivalent
TVET	technical and vocational education and training
UKM	Universiti Kebangsaan Malaysia
UM	Universiti Malaya
UNFCCC	United Nations Framework Convention on Climate Change
UNM	University of Nottingham Malaysia
VFR	venting and flaring reduction
ZRF	zero-routine flaring

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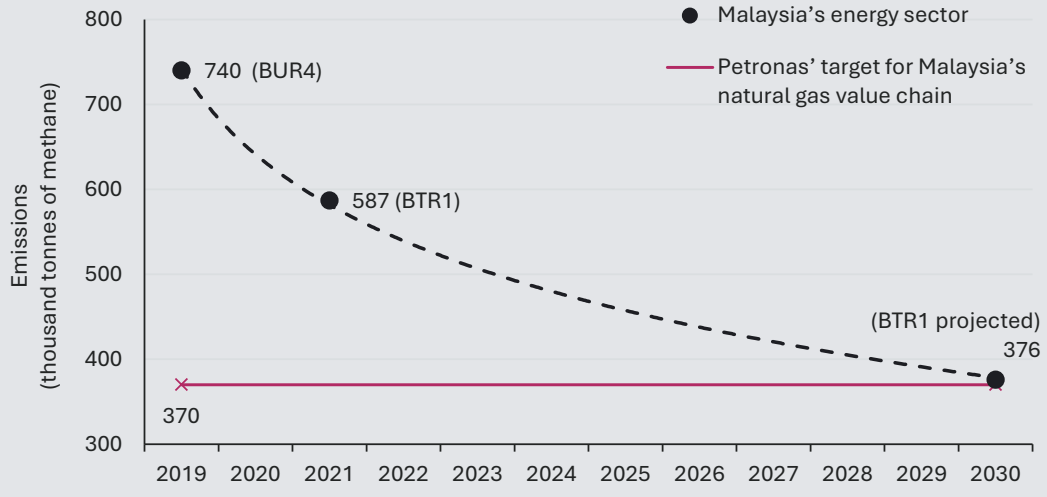
Executive summary

This study assessed the progress of methane-reduction initiatives in Malaysia's oil and gas (O&G) sector and the resulting workforce implications. The key findings indicate that meaningful reductions to O&G methane emissions have been achieved by focusing on upskilling, reskilling and job-scope expansion. However, opportunities exist to diversify methane-abatement approaches and achieve Malaysia's net-zero ambitions as well as Global Methane Pledge commitments while evolving the workforce to meet the needs of the energy transition.

- Methane is a more potent greenhouse gas than carbon dioxide, causing 30 times more warming over 100 years and 83 times more over 20 years.
- Malaysia's long-term methane emissions increased by 34% from 2000 to 2023, but this growth has dampened to 11% since 2010 and further declined to -4% since 2020. The waste sector was Malaysia's largest methane source in 2021 at 53% share, followed by O&G at 36%.
- Malaysia has signed the Global Methane Pledge, committing to a 30% reduction in methane emissions by 2030. Petronas leads efforts for the O&G sector, targeting reductions in its groupwide natural gas value chain of 50% by 2025 and 70% by 2030. At the national level, Petronas aims to cut methane by 50% for Malaysia's natural gas value chain by 2030.
- Fig. ES1: Malaysia's energy sector methane emissions reduced by 21% from 2019 to 2021. Projections suggest that the 2030 target will be met.

Fig. ES1. Malaysia's total energy sector methane emissions are projected to meet 50% reduction target by 2030

Energy sector methane-emission trend, Malaysia: 2019-2030

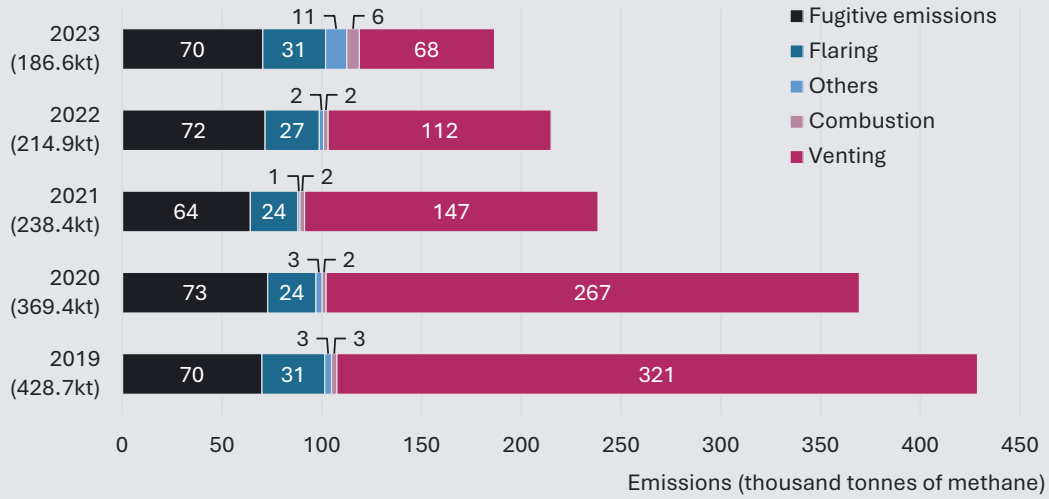


Source: Authors' analysis from Malaysia's Biennial Update Report 4 (BUR4) & Biennial Transparency Report 1 (BTR1)

- Fig. ES2: Petronas' reported progress on methane reduction has come exclusively from cuts in venting, the largest source, resulting in an 80% drop from 2019 to 2023. Using this as a proxy for the Malaysian O&G industry suggests that diversified approaches will be required to sustain methane action moving forward, particularly to address fugitive emissions, which have remained unchanged since 2019 and are now on a par with venting.

Fig. ES2. Petronas' methane cuts have been driven by 80% reduction in venting from 2019 to 2023

Petronas' groupwide methane sources: 2019-2023



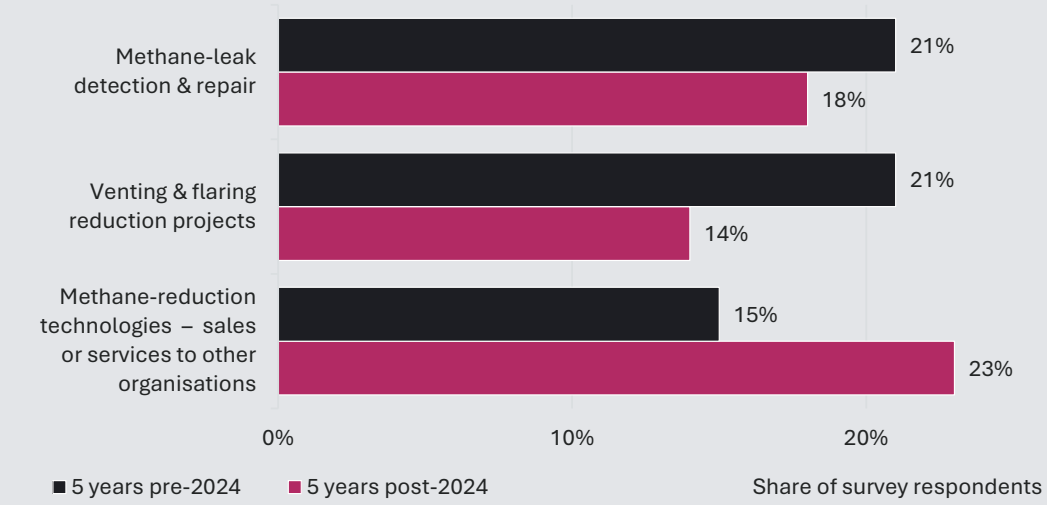
Source: Petronas 2023 Integrated Report

- Stakeholders indicate that assessing methane-specific workforce implications is challenging as methane-related tasks are typically integrated into other operational, sustainability and decarbonisation roles. Methane-mitigation measures have also been a key aspect of established industry safety practices prior to their current climate-driven focus.
- Methane-abatement awareness in the O&G industry is positive and momentum can be expected to increase. Findings from a survey[a] for this study in 2024 indicate that 77% of respondents claimed moderate or better awareness, with those acting or providing services to reduce methane emissions expected to double over the next five years.
- Fig. ES3: Past O&G methane initiatives have focused on leak detection and repair (LDAR) as well as projects for venting and flaring reduction (VFR). However, sales and services of methane-reduction technologies are expected to gain prominence, increasing from 15% of respondents to 23% compared to a decline for LDAR and VFR. This projects a larger role for companies involved in the O&G services and equipment sector in methane-abatement activities.

[a]*The high-level survey findings are aligned with qualitative stakeholder inputs and there is high confidence that they reflect broader industry trends. However, the results are constrained by response rates, sampling distributions and availability of methane-specific employment data. Hence, the caveats in Section 4.2 of the report should be considered for numerical values.*

Fig. ES3. Sales and services of methane-reduction technologies expected to gain prominence

Survey: top three methane-abatement initiatives pre- and post-2024

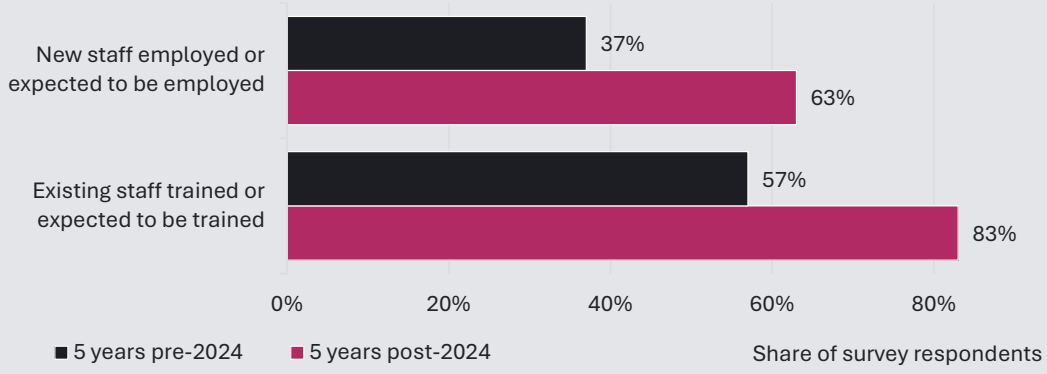


Source: ISIS Malaysia industry survey

- Fig. ES4: Upskilling, reskilling and job-scope expansion for existing staff has been and will continue to be preferred over new hires for emission-reduction roles, incentivising job retention. From the survey, 63% of respondents expect to expand their headcount, while 83% expect to train existing staff. Quantitatively decoupling methane-specific jobs from other sustainability or decarbonisation roles is challenging. Job displacement from methane action is unlikely.

Fig. ES4. Training prioritised over new hires

Survey: employment and training for emission-reduction roles

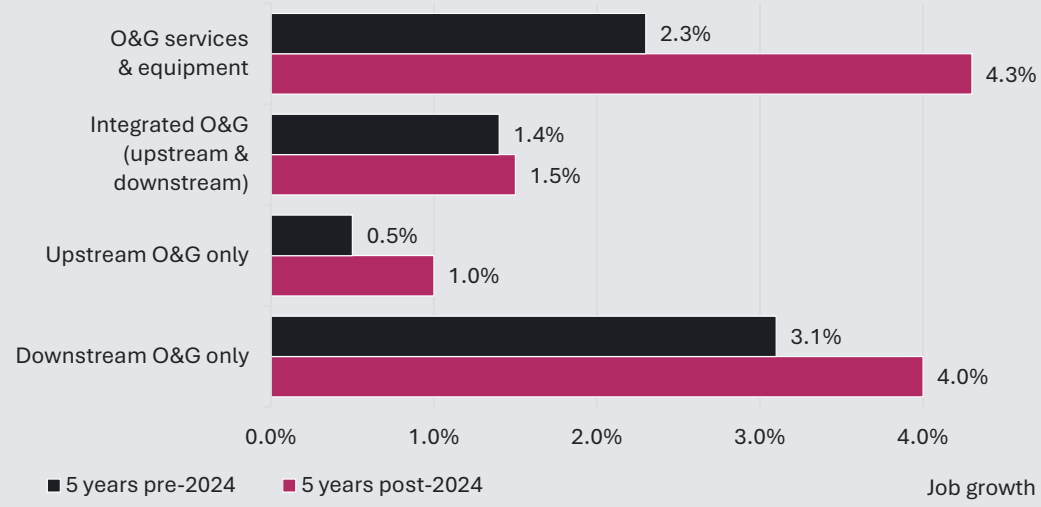


Source: ISIS Malaysia industry survey

- Job growth and skills development can be expected in remote sensing and drone inspections, measurement, monitoring, reporting and verification (MMRV), technology localisation, project management, data science, process automation, artificial intelligence and other methane-abatement measures beyond LDAR and VFR. From a broader perspective, roles related to sustainability, environmental, social and governance initiatives (ESG), carbon markets, and advanced decarbonisation technologies, such as carbon capture and hydrogen, are also anticipated to expand.
- Fig. ES5: The O&G services and equipment sector is projected to be the primary focus for employment growth across a broad spectrum of methane and other sustainability roles pre- and post-2024, increasing from 2.3% to 4.3%. Downstream O&G companies are also expected to see a 4% staff expansion, starting from a higher baseline of 3.1% in the past. The integrated and upstream only segments are projected to grow by 1%. However, companies in these areas may already have a high headcount and although the percentage may be lower, absolute staff increases may be notable.

Fig. ES5. Job growth expected in OGSE and downstream

Survey: O&G staff expansion, aggregated jobs



Source: ISIS Malaysia industry survey

The recommendations of the study are to:

- **strengthen the legal framework for methane abatement by incorporating targets into Malaysia's Climate Change Law.** This will ensure that integrated legislation governs methane emissions across all economic sectors and enhances the path to meeting national commitments. Furthermore, the Climate Change Law, overseen by the Ministry of Natural Resources and Environmental Sustainability (NRES), would ensure stronger oversight and provide crucial safeguards against prioritising economic and operational goals at the expense of environmental and climate objectives. This would align with Malaysia's National Climate Change Policy 2.0, also under the purview of NRES, which recognises curbing methane as a key strategic action.

- **increase opportunities for upskilling and reskilling to align with the preferred approach by the O&G industry for methane abatement.** Measures to facilitate the development of technical, vocational and professional skills should be explored and leveraged on to align with the evolving needs of energy transition and ensure continued progress while incentivising staff retention.

- **develop strategies to support methane action for the O&G services and equipment sector, which has the highest potential for job growth.** Key industry stakeholders should develop targeted initiatives within their existing sustainability frameworks and road maps to empower local companies to capitalise on the push for methane abatement and play a prominent role in methane-mitigation efforts.

- **expand methane action beyond O&G, focusing primarily on the waste sector, and encourage the cross-pollination of skills.** The trend of methane emissions for the energy sector has been decreasing but is largely stagnant for waste. Cross-sectoral opportunities to apply competencies and solutions from O&G methane action to accelerate progress in the waste sector should be encouraged and facilitated.

- **explore the spillover effects of methane-abatement efforts on employment trends in other areas.** Cross-sectoral initiatives to reduce methane emissions will have secondary benefits to employment trends in other areas, such as the training and manufacturing industries, and warrant deeper investigation.

- **improve accessibility and transparency of data on regulated methane-emission limits for O&G sources.** Public domain information on venting and flaring limits, as well as regulatory mandates, would catalyse collaboration, optimise growth and deployment of human capital, and promote industry driven skills development.

- **enhance accuracy of methane-emission measurements and reliability of reported values.** Adopting higher measurement, monitoring, reporting and verification standards across the O&G industry would provide further impetus for human resource expansion and development.

1 Introduction

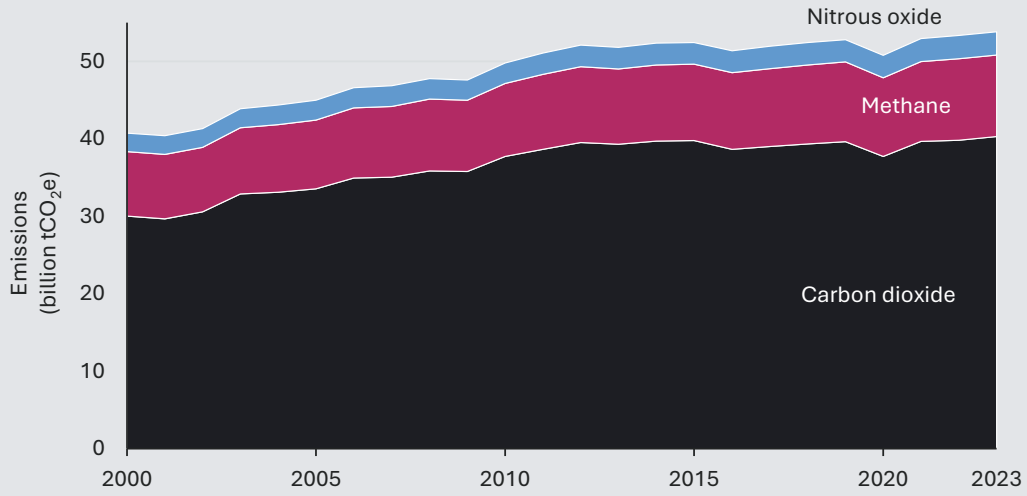
1.1 Case for methane abatement

The urgency of the climate crisis demands a multi-faceted global response. In the sphere of climate-change mitigation, reducing greenhouse gas (GHG) emissions has been recognised as the principal lever to limit anthropogenic global warming.

