Wood Mackenzie

# EU Methane Emissions Regulation Study

March 2026

Prepared for:

Concawe

IOGP International Association of Oil & Gas Producers

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# Introduction and Key Conclusions

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# Overall context for the study

- The European Union's **Methane Emissions Reduction Regulation (MER)** (EU 2024/1787), which entered into force on 4 August 2024 aims to reduce methane emissions from the energy sector, covering crude oil, gas, and coal activities across the entire supply chain within the EU — from production and processing to transmission and storage, and from the production level for EU imports. It sets rules for **measurement, reporting, and verification (MRV)** of emissions, as well as leak detection and repair (LDAR) and restrictions on venting and flaring within the EU. The regulation has an extraterritorial effect, imposing obligations on importers to ensure that producers of crude oil and natural gas meet equivalent standards.

- In this context, **Wood Mackenzie was commissioned by Concawe and IOGP Europe** to conduct an independent analysis of the potential impacts of MER's importer requirements on the EU's crude oil and natural gas supply and pricing.

- The study focuses on the MRV equivalence requirements outlined in **Article 28** and their potential effect on markets (key MER articles are defined on the next page). The study assesses the potential impact on the security of supply and pricing of natural gas/LNG, crude oil, and refined products in EU markets, based on an illustrative evaluation of producer and importer compliance with Article 28 of the Regulation.

- The bottom-up analysis draws on **Wood Mackenzie's proprietary research and data**, scenario modelling capabilities, and global energy market expertise. The 'Base Case' forecasts in the scenario modelling leverage Wood Mackenzie's published views from April 2025.

# MER's importer rules (Articles 27–29) create a three-step compliance ramp-up: Starting with reporting, then full MRV equivalence, and finally an intensity limit for methane emissions

- **2025**: **Article 27 – Early importer reporting** (importer obligations). From 5 May 2025, companies that import crude oil, natural gas or coal into the EU must submit to their national competent authority (and thereafter each year) qualitative information about the origin of the product, transit countries, and the monitoring, reporting and verification (MRV) arrangements applied at source level. This first step is designed to build transparency while more rigorous requirements phase in.
- **2026**: By 5 February 2026, the EU Commission is to launch a public methane transparency database for emissions data access.
- **2027**: **Article 28 – MRV equivalence for importers**. From 1 January 2027, importers placing crude oil, natural gas or coal on the EU market must demonstrate that the producer from which the product originates is subject to or has been verified to apply MRV rules deemed ''equivalent'' to those applied within the EU. Equivalence can be met via two pathways:
    - **Country-level equivalence**: The non-EU producer country has MRV rules for methane emissions that are equivalent to the EU MER's rules per Articles 8, 9, and 12.
    - **Producer-level equivalence**: Even if the country lacks equivalent regulation, the specific producer can demonstrate equivalency via either:
        - **Article 12 pathway**: The producer has monitoring, reporting and verification which meets EU MER's rules per Articles 8, 9, and 12.
        - **OGMP 2.0 Level 5 pathway**: The producer reports at the most rigorous level (Level 5: reconciliation of source- and site-level measurements) with third-party verification in addition. The annual OGMP 2.0 2024 report indicates that about 3% of gas and 3% of crude oil assets was reported at Level 5.

**Article 8 – Third-party verification**. Underpins Article 28 by requiring that all data used to demonstrate equivalence are verified by an accredited independent third party. Without Article 8 verification, importers cannot claim MRV equivalence at producer level (Article 28).

***This study includes scenario modelling of the impacts of the Article 28 requirements only. It also includes a high-level literature review of methane intensity (MI) estimates for key oil and gas producing countries, but does not model the impact of setting different MI thresholds.***

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# Key takeaways (1/2): MER risks EU's security of supply, driving up energy costs and eroding the competitiveness of Europe's industrial base

MER implementation (the Default Scenario in our modelling) could lead to the following outcomes, starting in 2027:

- Severe limitations on the availability of natural gas and crude oil that can be imported into the EU:
  - By 2027, **43%** (114 bcm) of natural gas imports and **87%** (9.8 mb/d) of crude oil imports in the EU in 2024 could be excluded from the EU market. The prevalence of long-term gas contracts signed before Aug 2024 may slightly reduce the impact on gas compared to crude oil.
  - Norway remains a key supplier to the EU, but **17%** (16 bcm) of gas and **29%** (456 kb/d) of crude oil imports, respectively, from Norway could be excluded
  - Most imports from key suppliers such as the US, UK, Algeria, and Canada could also be excluded
- A supply shortfall that cannot meet demand, driving energy prices to historically high levels, with several consequences:
  - Unprecedented high gas prices and a shift toward more affordable coal for power generation. While increases in gas prices would also drive wholesale electricity prices higher, this effect has not been evaluated as part of this study.
  - Gasoline and diesel prices could be around **24%** and **16%** higher, respectively, than they would be in the absence of MER.
  - Sharply lower EU refinery throughput, around 4.6 million b/d (50%) lower than Base Case when constraints are tightest in late 2020s. EU fuel exports could decrease and imports increase to compensate for the loss of refining capacity, with fuel import costs more than **$17 billion** higher than in the absence of MER. EU could flip from a major gasoline exporter to an importer; diesel imports could climb to record highs. Feedstock supply from EU refiners to chemical industry is sharply reduced.
  - Increased use of coal for power and longer shipping distances for MER-compliant crude oil, which increases carbon emissions.
  - Weakened competitiveness of energy-intensive industries (e.g., refining, chemicals, power generation, manufacturing) due to higher energy costs, which could accelerate deindustrialization in the EU.
- Developments in the EU triggered by MER could also impact global markets, putting upward pressure on gas prices in Asia and fuel prices globally.

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The impacts are less severe if the EU introduces modifications to MER (the Adaptive Scenario in our modelling) that allow for greater flexibility in granting country-level MRV equivalence, resulting in the following potential outcomes, starting in 2027:

- By 2027, **20%** (53 bcm) of natural gas imports and **38%** (4.3 mb/d) of crude oil imports in the EU in 2024 could be excluded from the EU market.
- TTF natural gas spot prices could reach approximately **$19/MMBtu**. This is still more than twice as high as they would be in the absence of MER, but well short of the $41/MMbtu average price in 2022 following the start of the Russia-Ukraine War.
- Gasoline and diesel prices could be around **1%** higher than they would be in the absence of MER

# Key takeaways (2/2): implementation challenges and policy considerations

**Significant implementation challenges remain, particularly at the producer level**. Despite progress under OGMP 2.0, fully verified Level-5 supply is unlikely to meet EU demand. Identifying the original producer is also a major challenge, as commingling, blending, and portfolio trading often prevent importers from demonstrating compliance—even when producers themselves may have met MRV requirements.

**Upstream methane intensity estimates remain highly uncertain**, with wide variation across methodologies and data sources. Establishing a realistic and effective methane-intensity threshold under MER will require improved, standardized emissions reporting at the producer level, covering a material share of global production. Work toward this standardization is underway.

# MER Impact Assessment and Scenario Modelling

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# Introduction to MER impact assessment and scenario modelling

- **The primary purpose of this analysis** is to evaluate the potential market impacts of different regulatory approaches, not to recommend specific equivalence or enforcement decisions by the European Commission or EU Member States.
- As such, the **market impacts shown are illustrative** and should not be interpreted as a forecast — the scenarios rely on assumptions about countries' policies and producers' progress on methane emissions. The severity of actual market impacts will depend on political and environmental priorities and on how the EU and Member States choose to enforce the equivalency requirements (Article 28).
- This analysis begins with a **Base Case** that represents a "business as usual" outlook in the absence of MER. Against this baseline, the study evaluates **two hypothetical policy implementation scenarios** to illustrate a range of possible market outcomes.

| *Baseline for analysis* | *Alternative policy enforcement scenarios* | |
|---|---|---|
| **Base Case**<br>*Assumes no MER* | **Default Scenario**<br>*Implementation of MER* | **Adaptive Scenario**<br>*Modifications to MER* |
| *"Business as usual" supply outlook in the absence of MER. Based on Wood Mackenzie's published views* | *MER is enforced as it was adopted in 2024.* | *Modifications are introduced to MER allowing for greater flexibility in granting country-level MRV equivalence.* |

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# Our approach allowed us to evaluate the impact of alternative scenarios vs. the Base Case

## Structure of analysis for impact assessment. Period of analysis is 2027-2035

| *Baseline for analysis* | *Alternative policy enforcement scenarios* | |
|---|---|---|
| **Base Case**<br>*Assumes no MER* | **Default Scenario**<br>*Implementation of MER* | **Adaptive Scenario**<br>*Modifications to MER* |

- *Leveraged* ***Wood Mackenzie's published base case outlook*** *for global gas, LNG, and crude oil markets, which assumes no MER is in place.*
- *This incorporated our latest production forecasts, trade flows, and demand trajectories, and serves as the baseline against which the alternative compliance scenarios are evaluated.*

*We followed a multi-step process to develop the alternative compliance scenarios:*

- ***Defined narratives*** *for scenarios that could reflect varying levels of compliance with MER's importer requirements.*
- ***Developed model constraints*** *for each major exporting country, by determining the expected percentage share of production that would achieve MRV equivalence under different levels of regulatory ambition and implementation progress.*
- ***Applied constraints*** *in Wood Mackenzie's proprietary modelling tools to simulate the impact on global gas/LNG and crude oil markets. Both the* ***Global Gas Model (GGM)*** *for gas/LNG and the* ***Refinery Supply Model (RSM)*** *for crude oil are linear optimization tools that simulate least-cost supply allocation under a range of bespoke market and policy constraints.*

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# We used a 4-step process to define the percentage of each exporting country's production that is allowed to be exported to the EU (i.e. the *constraint*) in each scenario

## Summary of process followed to develop scenario drivers

**1 Identify exporting countries**

Identify countries with capacity to export gas/LNG and crude oil to EU, leveraging Woodmac base case

**2 Country-level equivalence**

Assess countries' current methane regulation and their potential to be considered MRV equivalent

***If equivalent***

If country achieves MRV equivalence, then 100% of its production is allowed to be exported to EU

***If not equivalent, constraint is determined by Step 3% x Step 4%***

**3 Producer-level equivalence**

Estimate % of countries' production from companies achieving OGMP Level 5 equivalence

**x**

**4 Traceability assumptions**

Assume % of each country's production that is traceable (i.e. the importer can identify the producer)

If country does not achieve equivalence, then % of production allowed to export to EU = Step 3 % x Step 4 %

**Output:** % constraints on each country applied in scenario modelling for the 2025-2035 period. Constraints are dynamic, reflecting different levels of MRV equivalence in three time periods (2027-29, 2030-31, 2032-35)

# Notes on methodology and assumptions made in scenario definitions

**Country-level equivalence:**

- Analysis is based on policies in place as of July 2025. Our high-level review is intended only to inform reasonable boundary assumptions for these scenarios. Given that national and producer policy positions continue to evolve (e.g., US plans to pause GHGRP), the analysis is illustrative and should not be interpreted as policy positioning.
- Since no exporting countries fully meet the MRV-equivalence requirements outlined in Article 28, granting equivalency status in the Adaptive Scenario would require the EU to modify Article 28's criteria.

**Producer-level equivalence:**

- The study did not assess the additional requirement for third-party verification of OGMP 2.0 Level 5, as no standardized verification protocol currently exists. Verification was assumed to be available and completed at the same time as self-reported Level 5 achievement, with an additional six months added for verification. It remains unclear, however, whether these assumptions are realistic given current reporting practices, verification protocols, and the availability of accredited third-party verifiers.
- The study is based on data from the 2024 OGMP 2.0 report. A comparison of the 2024 and 2025 reports indicates that overall uptake of OGMP 2.0 Level 5 between 2023 and 2024 did not materially increase. Further explanation is provided in Section 2d "Comparison of 2025 vs. 2024 OGMP 2.0 data release".

**Traceability:**

- For countries assumed to have MRV equivalence in the Adaptive Scenario, the study simplifies by assuming the exports from these countries are exempted from a requirement to identify the producer per Art. 28.7. For other countries, traceability was set to 100% from the point at which a "tracing solution" (e.g., tradeable certificates) was assumed to become available.

**Other aspects:**

- The study assumes that penalties imposed by EU Member States on non-compliant imports would be punitive—effectively excluding such volumes from the market—as a simplifying assumption to enable scenario modelling focused on compliant supply rather than varying penalty levels.
- The optimization models assume non-compliant exports to the EU cease in 2027 (except long-term contracted gas supplies) and resume once compliance is achieved. In reality, importers may continue sourcing non-compliant volumes if willing to risk penalties or confident on exemptions—for example, if willing to rely on sufficient efforts taken to identify the producer. The model also assumes that destroyed EU gas demand or refinery throughput will rebound when compliant supply increases, but this is optimistic. In practice, refinery throughput lost due to closures may not return, and gas demand or industrial activity may be permanently lost if businesses fail, relocate, or invest elsewhere.
- Expectations around the timing of market impacts are purely indicative and will depend heavily on policy developments in exporting countries and the extent of voluntary action by companies.
- The study includes Russian natural gas and crude oil in the model. It was prepared before the publication of RepowerEU legislative proposal by the European Commission in June 2025 and as a consequence the phase-out of Russian natural gas is not included in the report. However, this does not affect the illustrative scenarios, as Russian volumes do not meet MER compliance requirements in any case.

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# Our analysis indicates that no country currently meets equivalence with EU MER Article 28

| Country / Key Policy or Framework | Measurement Methodology | Facility-Level Granularity | Verification & Auditing | Reporting Frequency | Transparency & Public Access | Legal Force / Enforcement | MRV Equivalence to MER |
|---|---|---|---|---|---|---|---|
| **EU – Methane Emissions Regulation (2024)** | Quantification of source-level emissions required for all segments; complemented by site-level measurements and reconciliation. | Required at facility level; data reported to central EU registry. | Third-party verification and competent authority audits. | Annual; updates required after changes. | Fully public EU registry. | Legally binding; penalties and market restrictions for non-compliance. | Baseline. |
| **Norway – Climate Reporting Regulations + Petroleum Act (Environment Agency)** | 🟧 **Measurement of source-level emissions** required for all offshore production and onshore gas processing facilities. **Gap**: Site-level measurements and reconciliation not required. | 🟩 **Facility-level data required** under national law for all segments. | 🟧 **Verified by national regulator**. **Gap**: No third-party verifier required, but state-led audit regime is robust. | 🟩 **Annual reporting required** under emissions inventory and climate reporting law. | 🟩 **Public access** through industry and authority websites and EEA portals. | 🟩 **Legally binding under national environmental law**, including penalties. | Likely closest to being considered equivalent, but still some minor gaps. |
| **Canada – Federal Methane Regulations (SOR/2018-66) + Provincial Frameworks (e.g., Alberta TIER)** | 🟩 **Direct source-level measurement** for key sources (vents, compressors, pneumatics) under federal and provincial rules. | 🟩 **Facility-level reporting required** federally and in major provinces. | 🟧 **Federal and provincial audits**. **Gap:** third-party verification is not mandatory. | 🟩 **Annual reporting + LDAR inspections** required. | 🟧 **Partial transparency** through NPRI and provincial databases. **Gap**: No unified methane database. | 🟩 **Legally binding federally and provincially**, with enforcement mechanisms. | Some elements equivalent but significant gaps remaining. |
| **United Kingdom – Environmental Permitting Regulations + NSTA Guidance** | 🟥 **Often relies on emission factors** and LDAR; direct and site-level measurement not uniformly required. **Gap**: Does not meet MER site/source measurement or reconciliation requirements. | 🟩 **Facility-level data required** under Environmental Permitting Regulations. | 🟧 **Verified by regulators** (NSTA, Environment Agency). **Gap**: No mandatory third-party verification. | 🟩 **Annual or more frequent** reporting required under permits. | 🟧 **Some data made public. Gap:** no centralized methane registry. | 🟩 **Legally binding permitting regime**, with penalties. **Gap**: Less methane-specific enforcement than MER. | More gaps, less likely to be equivalent. |
| **United States – EPA Methane Rule (2024) + GHGRP Subpart W** | 🟧 **Direct measurement required** for priority sources (compressors, flares, storage) under EPA Methane Rule. **Gap**: Not yet universal. | 🟥 **Facility-level reporting required** under GHGRP (Subpart W). **Gap:** in 2025 EPA proposed suspension until 2034. | 🟧 **Audits and enforcement by EPA**. **Gap**: Does not require third-party certification. | 🟥 **Annual reporting via GHGRP**. **Gap:** in 2025 EPA proposed suspension until 2034. | 🟧 **Public access** via EPA FLIGHT. **Gap**: data formats may be different than the ultimate EU registry. | 🟩 **Legally binding under Clean Air Act**, with penalties for non-compliance. | More gaps, less likely to be equivalent if GHGRP is suspended. |



Note: Reflects policies in place as of July 2025. Since policies continue to evolve, analysis is illustrative and is merely intended to inform credible boundary assumptions for scenarios.

2 Country-level equivalence

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# Our high-level analysis identified 11 other countries with some form of methane policy

| Country | Relevant Policy or Framework | Key Features | MRV Equivalence to MER |
|---|---|---|---|
| **Australia** | National Greenhouse and Energy Reporting (NGER) Act | Facility-level GHG reporting (including methane); regulated by Clean Energy Regulator | Partial – includes methane but lacks mandated direct measurement |
| **Brazil** | ANP Resolution No. 806/2020 (Regulation for flaring/venting) | Requires reporting of gas losses, including methane; lacks site-level granularity and transparency | Partial – some coverage, weak verification |
| **Indonesia** | MEMR Regulation No. 13/2018 on Oil & Gas Flaring and Venting | Limits flaring and venting; requires reporting to ministry; no direct methane quantification required | Partial – targeted controls but lacks MRV structure |
| **Kazakhstan** | Environmental Code (2021) | National inventory includes methane; facility-level granularity under development | Partial – intent is present but MRV not yet complete |
| **Mexico** | SENER / ASEA Methane Guidelines (2018) | Mandatory LDAR; reporting required; enforcement challenges exist | Partial – policy exists but inconsistent enforcement |
| **Nigeria** | Department of Petroleum Resources Guidelines for Flare Reduction | Methane emissions reduction targeted; lacks facility-level reporting or national enforcement mechanisms | Partial – policy direction present, execution limited |
| **Oman** | Ministerial Decrees on flaring; Environmental Impact Assessment Guidelines | Reporting of gas losses required; limited methane-specific measurement or enforcement | Partial – progress underway but lacking full MRV scope |
| **Qatar** | Ministry of Municipality and Environment (MME) Regulations | Some venting/flaring controls; no structured MRV or verification | Partial – high-level policy exists but lacks granularity |
| **Trinidad & Tobago** | Ministry of Energy Guidelines on Emissions | Emissions reporting program under development; lacks legal enforcement and public transparency | Partial – early stage MRV development |
| **Ukraine** | Draft MRV Development Roadmap (2023); National Environmental Strategy | Undergoing capacity building; policy commitment made; partial implementation | Partial – not yet fully implemented |
| **United Arab Emirates** | Environmental regulations under MOCCAE | GHG reporting requirements; methane not mandated specifically; flaring reduction enforced via permitting | Partial – lacks full methane MRV coverage |

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Note: Reflects policies in place as of July 2025. Since policies continue to evolve, analysis is illustrative and is merely intended to inform credible boundary assumptions for scenarios.

# For 16 countries we found no evidence of an enforceable MRV regime for methane

| Country | Relevant Policy or Framework | Key Features | MRV Equivalence to MER |
|---|---|---|---|
| **Azerbaijan** | Environmental Protection Law (general) | National GHG reporting required; lacks methane-specific or segment-level requirements | No evidence of enforceable MRV regime |
| **Belarus** | Law on Atmospheric Air Protection | National-level emission controls; no methane-specific MRV | No evidence of enforceable MRV regime |
| **Egypt** | Law 4/1994 (Environmental Protection Law) | No dedicated methane rules; general environmental regulation | No evidence of enforceable MRV regime |
| **Iraq** | Law No. 27 (Environment Protection and Improvement Law) | General emissions reporting; no methane-specific rule or enforcement | No evidence of enforceable MRV regime |
| **Mozambique** | Petroleum Law + flaring controls (basic provisions only) | No specific methane MRV or reporting mandate | No evidence of enforceable MRV regime |
| **Peru** | Law No. 28611 (General Environmental Law) | No specific methane emissions rules; general GHG reporting provisions | No evidence of enforceable MRV regime |
| **Russia** | Federal Law on Environmental Protection + Order No. 300 | GHG inventory required; no methane-specific regulation or facility-level granularity | No evidence of enforceable MRV regime |
| **Saudi Arabia** | No national methane regulation | Methane is addressed under energy efficiency but no MRV system in place | No evidence of enforceable MRV regime |
| **Turkey** | Environmental Permitting Regulation | Covers GHGs; methane not addressed specifically; lacks site-level measurement or verification | No evidence of enforceable MRV regime |
| **Algeria** | None identified | | No evidence of enforceable MRV regime |
| **Angola** | None identified | | No evidence of enforceable MRV regime |
| **Cameroon** | None identified | | No evidence of enforceable MRV regime |
| **Eq. Guinea** | None identified | | No evidence of enforceable MRV regime |
| **Libya** | None identified | | No evidence of enforceable MRV regime |
| **Mauritania** | None identified | | No evidence of enforceable MRV regime |
| **Tunisia** | None identified | | No evidence of enforceable MRV regime |

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Note: Reflects policies in place as of July 2025. Since policies continue to evolve, analysis is illustrative and is merely intended to inform credible boundary assumptions for scenarios.