Carbon dioxide (CO_2), methane and nitrous oxide (N_2O) are recognised as the primary GHGs, respectively comprising about 75%, 20% and 5% of total global emissions in 2023, measured in tonnes of CO_2-equivalent (tCO_2e)[1]. These proportions have remained relatively consistent since the early 2000s. In absolute terms, total GHG emissions have risen significantly over the past two decades, increasing by 32% from 40.7 billion tCO_2e in 2000 to 53.8 billion tCO_2e in 2023. During this period, CO_2 increased by 34% while emissions of both methane and N_2O each grew by 26% (Fig. 1).

Fig. 1. Global methane emissions grew by 26% since 2000

GHG-emission trend, world: 2000-2023



Source: Our World in Data[1]

Much of the discourse on emission reduction has focused on CO_2[2]. This emphasis stems from its significant volume relative to other GHGs, its unprecedented growth because of unabated fossil fuel use and long atmospheric lifetime, ranging from 300 to 1,000 years[3]. In tandem with this focus on CO_2, there are also clear opportunities to broaden the scope of climate action by addressing the second largest GHG component – methane.

Although methane concentration in the atmosphere is 200 times lower than CO_2[4], each methane molecule is far more potent and causes 30 times more warming than CO_2 over 100 years[5], the standard metric used in emission reporting. However, methane has a much shorter atmospheric lifespan, remaining in the atmosphere for around 12 years[4]. When assessed using an alternate 20-

year period, methane's warming potential, which is 83 times greater than that of CO_2, becomes even more significant[b].

Adopting parallel pathways for GHG reduction, with a long-term emphasis on CO_2 and a short-term focus on methane, allows specific sectors to implement targeted solutions. In the oil and gas (O&G) industry, for example, the International Energy Agency highlights that the measures to prevent methane emissions are well known and reductions of around 40% can be achieved at no net cost using existing technologies[4].

With practical solutions available readily and the potential to realise significant gains within the next decade, reducing methane emissions has been deemed a "low-hanging fruit" in the fight against climate change[5].

1.2 Objectives of study

The O&G sector is Malaysia's second-largest source of methane emissions[6]. Petroliam Nasional Berhad (Petronas), the national oil company, has committed to achieving a 50% reduction in methane emissions for Malaysia's natural gas value chain by 2030 compared with 2019 levels[7]. Key actions have been and will continue to be implemented throughout the industry to realise this target.

This study aimed to understand the progress of methane-abatement initiatives in the Malaysian O&G sector and assess the resulting impacts on employment. The research scope encompasses O&G operators, O&G services and equipment (OGSE) companies, downstream gas distributors and other entities involved in the human resources aspects of the industry.

1.3 Study methodology

The study commenced in November 2023 with literature reviews and desktop research, drawing on methane-employment studies from outside Malaysia as references[8,9]. The project team also gained insights by participating in a seminar by Universiti Malaya (UM) and University of Nottingham Malaysia (UNM) to launch their study on methane data, policies and transparency in Malaysia[10], as well as a focus group discussion by Swinburne University of Technology Sarawak (SUTS) for its study on cost-abatement curves for methane-mitigation technologies. Key researchers involved with these studies were interviewed in December 2023 and January 2024.

These engagements provided a valuable baseline for understanding the structure of the Malaysian O&G industry, connecting with key stakeholders, appreciating current methane-abatement efforts and scoping the availability of publicly accessible information.

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[b] *The Global Warming Potential (GWP) for methane from IPCC has evolved over the years as the science has developed. For the 100-year GWP, the 2007 4th Assessment Report (AR4) reported a value of 25. This was revised to 28 in the 2014 5th Assessment Report (AR5) and 29.8 in the 2021 6th Assessment Report (AR6). The 20-year GWP for methane was 72 in AR4, AR5 (84) and AR6 (82.5). This is detailed further in Section 2.2.*

In early 2024, the project team undertook a supplementary exercise to recalculate the GHG inventory from Malaysia's Fourth Biennial Update Report (BUR4) to the United Nations Framework Convention on Climate Change (UNFCCC)[11] using the latest available Global Warming Potential (GWP) factors from the Intergovernmental Panel on Climate Change (IPCC). This task was carried out for the standard 100-year horizon and an additional 20-year horizon scenario, which was previously unavailable. Given the significant impact of methane on global warming over a shorter period, it was believed that this reframing initiative would provide new data to convey better the potential of reducing methane emissions as a "low-hanging fruit" to industry stakeholders and enhance the discussions with them throughout the project.

From February 2024 to October 2024, representatives from O&G operators, industry associations, government agencies and technology providers were interviewed. These took the form of semi-structured in-person and online engagements, as well as informal interactions during conferences and trade exhibitions, such as the Offshore Technology Conference Asia, Asia-Pacific Green Hydrogen Conference, and Oil and Gas Asia. Valuable insights were gained regarding the awareness of the O&G industry on methane abatement, actions undertaken thus far and future plans, resulting in a broad qualitative understanding of the employment considerations involved.

Based on inputs from the initial round of interviews conducted from December 2023 to May 2024, a survey was developed and disseminated among industry stakeholders to collect data for a quantitative analysis of the employment impacts of methane abatement. The survey, conducted from May to November 2024, targeted recipients, including O&G producers, members of industry associations – Malaysian Oil, Gas and Energy Services Council (MOGSC), Malaysian Oil, Gas and Energy Engineering Council (MOGEC) and Malaysian Gas Association (MGA) – as well as participants from earlier interview sessions.

An interim report was published in June 2024 to compile preliminary findings from the interviews and survey. These were presented in August 2024 at a seminar for methane studies conducted by SUTS, Universiti Kebangsaan Malaysia (UKM) and Universiti Sains Malaysia (USM). This forum provided a valuable opportunity to gauge industry perceptions of the validity of the information obtained at the mid-point of the project.

Subsequently, ISIS Malaysia convened a stakeholder roundtable in October 2024 to facilitate discussions and solicit feedback on methane-related employment from a diverse spectrum of O&G industry participants. The qualitative and quantitative inputs were analysed and consolidated into a draft final report completed in December 2024.

Throughout the project, BUR4 was the principal reference for national GHG emissions as it provided the best available information at that time, with data up to 2019. However, Malaysia's First Biennial Transparency Report (BTR1)[6] was published on 31 December 2024 and contained new data until 2021. As a result, all relevant parameters in this report were revised to reflect the updated data from BTR1.

Fig. 2 summarises the key activities from November 2023 to January 2025.

Fig. 2. Project timeline and key activities

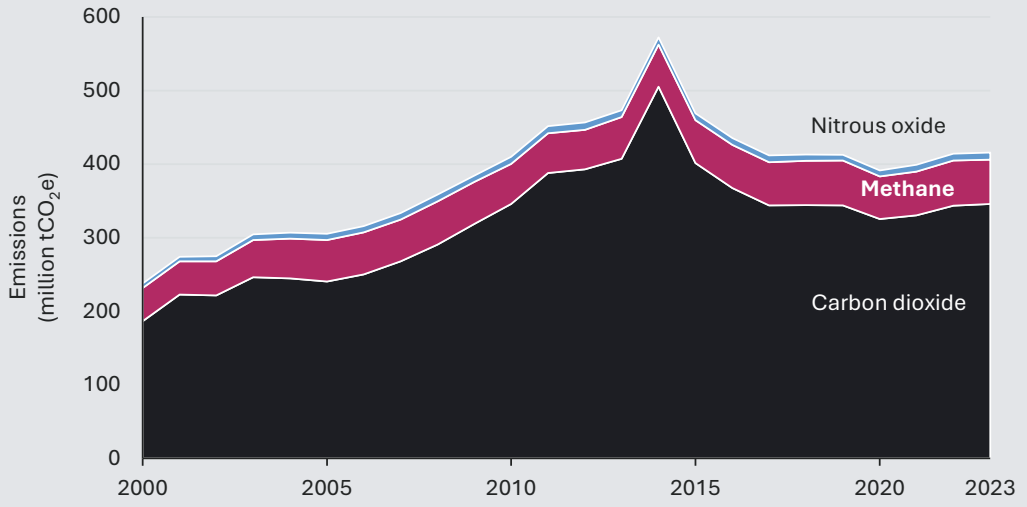
2 Methane emissions in Malaysia

2.1 National greenhouse gases

From 2000 to 2023, Malaysia's total emissions grew by 75%, driven by an 85% rise in CO_2 (Fig. 3). During the same period, methane emissions increased by 34%, from 45.1 million tCO_2e to 60.3 million tCO_2e, outpacing global growth by a factor of 1.3. While addressing CO_2 remains a priority, curbing methane emissions must also be a key focus. Encouragingly, overall methane growth has dampened to 11% since 2010 and further declined to -4% since 2020.

Fig. 3. Malaysia's methane emissions grew 34% since 2000

GHG-emission trend, Malaysia: 2000-2023



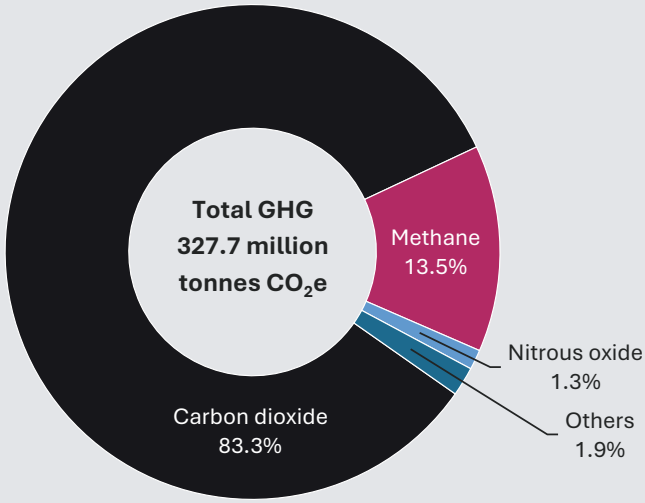
Source: Our World in Data[1]

BTR1 details Malaysia's GHG inventory for 2021 and is the most recent data source available as of 2025[6]. As reported by BTR1, Malaysia emitted 327.7 million tCO_2e in 2021, with methane comprising 13.5% (Fig. 4). The energy sector was the largest source of total emissions, contributing 259.7 million tCO_2e, with 6.3% from methane (Fig. 5).

More than half of Malaysia's total methane emissions in 2021 came from the waste sector, with energy being the second-largest contributor at 37.3% (Fig. 6). Section 3.2 delves into the contribution from various energy subsectors and offers a deeper analysis of methane from O&G.

Fig. 4. Methane comprised of 13.5% of Malaysia's emissions

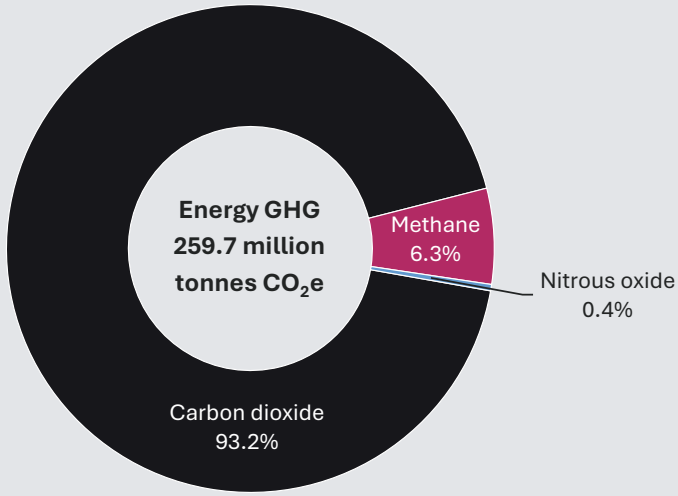
Total emissions by GHG, Malaysia: 2021 (GWP_{100})



Source: Data from BTR1 with visualisation by authors

Fig. 5. Methane comprised of 6.3% of energy sector emissions

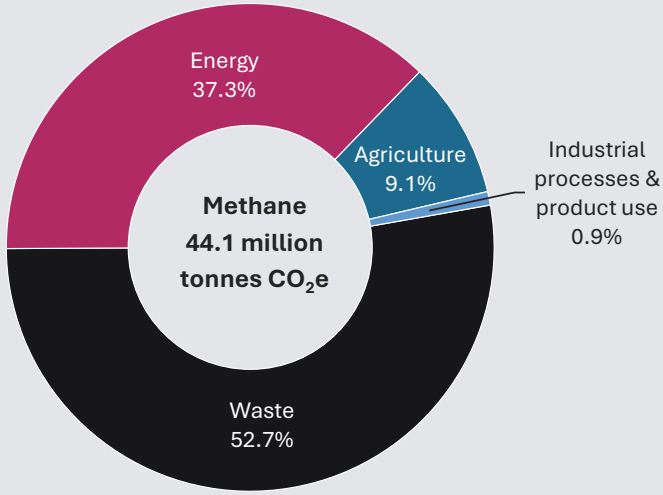
Energy sector emissions by GHG, Malaysia: 2021 (GWP_{100})



Source: Data from BTR1 with visualisation by authors

Fig. 6. Energy is Malaysia's second-largest source of methane emissions

Methane emissions by sector, Malaysia: 2021 (GWP_{100})



Source: Data from BTR1 with visualisation by authors

The energy sector's methane emissions have shown a significant downward trend over the years, reducing by 45% from 2010 to 2021 (Fig. 7). Between the reporting period of BUR4 (2019) and BTR1 (2021), the drop has been 21%. In contrast, the waste sector, Malaysia's largest methane source since 2017, has only experienced a reduction of about 7% over the same period. Contributions from agriculture and industry have been generally constant but these only comprise a small share of the overall emissions.

Hence, while progress in methane abatement is evident for energy, the waste sector might require greater attention.

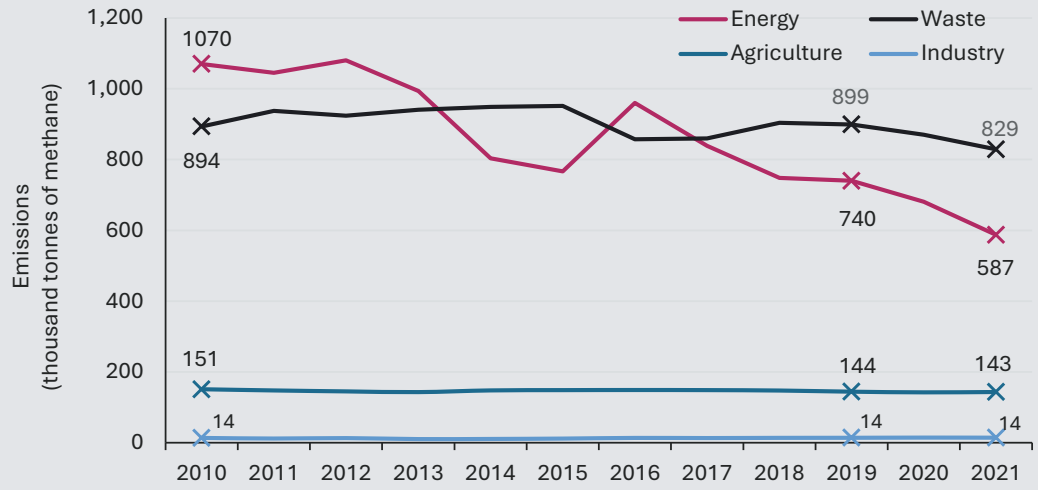
2.2 Reframing impact of methane

The Intergovernmental Panel on Climate Change (IPCC) introduced the Global Warming Potential (GWP) in 1990 in its First Assessment Report (AR1) to compare the warming impacts of different GHGs over specific time horizons relative to CO_2[12]. The GWP of CO_2 is assigned a value of one, while other gases are calculated based on the atmospheric heat they trap over the same period. This approach normalises the measurement of different GHGs and allows for more consistent comparisons.

In its most recent Sixth Assessment Report (AR6), published in 2021, IPCC states that methane has a 100-year GWP factor (or GWP_{100}) of 30, meaning that over 100 years, it causes 30 times more warming than CO_2[13]. However, as stated in Section 1.1, methane is a short-lived GHG compared to CO_2, residing in the atmosphere for about 12 years before breaking down. Therefore, a shorter GWP parameter better represents methane's near-term impact.

Fig. 7. The energy sector's methane emissions have reduced significantly compared to the waste sector

Methane-emission trends by sector, Malaysia: 2010-2021



Source: Authors' analysis from data in BTR1

AR6 also provides the 20-year GWP (GWP_{20}) as an alternative to GWP_{100}, with methane's potency increasing nearly threefold from 30 to 83 over the reduced time horizon. In other words, methane causes 83 times more warming than CO_2 over 20 years.

The understanding of methane's warming potential has advanced with progress in climate science, leading to increases in both GWP_{100} and GWP_{20} values over the past 30 years. Methane's GWP_{100} has risen from 21 in AR1 (1990) to 30 in AR6 (2021), while its GWP_{20} has increased from 63 to 83 during the same period (Fig. 8).

Malaysia's most recent GHG inventory in BTR1, presented in Section 2.1, uses the GWP_{100} factors from the 2014 Fifth Assessment Report (AR5), with a value of 28 for methane. This is a notable change from the GWPs applied in the previous four national emissions reports – 21 in BUR1 and 25 in BUR2, BUR3 and BUR4 (Table 1).

As part of this study, the emissions from BTR1 were recalculated, based on the latest AR6 factors for both GWP_{100} and GWP_{20} scenarios, to reflect the most recent available science. It also highlights methane's more significant short-term contribution to national emissions and enhances engagement with industry stakeholders. While the GWP_{100} recalculations provided a revised perspective on existing data, the GWP_{20} metric introduced new insights.

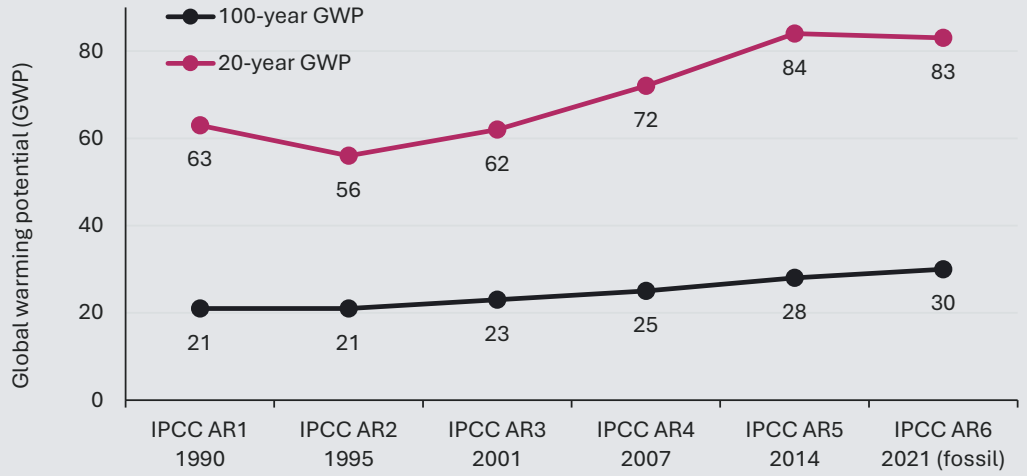
Table 2 compares these parameters for all GHGs, while Fig. 9 focuses solely on the differences for methane. Replacing the default AR5 GWP_{100} factor for methane (28) in BTR1 with the latest from AR6 GWP_{100} (29.8) results in a nominal increase to the baseline.

However, the analysis shows clearly that the short-term warming impacts of methane are far more pronounced when viewed from the perspective of AR6 GWP_{20} (82.5). The methane shares for total and energy sector emissions are more than double when considered over a reduced 20-year horizon compared with the 100-year baseline.

Methane's proportion of total and energy sector emissions rises from 13.5% to 31.4% and 6.3% to 16.6% respectively. These significant increases, if addressed, could play a crucial role in reducing Malaysia's short-term GHG inventory, helping the country meet its ambitions of achieving net-zero emissions by 2050.

Fig. 8. Understanding of methane's impacts has improved

Evolution of methane's GWP in IPCC reports, 1990-2021



Source: Compiled by authors from data in respective IPCC Assessment Reports

Table 1. Malaysia references IPCC AR5 for latest reporting

Methane GWP references for national IPCC reporting

Malaysia report	BUR1	BUR2	BUR3	BUR4	BTR1
Publication year	2015	2018	2020	2022	2024
Data for year	2011	2014	2016	2019	2021
Methane GWP_{100}	21	25	25	25	28
IPCC GWP reference	AR2 (1995)	AR4 (2007)	AR4 (2007)	AR4 (2007)	AR5 (2014)

Source: Compiled by authors from data in Malaysia's respective BURs

Table 2. Methane has significant short-term impacts

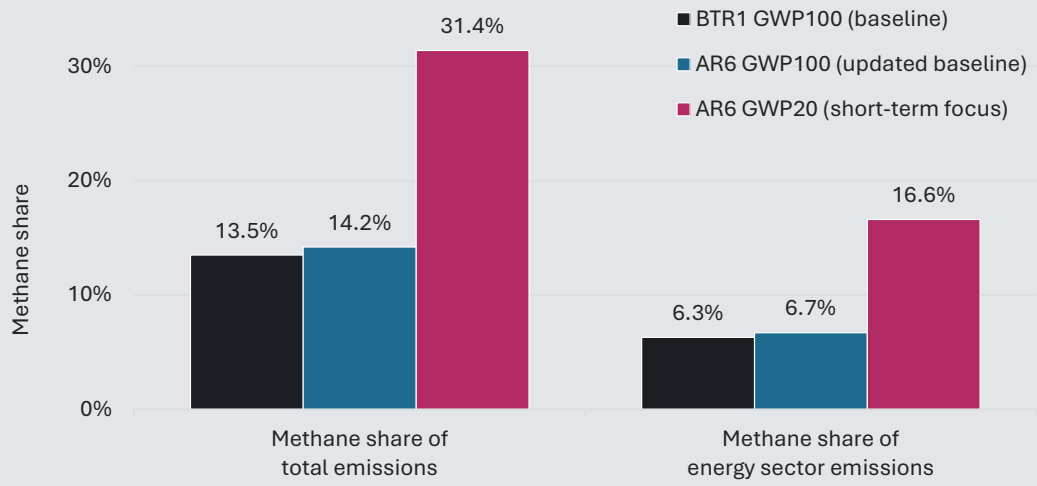
Total emissions using AR6 GWP factors, Malaysia: 2021

Category	Parameter	BTR1 GWP_{100} (AR5 baseline)	Recalculated: AR6 GWP_{100} (updated baseline)	Recalculated: AR6 GWP_{20} (short-term focus)
Total emissions by GHG	Total GHG	327.7 $MtCO_2e$	+ 0.9%	+ 26.2%
	CO_2	83.3%	82.5%	66.0%
	Methane	**13.5%**	**14.2%**	**31.4%**
	N_2O	1.3%	1.4%	1.1%
	Others	1.9%	1.9%	1.5%
Energy sector emissions by GHG	Sector GHG	259.7 $MtCO_2e$	+ 0.4%	+ 12.3%
	CO_2	93.2%	92.9%	83.9%
	Methane	**6.3%**	**6.7%**	**16.6%**
	N_2O	0.4%	0.4%	0.4%

Source: Calculated by authors from data in BTR1

Fig. 9. Short-term impacts of methane are more than double

Methane emissions using AR6 GWP factors, Malaysia: 2021



Source: Calculated by authors from data in BTR1

3 Methane emissions in Malaysian oil & gas sector

3.1 Governance and methane regulations

3.1.1 Upstream regulations

The Petroleum Development Act 1974 grants Petronas ownership and exclusive rights to manage and develop Malaysia's petroleum resources. Petronas is the industry regulator for upstream assets through Malaysia Petroleum Management (MPM), and primary O&G producer.

Other investors can participate in exploration and production activities in Malaysia through licensing agreements with Petronas. These are known as petroleum-arrangement contracts, with the vast majority taking the form of production-sharing contracts. As of 2023, MPM regulated 38 petroleum-arrangement contractors (PAC) under the guidance of the Petronas Procedures and Guidelines for Upstream Activities[5,14].

Supporting these PACs are more than 4,700 licensed companies, collectively referred to as the O&G services and equipment (OGSE) industry. About 85% are small-medium enterprises, with the OGSE sector employing about 59,000 personnel[15,16]. Therefore, a holistic assessment of the potential employment impacts resulting from methane-abatement measures would need to consider both PACs and OGSE companies.

Interviews with industry stakeholders indicate that MPM regulates methane emissions from assets under its purview by setting annual venting and flaring limits. PACs are also required to submit periodic reports on these activities to MPM. The thresholds are designed to align with the overall methane commitments of Malaysia and the O&G industry (Section 3.3).

Petronas has technical standards that specify methane-measurement protocols for its facilities, which are reflected in minimum environmental standards stipulated for other PACs. However, these details are not publicly available, which constrain granular analysis of methane emissions[5,15].

3.1.2 Downstream regulations

At the other end of the spectrum, regulation of Malaysia's downstream gas industry varies by region for assets beyond MPM's jurisdiction. The Energy Commission or Suruhanjaya Tenaga oversees this function in Peninsular Malaysia. At the same time, the Sarawak Ministry of Utility and Telecommunications and the Energy Commission of Sabah are the respective regulators in those regions[17,18,19].

Stakeholder feedback suggests that regulations addressing downstream methane emissions would be driven primarily by health and safety considerations, with environmental objectives being secondary. This perspective is supported by data from BUR4 (Section 3.2), which indicate that emissions from transmission, distribution, storage and other fugitive sources contribute less than 4% of total O&G methane emissions.

3.1.3 Current and upcoming policies

Malaysia's National Climate Change Policy 2.0, launched in September 2024 by the Ministry of Natural Resources and Environmental Sustainability (NRES), recognises curbing methane as a key action to achieve low-carbon development that aligns with the national sustainability agenda and international climate commitments.

Subsequently in October 2024, NRES issued a consultation paper for Malaysia's proposed Climate Change Law or Rang Undang-Undang Perubahan Iklim Negara (RUUPIN). The consultation paper references the various GHGs collectively and does not prescribe treatments for different components. However, it is reasonable to assume that the sections in RUUPIN relating to GHG targets, emission-reduction mechanisms and reporting frameworks, among others, may include consideration for methane.

In addition, Malaysia's 2023 National Energy Transition Roadmap (NETR) lists the Natural Gas Roadmap (NGR) as a key initiative and recognises the need to address sustainability while growing the sector. However, NGR is still under development as of May 2025 and it remains to be seen if methane-specific measures will be incorporated.

3.2 Methane emissions in oil and gas

According to BTR1[c], the O&G industry accounted for 9% of Malaysia's total emissions in 2021, comparable to the shares of the industrial and waste sectors (Fig. 10). While this is notably lower than the contributions from the most significant GHG sources – electricity and transport – a breakdown by gas type reveals that although CO_2 emissions from O&G are minimal, the sector is the second-largest source of methane with roughly one-third of the share (Table 3).

This breakdown and updated GWP analysis in Section 2.2 underscore the substantial benefits the O&G sector could gain through targeted methane-mitigation efforts.

BTR1 breaks down emissions in the O&G sector into process subsectors (Fig. 11) based on the categorisation defined by the 2006 IPCC Guidelines for National Greenhouse Gas Inventories[22]. The IPCC's definitions for these categories and raw data from BTR1 are detailed in Appendix A.

Gas production and venting[d] emerged as the two largest sources of O&G methane emissions, with a total of 85%. All other fugitive sources amounted to 15% of total methane emitted, with no single component exceeding 5%. Combustion from petroleum refining contributed only a nominal 0.06%.

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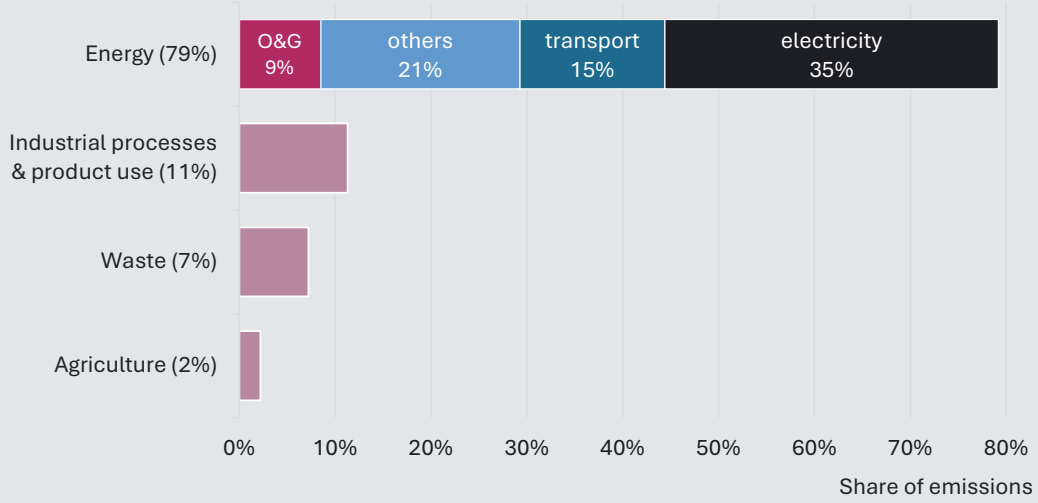
[c] *Default BTR1 values are used to allow direct comparability with official data from the government and Petronas.*

[d] *Venting releases unignited gas, while flaring ignites gas as it is released. Both are controlled processes to exhaust methane, essential for emergency and safety as well as when it is unfeasible or uneconomical for the gas, created as a by-product of oil extraction or other processes, to be captured, used, transported or reinjected [15].*

Fig. 10. The O&G sector produced 9% of Malaysia's total emissions

Total emissions by sector, Malaysia: 2021



Source: Data from BTR1 with visualisation by authors

Table 3. The O&G sector produced 36% of Malaysia's methane emissions

Sectoral emissions' ranking by GHG, Malaysia: 2021

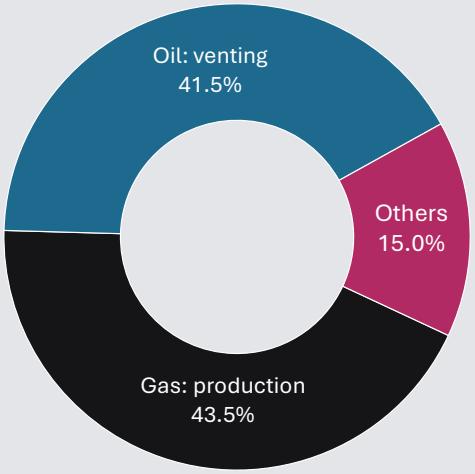
Rank	CO_2 source	CO_2 emissions
1	Energy: electricity	41.6%
2	Energy: others	25.0%
3	Energy: transport	17.8%
4	Industry	11.1%
5	**Energy: oil & gas**	**4.4%**
6	Agriculture	0.2%
7	Waste	0.02%

Rank	Methane source	Methane emissions
1	Waste	52.7%
2	**Energy: oil & gas**	**36.0%**
3	Agriculture	9.1%
4	Energy: transport	1.0%
5	Industry	0.9%
6	Energy: others	0.2%
7	Energy: electricity	0.1%

Source: Data from BTR1

Fig. 11. Gas production and venting caused 85% of O&G methane emissions

Methane sources in the O&G sector, Malaysia: 2021



Others (15%) comprise the following:

i) Other fugitive emissions:
- Gas: processing = 4.2%
- Oil: flaring = 3.7%
- Gas: distribution = 3.2%
- Gas: transmission & storage = 2.1%
- Gas: venting = 1.4%
- Gas: flaring = 0.4%
- Oil: refining & storage = 0.03%
- Oil: production = 0.003%

ii) Combustion:
- Petroleum refining = 0.06%

Source: Data from BTR1 with visualisation by authors

The most significant opportunities to address methane emissions are through improved gas production practices and reduced venting in oil extraction, both upstream activities under the purview of Petronas via MPM. Midstream and downstream activities are not a notable source of fugitive emissions and, as highlighted previously, safety concerns would likely take precedence over environmental requirements.

3.3 Methane-abatement commitments

Malaysia is a signatory to the Global Methane Pledge (GMP), launched during the 26th Conference of Parties of the UNFCCC with the aim to catalyse action to reduce global methane emissions across all sectors by at least 30% from 2020 levels by 2030. As of March 2024, more than 150 countries have joined GMP, representing more than 50% of global anthropogenic methane emissions [5,20].

In the O&G sector, Petronas also signalled its commitment to methane abatement by joining global frameworks like the Methane Guiding Principles (MGP) in 2020, Zero Routine Flaring by 2030 (ZRF) initiative in 2021 and the Oil and Gas Methane Partnership 2.0 (OGMP 2.0) in 2022.

MGP, launched in 2017, is a partnership of 47 international organisations committed to reducing methane emissions across the natural gas supply chain through the following five priority areas of action: continually reduce methane emissions; advance strong performance across the gas supply chain; improve accuracy of methane emissions data; advocate sound policy and regulations on methane emissions; and increase transparency[21].

ZRF was launched by the World Bank in 2015 to end routine flaring, a common industry practice of burning gas that is a by-product of oil production, by 2030. More than 100 governments and oil companies, accounting for about 60% of global gas flaring, currently endorse ZRF and are committed to reporting annually their flaring data and progress towards meeting the target[22].

OGMP 2.0 is the United Nations Environment Programme's flagship O&G methane-emission reporting and mitigation initiative, comprising more than 130 companies with assets in more than 70 countries. It aims to improve the accuracy and transparency of measurement-based reporting, representing about 40% of global O&G production and 80% of liquified natural gas flows[23].

In alignment with its global commitments, Petronas launched its Pathway to Net-Zero Carbon Emissions 2050 (NZCE-2050) initiative in November 2022[7]. Among the broad suite of decarbonisation targets include reducing methane emissions in its groupwide natural gas value chain by 50% in 2025 and 70% in 2030, compared with 2019. To complement national targets, NZCE-2050 also aspires to a 50% reduction in methane emissions for Malaysia's natural gas value chain, encompassing Petronas and all other O&G operators in the country.