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# Level 5 is the highest reporting level within the Oil & Gas Methane Partnership (OGMP) 2.0

## OGMP 2.0
## Reporting Levels

Levels

| LEVEL 1 | LEVEL 2 | LEVEL 3 | LEVEL 4 | LEVEL 5 |
|---|---|---|---|---|
| **Venture/Asset Reporting** | **Emissions Category** | **Generic Emission Source Level** | **Specific Emission Source Level** | **Level 4 + Site Level Measurement Reconciliation** |
| • Single, consolidated emissions number<br>• Only applicable where company has very limited information | • Emissions reported based on IOGP and Marcogaz emissions categories<br>• Based on generic emissions factors | • Emissions reported by detailed source type<br>• Based on generic emissions factors | • Emissions reported by detailed source type using specific emissions and activity factors<br>• Based on direct measurement or other methodologies | • Level 5: Integrating bottom-up source-level reporting (L4) with independent site-level measurements.<br>• Site-level measurements: direct measurement technologies at a site or facility level on a representative sample of facilities |

**GOLD STANDARD REPORTING**

Reporting all material assets at Level 4 and Level 5 within 3 years for operated assets and 5 years for non-operated assets

Source: United Nations Environment Programme *[Oil & Gas Methane Partnership (OGMP) 2.0]*

# We followed a structured, multi-step methodology to estimate the share of OGMP 2.0 Level 5 reported production for key exporting countries from 2027 to 2035

- **Step 1**: **Identified countries** exporting gas, LNG, and crude oil to the EU leveraging Wood Mackenzie's *H1 2025 Strategic Planning Outlooks.*
- **Step 2**: Leveraged Wood Mackenzie's *Lens Upstream* field database to **identify key producer companies in each exporting country**, quantifying each company's production on a gross-operated basis at the field level. Calculated each company's share of national production.
- **Step 3**: **Assessed each company's OGMP 2.0 reporting profile** using the OGMP 2.0 *Company Factsheet 2024*, which shows the globally aggregated reporting levels across each company's assets. Used this to determine the percentage split of assets reported across Levels 1 to 5 for each company. Since the company data in the factsheet is globally aggregated, we assumed that the percentage split applies uniformly across the company's operated portfolio in all countries.
- **Step 4**: Linked each producer company's share of national production (from Step 2) to the company's OGMP reporting profile (from Step 3) to **determine the share of Level 5-reported production in each country in 2024**.
- **Step 5**: **Developed a forecast of the share of Level 5-reported production in each country in 2027-2035**, leveraging Wood Mackenzie's field-level production forecasts and an assumed number of years for companies to move up a reporting level reflecting the capital, time and resources needed.



Step 3 source: United Nations Environment Programme *[Oil & Gas Methane Partnership (OGMP) 2.0 Company factsheets]*

3 Producer-level equivalence

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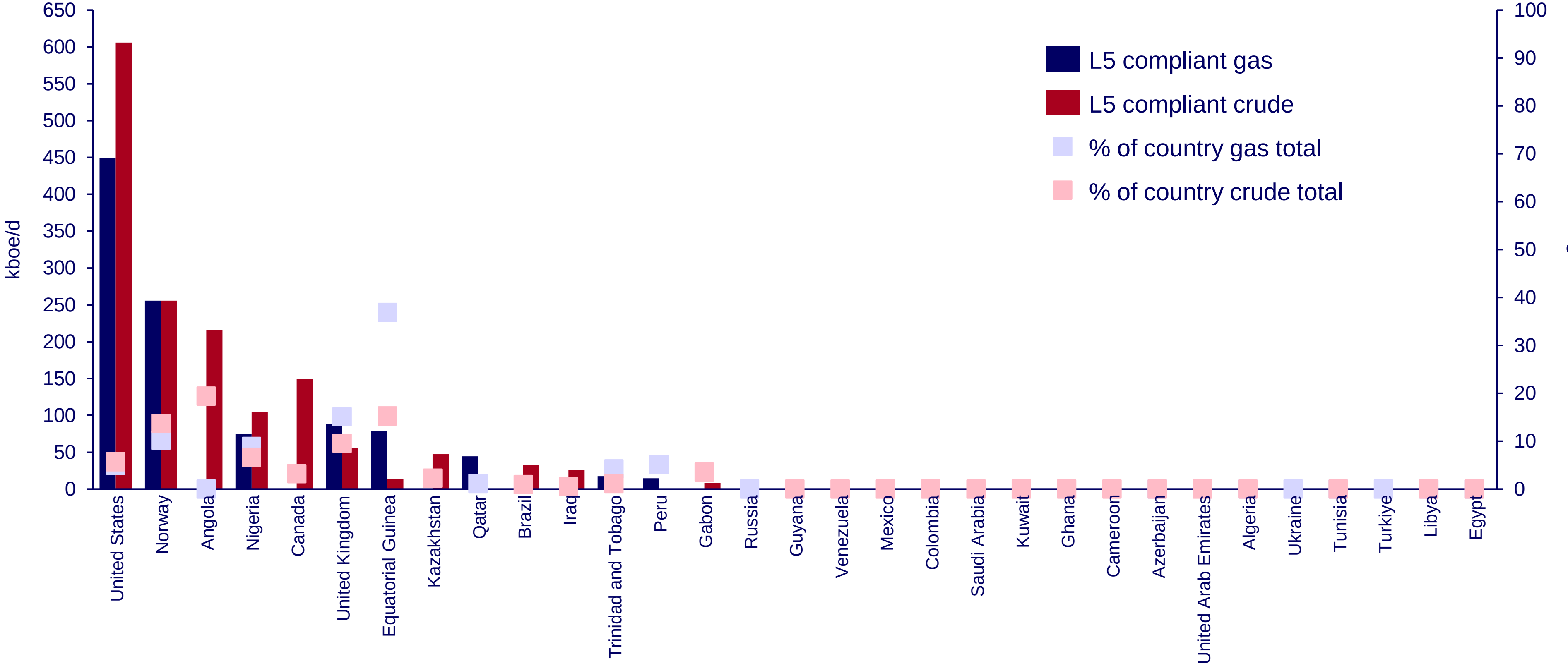
# In 2024, an average of just 3% of gas and 3% of crude oil was reported at OGMP 2.0 Level 5

**2024 estimated share of national production at Level 5 reporting**




Source: Wood Mackenzie analysis of OGMP 2.0 Company Factsheets

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# We developed a linear forecast of the share of Level 5-reported production in each country in 2027-2035, using an assumed number of years for companies to move up a reporting level

## Illustrative example of linear forecast of L5-reported production

1 Base year is 2024, leveraging the latest available data from the UNEP factsheet

2 Select year for forecast

3 Set assumed number of years to progress levels

| https://wedocs.unep.o | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2024 | | | | | | | | | Total gas kboe/d | Total liquid kboe/d |
| | Current Compliance level (OPERATED ASSETS) | | | | | | | | | 590 | 954 |
| Company | OMGP member (Y/N) | L1 | L2 | L3 | L4 | L5 | Gas production (kboe/d) | Liquid production (kboe/d) | Total production (kboe/d) | 2024 L5 compliant gas volume | 2024 L5 compliant liquid volume |
| Example A | Y | 0% | 0% | 10% | 40% | 50% | 50 | 50 | 100 | 25 | 25 |
| Example B | Y | 20% | 20% | 20% | 20% | 20% | 50 | 50 | 100 | 10 | 10 |
| Example C | Y | 80% | 20% | 0% | 0% | 0% | 50 | 50 | 100 | 0 | 0 |

[redacted]

| Year | L1>L2 | L2>L3 | L3>L4 | L4>L5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2027 | 0.5 | 1 | 2 | 2.5 | | | | Total gas kboe/d | Total liquid kboe/d |
| Compliance Forecast | | | | | 2027 | 2027 | 2027 | 2974 | 9214 |
| L1 | L2 | L3 | L4 | L5 | Gas production (kboe/d) | Liquid production (kboe/d) | Total production (kboe/d) | L5 compliant gas volume | L5 compliant liquid volume |
| 0% | 0% | 0% | 10% | 90% | 50 | 50 | 100 | 45 | 45 |
| 0% | 0% | 20% | 40% | 40% | 50 | 50 | 100 | 20 | 20 |
| 0% | 0% | 80% | 20% | 0% | 50 | 50 | 100 | 0 | 0 |

4 As 3 years pass, the model shifts the share of assets reported at each level forward. If time allows progress is made through multiple levels. In this example Company C's Level 1 share of assets progresses straight to Level 3 over the period 2024 – 2027

| https://wedocs.unep.o | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2024 | | | | | | | | | Total gas kboe/d | Total liquid kboe/d |
| | Current Compliance level (OPERATED ASSETS) | | | | | | | | | 590 | 954 |
| Company | OMGP member (Y/N) | L1 | L2 | L3 | L4 | L5 | Gas production (kboe/d) | Liquid production (kboe/d) | Total production (kboe/d) | 2024 L5 compliant gas volume | 2024 L5 compliant liquid volume |
| Example A | Y | 0% | 0% | 10% | 40% | 50% | 50 | 50 | 100 | 25 | 25 |
| Example B | Y | 20% | 20% | 20% | 20% | 20% | 50 | 50 | 100 | 10 | 10 |
| Example C | Y | 80% | 20% | 0% | 0% | 0% | 50 | 50 | 100 | 0 | 0 |

[redacted]

| Year | L1>L2 | L2>L3 | L3>L4 | L4>L5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2030 | 0.5 | 1 | 2 | 2.5 | | | | Total gas kboe/d | Total liquid kboe/d |
| Compliance Forecast | | | | | 2030 | 2030 | 2030 | 7671 | 15577 |
| L1 | L2 | L3 | L4 | L5 | Gas production (kboe/d) | Liquid production (kboe/d) | Total production (kboe/d) | L5 compliant gas volume | L5 compliant liquid volume |
| 0% | 0% | 0% | 0% | 100% | 50 | 50 | 100 | 50 | 50 |
| 0% | 0% | 0% | 0% | 100% | 50 | 50 | 100 | 50 | 50 |
| 0% | 0% | 0% | 0% | 100% | 50 | 50 | 100 | 50 | 50 |

Note: The assumed time required to move from L4 to L5 is 2.5 years. This assumes that 0.5 years (6 months) are required for independent verification. This is only a rough estimate; verification may take less or more time depending on the complexity/location of the asset. Time estimate reflects the capital, time and resources needed to move up a level.

# Approach to traceability assumptions

Traceability is a key factor in determining a country's export compliance under MER, particularly for countries that may not achieve full national MRV equivalence. Our approach to traceability assumptions considers the complexity of supply chains and the feasibility of implementing robust certification schemes.

- We combined a high-level assessment of each country's gas and oil system complexity (i.e., the degree of comingling of production streams) with an evaluation of when a reliable, verified certification scheme (covering volumes injected and transiting through different networks) could realistically be in place.
- Based on system complexity, we set the 2027 starting values to represent the assumed share of 'simple' value chains where importers can directly identify the producer.
- We assumed these values increase over time as communication and contractual arrangements improve along the chain—by around 20% between 2027–30 and again between 2030–32.
- Once a reliable, accredited certification scheme is established in a country, and certificates can credibly 'survive' transit to the EU, we assume all production from that country becomes fully traceable (100%). On this basis, we assumed five countries achieve this by 2030 and thirteen by 2032. For some countries, we made the conservative assumption that a robust certification system is unlikely to be operational by 2032.

As such, the assumed traceability figures reflect the percentage of a country's production where EU importers can connect with a producer directly or via certificates. Our assumptions are based on the gradual setup of constrained book-and-claim systems covering key export countries. We also assume that no other approach to the tracing issue can be scaled-up faster.

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# In Step 2 we used a policy gap analysis to determine which countries achieve equivalence. In Step 3 we forecasted the number of years required for companies to move up each OGMP level

| ① Identify exporters | ② Country-level equivalence | | | ③ Producer-level equivalence | | | | | | ④ Traceability assumptions | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Based on Base Case*** | *Equivalence assumed in each scenario* → | Default Scenario | Adaptive Scenario | ***OGMP L5 % of production, forecast for gas / LNG*** | | | ***OGMP L5 % of production, forecast for crude oil*** | | | ***Traceable % of production, based on qualitative assessment*** | | |
| **Major exporter to EU** | **Current MRV equivalence** | **Country policy achieves MRV equivalence?** | | **2027-29** | **2030-31** | **2032-35** | **2027-29** | **2030-31** | **2032-35** | **2027-29** | **2030-31** | **2032-35** |
| Norway | Likely equivalent | No | Yes | 91% | 100% | 100% | 89% | 100% | 100% | 80% | 100% | 100% |
| United States | Likely equivalent | No | Yes | 21% | 55% | 55% | 19% | 48% | 48% | 10% | 100% | 100% |
| Canada | Likely equivalent | No | Yes | N/A | N/A | N/A | 5% | 7% | 8% | 10% | 100% | 100% |
| United Kingdom | Likely equivalent | No | Yes | 53% | 65% | 66% | 62% | 76% | 76% | 10% | 30% | 100% |
| Brazil | Partially equivalent | No | Yes | N/A | N/A | N/A | 8% | 90% | 92% | 25% | 45% | 100% |
| Kazakhstan | Partially equivalent | No | Yes | N/A | N/A | N/A | 15% | 47% | 47% | 25% | 45% | 65% |
| Mexico | Partially equivalent | No | Yes | N/A | N/A | N/A | 3% | 22% | 25% | 10% | 30% | 100% |
| Nigeria | Partially equivalent | No | Yes | 15% | 22% | 25% | 17% | 40% | 45% | 10% | 30% | 50% |
| Qatar | Partially equivalent | No | Yes | 5% | 91% | 93% | N/A | N/A | N/A | 80% | 100% | 100% |
| United Arab Emirates | Partially equivalent | No | Yes | N/A | N/A | N/A | 97% | 97% | 98% | 80% | 100% | 100% |
| Algeria | Not equivalent | No | No | 2% | 3% | 3% | 4% | 9% | 11% | 25% | 45% | 65% |
| Angola | Not equivalent | No | No | 1% | 35% | 38% | 43% | 95% | 95% | 25% | 45% | 100% |
| Azerbaijan | Not equivalent | No | No | 58% | 79% | 81% | 59% | 88% | 88% | 25% | 45% | 65% |
| Egypt | Not equivalent | No | No | 32% | 68% | 77% | 2% | 4% | 4% | 25% | 45% | 65% |
| Equatorial Guinea | Not equivalent | No | No | 64% | 100% | 100% | 22% | 31% | 39% | 80% | 80% | 100% |
| Iraq | Not equivalent | No | No | N/A | N/A | N/A | 7% | 10% | 10% | 25% | 45% | 65% |
| Libya | Not equivalent | No | No | 0% | 0% | 0% | 0% | 0% | 0% | 10% | 30% | 50% |
| Peru | Not equivalent | No | No | 10% | 17% | 12% | N/A | N/A | N/A | 10% | 30% | 100% |
| Russia | Not equivalent | No | No | 0% | 0% | 0% | 0% | 0% | 0% | 25% | 45% | 65% |
| Saudi Arabia | Not equivalent | No | No | N/A | N/A | N/A | 0% | 0% | 0% | 80% | 80% | 100% |
| Tunisia | Not equivalent | No | No | *Transit country only* | | | 12% | 20% | 9% | 25% | 45% | 100% |

N/A - No forecasted imports to the EU in Base Case. Note: assumptions for steps 3 and 4 are the same in both scenarios. In step 3, some countries' (e.g. the US) OGMP L5 % of production plateaus between 2030 and 2032 because all OGMP members in these countries are assumed to have achieved L5 by 2030; remaining production is by non-members of OGMP.

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# We used the scenario drivers to estimate the share of compliant production available to the EU

## We applied the following constraints to our least-cost supply allocation model for gas/LNG

| Major exporter to EU | *Production 2024 (kboed)* | *EU export 2024 (kboed)* | Default Scenario – % of production allowed to flow to EU: 2027-29 | Default Scenario: 2030-31 | Default Scenario: 2032-35 | Adaptive Scenario – % of production allowed to flow to EU: 2027-29 | Adaptive Scenario: 2030-31 | Adaptive Scenario: 2032-35 |
|---|---|---|---|---|---|---|---|---|
| Norway | 1,864 | 1,566 | 73% | 100% | 100% | 100% | 100% | 100% |
| Russia | 14,065 | 888 | 0% | 0% | 0% | 0% | 0% | 0% |
| United States | 16,192 | 854 | 2% | 55% | 55% | 100% | 100% | 100% |
| Algeria | 1,704 | 494 | 1% | 1% | 2% | 1% | 1% | 2% |
| Qatar | 3,134 | 228 | 4% | 91% | 93% | 100% | 100% | 100% |
| Azerbaijan | 663 | 126 | 14% | 35% | 53% | 14% | 35% | 53% |
| United Kingdom | 566 | 105 | 5% | 19% | 66% | 100% | 100% | 100% |
| Nigeria | 936 | 84 | 2% | 7% | 12% | 100% | 100% | 100% |
| Trinidad and Tobago | 500 | 36 | 1% | 27% | 62% | 1% | 27% | 62% |
| Peru | 243 | 25 | 1% | 5% | 12% | 1% | 5% | 12% |
| Libya | 257 | 22 | 0% | 0% | 0% | 0% | 0% | 0% |
| Angola | 139 | 15 | 0% | 16% | 38% | 0% | 16% | 38% |
| Equatorial Guinea | 103 | 5 | 51% | 80% | 100% | 51% | 80% | 100% |
| Egypt | 1,102 | 5 | 8% | 31% | 50% | 8% | 31% | 50% |
| Argentina | 724 | 0 | 6% | 9% | 19% | 6% | 9% | 19% |
| Oman | 808 | 0 | 9% | 21% | 48% | 9% | 21% | 48% |
| Australia | 2,558 | 0 | 5% | 32% | 72% | 5% | 32% | 72% |
| Brunei | 184 | 0 | 0% | 0% | 0% | 0% | 0% | 0% |
| Cameroon | 41 | 0 | 0% | 0% | 0% | 0% | 0% | 0% |
| Congo | 15 | 0 | 15% | 45% | 100% | 15% | 45% | 100% |
| Indonesia | 1,125 | 0 | 13% | 35% | 64% | 13% | 35% | 64% |
| Malaysia | 1,125 | 0 | 15% | 41% | 94% | 15% | 41% | 94% |
| Mauritania | 34 | 0 | 20% | 45% | 100% | 20% | 45% | 100% |
| Mozambique | 181 | 0 | 0% | 24% | 46% | 0% | 24% | 46% |
| Papua New Guinea | 213 | 0 | 5% | 45% | 100% | 5% | 45% | 100% |
| Senegal | 34 | 0 | 20% | 45% | 100% | 20% | 45% | 100% |
| **Total (wt. avg. % of 2024 EU imports)** | | | **27%** | **53%** | **55%** | **64%** | **65%** | **66%** |
| **Total (after accounting for pre-Aug 2024 contracts)** | | | **57%** | **66%** | **64%** | **80%** | **75%** | **73%** |

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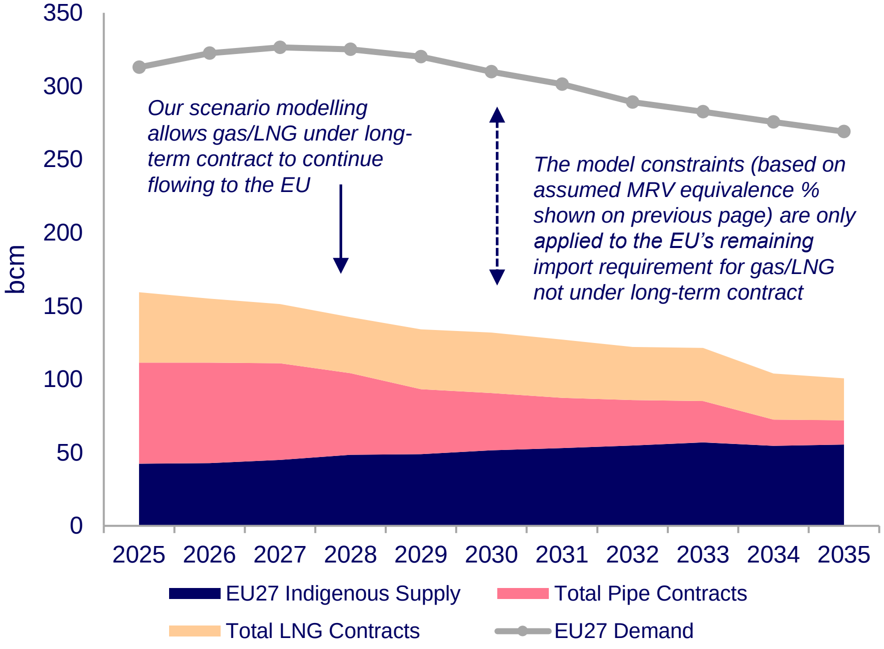
# Our modelling accounts for both MRV equivalence and contracts signed before 4th August 2024.* We estimate 57% of the EU's imported gas/LNG is compliant in the Default Scenario in 2027

## In the Adaptive Scenario, we estimate that 80% the EU's imported gas/LNG is compliant in 2027

### EU imported gas supply contracts




### MER-compliant EU gas/LNG imports, as a share of 2024 total imports

| | Default Scenario | | | Adaptive Scenario | | |
|---|---|---|---|---|---|---|
| | 2027-29 | 2030-31 | 2032-35 | 2027-29 | 2030-31 | 2032-35 |
| **MER-compliant** | **57%** | **66%** | **64%**** | **80%** | **75%** | **73%**** |
| **Not MER-compliant** | **43%** | **34%** | **36%** | **20%** | **25%** | **27%** |

*LNG imports under long-term contract total 40 bcm in 2027, 41 bcm in 2030, and 36 bcm in 2032. The largest suppliers are the United States, Qatar, and Nigeria.*

*Pipe imports under long-term contract total 66 bcm in 2027, 39 bcm in 2030, and 31 bcm in 2032. The largest suppliers are Norway, Algeria, and Azerbaijan.*

**MER-compliant share is a function of both producers' OGMP Level 5 achievement and the quantity of EU gas imports under long-term contract signed before August 2024. OGMP Level 5 achievement gradually increases over time, while gas under long-term contract gradually decreases. The net effect of this causes a drop in MER-compliant supply between 2030 and 2032.