Petronas also plays a leading role in regional capacity building via the Methane Leadership Programme (MLP), which is conducted in collaboration with energy sector partners from ASEAN. The inaugural MLP ran from June 2023 to October 2024 and the next iteration, MLP 2.0, was launched immediately after[24].

3.4 Methane-abatement progress in oil and gas

Data from BTR1 suggest that Malaysia has made notable progress in methane reduction within the energy sector (Fig. 12).

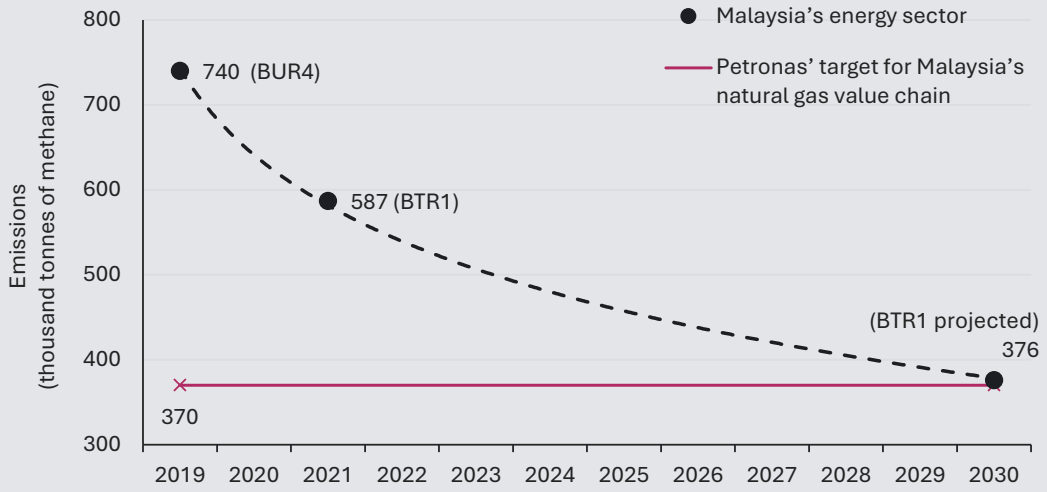
Methane emissions in 2021 were about 20% lower than the baseline of 740kt in 2019. Looking ahead, BTR1 projects that methane emissions in 2030 will be about 49% below 2019 levels, almost meeting Petronas' target of a 50% reduction for the Malaysian natural gas value chain. This assessment signals confidence in the industry's ability to continue advancing the initiatives implemented from 2019 to 2022 and cut further methane emissions until 2030 in alignment with GMP and NZCE-2050, albeit at a gradually reducing rate.

The 2023 Petronas Integrated Report (PIR)[25] supports this downtrend for the national O&G sector (Fig. 13). The company's groupwide methane emissions in 2023 were 56% lower than the 2019 reference value, with the NZCE-2050 milestone of 50% reduction achieved in 2022 – three years ahead of target.

Extrapolating the published data suggests that Petronas is on track to meet its 75% milestone for groupwide methane cuts by 2028 – two years before 2030. However, the rate of reduction is projected to slow in the latter half of the decade compared with the preceding period. This indicates diminishing returns from current abatement strategies and suggests that new approaches might be necessary to sustain progress.

Fig. 12. Malaysia's total energy sector methane emissions are projected to meet 50% reduction target by 2030

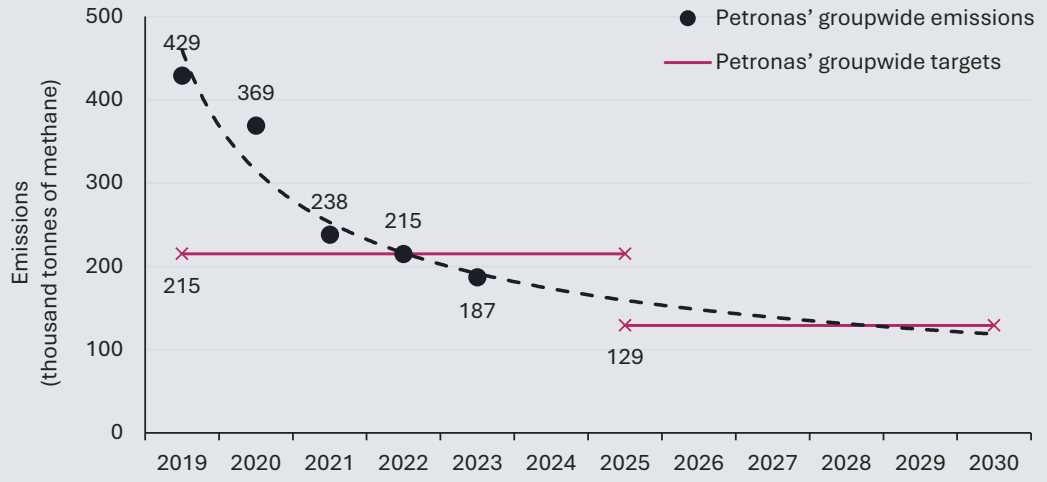
Energy sector methane-emission trend, Malaysia: 2019-2030



Source: Authors' analysis from data in BUR4 & BTR1

Fig. 13. Petronas achieved its 2025 groupwide methane-emission reduction target in 2022 and projected to reach 2030 target two years earlier

Petronas' groupwide methane emissions trend: 2019-2030

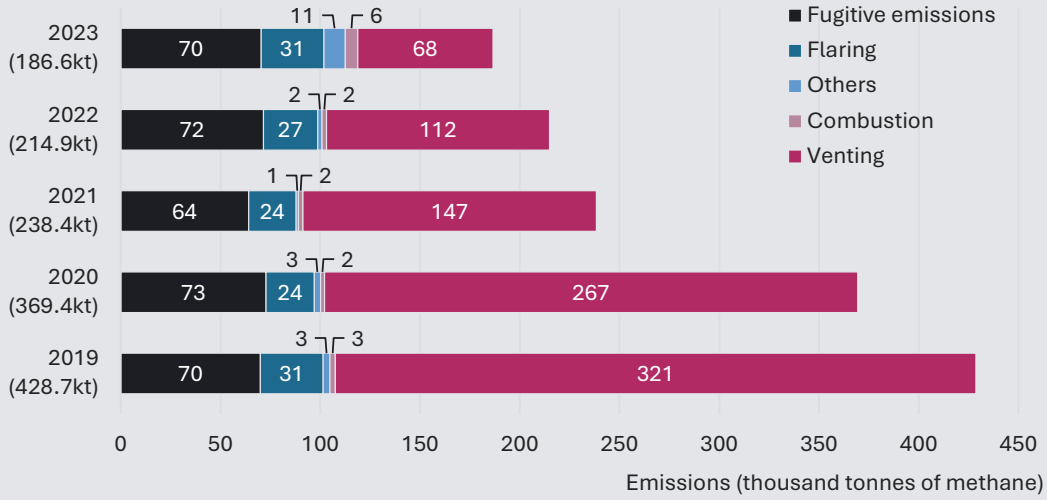


Source: Authors' analysis from data in Petronas 2023 Integrated Report

The primary driver of Petronas' achievements in methane abatement to date has been the substantial reduction in venting, which decreased by 80% from 321kt of methane in 2019 to just 68kt in 2023 (Fig.14). In contrast, methane emissions from fugitive sources and flaring were the same in 2023 as they were in 2019, despite showing a dip in 2021. Methane from combustion and other sources, defined as acid gas removal, glycol dehydrators, mobile and transportation, remained relatively constant from 2019 to 2022 before showing a marked increase in 2023.

Fig. 14. Petronas' methane cuts have been driven by 80% reduction in venting from 2019 to 2023

Petronas' groupwide methane sources: 2019-2023



Source: Petronas 2023 Integrated Report

Feedback from the OGSE sector indicates that projects undertaken for methane abatement include converting vent stacks to flare stacks, installing flare gas recovery systems, improving process efficiencies and enhancing the detection of methane leaks via both in-situ and remote measurements[15]. Petronas' 2024 MGP report aligns with these and describes measures, such as flaring and venting-reduction projects and improvements to methane quantification and reporting through various advanced technologies[26]. In addition, advocacy efforts to enhance awareness and capacity for the national O&G industry and promote regional collaboration were also highlighted.

The success of methane mitigation through venting reduction has shifted its relative significance from being the largest source between 2019 and 2022 to second in 2023, marginally behind fugitive emissions. While this is laudable, it highlights the need to diversify the technologies, explored by SUTS in its methane study[27], and investments to address emissions in other areas of O&G production and achieve further reductions across the board.

It should be noted that the reported values represent Petronas' groupwide operations, which span both Malaysian and international activities. While PIR disaggregates total emissions geographically, it does not provide a breakdown for methane or other GHGs. Emissions from operations within Malaysia accounted for an average of 94% of Petronas' total groupwide emissions from 2019 to 2023. Based on this proportion, it is reasonable to infer that most reported methane emissions also come from domestic operations. However, without geographic segmentation of methane emissions, this remains an assumption supported by overall trends in its emission data.

Progress has also been reported in the methods for methane quantification. OGMP 2.0 defines five methane performance levels[e] that represent increasing granularity, accuracy and transparency of measurements[28]. Petronas' MGP reports indicate an ongoing transition from level 3 to 4, with aspirations for level 5 in a representative sample of its assets[26].

Similar reporting levels can be seen for other participants in the Malaysian O&G sector, such as Shell[29], but this information is not geographically segregated nor available for all PACs. Petronas also describes efforts for collaboration, capacity building and knowledge sharing. Hence, it is reasonable to assume that methane measurement accuracy will progressively improve throughout the domestic industry. Once available, external sources of methane data, such as satellite measurements from the Environmental Defense Fund's MethaneSat[30] and ASEAN's Oil and Gas Emissions Dashboard[31], will enhance accuracy by enabling third-party verification of reported data.

[e] *OGMP 2.0 Methane performance levels:*
Level 1: basic measurement, reporting at asset or country level, default emission factors.
Level 2: enhanced measurement, reporting in consolidated or simplified categories.
Level 3: advanced measurement, reporting by detailed source type, generic emission factors.
Level 4: leading practices, reporting by detailed source type, specific emission/activity factors.
Level 5: highest standard, level 4 with additional site-level measurement and reconciliation.

4 Employment impacts of methane abatement

4.1 Qualitative assessment

From February to October 2024, a wide range of stakeholders in Malaysia's O&G sector, comprising of operators, industry associations, recruitment agencies, subject-matter experts, government agencies, technology providers and researchers were interviewed to gather insights into methane-abatement initiatives and the associated employment impacts. These were conducted through semi-structured in-person and online engagements as well as informal interactions during conferences and trade exhibitions, such as the Offshore Technology Conference Asia, Asia-Pacific Green Hydrogen Conference, Oil and Gas Asia, and International Greentech & Eco Products Exhibition & Conference Malaysia.

Observations from the interviews were supplemented by an industry survey (Section 4.2) and consolidated during a multi-stakeholder roundtable outlined in Appendix B. Feedback related to the areas of methane governance, technology and data have been incorporated into Chapter 3, while the salient points on employment are elaborated further in the subsections that follow.

4.1.1 Quantifying methane-specific jobs 'challenging'

A critical recurring input from stakeholders was that assessing the employment impacts directly associated with methane-emission reduction for environmental reasons would be challenging. These tasks are not standalone functions but typically integrated into broader job roles to optimise operational efficiency. Activities like inspections, measurement, monitoring, reporting and verification (MMRV), as well as leak detection and recovery (LDAR), have been longstanding practices in the O&G industry to manage methane, primarily for process-safety reasons but also to minimise gas wastage, given its economic value. Job roles for these functions and companies that provide such services have already been established within the industry and these would now add an environmental dimension to their responsibilities. While the methane-abatement commitments driven by climate action will add impetus to such activities, they are unlikely to add substantially new jobs to mature practices.

4.1.2 Skills development and role expansions preferred over increasing headcount for methane-abatement tasks

Applying Petronas' data in Fig. 14 as a proxy for the overall Malaysia O&G sector suggests that in addition to venting, opportunities exist to reduce methane from other sources, especially fugitive emissions. The industry preference is to upskill, reskill or expand the job scopes of existing personnel before adding new hires to address these needs. In addition to developing the key frontline competencies of inspections, MMRV and LDAR, other skills mentioned by stakeholders include project management, remote-emission surveying and data analysis. A common observation, particularly among the OGSE sector, is the need to develop a larger pool of Malaysian talent through collaboration with foreign counterparts to implement effective knowledge and skill-transfer programmes.

4.1.3 Malaysia can leverage on sectoral leadership for regional opportunities

The emphasis on capacity building is reflected in the ASEAN MLP, which has seen its members grow from 13 upon inception in June 2023 to 18 at the launch of the second phase in October 2024. Establishing the Southeast Asia Methane Emissions Technology Evaluation Centre in Malaysia also underscores the country's prominent role in regional methane-abatement initiatives[24]. In this respect, local service providers have highlighted that increased awareness and action on methane in ASEAN member states could create opportunities for job growth arising from their potential participation in more methane-reduction projects outside Malaysia.

4.1.4 Growth likely in broader sustainability and decarbonisation jobs

The consensus among stakeholders is that the drive towards more sustainable practices within the O&G industry and its supply chains, guided by initiatives such as Petronas' NZCE-2050, National OGSE Sustainability Roadmap by Malaysia Petroleum Resources Corporation (MPRC), corporate ESG requirements, and others, will result in employment growth across a diverse spectrum of roles related to the energy transition. This includes jobs in energy efficiency, carbon capture, utilisation and storage (CCUS), hydrogen economy, deployment of solar energy and energy storage at O&G facilities, data science, process optimisation, GHG reporting and compliance, transition financing, carbon trading and more. Within this broad landscape, decoupling and quantifying the impact of methane-specific initiatives, such as MMRV, LDAR, reducing venting and flaring, mitigating fugitive emissions and others, will be challenging.

4.1.5 Clarity on job types and longevity of initiatives would facilitate planning

Several interviewees from the OGSE sector drew a notable distinction between project-based methane-abatement jobs, which would be more pertinent to them, compared to ongoing or long-term jobs at O&G producers. As service providers and equipment suppliers, their capacity to invest in skills development or increase headcount would be contingent upon initiatives driven by the producers as well as market cycles. They also indicated the need for clarity on industry direction once current targets were met or if costs for marginal-abatement measures become uneconomical.

4.1.6 Impact of methane reduction on domestic manufacturing sector warrants further investigation

Manufacturing is another sector where methane-reduction efforts could impact on employment but an in-depth assessment of this aspect was beyond this project's scope. However, discussions with industry experts suggest that domestic methane initiatives are unlikely to be a primary driver for expanding O&G solution providers with manufacturing facilities in Malaysia, such as Honeywell and Baker Hughes. Further investigation is warranted, especially on the potential for Malaysia to be a manufacturing hub to support the regional expansion of local OGSE players.

4.1.7 Job displacement resulting from methane action unlikely

Stakeholders unanimously agreed that methane-abatement initiatives will not lead to job displacement in the O&G sector. The industry is pivotal to the economy and the job market and will remain so in the coming decades. NETR reinforces this outlook and projects that by 2050, natural gas will account for 57% of Malaysia's total primary energy supply, with crude oil and petroleum products contributing 21%. Efforts to curb CO_2 and methane emissions will play an especially vital role as the sector seeks to balance economic growth with climate commitments. Prioritising skills development will support workforce retention and maintain the domestic industry's appeal despite the global narrative of a shift away from fossil fuels. Furthermore, advancements in decarbonisation technologies are anticipated to create new employment opportunities, ensuring continued sectoral growth and resilience.

4.2 Quantitative assessment

As methane-reduction strategies become increasingly integrated into industry operations, it is critical to understand how such changes could impact on Malaysia's O&G labour market. An online survey was disseminated among O&G industry stakeholders from May to November 2024 to collect data for a quantitative analysis of the employment impacts of methane abatement. The survey aimed to identify industry awareness and actions, types of employment created, and knowledge and skill sets required for Malaysia's methane targets.

The survey compared respondents' perspectives on several metrics during the five years before 2024 with their plans for the next five years. The data provided valuable insights into the state of methane-abatement strategies of Malaysian O&G players, focusing on receptivity and employment impacts. The target recipients included O&G producers, members of industry associations – MOGSC, MOGEC and MGA – and participants from ISIS Malaysia's qualitative interview sessions and stakeholder roundtable.

The survey was disseminated via three avenues – direct engagement with stakeholders, distribution by industry associations to their members and peer-to-peer sharing by respondents. The estimated survey reach was more than 500 respondents, based on the membership of the industry associations and accounting for some overlap between them[32,33,34]. However, from May to November 2024, only 30 responses were received.

Although the low response rate, skewed sampling distribution and unavailability of methane-specific employment data constrained the ability to perform detailed employment analysis and extrapolate accurate projections, the survey's high-level findings align closely with insights from stakeholder interviews and the roundtable discussion (Section 4.1).

Hence, while there is high confidence that the survey provides a reliable indication of broader sectoral trends, this does not extend to a more granular analysis of the results. Therefore, numerical values should be interpreted in the context of respondent profiles, their level of awareness, past initiatives, reported progress and the challenges outlined previously in decoupling methane-related employment from broader sustainability roles.

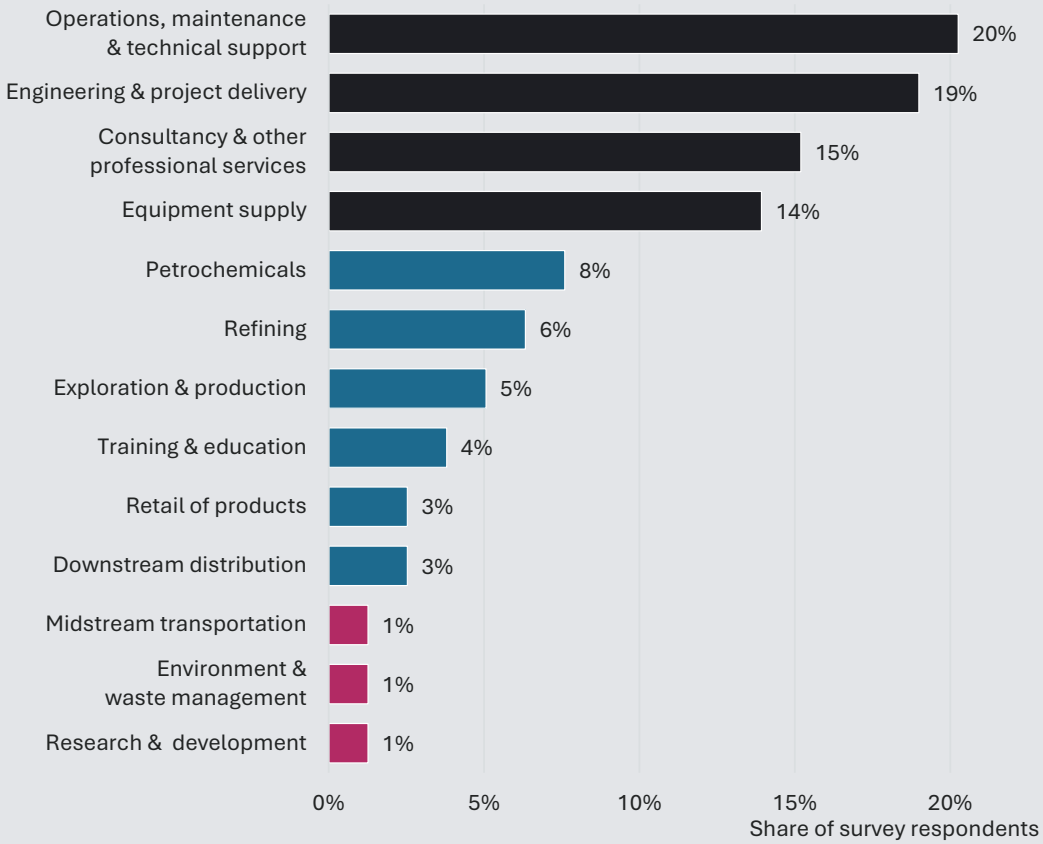
4.2.1 Survey primarily captures sentiments of small- to mid-sized OGSE companies

The survey targeted companies in the O&G landscape based on supply chain segments while accounting for their size and capacity proxied by total number of employees and annual revenue. The top four sectors were: operations, maintenance and technical support; engineering and project delivery; consultancy and other professional services; and equipment supply. Notably, sectors expected to be sources of methane emissions – refining, exploration and production, distribution, and transportation – comprised about 15% of responses (Fig. 15).

80% of respondents were from companies with 250 employees or fewer, with 37% having headcount below 50 (Fig. 16). More than 85% reported annual earnings of less than RM500 million and half of these were in the lowest bracket below RM50 million (Fig. 17). Due to respondent anonymity, it was not possible to determine whether these figures refer to an entire organisation or subsidiaries.

Fig. 15. Most respondents were from OGSE sector

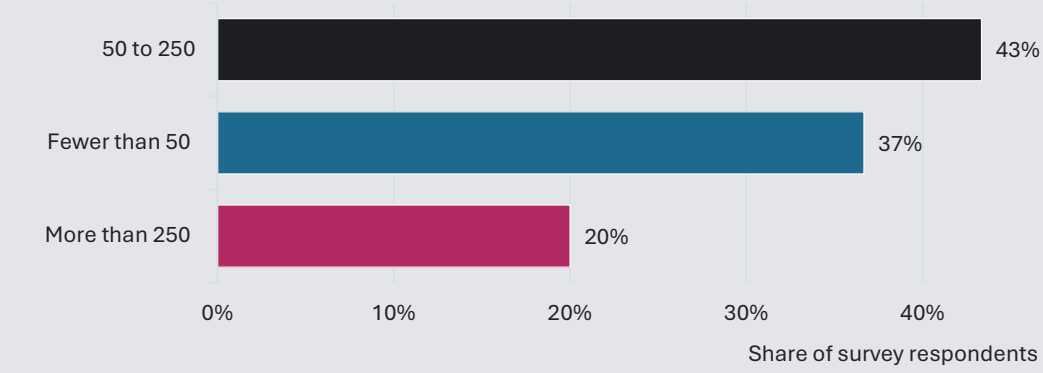
Survey: organisation by involvement in O&G supply chain



Source: ISIS Malaysia industry survey

Fig. 16. Most respondents had fewer than 250 employees

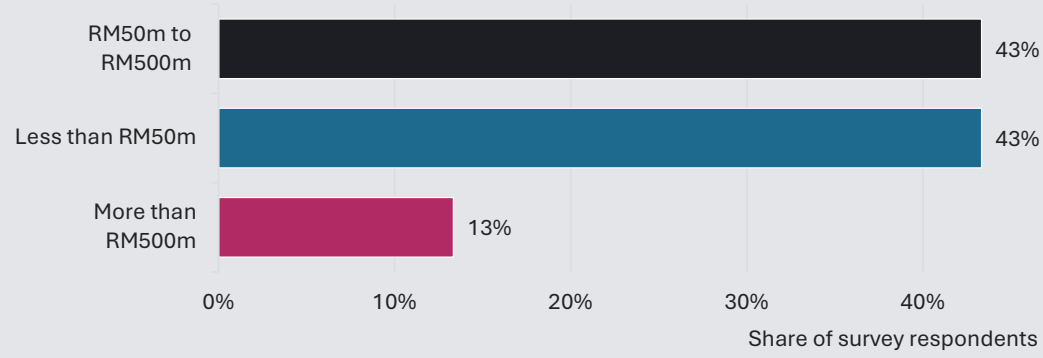
Survey: organisation size by employees



Source: ISIS Malaysia industry survey

Fig. 17. Annual earnings of most respondents were less than RM500 million

Survey: organisation size by annual revenue



Source: ISIS Malaysia industry survey

4.2.2 Respondents indicate positive awareness of reducing methane emissions and related national initiatives

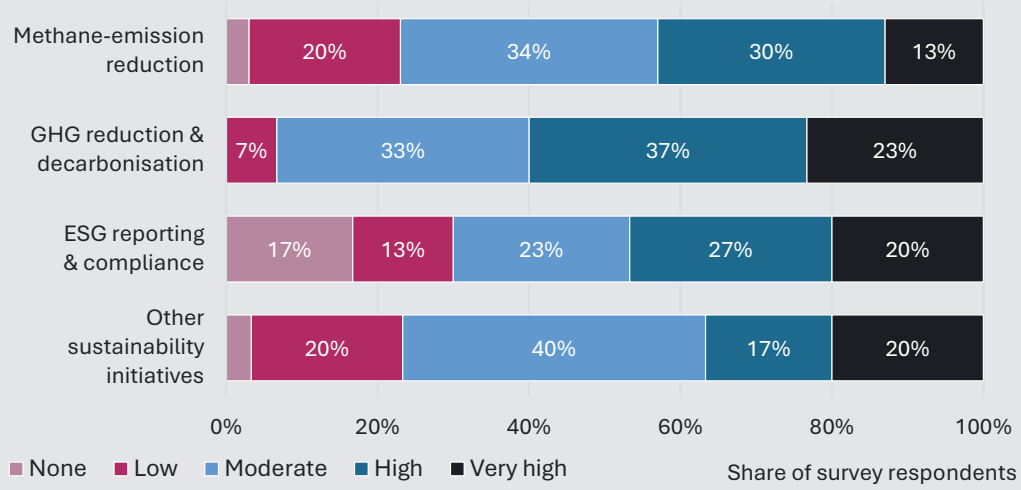
Pre-survey interviews indicated that the overall industry awareness of methane emissions may be mixed relative to the broader topics of decarbonisation and ESG, particularly among smaller companies. Stakeholders recommended that the survey gauge respondents' familiarity with the overarching themes first before introducing methane within that context. This approach was adopted by ISIS Malaysia when developing the survey.

Encouragingly, the gap between methane awareness in contrast to decarbonisation and ESG was not as large as anticipated, especially given the prevalence of respondents from smaller companies in the survey (Fig. 18). The survey reveals that 77% of participants claimed a moderate or better awareness of methane abatement compared to 97% for GHG reduction and decarbonisation, and 70% for ESG reporting and compliance.

Further analysis of the responses also indicated a close correlation between methane awareness and past abatement initiatives. This suggests that past advocacy, knowledge sharing and capacity building initiatives for methane within the O&G industry had positive impacts and complemented the broader decarbonisation and ESG discourse. However, this perspective should be tempered with the possibility that respondents more aware of methane abatement would also be more inclined to answer the survey, leading to potential bias in the findings.

Fig. 18. Awareness of reducing methane is positive

Survey: awareness of methane and other climate measures

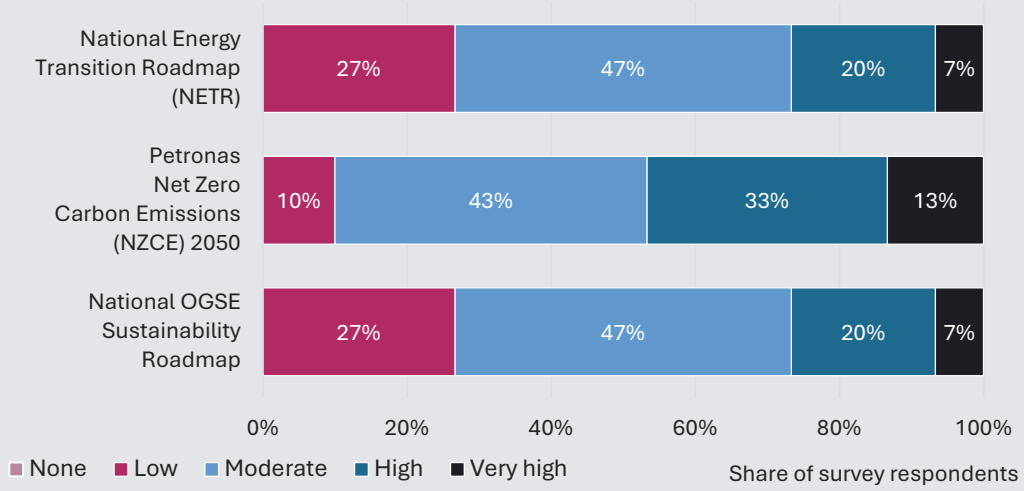


Source: ISIS Malaysia industry survey

There is also a significant awareness regarding key national sustainability road maps guiding energy transition and sustainability efforts within the O&G sector. The survey revealed that 90% of respondents reported having a moderate or higher awareness of Petronas' NZCE 2050, while 73% had similar awareness levels of the NETR and the National OGSE Sustainability Roadmap (Fig. 19). Greater familiarity with the NZCE-2050 reinforces the perception of a top-down industry where regulator-driven mandates supported by Petronas' engagement initiatives represent the primary mechanism to realise methane-abatement targets.

Fig. 19. Awareness of relevant national initiatives is positive

Survey: awareness of road maps impacting on O&G sector



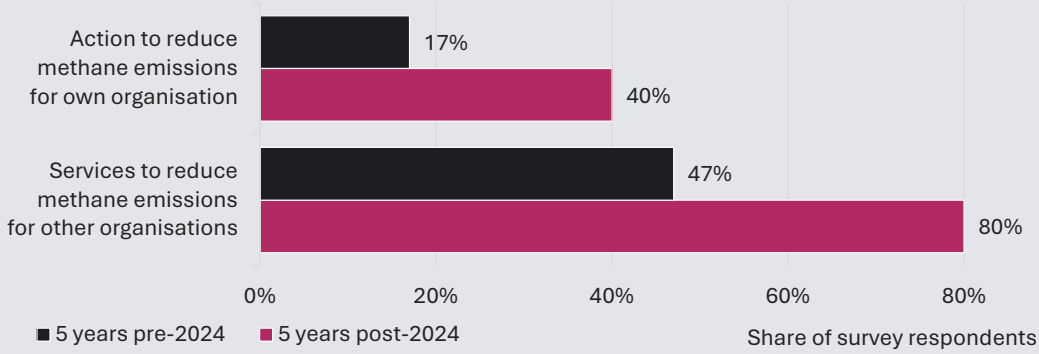
Source: ISIS Malaysia industry survey

4.2.3 Increasing action on methane

With 2024 as the baseline, 17% of respondents indicated that they had taken action to reduce methane emissions in their own organisations in the preceding five years (Fig. 20). In contrast, 47% provided methane-reduction services to other organisations during that same period, underscoring the role of the OGSE sector in supporting the O&G producers in achieving the progress highlighted in Section 3.4.

Fig. 20. Increasing action on methane expected up to 2030

Survey: indication of positive action on methane



Source: ISIS Malaysia industry survey

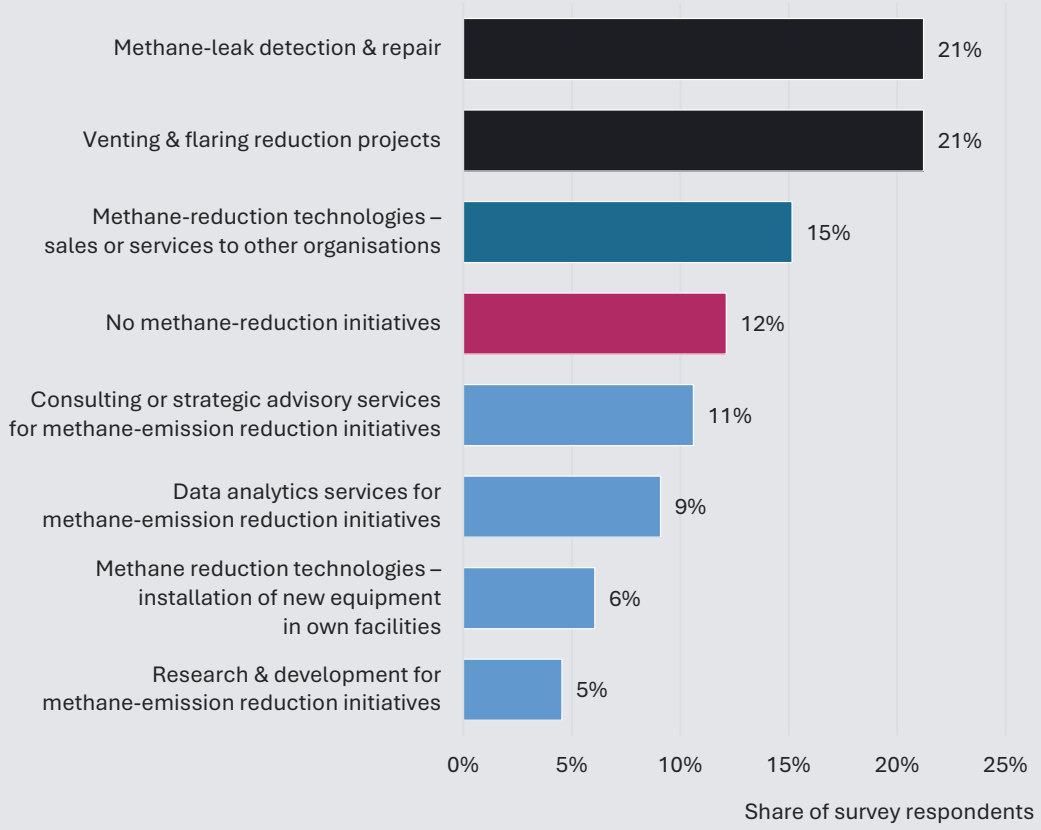
The next five years present a promising trajectory for methane-abatement initiatives within the O&G sector on both fronts. The survey revealed that 40% of respondents were willing to reduce further their methane emissions, with 80% planning to expand their methane-abatement service capacities. This anticipated growth is poised to generate broad employment opportunities and supports the BTR1 projection of a continued decline in methane emissions up to 2030.

4.2.4 Pre-2024: methane-reduction initiatives focused on LDAR and VFR

Between 2019 and 2024, respondents indicated that methane reduction initiatives have primarily focused on LDAR as well as venting and flaring reduction (VFR), accounting for 21% each of total responses, followed by sales and services of methane technologies to other organisations with 15% of responses (Fig. 21). These emerged as the top three methane-abatement categories reported in the survey, garnering 57% of responses, broadly aligning with feedback from stakeholder interviews.