Source: Woodmac Gas Service (April 2025 Report). *Our modelling assumes that volumes under contracts signed before 4th August 2024 will continue to flow based on lower requirements to demonstrate equivalency (reasonable efforts). Note: pre-2024 contracts are not material for crude oil because term contracts for oil tend to be "annual evergreen" and renewed annually

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# We used the scenario drivers to estimate the share of compliant production available to the EU

## We applied the following constraints to our least-cost supply allocation model for crude oil and the refining system

| Major exporter to EU | Production 2024 (kboed) | EU export 2024 (kboed) | Default Scenario – % of production allowed to flow to EU: 2027-29 | Default: 2030-31 | Default: 2032-35 | Adaptive Scenario – % of production allowed to flow to EU: 2027-29 | Adaptive: 2030-31 | Adaptive: 2032-35 |
|---|---|---|---|---|---|---|---|---|
| United States | 11,541 | 1,841 | 2% | 48% | 48% | 100% | 100% | 100% |
| Norway | 1,909 | 1,574 | 71% | 100% | 100% | 100% | 100% | 100% |
| Kazakhstan | 1,922 | 1,090 | 4% | 21% | 30% | 100% | 100% | 100% |
| Saudi Arabia | 9,686 | 865 | 0% | 0% | 0% | 0% | 0% | 0% |
| Nigeria | 1,597 | 821 | 2% | 12% | 23% | 100% | 100% | 100% |
| Libya | 1,411 | 792 | 0% | 0% | 0% | 0% | 0% | 0% |
| Iraq | 6,215 | 648 | 2% | 5% | 6% | 2% | 5% | 6% |
| United Kingdom | 766 | 600 | 6% | 23% | 76% | 100% | 100% | 100% |
| Azerbaijan | 589 | 500 | 15% | 40% | 57% | 15% | 40% | 57% |
| Brazil | 3,938 | 496 | 2% | 40% | 92% | 100% | 100% | 100% |
| Russia | 10,901 | 491 | 0% | 0% | 0% | 0% | 0% | 0% |
| Algeria | 844 | 326 | 1% | 4% | 7% | 1% | 4% | 7% |
| Guyana | 383 | 325 | 5% | 45% | 100% | 5% | 45% | 100% |
| Mexico | 1,437 | 246 | 0% | 6% | 25% | 100% | 100% | 100% |
| Angola | 1,125 | 189 | 11% | 43% | 95% | 11% | 43% | 95% |
| Canada | 4,880 | 136 | 0% | 7% | 8% | 100% | 100% | 100% |
| Equatorial Guinea | 87 | 28 | 18% | 24% | 39% | 18% | 24% | 39% |
| United Arab Emirates | 4,094 | 67 | 77% | 97% | 98% | 100% | 100% | 100% |
| Egypt | 409 | 57 | 1% | 2% | 3% | 1% | 2% | 3% |
| Gabon | 198 | 38 | 2% | 7% | 20% | 2% | 7% | 20% |
| Tunisia | 28 | 28 | 3% | 9% | 9% | 3% | 9% | 9% |
| Trinidad and Tobago | 54 | 13 | 1% | 27% | 62% | 1% | 27% | 62% |
| Bolivia | 0 | 0 | 12% | 43% | 94% | 12% | 43% | 94% |
| Suriname | 16 | 0 | 0% | 42% | 72% | 0% | 42% | 72% |
| Uganda | 0 | 0 | 14% | 27% | 61% | 14% | 27% | 61% |
| Sudan | 31 | 0 | 0% | 0% | 0% | 0% | 0% | 0% |
| **Total (wt. avg. % of 2024 EU imports)** | | | **13%** | **33%** | **44%** | **62%** | **65%** | **69%** |

Note: pre-2024 contracts are not material for crude oil because term contracts for oil tend to be "annual evergreen" and renewed annually

# MER Impact Assessment and Scenario Modelling

*Base Case –*

*Gas & LNG*

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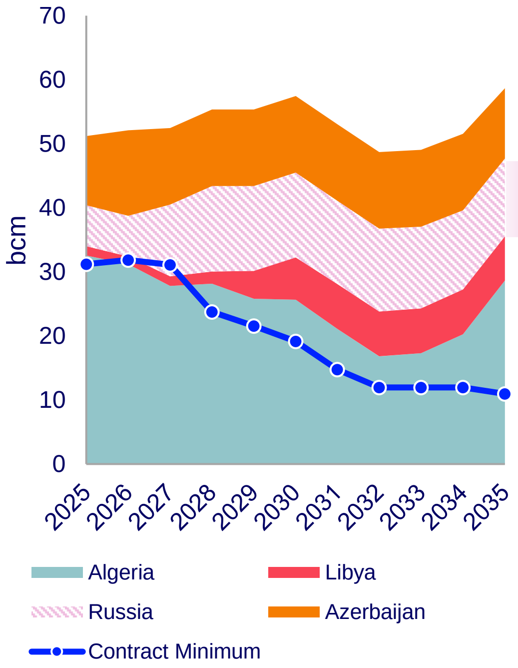
# Evolving EU sanctions and uncertainty around ongoing negotiations to end the Russia-Ukraine war has shifted the outlook for Russian **pipe gas supplies** to the EU

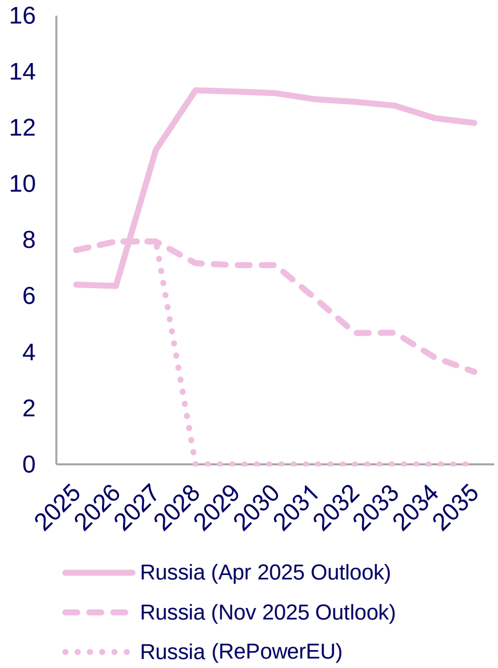
## The scenario analysis in this study uses WoodMac's April 2025 outlook as the Base Case

### EU Pipe Imports (Base Case) using Apr 2025 outlook




Source: Wood Mackenzie Gas Service

### EU Pipe imports from Russia (comparison of Apr 2025 vs. Nov 2025 outlook)




In our **April 2025 outlook** (represented by the solid pink line in the chart at left), despite EU sanctions on Russia we assumed the EU and Ukraine concede some transit flows through Ukraine to Hungary and Slovakia, in exchange for their support in maintaining a unified EU position on Russia.

Our **Nov 2025 outlook** (represented by the thick dotted line in the chart at left), which was developed after the EU's 19th sanction package and the RePowerEU legislation, assumes the EU proceeds with plans to ban Russian pipeline imports into the bloc by January 2028. This leads to a reduction in Russian pipeline gas to Europe from 2028, but we assume Hungary and Slovakia negotiate some exemptions enabling them to continue receiving gas under existing long-term contracts via TurkStream. We no longer expect any resumption in pipeline volumes transiting Ukraine.

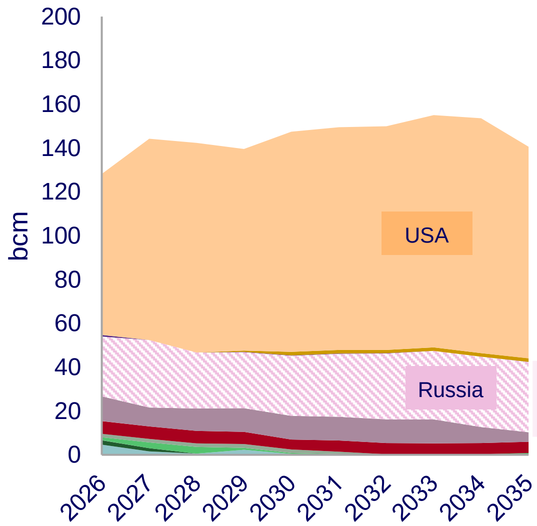
Given the significant uncertainty around the ongoing negotiations around a Russia-Ukraine peace agreement, we have also plotted a **complete exclusion** outcome in the chart at left. This assumes the EU's 19th sanction package is implemented strictly with no exemptions.

The scenario analysis in the following pages (**Default** and **Adaptive** Scenarios) was done in the summer of 2025 and uses the April 2025 outlook as the Base Case. The difference in the Russia outlook has minimal impact on the scenario outcomes, since all Russian supply is excluded in both scenarios due to 0% OGMP Level 5 achievement among Russian producers.

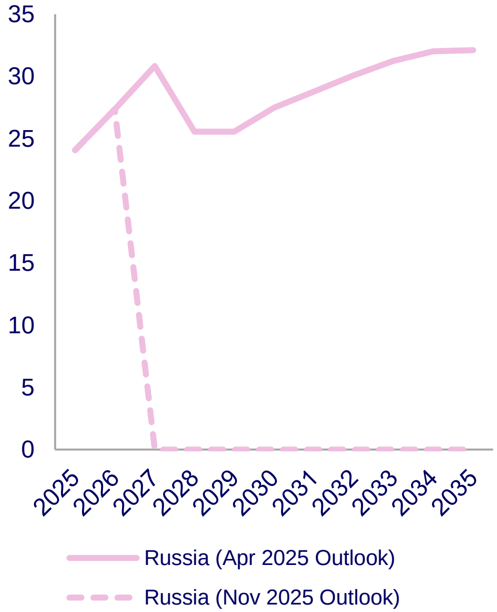
# Evolving EU sanctions and uncertainty around ongoing negotiations to end the Russia-Ukraine war has shifted the outlook for Russian **LNG supplies** to the EU

## The scenario analysis in this study uses WoodMac's April 2025 outlook as the Base Case

**EU LNG imports (Base Case) using Apr 2025 outlook**




**EU LNG imports from Russia (comparison of Apr 2025 vs. Nov 2025 outlook)**




In our **April 2025 outlook** (represented by the solid pink line in the chart at left), we assumed the EU maintains its transshipment ban and avoids Arctic LNG-2 cargoes, but continues importing LNG from Russia's Yamal LNG project.

Our **Nov 2025 outlook** (represented by the thick dotted line in the chart at left), which was developed after the EU's 19th sanction package, assumes the EU completely halts Russian LNG imports from 2027.

The scenario analysis in the following pages (**Default** and **Adaptive** Scenarios) was done in the summer of 2025 and uses the April 2025 outlook as the Base Case. The difference in the Russia outlook has minimal impact on the scenario outcomes, since all Russian supply is excluded in both scenarios due to 0% OGMP Level 5 achievement among Russian producers.

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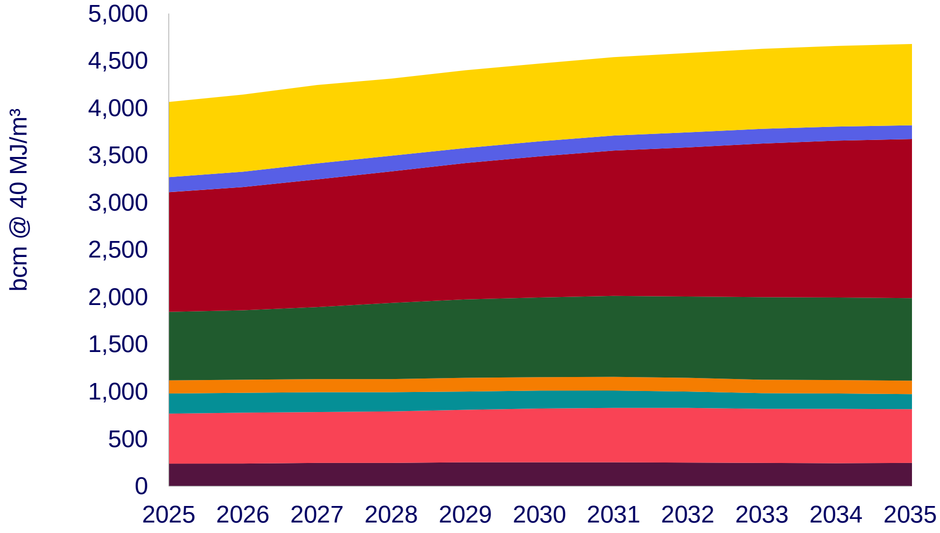
Source: Wood Mackenzie Gas Service

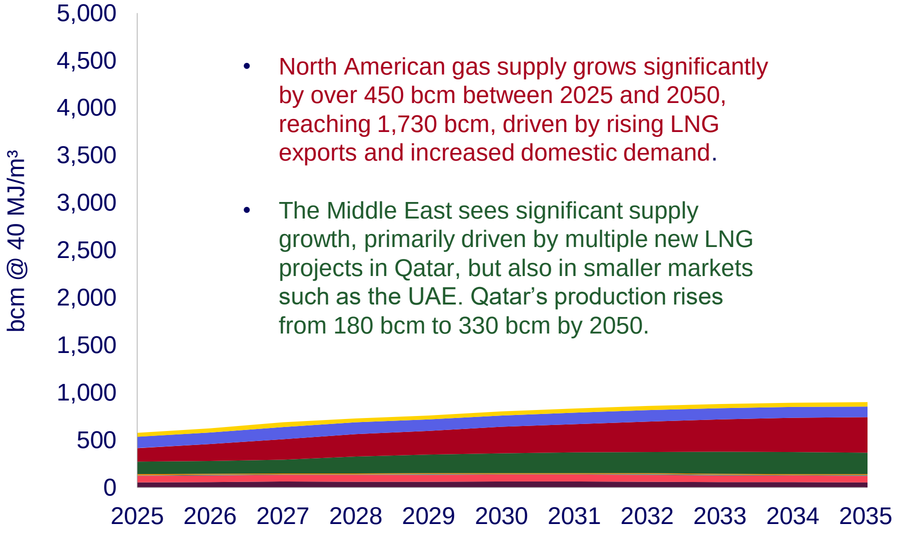
# US' and Qatar's new LNG liquefaction projects and the countries' vast resources drive global production growth in the long term

## Europe and Asia will face long-term output decline, increasing reliance on LNG imports to meet gas demand

### Global Gas & LNG Supply by Region




### Global LNG-only Supply by Region




Africa | Asia | Europe | Latin America and the Caribbean | Middle East | North America | Oceania | Russia and the Caspian

Source: Wood Mackenzie Gas Service (April 2025 Report)

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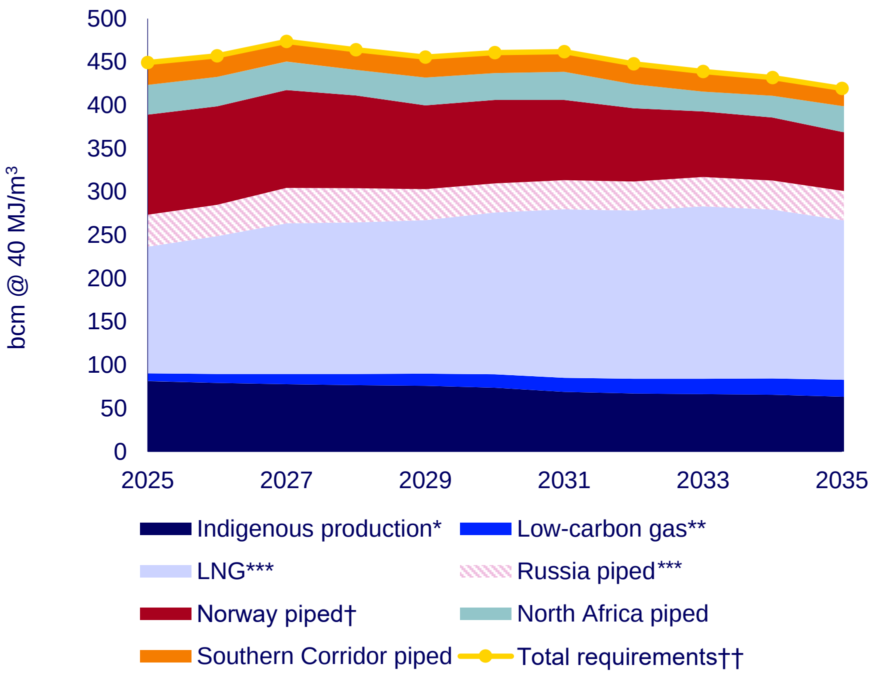
# Imported LNG will continue to provide the largest share of Europe's gas balance

## Europe gas balance 2025-2035




Wood Mackenzie Gas & LNG | * Excludes Cyprus production **Grid-quality biomethane *** Includes demand for marine bunkering † Includes Norway domestic demand ††Total Supply = Total Requirements = Demand + Exports - Net Stock Change

**2025 – 2029**

- A wave of **new LNG supply** from US and Qatari projects will arrive on the market in 2026, **backfilling the decline of North Sea production**.
- **European gas demand grows marginally** over the period as the rebound in industrial gas demand and consumer confidence remains weak.
- Pipeline gas from Russia has dropped sharply since 2022, but some countries (notably Hungary and Slovakia) **continue to receive Russian pipeline gas** via the TurkStream route, through Turkey and the Balkans.

**2030 – 2035**

- More LNG comes on to the market but **global demand growth slows,** putting downward pressure on LNG prices.
- **Europe acts as a sink for LNG** with imports peaking at 186 bcm in 2033. LNG imports help offset Norwegian output decline.
- European gas **demand starts to decline** in this period (though **slower energy transition policy implementation and a period of lower prices may delay this pivot point.**
- **LNG takes an increasing share of the supply** mix as piped imports go into decline, **exceeding 50% by 2035.**

***The study includes Russian natural gas and crude oil in the Base Case. However, sanctions and the agreed regulation (RePowerEU) to phase-out Russian natural gas must be considered. Under the Base Case, all Russian volumes could potentially exit the EU market.