Fig. 21. Pre-2024: LDAR and VFR the primary methane initiatives

Survey: initiatives on methane reduction pre-2024



Source: ISIS Malaysia industry survey

The positive impact of measures to reduce venting is clear, as evidenced by the 80% drop in methane emissions from this source between 2019 and 2023 (shown in Fig. 14, using Petronas as a proxy for the Malaysian O&G sector). However, the same data also suggest that the results from actions related to flaring, LDAR, and the deployment of other technologies have yet to fully materialise, presenting opportunities for future reductions.

Meanwhile, installing new equipment in the respondents' facilities ranked low on the list. This is likely due to the disproportionately lower participation in the survey from O&G producers, which directly emit methane from their activities, relative to OGSE companies, which mostly do not. However, stakeholder feedback suggests that O&G producers have prioritised methane abatement through LDAR and VFR before committing to capital expenditures for new technologies.

Supplementary measures that do not tackle directly methane emissions at the source, such as consulting, strategic advisory, data analytics and research, also ranked lower. This could indicate that providing these services is not currently a key focus for Malaysian companies and is likely outsourced to external solution providers. This suggests opportunities to expand some of these services through strategic partnerships between local companies and their foreign counterparts.

Lastly, 12% of respondents did not conduct any methane-related activity during the assessed period.

4.2.5 Post-2024: methane-reduction initiatives expected to shift beyond LDAR and VFR to other technological solutions

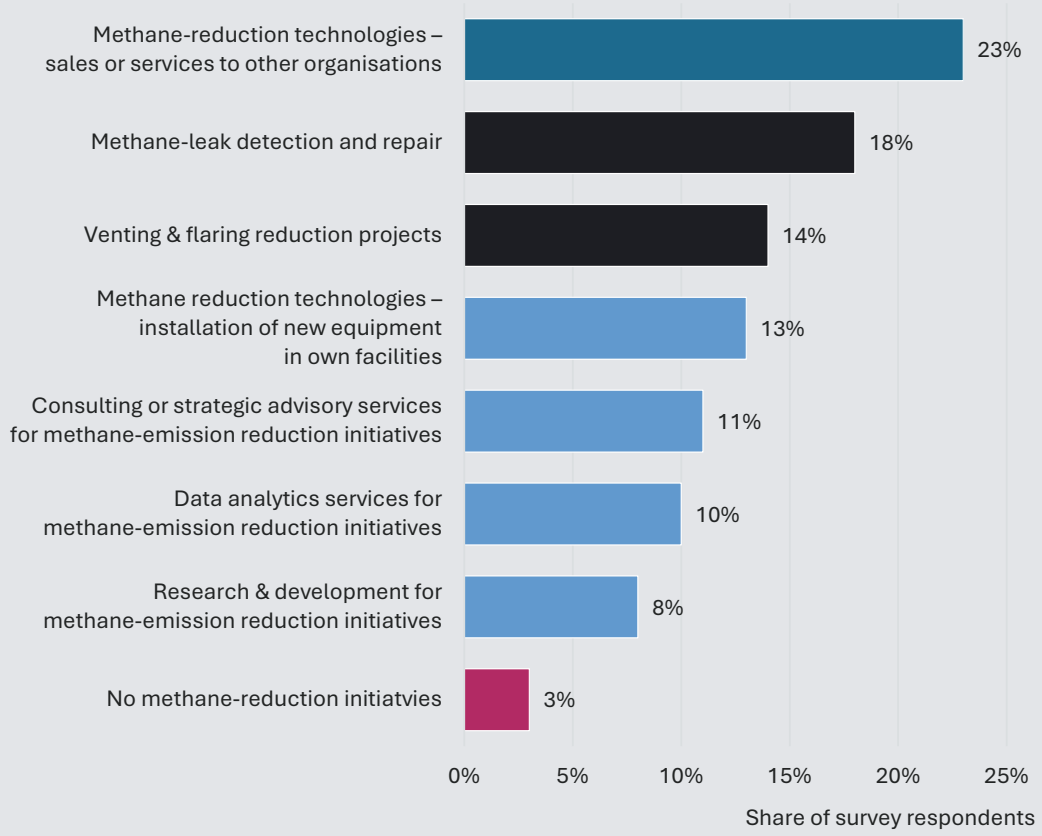
Over the second half of the decade, sales and services related to methane-reduction technologies are expected to grow, increasing their share to 23% of total responses, up from 15% (Fig. 22). This growth will push methane-reduction technologies ahead of LDAR and VFR, making them the top priority. While LDAR and VFR will still play crucial roles, their prominence is expected to diminish, with their shares declining by three and seven percentage points respectively in the post-2024 period.

This trend is consistent with the pattern seen in Fig. 14, where methane emissions from venting have steadily decreased and are now lower than those from fugitive emissions, prompting a shift in focus towards the latter. Despite these changes, LDAR, VFR and methane-reduction technologies will continue to represent the top three categories, collectively accounting for around 55% of total responses.

The increase in responses for sales and services of methane-abatement technologies to other organisations is matched by a doubling of responses for installation of new equipment at the respondents' own facilities. As opportunities to cut methane emissions by reducing venting narrow in the coming years, O&G producers will likely explore investments in other solutions to meet targets. A study conducted by SUTS describes the marginal abatement cost curve for the various technologies available for this purpose[27].

Fig. 22. Post-2024: sales and services of other methane solutions expected to gain prominence

Survey: methane initiatives with high or very high likelihoods post-2024



Source: ISIS Malaysia industry survey

Initiatives related to consulting, strategic advisory and data-analytic services are expected to remain primarily unchanged, while research and development (R&D) shows a minor increase by three percentage points. The responses suggest that localising these functions on a broader scale, specifically for methane, is not yet seen as a priority as external solutions may be more available readily. However, as previously highlighted, these areas offer niche opportunities to develop the capabilities of Malaysian entities that could be exported for methane-abatement projects across ASEAN and beyond.

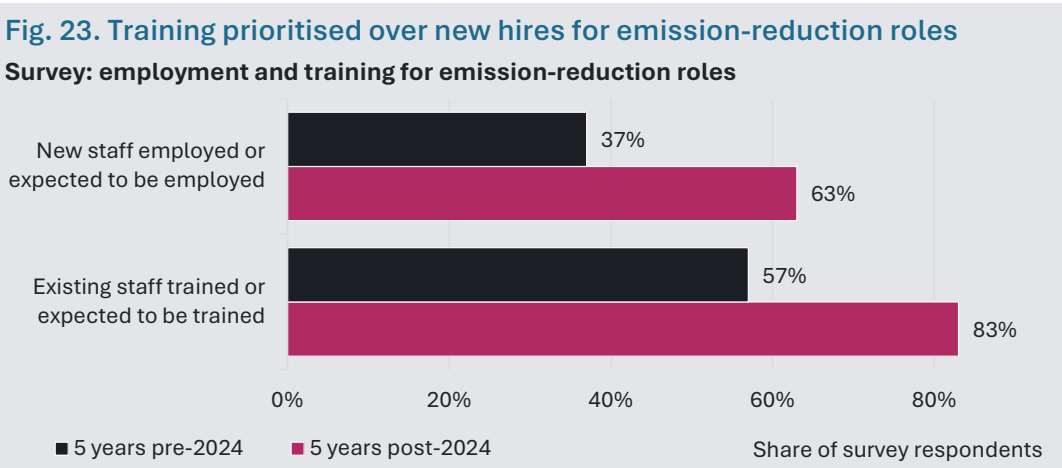
On a final note, it is encouraging that only 3% of respondents do not expect to undertake any methane-mitigation initiative over the next five years, a sharp decline compared with 12% for the preceding period. This illustrates a growing awareness of the value of reducing methane emissions, both in economic and environmental terms.

4.2.6 Training existing staff preferred over new hires for emission reduction

As noted in Section 4.1, a recurring input from stakeholder interviews was the challenge of assessing employment linked directly to methane-emission reduction for environmental reasons. These tasks are typically not standalone but integrated into other operational roles, with many safety related functions already well established.

Considering this, the survey sought to gauge overall hiring and training trends pre- and post-2024 for jobs related to methane abatement, GHG reduction or decarbonisation collectively (Fig. 23).

Fig. 23. Training prioritised over new hires for emission-reduction roles



Source: ISIS Malaysia industry survey

Employment for emission-reduction functions is expected to increase with 63% of respondents indicating that they would be hiring for these roles over the coming years compared to 37% who said they had done so in the past. However, the preference to upskill or reskill existing staff before increasing headcount is evident as training is consistently 20 percentage points higher in both past and future scenarios. Training needs will also grow, with 83% of respondents expected to utilise this avenue to address emissions post-2024 compared with 57% pre-2024.

Stakeholder feedback reinforces the drive towards skills development in the O&G industry as a crucial lever towards implementing more sustainable practices, decarbonising the production and delivery process, and diversifying into other areas within the energy transition landscape, such as hydrogen economy, CCUS, energy efficiency, green mobility and renewable energy.

4.2.7 New hires: respondents selected the 1-10 range for most emission-reduction roles in pre- and post-2024 scenarios

Respondents who indicated that they have added, or plan to add, new staff in emission-reduction jobs were asked to estimate the number of hires across a disaggregated list of roles. The breakdown of options was intentionally kept small, with LDAR and VFR singled out as they were the top two measures implemented in the past, complemented by two open-ended options for other methane jobs and other GHG-reduction jobs that prompted the respondent to provide descriptive answers.

For the pre-2024 period, the most common selection for respondents from organisations that hired new staff was between one and 10 people for all the areas queried except the "other methane jobs" option (Fig. 24). The largest quantum of new hires was for VFR, which aligns with stakeholder feedback on the focus accorded to this abatement measure in the recent past.

LDAR jobs were also added but to a lesser degree, suggesting that long-standing industry practices in this area for safety purposes had already established the necessary workforce. Increased employment would likely have been essential to meet new environmental targets by enhancing existing approaches, such as utilising remote-detection drones or increasing inspection frequencies.

Higher staff growth is expected in the generic GHG category in contrast to methane, which was the outlier across all past and future scenarios. This aligns with the past prioritisation of LDAR and VFR for methane reduction over the deployment of other solutions (Fig. 21). Some of the functions described by respondents for both these open-ended categories include inspection, MMRV, ESG, project management, sales, safety, auditing and engineering design.

Expected hires post-2024 are consistent across all areas, with selections for the one to 10 employees' range averaging about 60% of respondents while the 11-20 range was around 25% (Fig. 25). The significant increase for the generic methane category compared with the preceding five years reflects the anticipated shift in focus beyond LDAR and VFR (Fig. 22).

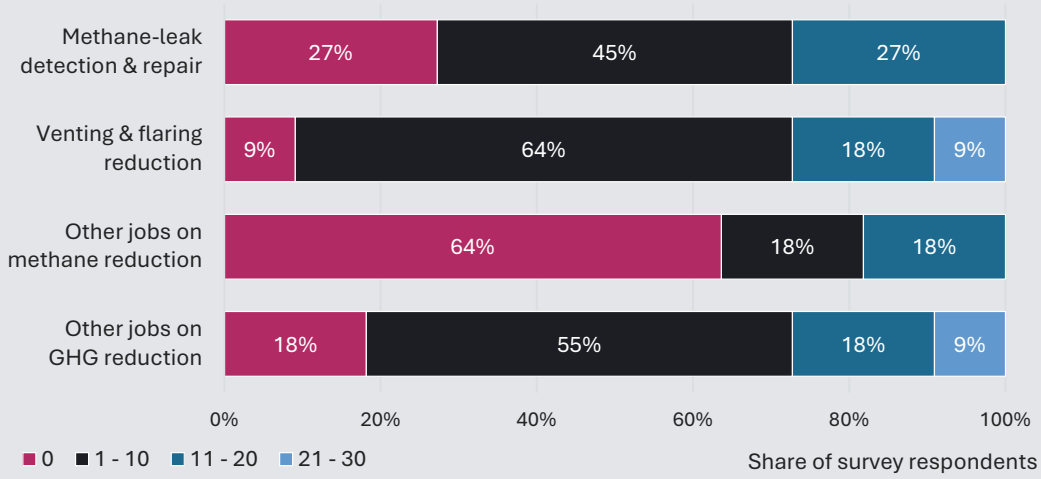
Input by respondents for the generic categories includes inspection, MMRV, ESG, project delivery, market research, new technologies for GHG reduction, technology localisation, technical support, R&D, CCUS and carbon trading.

Table 4 summarises the roles identified by respondents for the "other jobs" categories for both the pre- and post-2024 scenarios. A key trend is the shift towards more technology driven roles for emission reduction post-2024, reflecting growing industry awareness that diverse approaches to emissions are needed to meet targets, particularly as the effectiveness of current methods plateau and priorities evolve (Section 3.4).

Further investigation into this trend is warranted, especially for institutions responsible for developing future O&G human capital, to ensure that the talent pipeline could adapt to changing demands.

Fig. 24. Pre-2024: most respondents with new hires added up to 10 personnel for LDAR, VFR and other GHG roles

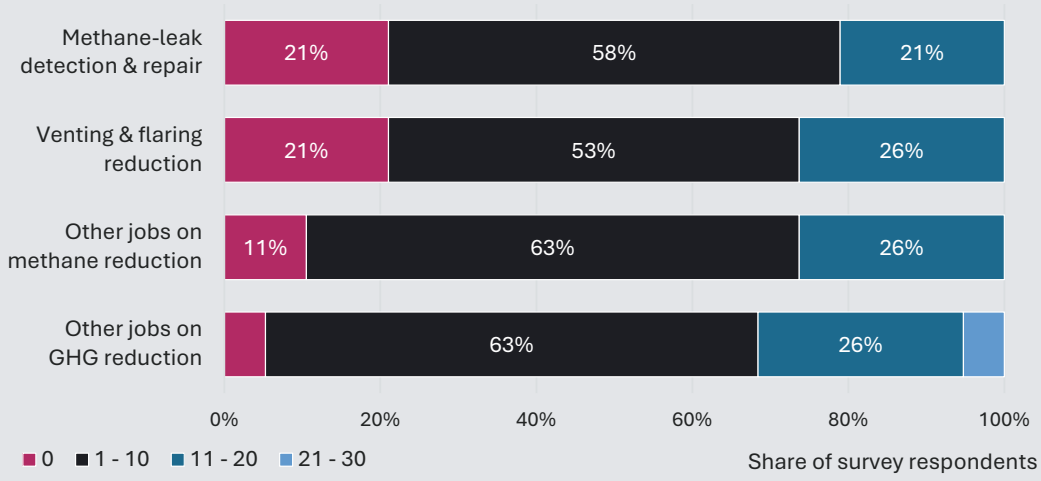
Survey: new hires for emission reduction pre-2024



Source: ISIS Malaysia industry survey

Fig. 25. Post-2024: most respondents planning to hire expect to add up to 10 personnel for all emission reduction roles

Survey: new hires expected for emission reduction post-2024



Source: ISIS Malaysia industry survey

Table 4. New hires post-2024 likely for industry technologies

Survey: new hire roles in emission reduction besides LDAR and VFR

Job function	Five years pre-2024	Five years post-2024
Auditing	√	
Engineering design	√	
Safety	√	
ESG	√	√
Inspection	√	√
MMRV	√	√
Project management & delivery	√	√
Sales & market research	√	√
Carbon trading		√
CCUS		√
New technologies for GHG abatement		√
R&D		√
Technical support & technology localisation		√

Source: ISIS Malaysia industry survey

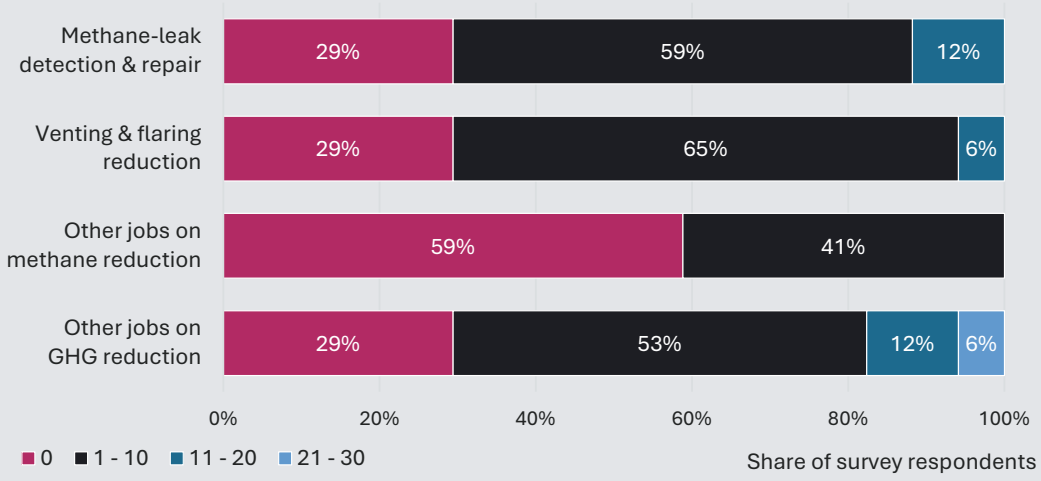
4.2.8 Staff training: respondents selected the 1-10 range for most emission-reduction training areas in pre- and post-2024 scenarios

The approach used to assess new hires in Section 4.2.7 was adopted for respondents who indicated that they have trained or plan to train existing staff in emission-reduction jobs (Fig. 26 and 27). The response patterns for upskilling and reskilling align with those for new hires, with respondents mostly selecting one to 10 staff members trained across all but one scenario.

A shift is expected from past preferences for VFR to a focus on LDAR as well as other emission-reduction skills. These parallels suggest that the O&G sector is aware of the workforce requirements for emission-reduction pathways, opting to develop existing personnel before expanding headcount. This approach optimises labour efficiency and incentivises staff retention, offering growth and development opportunities in an industry crucial to Malaysia's economy while navigating the transition to meet climate imperatives.

Fig. 26. Pre-2024: most respondents trained up to 10 staff members for LDAR, VFR and other GHG-reduction roles

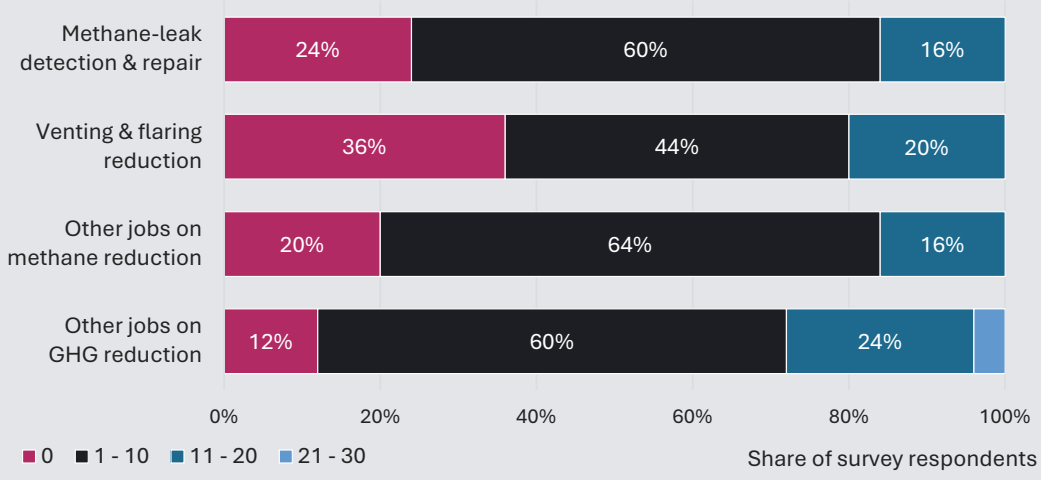
Survey: staff trained for emission-reduction roles pre-2024



Source: ISIS Malaysia industry survey

Fig. 27. Post-2024: most respondents planning to train up to 10 staff members for all emission-reduction roles

Survey: staff training expected for emission-reduction roles post-2024



Source: ISIS Malaysia industry survey

Table 5 summarises the skill sets highlighted by respondents in the "other jobs" categories. Like new hires described previously, the outlook favours greater application of advanced technologies for emission-reduction hires post-2024. In line with broader trends observed across other industries, an added dimension for O&G involves intentions to integrate artificial intelligence and big data to drive process optimisation and realise sustainability goals.

Respondent feedback suggests increasing demand for training providers specialising in competencies related to emission reduction, information technology, sustainability reporting and management, signalling a rise in employment opportunities for the training and development sector. Avenues for collaboration between industry, training institutions and academia should be strengthened to maximise cross-sectoral synergies in job growth.

Table 5. More training anticipated post-2024 for advanced technologies and data-driven solutions

Survey: training areas in emission reduction besides LDAR and VFR

Job function	Five years pre-2024	Five years post-2024
ESG	√	√
Inspection	√	√
MMRV	√	√
New technologies for GHG abatement	√	√
Project management & delivery	√	√
Artificial intelligence		√
Condition monitoring & predictive maintenance		√
Data collection, management & analytics		√
Process automation		√
RE, CCUS, hydrogen & other low-carbon solutions		√
Remote sensing & drone inspections		√
Safety		√

Source: ISIS Malaysia industry survey

4.2.9 Deeper insights possible but constrained by survey response, stakeholder sampling and data fidelity

The survey was designed to gather information for deeper analysis of the workforce implications of methane initiatives across the O&G industry through identifying correlations and forecasting trends. However, the low response rate, unbalanced sampling distribution and unavailability of methane-specific employment data constrained the confidence level of second-degree analysis from the survey results. These challenges also inhibit accurate projections regarding the number of jobs directly created by methane-abatement efforts.

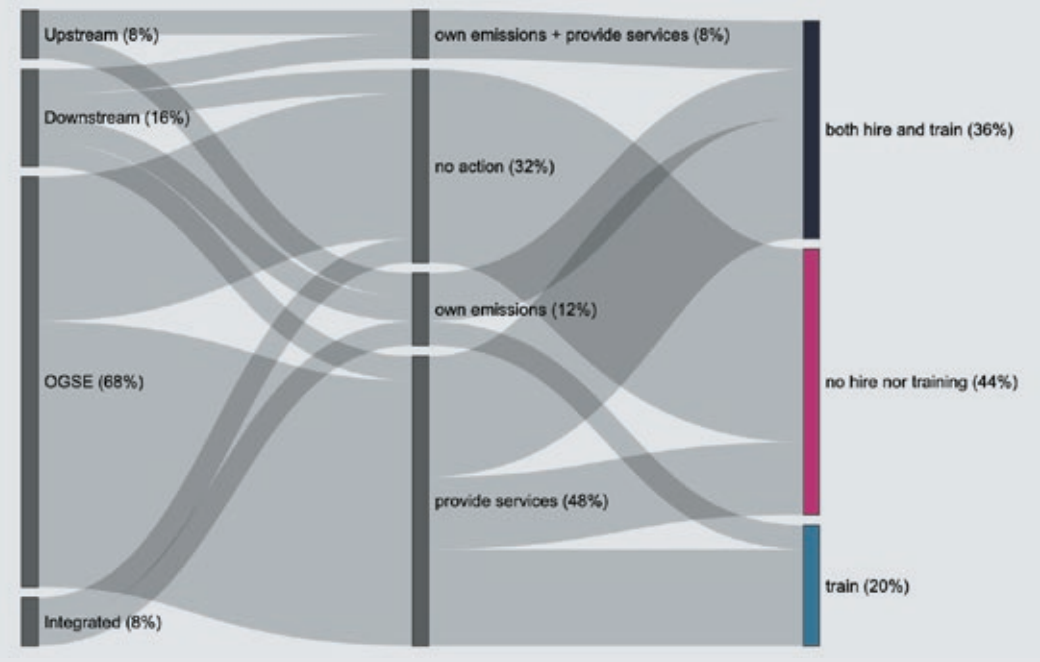
Despite these limitations, this section presents a small selection of the analytical approaches envisioned to gain further insights into the topic. Given the data constraints, the findings should be regarded as an approximation of respondent perspectives rather than a representation of the industry, considering the earlier caveats. These results should not be used to draw firm conclusions but serve as a basis for further investigation and analysis within each subsector to identify detailed trends and opportunities.

The survey respondents were categorised into industry subsectors, with about 73% from OGSE, downstream (13%), upstream (7%) and integrated companies (7%). These were mapped to their responses on methane action as well as hiring and training practices to visualise correlations and broad trends (Fig. 28 and 29)[f].

Before 2024, 32% of respondents reported no action on methane reduction. These were primarily from OGSE with a smaller share from downstream and integrated. This number drops significantly to 3% post-2024, exclusively from OGSE, suggesting a growing awareness of sustainability issues and an interest in being involved with methane-abatement efforts.

Fig. 28. Pre-2024: 44% indicate no past hiring or training

Survey: sectoral analysis for methane hiring and training pre-2024

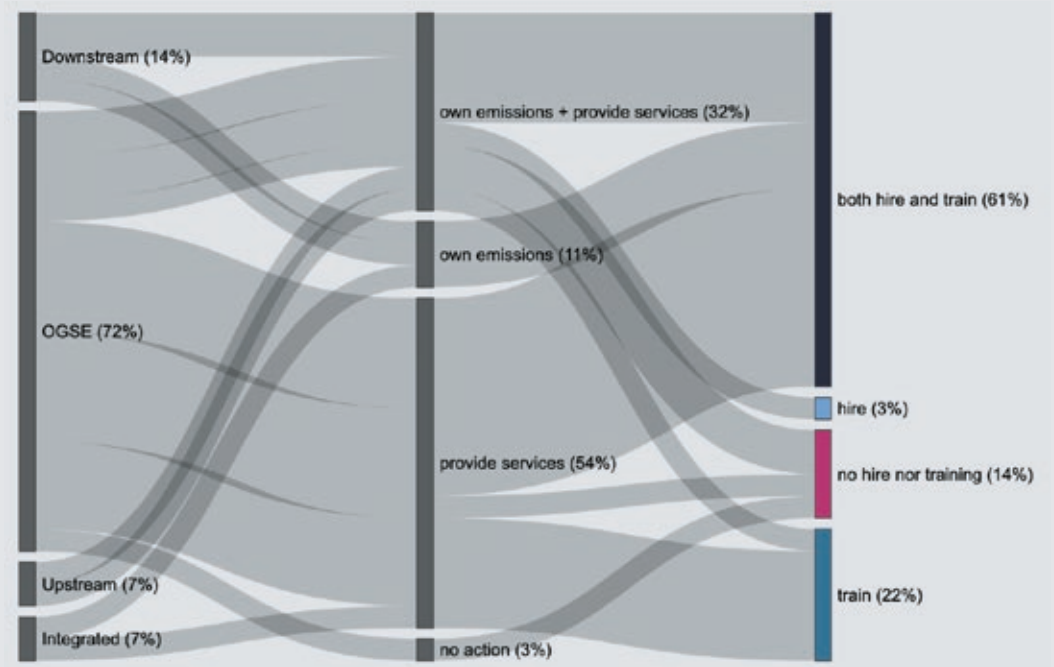


Source: ISIS Malaysia industry survey

[f]*Five respondents pre-2024 and two post-2024 who answered "no action" but indicated that they were still hiring or training were removed from the sample. Own emissions = reducing their own methane emissions; provide services = providing methane-reduction services to others; no action = not reducing their own methane emissions nor providing services to others.*

Fig. 29. Post-2024: 14% indicate no plans for hiring or training

Survey: sectoral analysis for methane hiring and training post-2024



Source: ISIS Malaysia industry survey

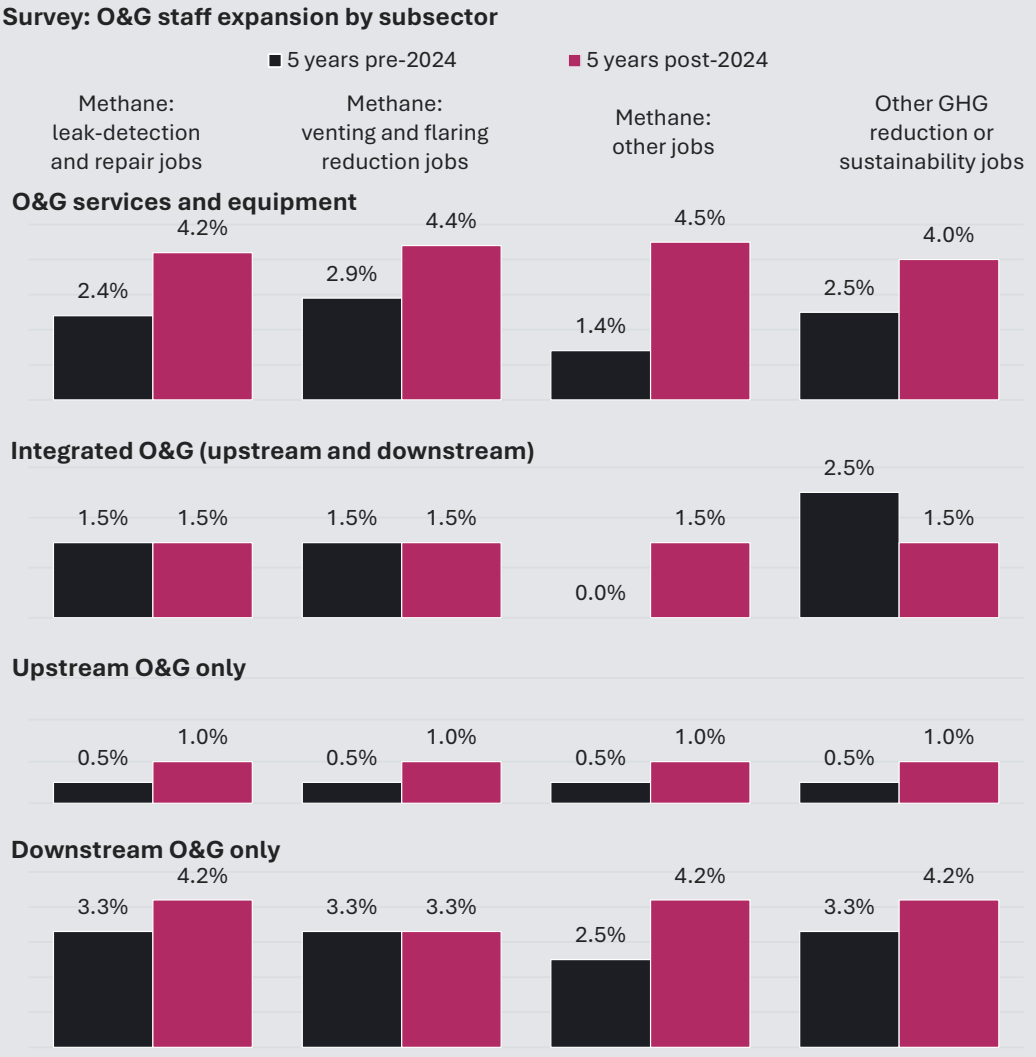
The share of companies indicating no plans for hiring or training is expected to decline from 44% to 14%, signalling employment growth across the sector. Interestingly, a slightly larger share of the post-2024 "no hiring or training" category comes from respondents who will still address their own emissions while providing services to others. It could be theorised that this group comprises of companies that hired and trained staff in the recent past and now possess the necessary personnel to continue acting on and providing services for methane abatement.

A hybrid approach to hiring and training seems to be the preferred strategy where positive measures are implemented, with "training-only" responses staying almost constant at about 20% over the assessed periods. Notably, no respondents indicated a "hiring-only" approach in the recent past but 3% stated a desire to do so in the coming years.

Further analysis estimated employment growth rates by industry subsectors (Fig. 30). Decoupling methane abatement from broader decarbonisation efforts was highlighted as a key challenge in stakeholder interviews. This is reflected in the findings, where the values for "other GHG jobs" closely align with those of the methane-focused categories. This reinforces the perception that respondents view methane action as part of their broader sustainability strategies rather than a standalone endeavour, influencing their hiring or training practices.

The OGSE sector is projected to be the main focus for employment growth across a spectrum of methane and other decarbonisation roles pre- and post-2024, increasing from 2.3% to 4.3%. Downstream O&G companies are also expected to see staff expansion of 4% but starting from a higher baseline of 3.1%. The integrated and upstream-only segments are estimated to grow by 1%. However, these companies may already have a high headcount. Existing staffing levels and prior involvement in methane mitigation, for safety or environmental reasons, should be considered. Further investigations within each subsector, based on their roles in the O&G value chain, would provide more accurate projections of employment impacts from methane abatement.

Fig. 30. OGSE and downstream job growth expected to outpace others



Source: ISIS Malaysia industry survey; sampling caveats apply

5 Conclusion and summary of findings

Meaningful reductions to Malaysia's O&G methane emissions have been achieved by focusing on upskilling, reskilling and job-scope expansion.

1. The O&G sector has opted to develop existing personnel before expanding the workforce to meet emission-reduction commitments. This approach optimises labour efficiency and incentivises staff retention, offering growth and development opportunities in an industry that is critical to Malaysia's economy and must navigate climate-driven imperatives.

2. However, opportunities exist to diversify methane-abatement approaches and achieve Malaysia's net-zero ambitions as well as GMP commitments while evolving the workforce to meet the needs of the energy transition.

O&G methane emissions are regulated and progress is evident but more diverse approaches are required to maintain current trajectory and meet targets.

3. The O&G industry is the second-largest source of Malaysia's methane emissions at 37%, behind the waste sector, which accounts for 53%. Venting and gas production contribute almost 85% of O&G methane emissions. Petronas, through MPM, regulates methane emissions by setting annual venting and flaring limits for assets under its purview. However, details are not disclosed publicly. The dual role of Petronas as regulator and industry leader shapes the framework to realise national, sectoral and corporate methane commitments through regulatory requirements, technical standards and industry driven initiatives.

4. National data show that Malaysia is making progress in reducing methane emissions. Energy sector methane emissions were 20% lower in 2021 compared with 2019 and are expected to meet the 50% reduction target by 2030. This trend is supported by Petronas' data, which reveal that the company achieved its 2025 groupwide methane-reduction target of 50% in 2022, three years ahead of schedule. Projections suggest that Petronas could meet its target of 75% reduction by 2030 as early as 2028.