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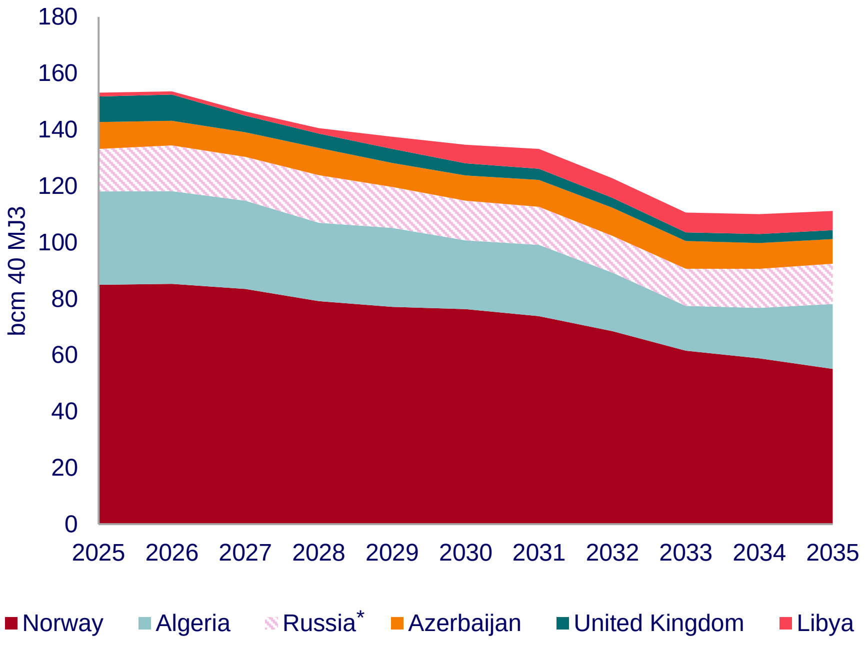
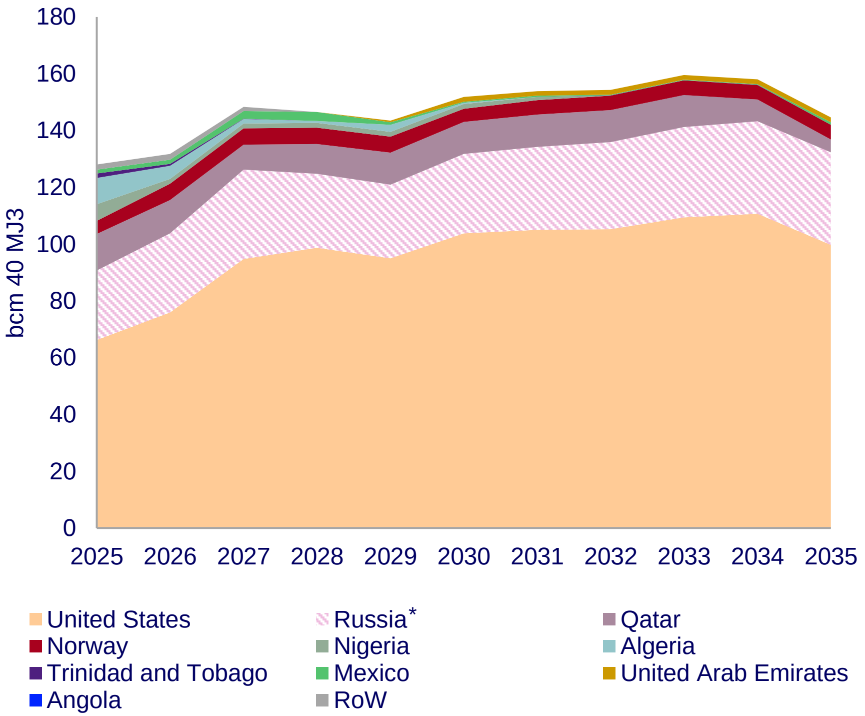
# The EU is becoming more reliant on LNG imports as gas production in the North Sea and North Africa enters decline

## Pipe gas imports to the EU




## LNG imports to the EU




Source: Wood Mackenzie Gas Service (April 2025 Report)

*The study includes Russian natural gas and crude oil in the Base Case. However, sanctions and the agreed regulation (RePowerEU) to phase-out Russian natural gas must be considered. Under the Base Case, all Russian volumes could potentially exit the EU market.

# MER Impact Assessment and Scenario Modelling

*Alternative Scenario Results – Gas/LNG*

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# Summary of modelled scenario results: gas/LNG

## **Default Scenario**: assumes implementation of the Methane Regulation as it is

- **Supply Impact:**
  - Severe shortage of natural gas from both piped and LNG imports. In 2027, available natural gas supplies decline by 114 billion cubic metres (bcm), equivalent to 43% of total EU imports in 2024.
  - The most significant constraint is the exclusion of most US LNG and of Algerian pipe flows in the 2027–2029 period, severely restricting supply.
  - Although the model attempts to increase imports from the Middle East, this is nowhere near sufficient to meet demand.
  - After 2030, US producers are assumed to have made considerable progress toward achieving OGMP Level 5, and the wide availability of verification and certificate schemes connecting producers with EU importers enables a swing back to high levels of LNG imports into the EU, exceeding Base Case volumes.
- **Market Imbalance and Price Impact:**
  - Across the entire modelled period (2027–2035), the model is unable to generate a spot gas price (TTF) in the EU because supply is insufficient to meet demand—indicating that prices would rise to historically high, unsustainable levels, with demand destruction becoming the primary balancing mechanism.
  - The inability to meet demand leads to a significant degree of coal switching for power generation, highlighting the risk of severe and unintended carbon leakage.
  - Additional LNG import capacity, particularly in Northwest and Eastern EU, could offer limited support in absorbing increased US LNG exports after 2030—but the initial exclusion of potential LNG suppliers remains the primary cause of the market imbalance.
- **Global impact:**
  - Asia is flooded with LNG that is shut out of the EU market between 2027–2029, causing Asian prices to temporarily fall relative to the Base Case. The global Market almost rebalances in early 2030s as new US LNG comes online, but this is mostly allocated to the EU to compensate for lower pipe gas availability. Asian LNG demand grows strongly but goes unmet, causing Asian gas prices to jump to historic highs from 2030 onward.

Since the market impacts are most severe when compliance is lowest in the first 3 years of Article 28 being in force, **a delay of Article 28 requirements by 3-4 years may help avoid the most disruptive outcomes**. While such a delay could avoid market disruption almost entirely in the **Adaptive Scenario**, in the **Default Scenario** a disruption is still to be expected after the delay, as the disruptions persist throughout the entire modelling period.

# Summary of modelled scenario results: gas/LNG

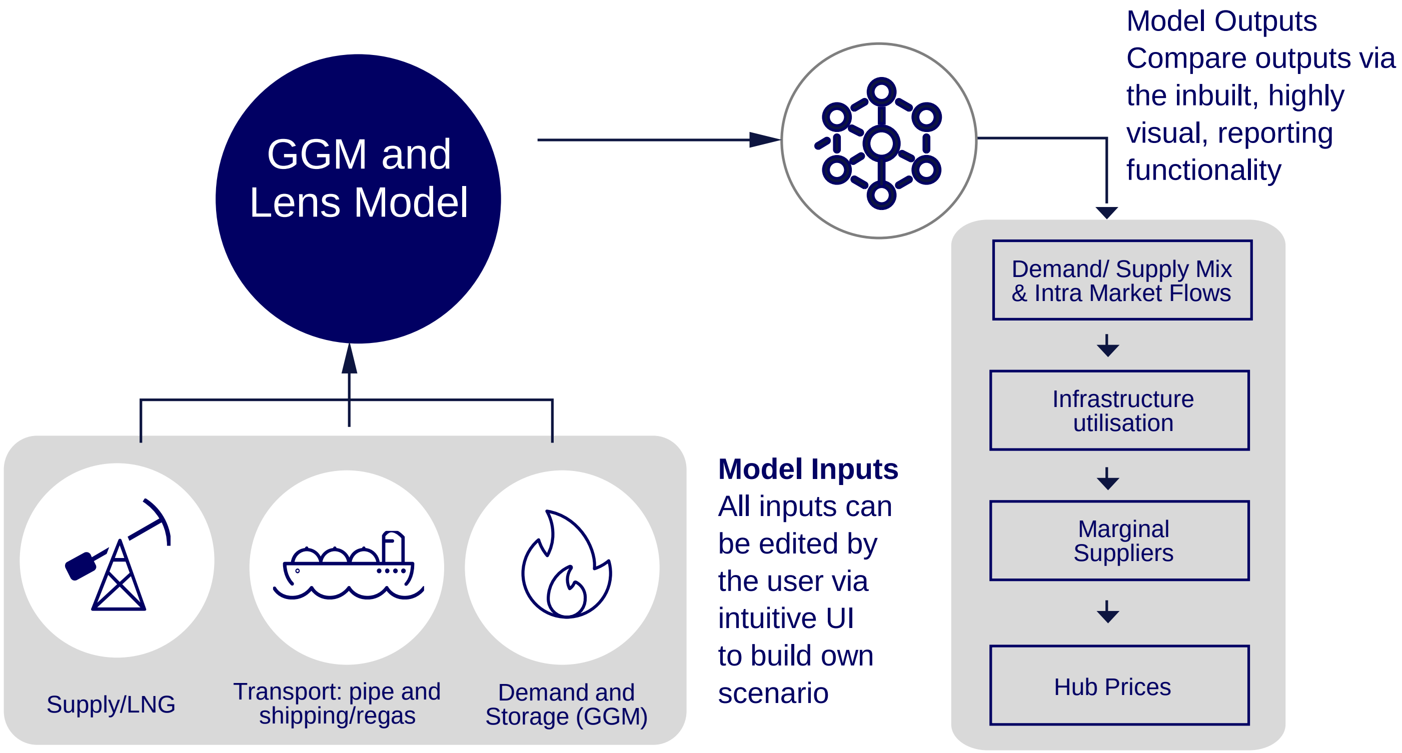
## **Adaptive scenario**: modifications are introduced to MER, allowing greater flexibility in granting country-level MRV equivalence

- **Supply Impact:**
  - More limited impact on natural gas imports. Available and compliant natural gas supplies could decline by around 53 billion cubic metres (bcm), equivalent to 20% of total EU imports in 2024.
  - Gas/LNG from the US and select other countries (such as Norway, Qatar, UK, and Nigeria) is assumed to be 100% compliant, based on reduced requirements for country-level equivalence.
  - While EU pipeline gas imports from Libya, Azerbaijan, and Russia fall to contract minimum levels—as in the Default Scenario—increased imports of US LNG compensate for most of the 40 bcm of lost pipeline supply.
  - We assume Italy & Spain make Security of Supply (SoS) Allowances for some non-compliant Algerian pipe gas. These allowances are necessary for the market to balance (i.e. supply to meet EU demand) in 2027-28. These SoS Allowances are not made in the Default Scenario because the market would not balance unless very large SoS Allowances are made.
- **Market Imbalance and Price Impact:**
  - TTF spot prices more than double compared to the Base Case forecast, climbing to approximately $19 per MMBtu in 2028.
  - The greater availability of US LNG, combined with the Security of Supply Allowance, helps moderate the gas price impact relative to the Default Scenario.
  - Higher gas prices result in some demand switching from gas to coal in the power sector—an unintended consequence that may increase carbon emissions—but to a lesser extent than in the Default Scenario.
- **Global impact:**
  - The price impact is global, with Asian gas prices also increasing by a similar magnitude.

Since the market impacts are most severe when compliance is lowest in the first 3 years of Article 28 being in force, **a delay of Article 28 requirements by 3-4 years may help avoid the most disruptive outcomes**. While such a delay could avoid market disruption almost entirely in the **Adaptive Scenario**, in the **Default Scenario** a disruption is still to be expected after the delay, as the disruptions persist throughout the entire modelling period.

# Our **Global Gas Model (GGM)** matches demand/supply through appropriate infrastructure to define equilibrium prices

- Match supply to demand globally, on a seasonal basis, via least cost linear programming (LP) optimisation
- Produce market prices at which incremental demand and supply are in equilibrium
- Identify likely competitive market conditions and price linkages between markets
- Identify timing and markets for future supply developments

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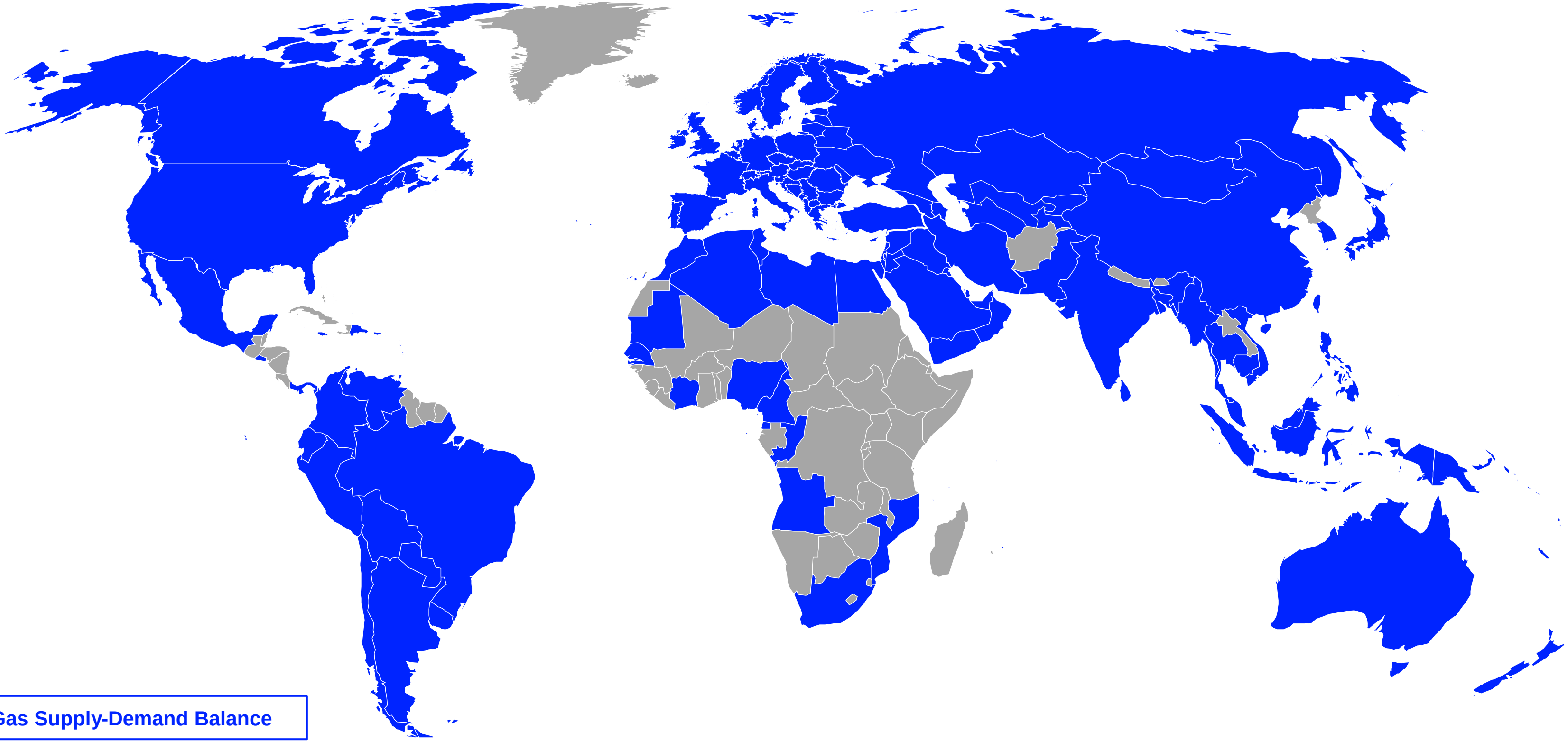
# The Global Gas Model provides a detailed supply-demand balance for each gas market



**Full Gas Supply-Demand Balance**

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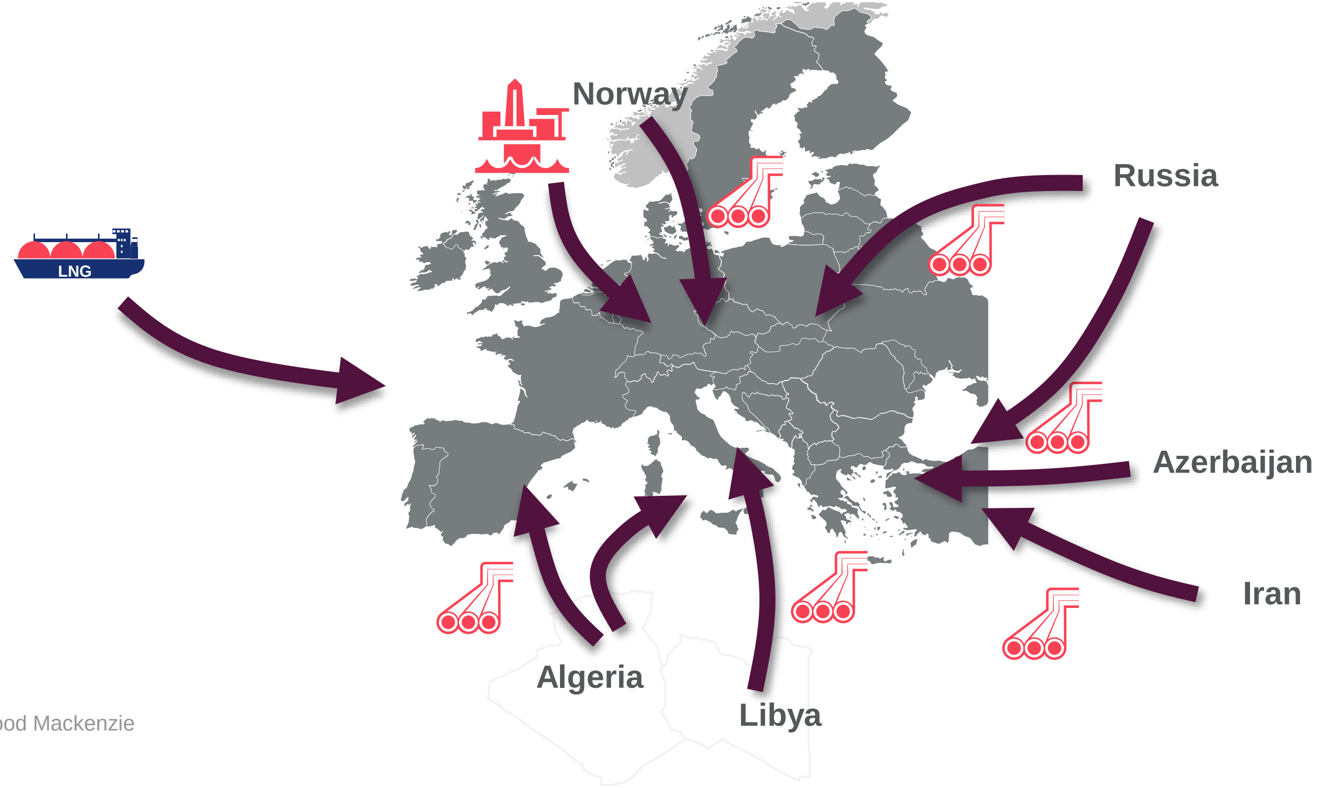
# The European balance in the GGM considers LNG, international piped flows and indigenous production

## The model incorporates piped-flows dynamics from Algeria, Azerbaijan, Iran, Libya, Norway and Russia into Europe as well as all LNG import terminals and internal EU pipelines



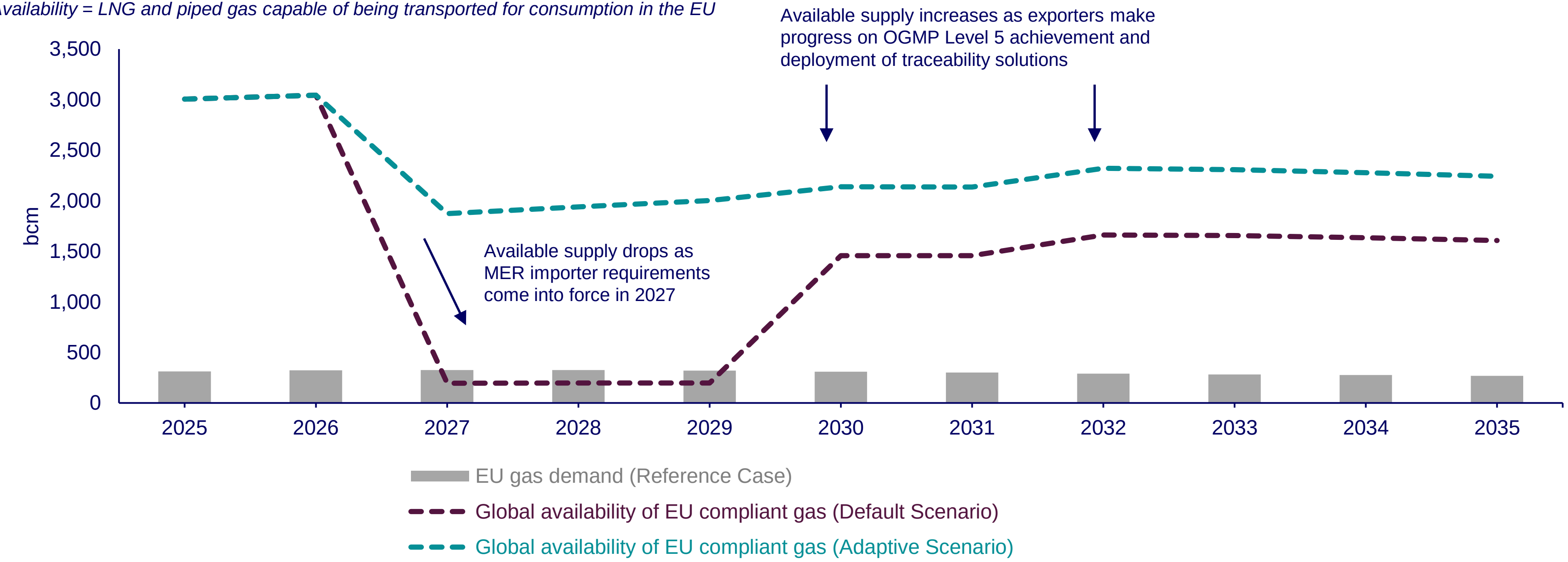

Source: Wood Mackenzie

# In the Default Scenario, insufficient compliant gas is available globally for the EU to maintain its business-as-usual level of demand

## In the Adaptive Scenario, the supply constraint is less acute, but volumes available to the EU are still limited

### Global Gas Availability vs. EU Gas Demand

*Availability = LNG and piped gas capable of being transported for consumption in the EU*

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Source: Wood Mackenzie Gas Service (April 2025 Report) (for Base Case) and Global Gas Model (for alternate scenarios). Note: does not account for pre-Aug 2024 gas contracts.