5. The primary driver behind Petronas' methane reduction has been substantial cuts in emissions from venting, which dropped by 80% from 2019 to 2023. As a result, the contribution of venting to total methane emissions has shifted from being the most prominent source in 2019 to the second largest in 2023, now marginally behind fugitive emissions. This shift highlights the need for a renewed focus on diversifying methane-emission reduction efforts across other sources.

Assessing direct employment impacts of methane abatement is challenging because of tight integration with other operational roles but feedback indicates preference for upskilling, reskilling and job-scope expansion.

6. Interviews with O&G stakeholders provided insights into perceptions, actions and outlook on methane abatement, and its potential workforce impact. These discussions highlighted that:
   - Quantifying methane-specific jobs is challenging as these tasks are typically integrated into other roles and have long been carried out for safety and economic reasons;
   - The industry preference is to upskill, reskill or expand the job scopes of existing personnel to undertake methane-reduction activities before adding new hires;
   - The focus on developing human capital would incentivise job retention as O&G companies navigate the energy transition;
   - Job creation is highly likely in the O&G sector resulting from increased initiatives across broader sustainability and decarbonisation fields, not just on methane;
   - Malaysian companies can leverage on domestic progress to participate in regional methane projects, leading to potential opportunities for workforce expansion; and,
   - Job displacement because of methane abatement is highly unlikely.

7. An industry survey provided quantitative data that enhanced understanding of the topic. Most participants were from small- to mid-sized O&G service providers, while sectors likely to be methane sources represented 15% of respondents. The findings align with stakeholder inputs and there is high confidence that they reflect broader industry trends. However, the granular survey results are constrained by response rates, sampling distributions and availability of methane-specific employment data. With these caveats, the survey findings show that:
   - Knowledge of sustainability initiatives and road maps relevant to the O&G industry is positive, with an average of 80% of respondents reporting moderate or better awareness;
   - Action on methane is expected to grow significantly, with nearly twice as many respondents planning to reduce their own emissions or offer services to others for that purpose in the five years post-2024 compared with the preceding period;
   - The past focus on LDAR and VFR as methane-reduction initiatives will continue but other solutions will gain prominence as companies diversify strategies to meet targets;
   - Training existing staff has priority over adding new staff for a broad range of emission-reduction roles, with 83% of respondents expected to upskill or reskill their personnel in the five years post-2024 compared with 63% who plan to hire;
   - The most common response to new hires or training existing staff is one to 10 staff members across various scopes and timeframes, reflecting optimistic yet conservative projections;
   - Future roles for new hires and trained staff gravitate towards remote sensing and drone inspections, MMRV, technology localisation, project management, data science, process automation, AI and methane-abatement measures beyond LDAR and VFR;
   - Roles related to the broader aspects of ESG, carbon markets and advanced decarbonisation technologies, such as carbon capture and hydrogen, are also anticipated to grow;
   - The preference for upskilling and reskilling may expand employment opportunities in human-capital development and diversify the services of training providers; and,
   - The OGSE sector is likely to be the primary growth vector for sustainability, decarbonisation and methane-abatement role, with staff expansion almost doubling to 4.3% post-2024.

6 Recommendations

The study acknowledges that the Malaysian O&G industry has made considerable progress in abating methane emissions since 2016, with climate-driven motives evident since 2019. This has mainly been achieved by low-to-modest job growth and a preference for upskilling and reskilling existing staff. Recent reductions have come primarily from significant cuts in venting, with diminishing returns expected from this source.

While current trajectories are on track to meet 2030 targets, diversified approaches will be necessary to realise further methane cuts from flaring and fugitive emissions, which have remained unchanged. The recommendations below aim to complement the industry's ongoing efforts and propose parallel strategies to maintain the current momentum while facilitating job growth, job retention and human resource development.

1. **Strengthen legal framework for methane abatement by incorporating targets into Malaysia's Climate Change Law.**
2. **Increase opportunities for upskilling and reskilling to align with the preferred approach by the O&G industry for methane abatement.**
3. **Develop strategies to support methane action for the O&G services and equipment sector, which has the highest potential for job growth.**
4. **Expand methane action beyond O&G, focusing primarily on the waste sector, and encourage the cross-pollination of skills.**
5. **Explore spillover effects of O&G methane-abatement efforts on employment trends in other areas.**
6. **Improve accessibility and transparency of data on regulated methane-emission limits for O&G sources.**
7. **Enhance accuracy of methane-emission measurement and reliability of reported values.**

Strengthen legal framework for methane abatement by incorporating targets into Malaysia's Climate Change Law.

Currently, methane-reduction targets in the O&G sector are driven by industry initiatives, primarily led by Petronas. While this approach has proven effective, elevating methane governance to the national level will establish a codified compliance framework independent of corporate considerations. This will ensure that an integrated legislation governs methane emissions across all sectors to meet national commitments. Furthermore, incorporating methane abatement into the Climate Change Law, overseen by NRES, would ensure a stronger climate focus, providing a crucial safeguard against prioritising economic and operational goals at the expense of environmental and climate objectives. This would also align with Malaysia's National Climate Change Policy 2.0, also under the purview of NRES, which recognises curbing methane as a key strategic action.

Increase opportunities for upskilling and reskilling to align with the preferred approach by the O&G industry for methane abatement.

The O&G industry has indicated a preference for skills development and task diversification over headcount growth for methane reduction and other sustainability initiatives. Measures to facilitate this approach should be explored. These include enhanced training opportunities, incentives for staff development, standardised frameworks and assessments for skills progression, and increased collaboration between the O&G industry, academia and training providers. Malaysia's existing avenues for professional development, as well as technical and vocational education and training (TVET), should be leveraged on to align with the evolving needs of the energy transition.

Develop strategies to support methane action for the O&G services and equipment sector, which has the highest potential for job growth.

Companies providing support, services and equipment to major methane emitters in the O&G sector stand to gain the most in terms of employment growth and skills development, particularly as mitigation efforts evolve beyond LDAR and VFR or extend regionally. Given methane's significant contribution to O&G emissions compared to CO_2, it is essential for key stakeholders – such as MPRC and OGSE industry associations – to develop targeted initiatives within their existing sustainability frameworks and road maps. These initiatives should empower local OGSE companies to capitalise on the push for methane abatement and take a prominent role in methane-mitigation efforts.

Expand methane action beyond O&G, focusing primarily on the waste sector, and encourage the cross-pollination of skills.

The O&G industry has made commendable progress in reducing methane emissions driven by climate-centric reasons, resulting in a drop of 20% for the energy sector between 2019 and 2021. However, to meet Malaysia's GMP commitments, greater attention will also be necessary for the waste sector, the largest contributor to Malaysia's total methane emissions in 2021. Furthermore, the trend of methane emissions for the energy sector has been decreasing since 2016 but has been largely stagnant for waste since 2010. Cross-sectoral opportunities to apply relevant competencies and solutions from O&G methane abatement to accelerate progress in the waste sector should be encouraged and facilitated.

Explore spillover effects of methane-abatement efforts on employment trends in other areas.

Cross-sectoral initiatives to reduce methane emissions will have secondary benefits to employment trends in other areas. With the preference for upskilling and reskilling across a broad spectrum of topics, including sustainability, project management, advanced technologies, data science, and AI, the training industry may experience increased demand for these competencies,

many of which are cross-cutting. In addition, manufacturing and technology companies involved in the supply chain for methane-abatement solutions and based in Malaysia could also see positive effects from a diversified approach to mitigation efforts. Both these perspectives warrant deeper investigation.

Improve accessibility and transparency of data on regulated methane-emission limits for O&G sources.

Annual venting and flaring limits are defined for assets under the purview of the industry regulator but this information is not disclosed. Timely and granular public domain data, either at the asset or company level, on methane emissions, regulatory mandates and operational standards for all operators in the Malaysian O&G sector would catalyse industry collaboration, optimise growth and deployment of human capital, and promote industry driven skills development.

Enhance accuracy of methane-emission measurement and reliability of reported values.

Given methane's potency compared to CO_2, minor variations in data can affect GHG inventory reporting and mitigation strategies. The Malaysian O&G industry should expand its adoption of the OGMP 2.0 level 4 practices, aiming for more source-level measurements with specific emission and activity factors. Larger emitters should progress to level 5, reconciling source and site-level data to achieve the highest standards. An industry wide drive to upgrade MMRV standards would provide further impetus for human-resource expansion and development. Encouraging methane reporting from the perspective of 20-year GWPs will emphasise its greater short-term impact relative to other GHGs, thereby strengthening the urgency for industry-wide action. External platforms, such as EDF's MethaneSat and ASEAN's Oil and Gas Emissions Dashboard, could be leveraged on for data verification.

Appendix A. IPCC categorisation for oil and gas subsectors

Table A1. IPCC descriptions for O&G subsectors

IPCC code	Sector name	Explanation
1.A.1.b	Petroleum refining	All combustion activities supporting the refining of petroleum products, including on-site combustion for the generation of electricity and heat for own use. Does not include evaporative emissions occurring at refinery. These emissions should be reported separately under 1B2a.
1.B.2	Oil and natural gas	Comprises of fugitive emissions from all oil and natural gas activities. The primary sources of these emissions may include fugitive equipment leaks, evaporation losses, venting, flaring and accidental releases.
1.B.2.a	Oil	Comprises of emissions from venting, flaring and all other fugitive sources associated with the exploration, production, transmission, upgrading, and refining of crude oil and distribution of crude oil products.
1.B.2.a.i	Venting	Emissions from venting of associated gas and waste gas/vapour streams at oil facilities. (Authors' note: Venting from oil is listed under new IPCC code 1.B.2.c.i.1 in BTR1)
1.B.2.a.ii	Flaring	Emissions from flaring of natural gas and waste gas/vapour streams at oil facilities. (Authors' note: Flaring from oil is listed under new IPCC code 1.B.2.c.ii.1 in BTR1)
1.B.2.a.iii	All other	Fugitive emissions at oil facilities from equipment leaks, storage losses, pipeline breaks, well blowouts, land farms, gas migration to the surface around the outside of wellhead casing, surface casing vent bows, biogenic gas formation from tailings ponds and any other gas or vapour release not specifically accounted for as venting or flaring.

IPCC code	Sector name	Explanation
1.B.2.a.iii.1	Exploration	Fugitive emissions (excluding venting and flaring) from oil well drilling, drill stem testing, and well completions.
1.B.2.a.iii.2	Production and upgrading	Fugitive emissions from oil production (excluding venting and flaring) occur at the oil wellhead or at the oil sands or shale oil mine through to the start of the oil-transmission system. These include fugitive emissions related to well servicing, oil sands or shale oil mining, transport of untreated production (i.e. well effluent, emulsion, oil shale and oil sands) to treating or extraction facilities, activities at extraction and upgrading facilities, associated gas re-injection systems and produced water disposal systems. Fugitive emissions from upgraders are grouped with those from production rather than those from refining since the upgraders are often integrated with extraction facilities and their relative emission contributions are difficult to establish. However, upgraders may also be integrated with refineries, cogeneration plants or other industrial facilities and their relative emission contributions can be difficult to establish in these cases.
1.B.2.a.iii.3	Transport	Fugitive emissions (excluding venting and flaring) related to the transport of marketable crude oil (including conventional, heavy and synthetic crude oil and bitumen) to upgraders and refineries. The transportation systems may comprise of pipelines, marine tankers, tank trucks and rail cars. Evaporation losses from storage, filling and unloading activities and fugitive equipment leaks are the primary sources of these emissions.
1.B.2.a.iii.4	Refining	Fugitive emissions (excluding venting and flaring) at petroleum refineries. Refineries process crude oils, natural gas liquids and synthetic crude oils to produce final refined products (e.g. primarily fuels and lubricants). Where refineries are integrated with other facilities (for example, upgraders or co-generation plants) their relative emission contributions can be difficult to establish.

IPCC code	Sector name	Explanation
1.B.2.a.iii.5	Distribution of oil products	This comprises of fugitive emissions (excluding venting and flaring) from the transport and distribution of refined products, including those at bulk terminals and retail facilities. Evaporation losses from storage, filling and unloading activities and fugitive equipment leaks are the primary sources of emissions.
1.B.2.a.iii.6	Other	Fugitive emissions from oil systems (excluding venting and flaring) not otherwise accounted for in the above categories. These include fugitive emissions from spills and other accidental releases, waste oil-treatment facilities and oilfield waste-disposal facilities.
1.B.2.b	Natural gas	Comprises of emissions from venting, flaring and all other fugitive sources associated with the exploration, production, processing, transmission, storage and distribution of natural gas (including both associated and non-associated gas).
1.B.2.b.i	Venting	Emissions from venting of natural gas and waste gas/vapour streams at gas facilities. (Authors' note: Venting from gas is listed under new IPCC code 1.B.2.c.i.2 in BTR1)
1.B.2.b.ii	Flaring	Emissions from flaring of natural gas and waste gas/vapour streams at gas facilities. (Authors' note: Flaring from gas is listed under new IPCC code 1.B.2.c.ii.2 in BTR1)
1.B.2.b.iii	All Other	Fugitive emissions at natural gas facilities from equipment leaks, storage losses, pipeline breaks, well blowouts, gas migration to the surface around the outside of wellhead casing, surface casing vent bows and any other gas or vapour release not specifically accounted for as venting or flaring.
1.B.2.b.iii.1	Exploration	Fugitive emissions (excluding venting and flaring) from gas well drilling, drill stem testing and well completions.

IPCC code	Sector name	Explanation
1.B.2.b.iii.2	Production	Fugitive emissions (excluding venting and flaring) from the gas wellhead through to the inlet of gas processing plants or, where processing is not required, to the tie-in points on gas transmission systems. These include fugitive emissions related to well servicing, gas gathering, processing and associated wastewater and acid gas disposal.
1.B.2.b.iii.3	Processing	Fugitive emissions (excluding venting and flaring) from gas-processing facilities.
1.B.2.b.iii.4	Transmission and storage	Fugitive emissions from systems used to transport processed natural gas to market (i.e. to industrial consumers and natural gas distribution systems). Fugitive emissions from natural gas storage systems should also be included. Emissions from natural gas liquid-extraction plants on gas-transmission systems should be reported as part of natural gas processing (1B2b iii 3). Fugitive emissions related to the transmission of natural gas liquids should be reported under 1B2a iii 3.
1.B.2.b.iii.5	Distribution	Fugitive emissions (excluding venting and flaring) from the distribution of natural gas to end users.
1.B.2.b.iii.6	Other	Fugitive emissions from natural gas systems (excluding venting and flaring) not otherwise accounted for in the above categories. This may include emissions from well blowouts and pipeline ruptures or dig-ins.

Source: IPCC

Table A2. BTR1 O&G methane emissions, Malaysia: 2021

IPCC code	Sector name	BTR1 methane emissions (kt)	BTR1 methane emissions (%)
1.A	**Fuel combustion**		
1.A.1.b	Petroleum refining	0.33	0.06%
1.B.2.a	**Oil**		
1.B.2.a.i *(1.B.2.c.i.1)*	Venting	235.14	41.5%
1.B.2.a.ii (1.B.2.c.ii.1)	Flaring	21.01	3.7%
1.B.2.a.iii.1	Exploration	NE	-
1.B.2.a.iii.2	Production & upgrading	0.02	0.003%
1.B.2.a.iii.3	Transport	NE	-
1.B.2.a.iii.4	Refining	0.18	0.031%
1.B.2.a.iii.5	Distribution of oil products	NE	-
1.B.2.a.iii.6	Other	NE, NO	-
1.B.2.b	**Natural gas**		
1.B.2.b.i *(1.B.2.c.i.2)*	Venting	7.98	1.4%
1.B.2.b.ii *(1.B.2.c.ii.2)*	Flaring	1.99	0.4%
1.B.2.b.iii.1	Exploration	NE	-
1.B.2.b.iii.2	Production	246.31	43.5%
1.B.2.b.iii.3	Processing	23.76	4.2%
1.B.2.b.iii.4	Transmission & storage	11.99	2.1%
1.B.2.b.iii.5	Distribution	17.92	3.2%
1.B.2.b.iii.6	Other	NE, NO	-

Source: BTR1

Notes:
NE: Not estimated
NO: Not occurring

Appendix B. Stakeholder roundtable

Title : Roundtable on employment impacts of mitigating methane emissions in the Malaysian oil and gas sector.
Date & Time : Friday, 25 October 2024, 10am-12pm

Objectives:
- Share interim findings from the study
- Explore current developments in methane-abatement initiatives
- Understand perspectives on workforce implications of methane reduction

Participants: 23 from the following organisations
- ISIS Malaysia
- Environmental Defense Fund
- Ministry of Economy
- Petronas
- Kemuncak Lanai
- Aerodyne Ventures
- Essem Group
- Gas Malaysia Berhad
- Shell Malaysia (virtual)
- Sunway University
- University of Nottingham Malaysia
- Universiti Sains Malaysia (virtual)
- Vysus Malaysia Sdn Bhd
- Independent (formerly from Malaysian Petroleum Resources Corporation)
- Independent (formerly from Malaysian Gas Association)

Agenda:
- EDF presentation: methane-emission reduction in the oil & gas industry
- ISIS Malaysia presentation: interim research findings
- Discussion: methane-abatement job opportunities and challenges.

Outcome: Stakeholder perspectives were incorporated into the report.

Endnotes

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