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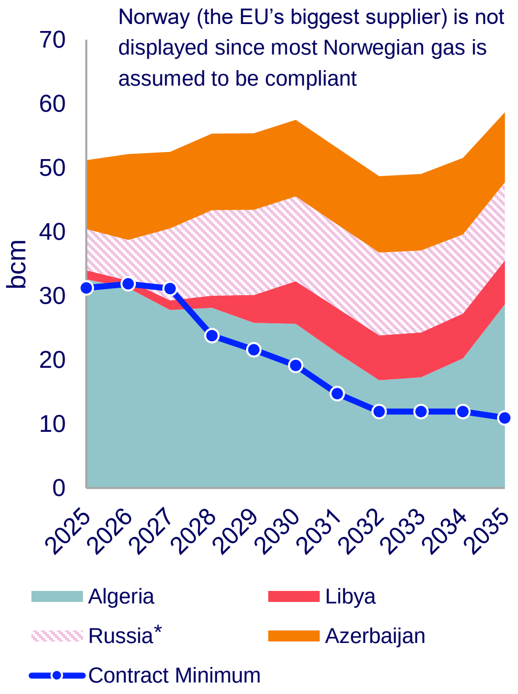
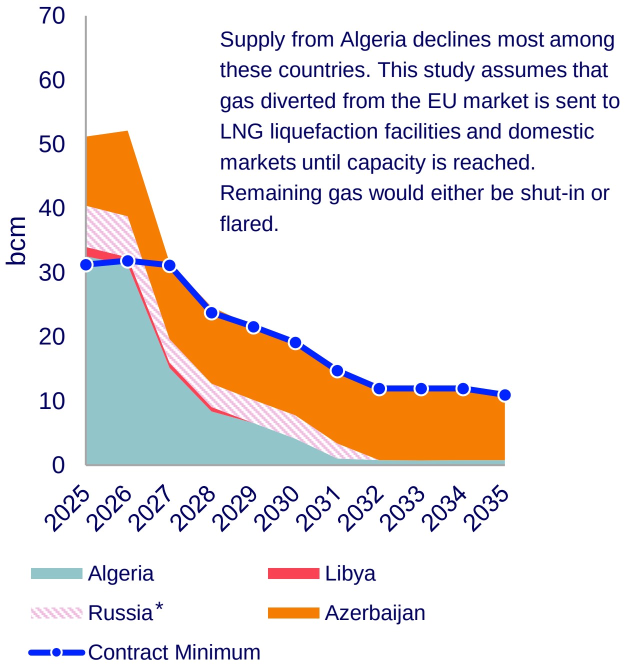
# EU pipe imports from Libya, Azerbaijan and Russia fall to contracted levels in the Default Scenario, falling by up to 45 bcm (or 85%) compared to Base Case

### EU Pipe Imports (Base Case)




### EU Pipe imports (Default Scenario)




### Change in Pipe Imports by Source


Source: Wood Mackenzie Gas Service (April 2025 Report) (for Base Case) and Global Gas Model (for alternate scenarios)

*The study includes Russian natural gas and crude oil in the Base Case. However, sanctions and the agreed regulation (RePowerEU) to phase-out Russian natural gas must be considered. Under the Base Case, all Russian volumes could potentially exit the EU market.

Default Scenario – Gas/LNG

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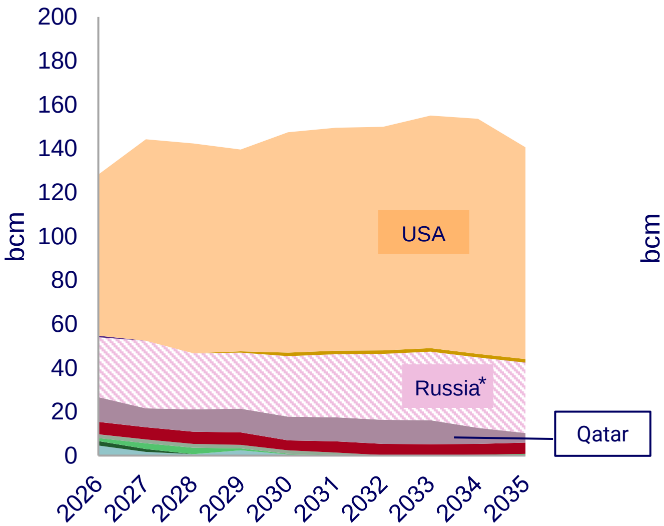
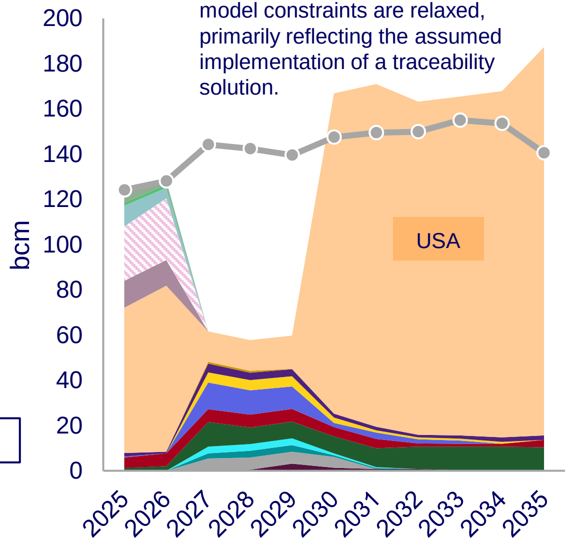
# A lack of available compliant LNG, especially from the USA, leads to a deep supply-demand imbalance. EU increases reliance on Middle East, but supply is not enough

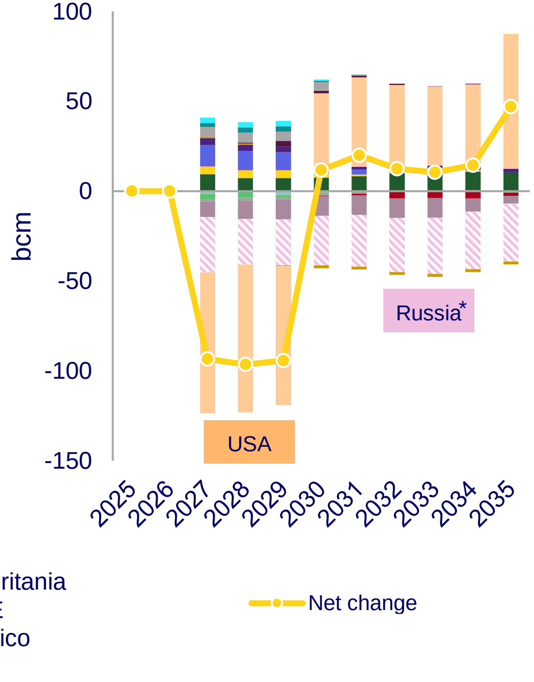
## EU LNG imports by source (Base Case)




## EU LNG imports by source (Default Scenario)




## Change in EU LNG import by Source




Source: Wood Mackenzie Gas Service (April 2025 Report) (for Base Case) and Global Gas Model (for alternate scenarios)

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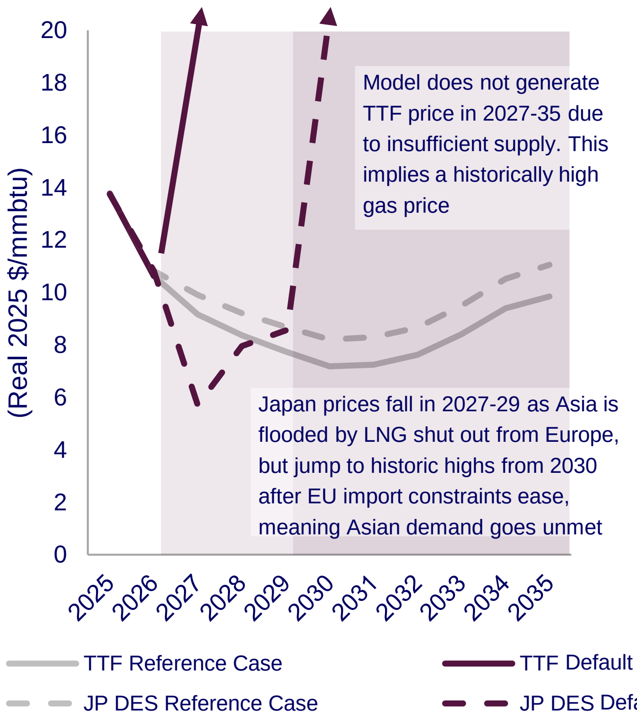
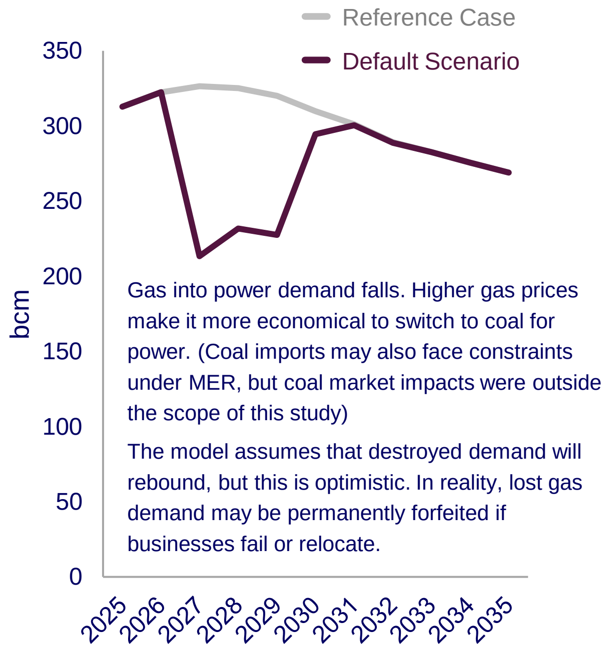
# Gas prices skyrocket to historic highs. Over 110 bcm (35%) of EU demand is destroyed

## Asia benefits in the short term as LNG is diverted from Europe, but after 2030 the global market fails to balance

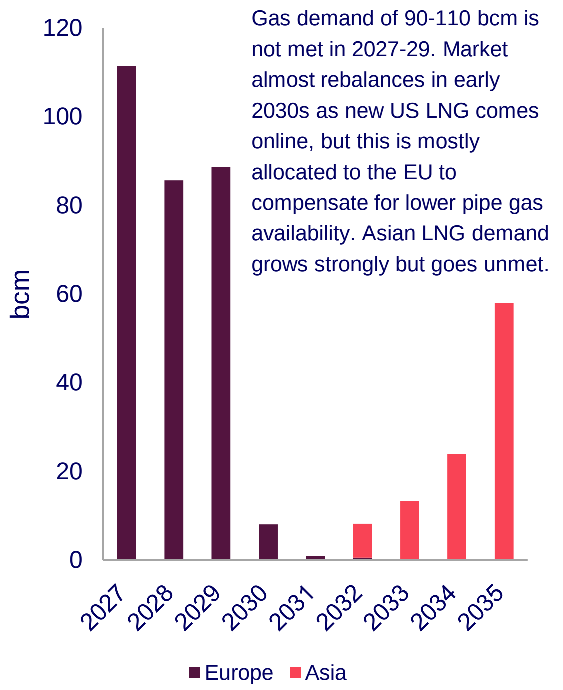
### TTF and Japan DES Benchmark Price




### EU 27 Gas Demand




### Global demand destroyed / not met




Source: Wood Mackenzie Gas Service (April 2025 Report) (for Base Case) and Global Gas Model (for alternate scenarios)

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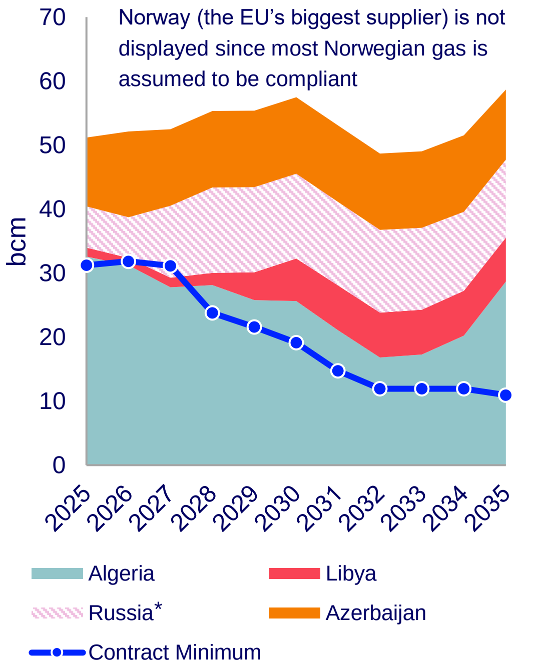
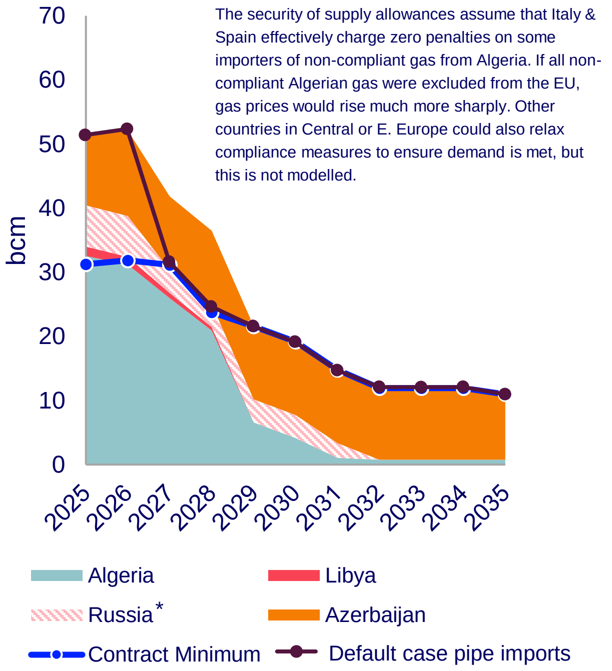
# In the Adaptive Scenario, EU pipe imports fall (as in the Default Scenario), but Italy & Spain make security of supply allowances for some non-compliant Algerian pipe gas

These allowances are necessary for the market to balance (i.e. supply to meet EU demand) in 2027-28

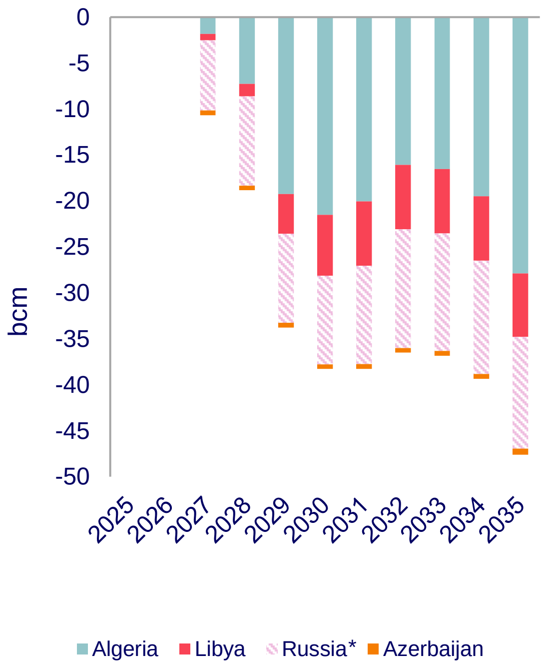
## EU Pipe Imports (Base Case)




## EU Pipe imports (Adaptive Scenario)




## Change in Pipe Imports by Source




Source: Wood Mackenzie Gas Service (April 2025 Report) (for Base Case) and Global Gas Model (for alternate scenarios).

*The study includes Russian natural gas and crude oil in the Base Case. However, sanctions and the agreed regulation (RePowerEU) to phase-out Russian natural gas must be considered. Under the Base Case, all Russian volumes could potentially exit the EU market.

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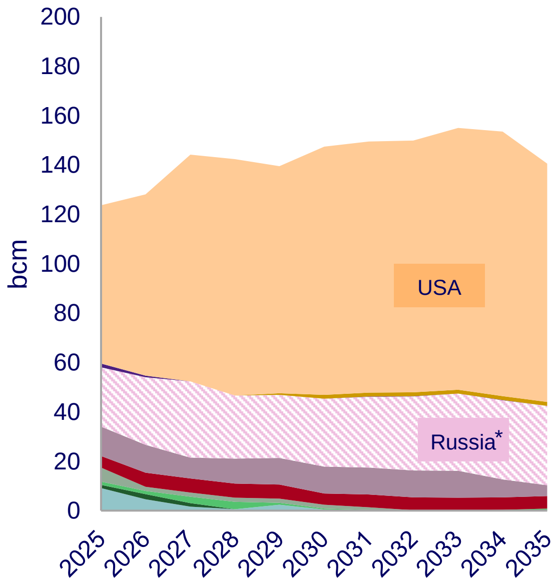
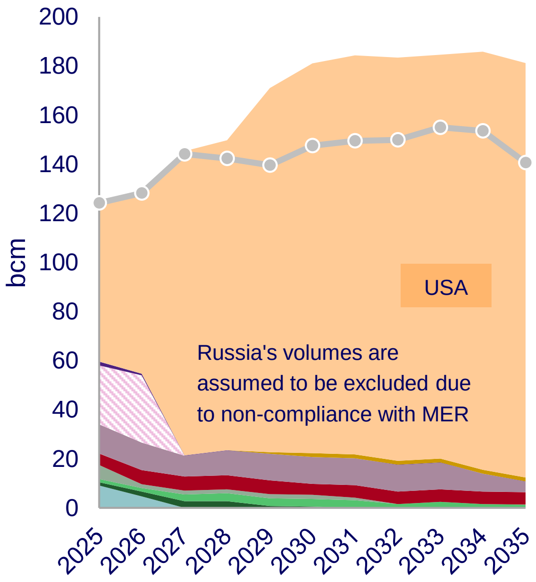
# Critical suppliers of LNG are assumed to be compliant in the Adaptive Scenario. This enables increased imports of US LNG to make up for the fall in pipe gas imports

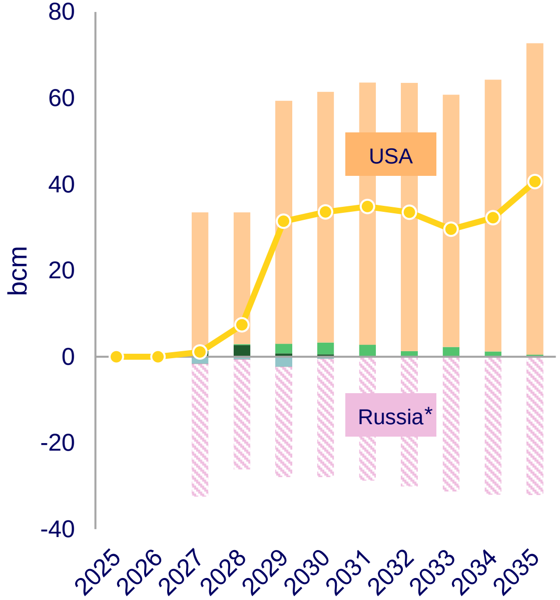
## EU LNG imports by source (Base Case)




## EU LNG imports by source (Adaptive Scenario)




## Change in EU LNG import by Source




Algeria | Mauritania | Mexico | Nigeria | Norway | Qatar | Net change
Russia* | Trinidad | UAE | USA | Reference Case

Source: Wood Mackenzie Gas Service (April 2025 Report) (for Base Case) and Global Gas Model (for alternate scenarios)

*The study includes Russian natural gas and crude oil in the Base Case. However, sanctions and the agreed regulation (RePowerEU) to phase-out Russian natural gas must be considered. Under the Base Case, all Russian volumes could potentially exit the EU market.

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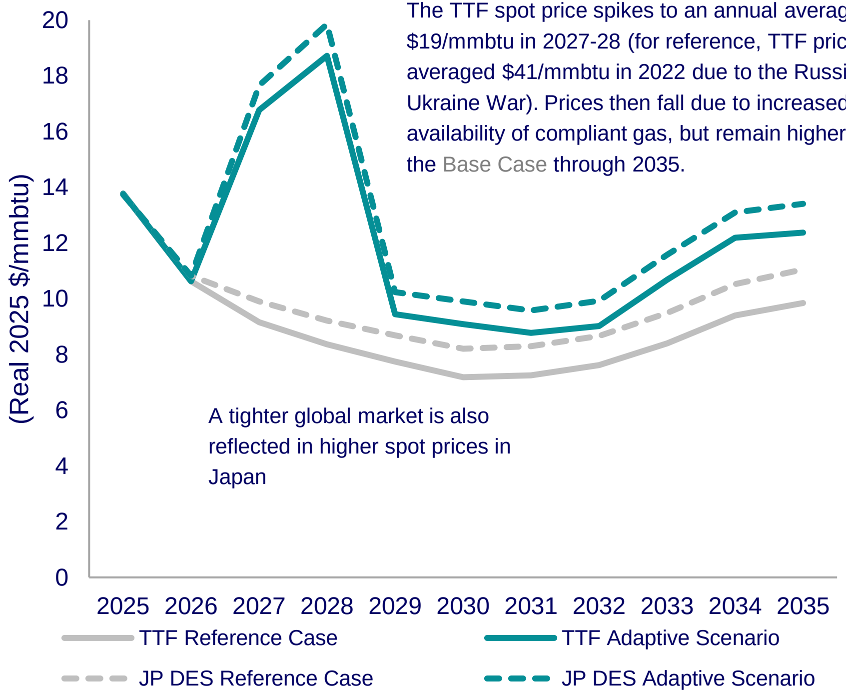
# Smaller spot price impact than Default Scenario, but prices still climb sharply. EU demand falls 10 bcm (3%) due to higher prices, with more expensive sources of gas required to meet demand

## Increased use of coal into power in Europe in the Adaptive Scenario

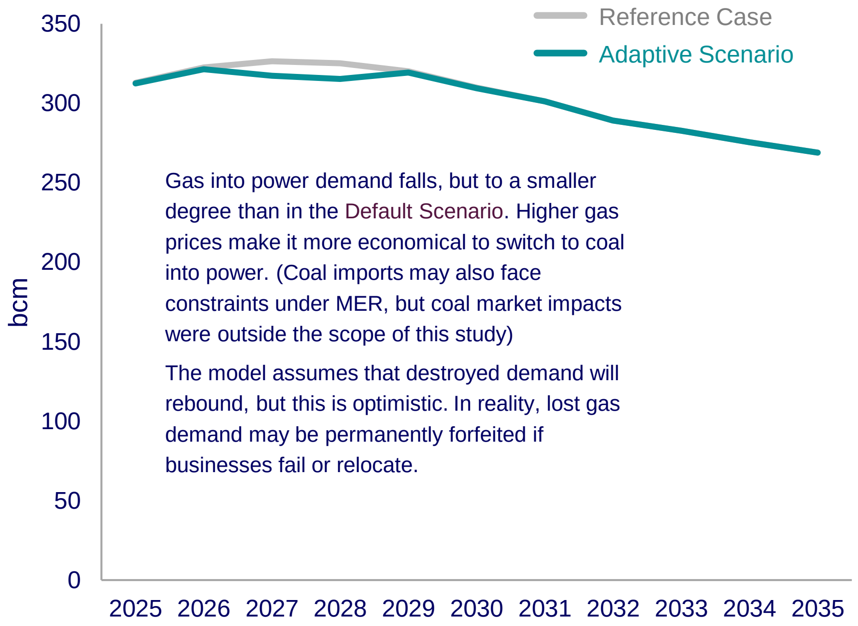
### TTF and Japan DES Benchmark Price




The TTF spot price spikes to an annual average of $19/mmbtu in 2027-28 (for reference, TTF prices averaged $41/mmbtu in 2022 due to the Russia-Ukraine War). Prices then fall due to increased availability of compliant gas, but remain higher than the Base Case through 2035.

A tighter global market is also reflected in higher spot prices in Japan

### EU 27 Demand




Gas into power demand falls, but to a smaller degree than in the Default Scenario. Higher gas prices make it more economical to switch to coal into power. (Coal imports may also face constraints under MER, but coal market impacts were outside the scope of this study)

The model assumes that destroyed demand will rebound, but this is optimistic. In reality, lost gas demand may be permanently forfeited if businesses fail or relocate.

Source: Wood Mackenzie Gas Service (April 2025 Report) (for Base Case) and Global Gas Model (for alternate scenarios)

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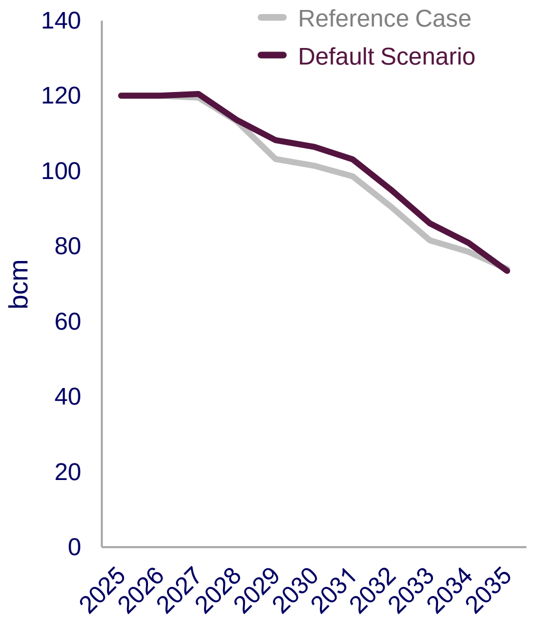
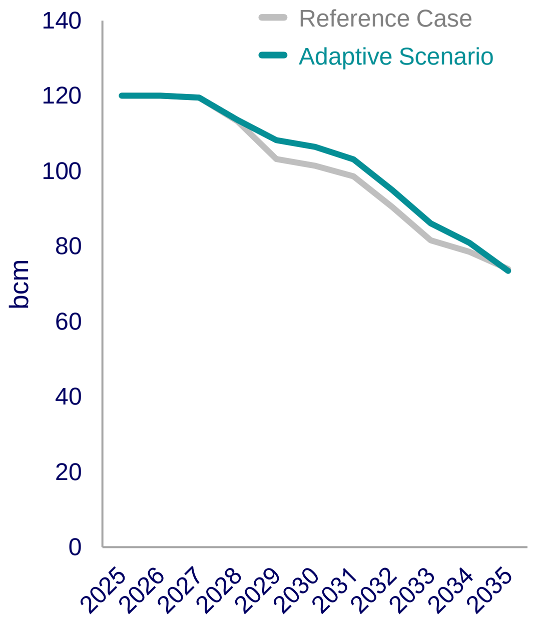
# In both scenarios, Norway uses additional, flexible, and potentially costlier production to meet EU demand. However, Norway's ability to act as a swing producer is limited

## Norway gas exports to EU




## Norway gas exports to EU




- Norway's gas production is somewhat flexible, allowing it to modestly increase short-term gas supply through optimization rather than new development. This flexibility relies on swing capacity at key fields, integrated pipeline rerouting, and operational headroom at processing plants. Operators can also employ reservoir management strategies, such as temporarily prioritizing gas over liquids production.
- However, this incremental supply comes at a higher marginal cost because it utilizes fields with higher compression needs or less optimal conditions, thereby requiring higher prices to justify the short-term output.
- **Norway's increased gas exports to the EU are the same in both alternative scenarios, reflecting the maximum spare capacity available and the maximum allowable exports to the EU based on Norway's MER-compliant share of production.**

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Source: Wood Mackenzie Gas Service (April 2025 Report) (for Base Case) and Global Gas Model (for alternate scenarios)

# MER Impact Assessment and Scenario Modelling

*Base Case – Crude Oil*

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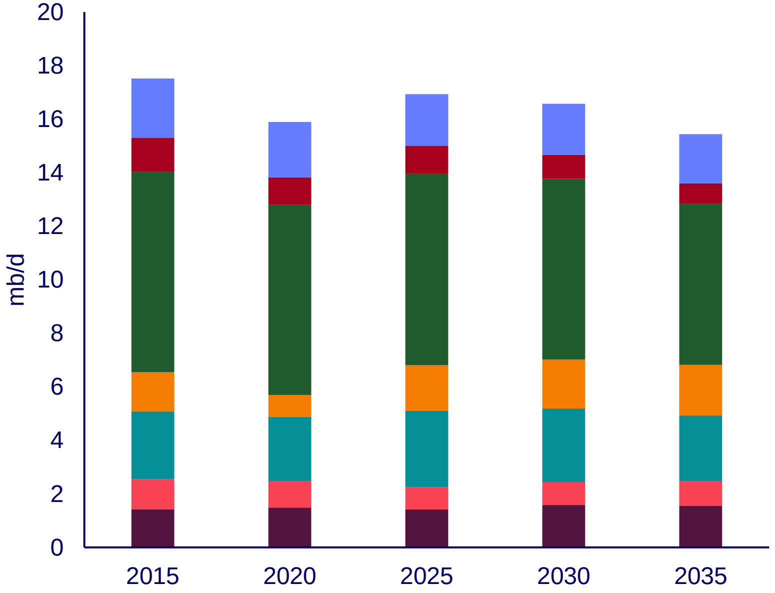
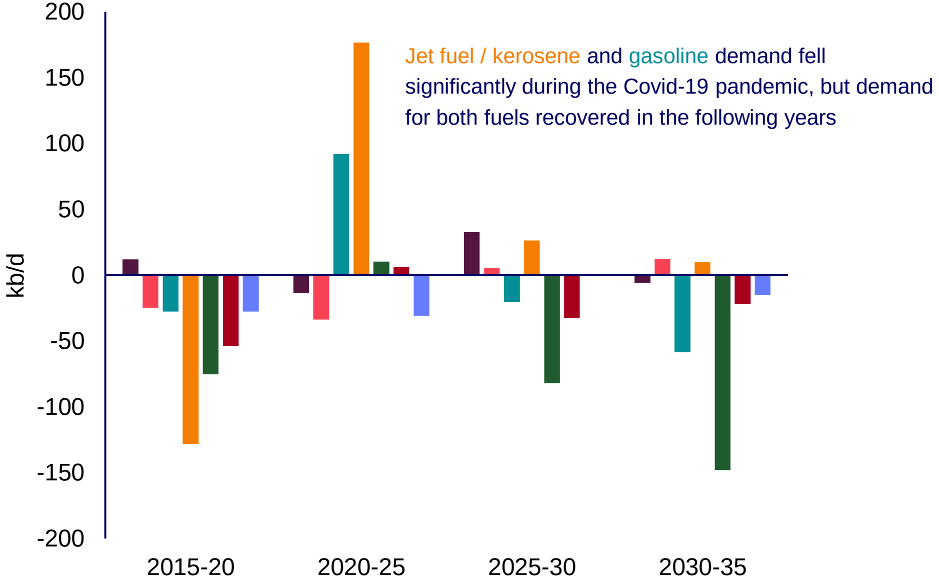
# Oil product demand in Greater Europe falls by 1.4 million b/d by 2035, to just over 15 million b/d, driven by increasing electrification of the vehicle fleet

## Gasoline and diesel/gasoil sales lead the decline; petrochemical feedstocks and jet are the main areas of growth

### Oil product demand* in Greater Europe, 2015-2035




### Average annual change in oil product* demand, 2015-2035




LPG · Naphtha · Gasoline · Jet kero · Dieselgasoil · Fuel oil · Other

Source: Wood Mackenzie Macro Oils (April 2025) *includes biofuels. Greater Europe includes Mainland Europe + UK, North Africa, and Turkey

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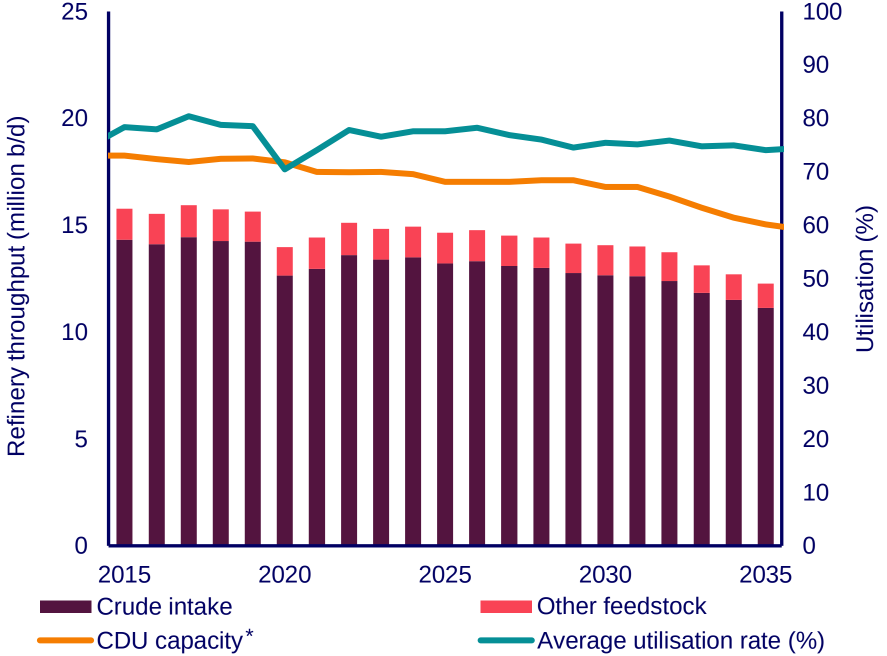
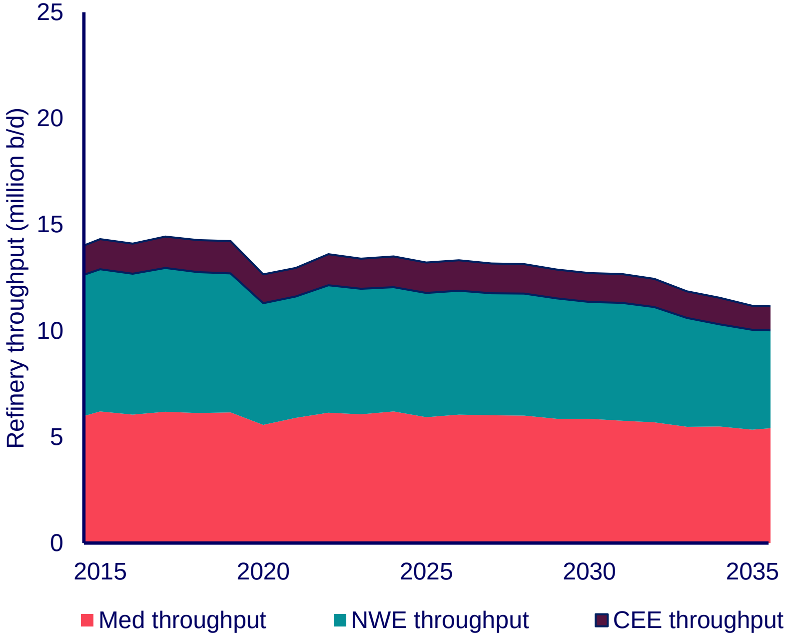
# By 2035 refinery rationalisation decreases Europe's crude processing capacity by 12%

North-West Europe's crude runs see the most prominent decline, whilst more resilient demand in the Mediterranean keeps refinery throughput relatively sustained

## Greater Europe refinery input and utilisation forecast




## Greater Europe throughput forecast




History: IEA Energy Statistics, National Statistics Forecast: Wood Mackenzie. Greater Europe includes Mainland Europe + UK, North Africa, and Turkey
*CDU = crude distillation unit

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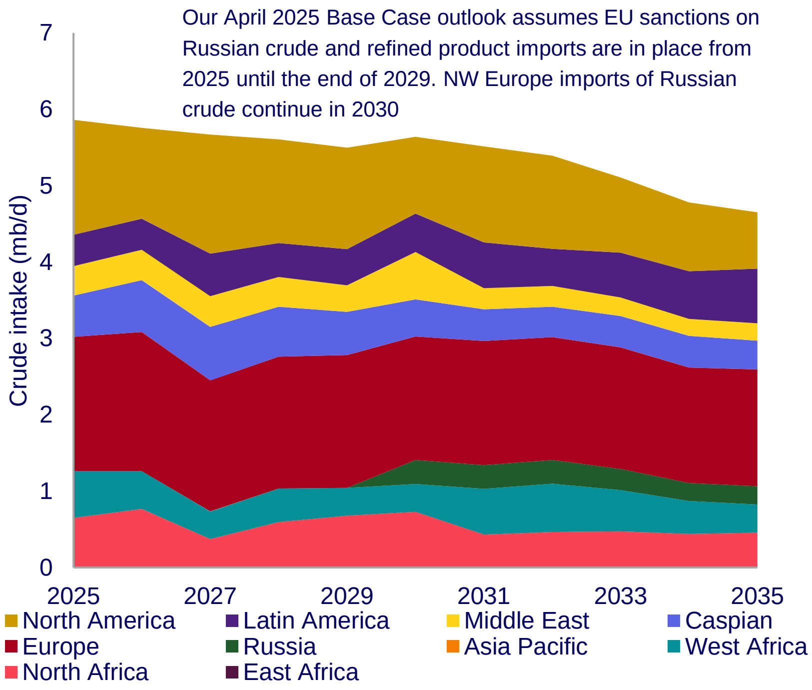
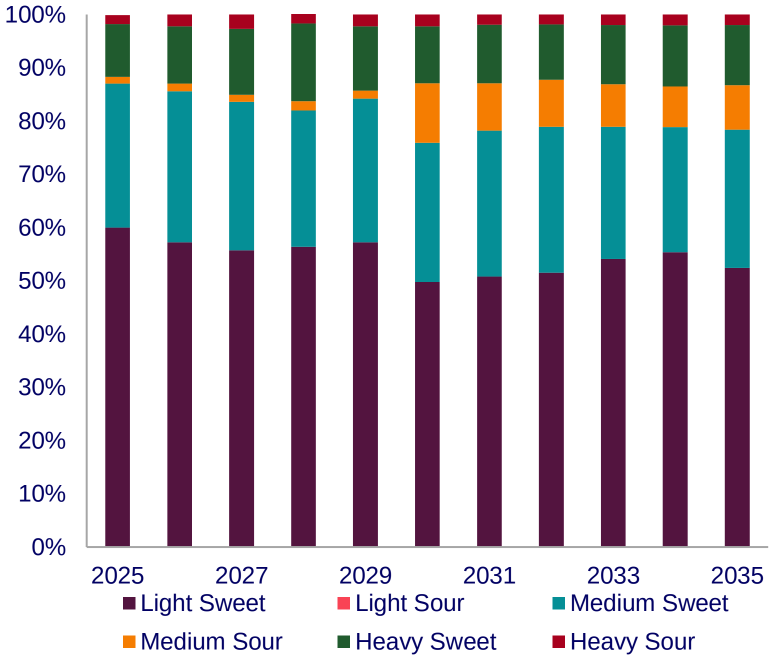
# North-West Europe replaces sanctioned Russian crude with lighter, sweeter alternatives from North America, Europe and West Africa

## The region's crude slate sweetens significantly in the absence of medium-sour Urals

### North-West Europe crude slate by origin




### North-West Europe crude slate by quality




Source: Wood Mackenzie Macro Oils (April 2025)

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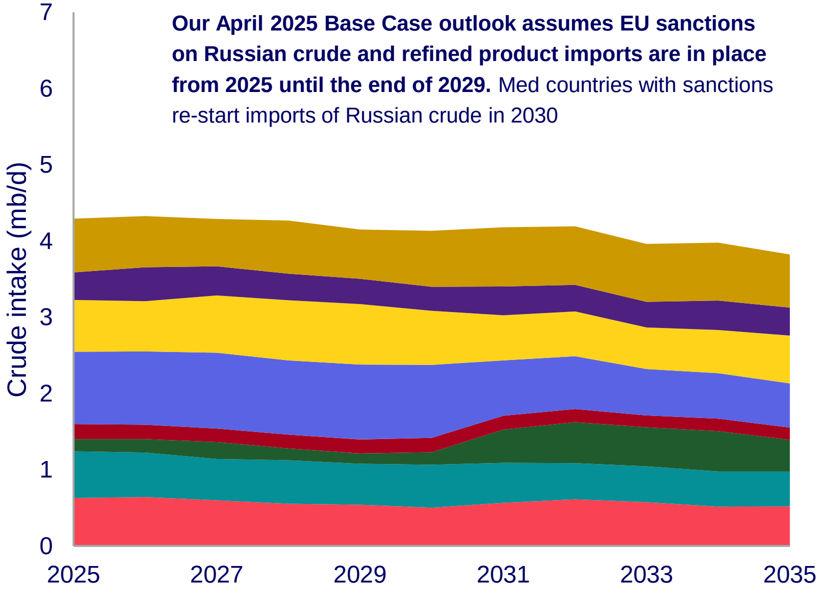
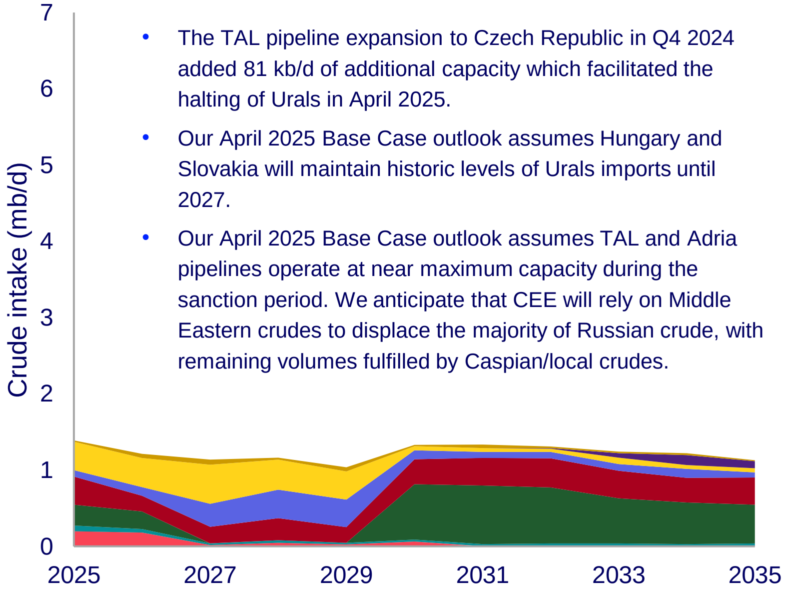
# In Euro Mediterranean, Turkish assets continue to import Russian grades while sanctioning countries seek Caspian, African and Atlantic Basin alternatives

## Caspian crude become the key alternative for CEE refiners as they phase out Russian crude imports in 2027

### Euro Med crude slate by origin




### Central & Eastern Europe (CEE) crude slate by origin




North America | Latin America | Middle East | Caspian | Europe | Russia | Asia Pacific | West Africa | North Africa | East Africa

Source: Wood Mackenzie Macro Oils (April 2025)

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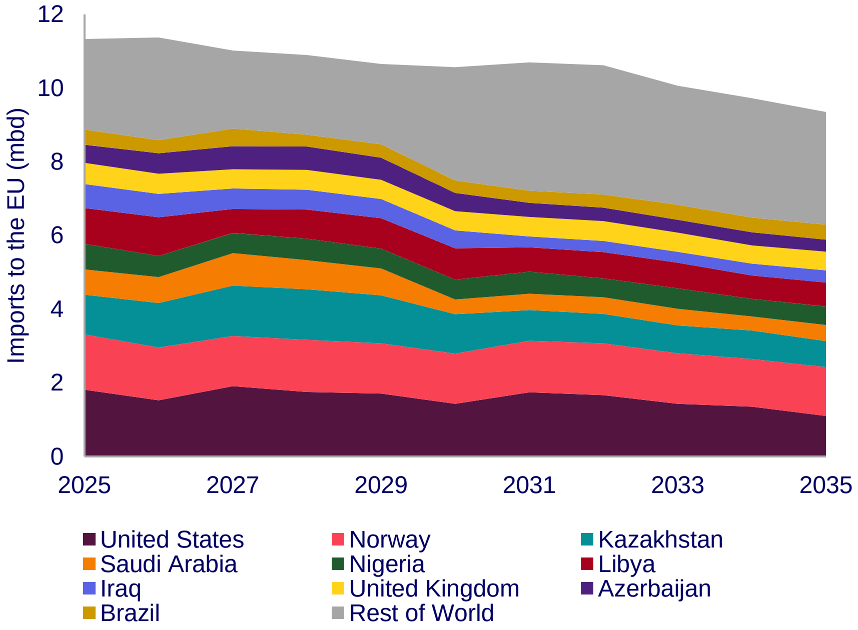
# The EU imports most of its crude, with the US, Norway, Kazakhstan the largest sources

## Domestic output in Denmark and the Netherlands is expected to shrink as production slows in mature fields

### EU crude oil imports, 2025-2035




- Decreases in overall demand for refined oil products drives refinery rationalisations from the early 2030s.
- Demand decreases most in Northwest Europe, where domestic decarbonisation policies are most aggressive.
- An increase in Poland's capacity to produce propylene via Propane Dehydrogenation (PDH) and ethylene using ethylene crackers is leading to a greater need for light distillates (specifically naphtha and potentially ethane/propane) as the primary raw materials (feedstocks) for these processes.
- As a result, demand for lighter, sweeter crudes from North America, Europe and Africa increase.
- Sanctions on Russia are assumed to be lifted in 2030. While sanctions remain, refineries seek alternatives for medium-sour Ural crudes. Most of this demand is met by Caspian, North American and North and West African volumes.
- Imports from Guyana, Colombia, Angola and the United Arab Emirates are expected to increase significantly within the “Rest of World” category as each country increases its crude output.

Source: Wood Mackenzie Macro Oils (April 2025)

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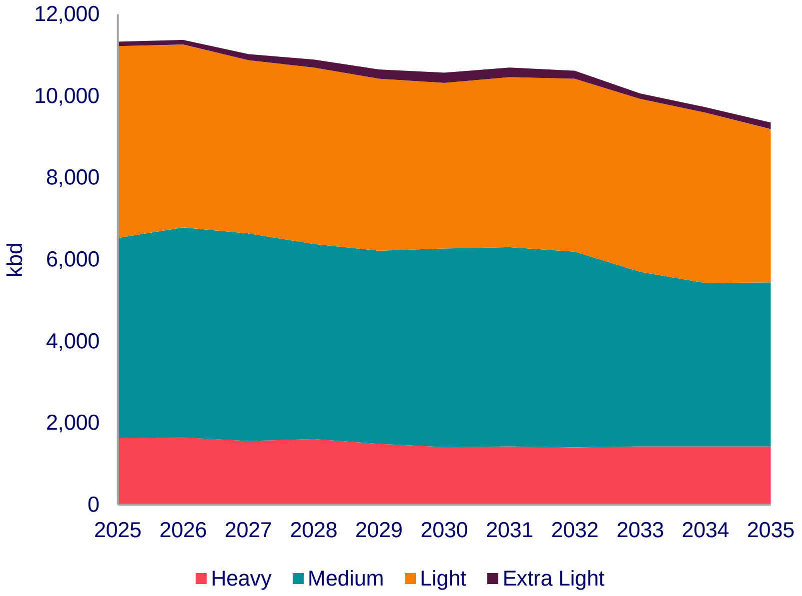
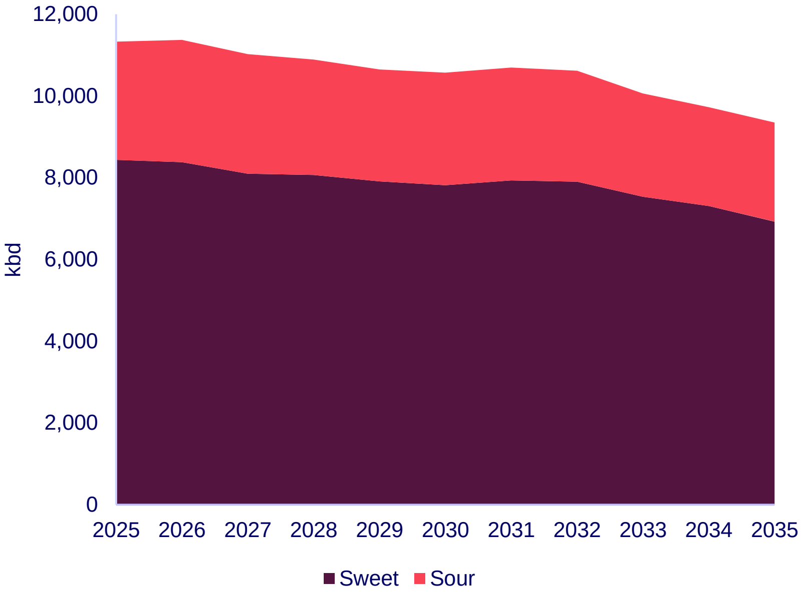
# Light/medium and sweet crudes remain the predominant feedstocks processed by EU refineries, which lack the capacity to handle heavier and high sulphur crude grades

## EU crude oil imports by API gravity




## EU crude oil imports by sulfur content




Source: Wood Mackenzie Macro Oils (April 2025)

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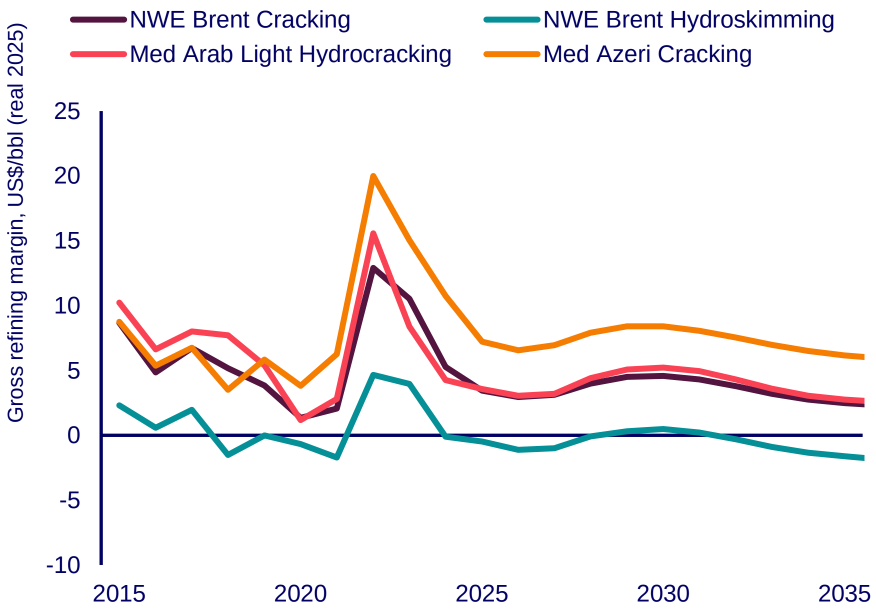
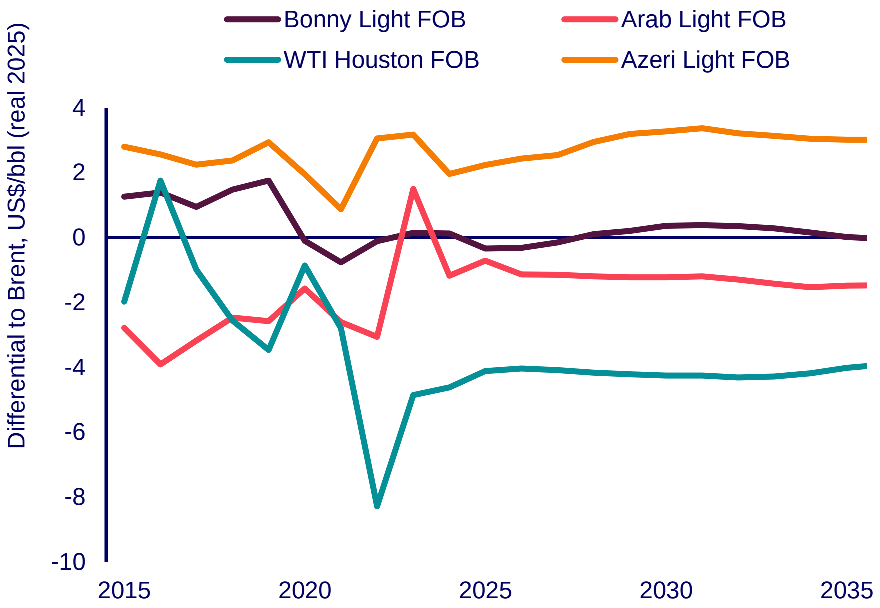
# Refining margins recover in the late 2020s as the global products market tightens. Margins decline with falling demand from 2030

Light-heavy differentials widens in the 2040s as the global crude slate gets heavier

## Reference gross refining margin forecast




## Crude differential forecast




Source: Wood Mackenzie Macro Oils (April 2025)

# MER Impact Assessment and Scenario Modelling

*Alternative Scenario Results – Crude Oil*

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# Summary of modelled scenario results: crude oil

## **Default Scenario**: assumes implementation of the Methane Regulation as it is

- **Crude Supply and Refinery Throughput Impact:**
  - Global availability of EU-compliant crudes could be severely limited in 2027–29
  - In 2027, available supply could decline by around 9.8 million b/d, equivalent to 87% of total EU imports in 2024.
  - EU refineries' inability to secure sufficient feedstock could force a sharp decline in refinery throughput of approximately 4.6 million b/d (50%) versus the Base Case when constraints are tightest in the late 2020s, and 40 EU refineries could be forced to suspend operations with a collective capacity of 5 million b/d.
  - Some EU refiners in certain Member States could be hit harder due to the mismatch between available crude qualities and refinery configurations.
- **Crude Price Impact:**
  - EU refiners could be forced to bid aggressively for the very small pool of compliant crude available globally. This drives the price of the weighted-average EU refinery crude basket about $9/bbl (11%) higher versus the Base Case in the late 2020s, eroding EU refiners' competitiveness relative to other regions.
- **Product Market Impact:**
  - The large reduction in EU refinery supply could cause refined product prices and crack spreads to rise sharply across global hubs. Higher crack spreads could incentivize foreign refiners (including facilities in the Americas, Asia, and the Middle East, as well as less complex assets elsewhere) to run at higher utilization rates and export more products to the EU to fill the supply gap.
  - European gasoline and diesel prices could be around 24% and 16% higher, respectively, than in the Base Case in 2027. Since oil markets are globally interconnected, fuel prices are higher globally.
  - Significantly higher EU imports of high-priced refined products ultimately benefit export-oriented refiners in other regions at the expense of both EU consumers and the EU refining industry. Because MER importer requirements apply only to upstream products (crude oil) and not refined products, the EU's increasing reliance on imported fuels could become a major source of economic and carbon leakage.

Since the market impacts are most severe when compliance is lowest in the first 3 years of Article 28 being in force, **a delay of Article 28 requirements by 3-4 years may help avoid the most disruptive outcomes**. However in both scenarios, a disruption is still to be expected after the delay, as the disruptions persist throughout the entire modelling period.

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# Summary of modelled scenario results: crude oil

## **Adaptive scenario**: modifications are introduced to MER, allowing greater flexibility in granting country-level MRV equivalence

- **Crude Supply and Refinery Throughput Impact:**
  - In 2027, available supply could decline by around 4.3 million b/d, equivalent to 38% of total EU imports in 2024.
  - Global availability of EU-compliant crudes could remain limited, but to a far lesser degree than in the Default Scenario.
  - EU refinery throughput could decline by approximately 150,000 b/d (2%) versus the Base Case by the early 2030s—equivalent to the closure of one medium-sized refinery.
- **Crude Price Impact:**
  - The average EU refinery crude cost could increase by about $3/bbl (4%) versus the Base Case in the late 2020s due to the reduced pool of compliant crude supplies, which forces EU refiners to bid volumes away from other buyers.
  - This could erode EU refiners' competitiveness relative to other regions, but much less than in the Default Scenario.
- **Product Market Impact:**
  - The moderate decline in EU throughput could result in a small but noticeable increase in EU refined product imports. The crude slate shifts modestly, with runs of non-compliant crudes (e.g., North African light-sweet) declining and compliant crudes (e.g., Permian light-sweet from the USA) increasing.
  - European gasoline and diesel prices could be around 0.5% higher than in the Base Case over the forecast period.
  - EU oil product imports could increase moderately to compensate for lost EU refinery supply. The same economic and carbon leakage dynamics are visible as in the Default Scenario, but to a much lesser extent.

Since the market impacts are most severe when compliance is lowest in the first 3 years of Article 28 being in force, **a delay of Article 28 requirements by 3-4 years may help avoid the most disruptive outcomes**. However in both scenarios, a disruption is still to be expected after the delay, as the disruptions persist throughout the entire modelling period.

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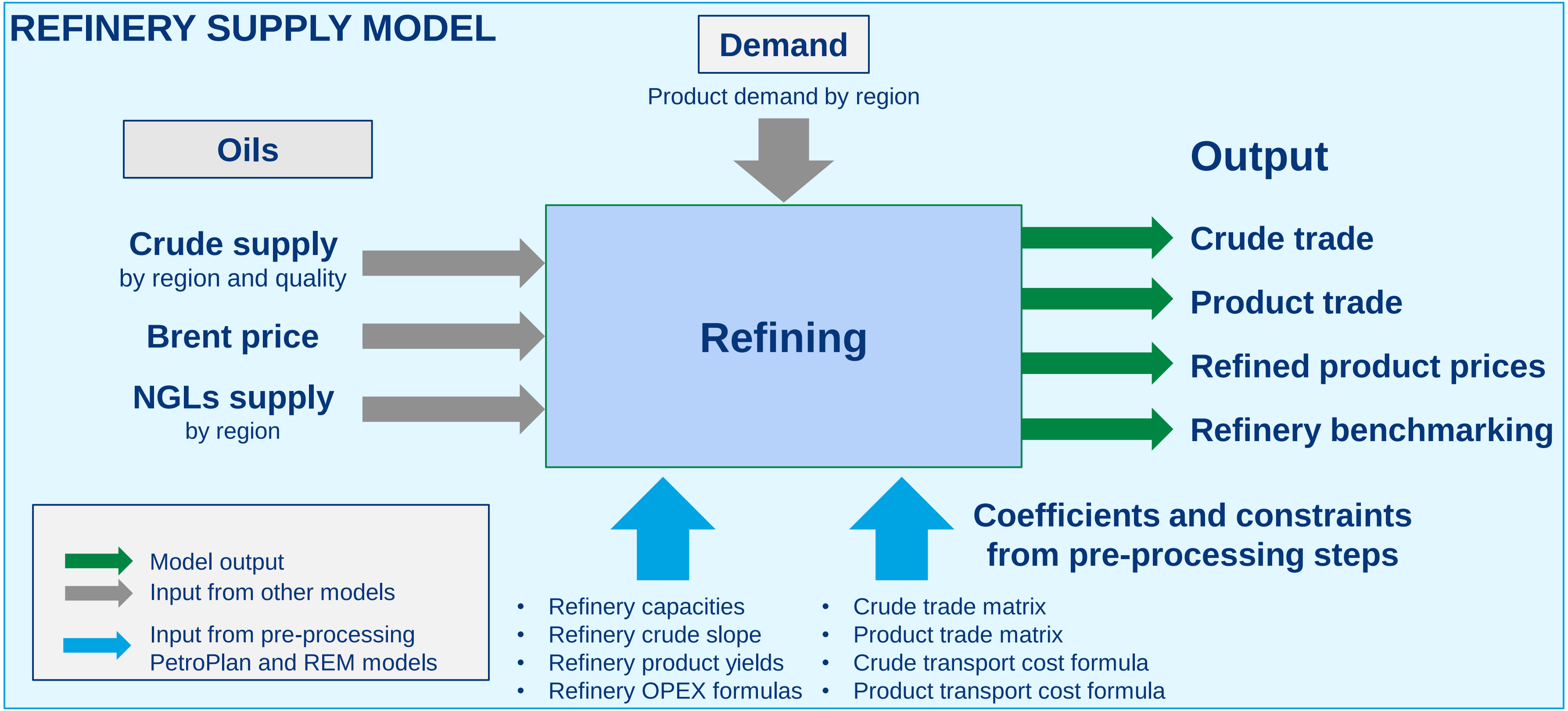
# The Refinery Supply Model (RSM) is a least cost optimiser solving for the most efficient possible way to meet global oil product demand



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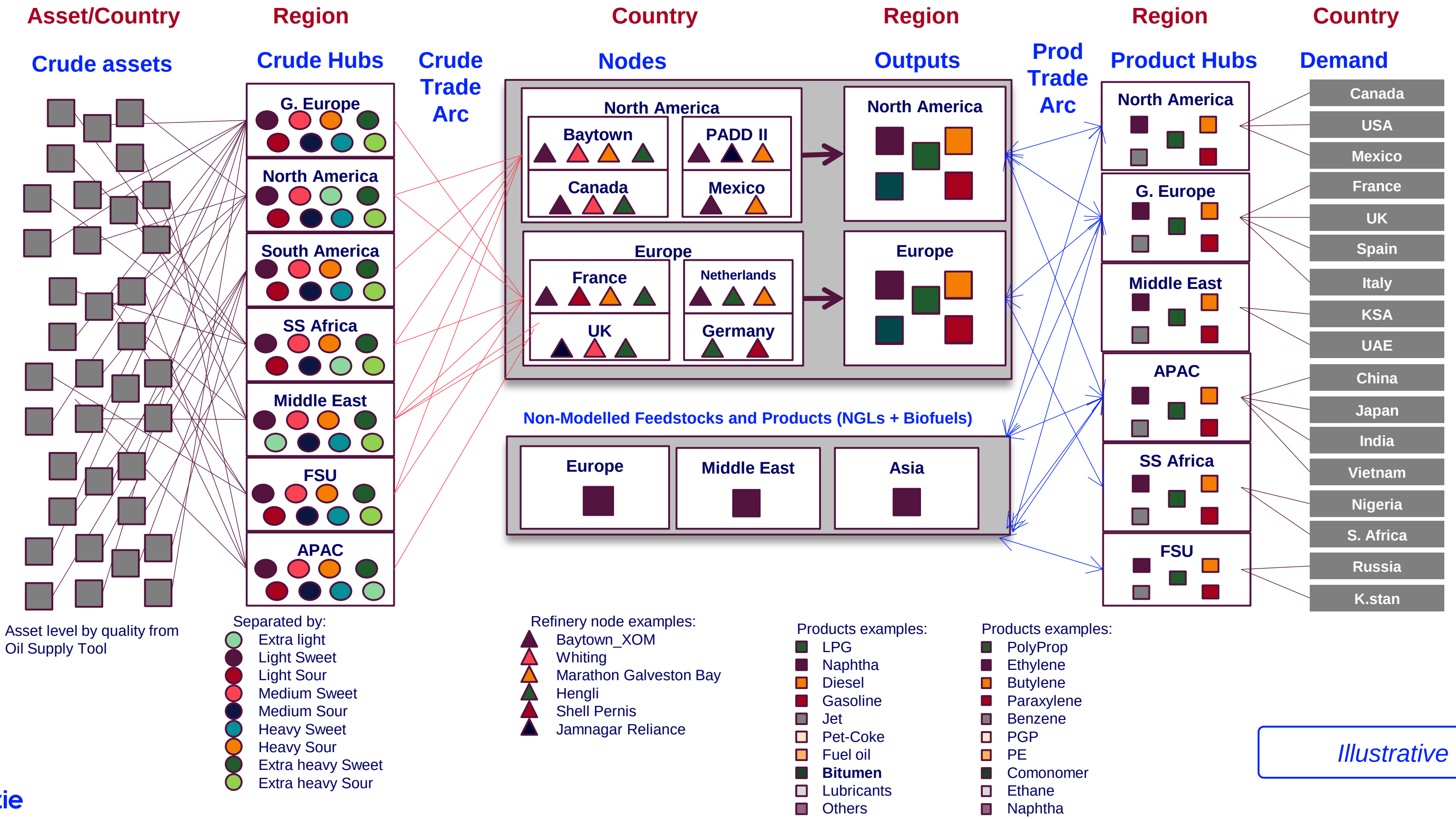
# RSM optimises refinery asset outputs to meet global refined product demand

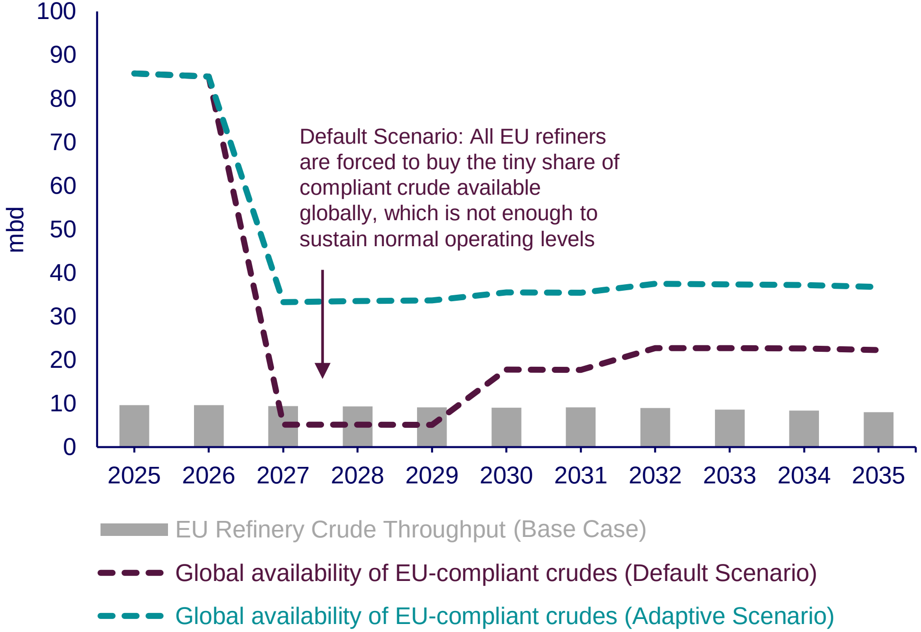



*Illustrative*

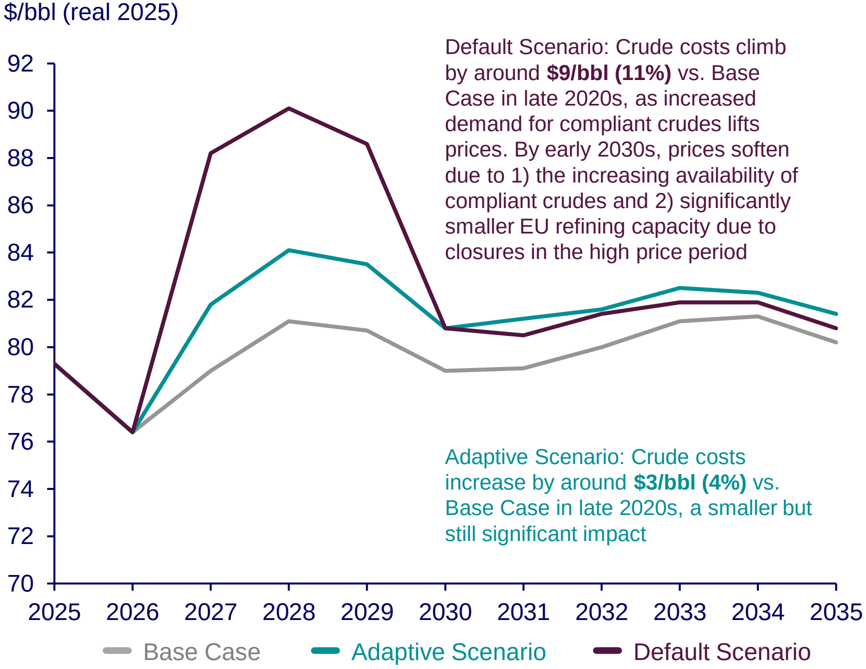
# A lack of crude availability forces EU refiners to bid compliant crudes away from other refiners, driving higher prices for compliant crudes and eroding EU competitiveness

*In the Default Scenario, insufficient compliant crude is available globally for EU refiners to maintain throughput*

## Global Crude Availability vs. EU Refinery Throughput




## EU Refinery Crude Price, volume-weighted average




Source: Wood Mackenzie Refinery Supply Model

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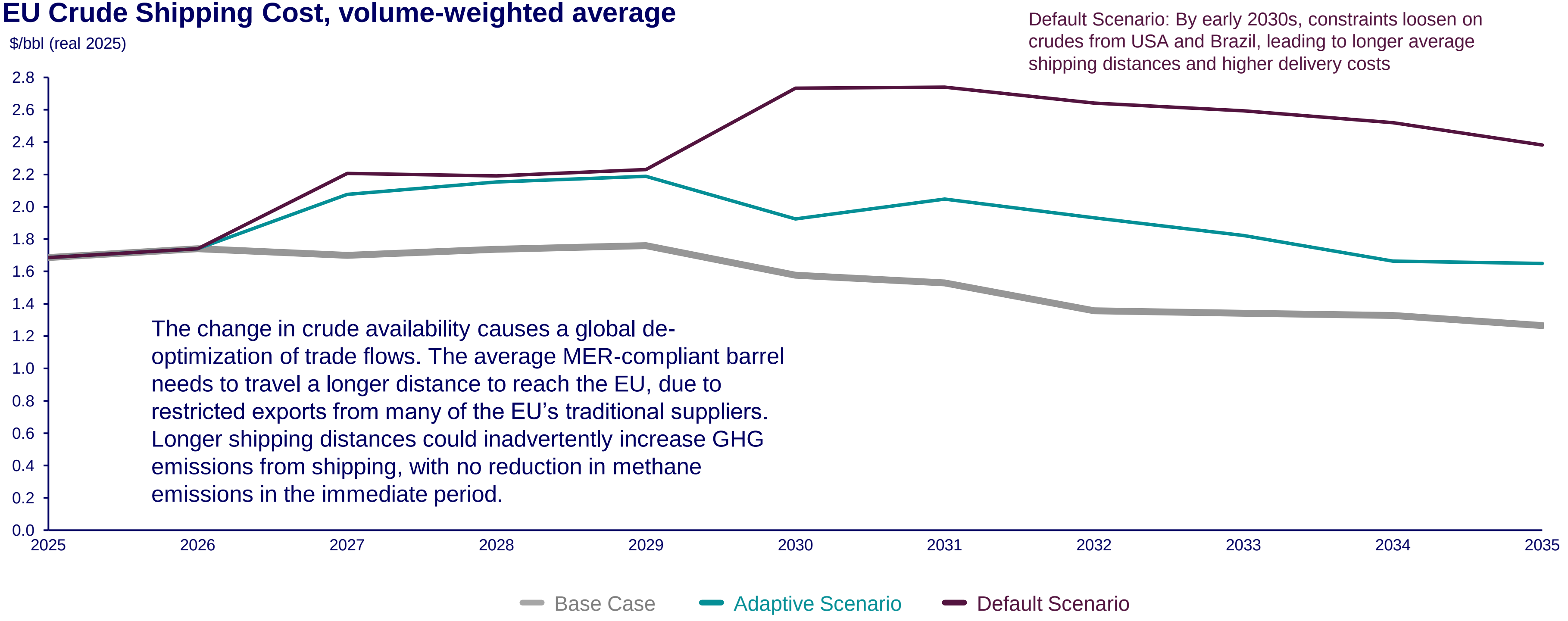
Adaptive Scenario – Crude Oil | Default Scenario – Crude Oil

# Limited availability of compliant crudes forces EU refiners to compete for a narrower set of compliant barrels. Crude delivery costs also rise, reflecting longer shipping distances for compliant sources of crude

## EU Crude Shipping Cost, volume-weighted average




Source: Wood Mackenzie Refinery Supply Model

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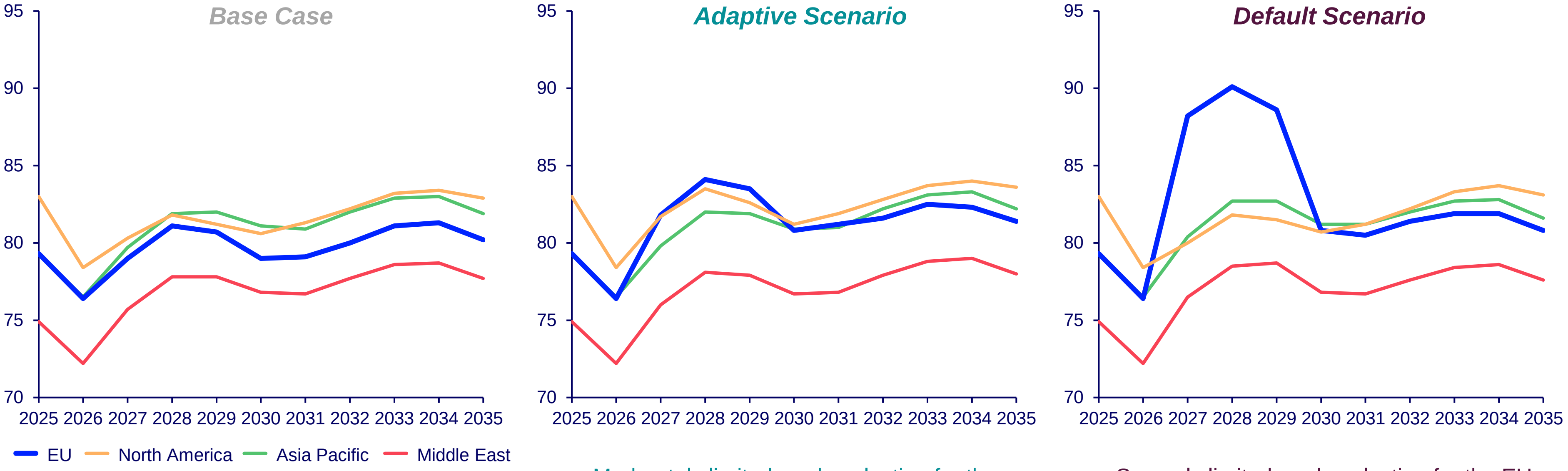
Default Scenario – Crude Oil | Adaptive Scenario – Crude Oil

# Lower availability of compliant crude in the EU increases the price it pays for crude relative to other regions, adding to the competitive disadvantage for EU refiners

**Regional weighted average refinery crude prices (absolute, $/bbl real 2025)**




*North America increases product exports to the EU most in the alternative scenarios. Asia Pacific and Middle East also increase exports*

Moderately limited crude selection for the EU and trade flow changes translate to the EU refinery crude price rising moderately relative to other regions

Severely limited crude selection for the EU leads to a **much sharper crude price increase** relative to other regions, particularly in 2027-29 when availability of compliant crude is lowest

Source: Wood Mackenzie Refinery Supply Model

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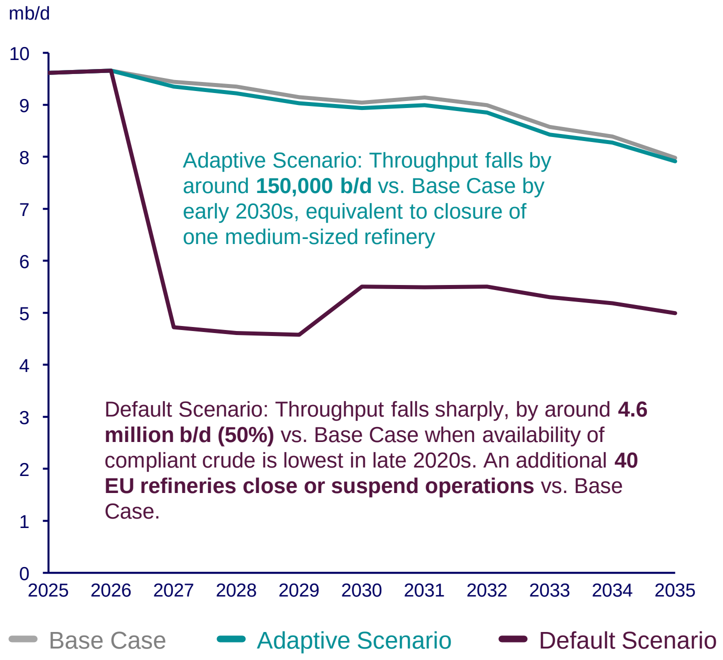
Default Scenario – Crude Oil | Adaptive Scenario – Crude Oil

Wood Mackenzie

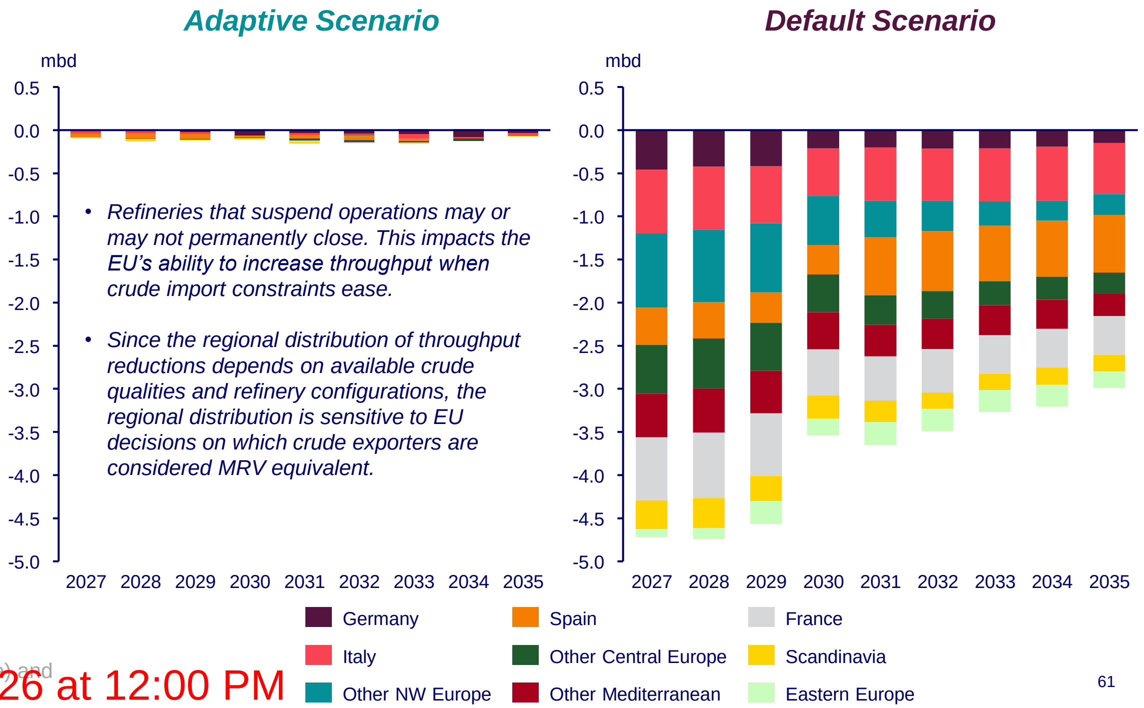
# Lack of crude and higher crude prices force reductions in refinery throughput in the EU. Competitively weak sites are unable to secure sufficient feedstock to operate

*Some EU refiners are hit harder, due to a mismatch of available crude qualities and refinery configurations*

## EU Refinery Crude Oil Throughput




## Change in EU Refinery Throughput vs. Base Case




Source: Wood Mackenzie Product Markets Service (April 2025)(for Base Case) and Refinery Supply Model (for alternate scenarios)

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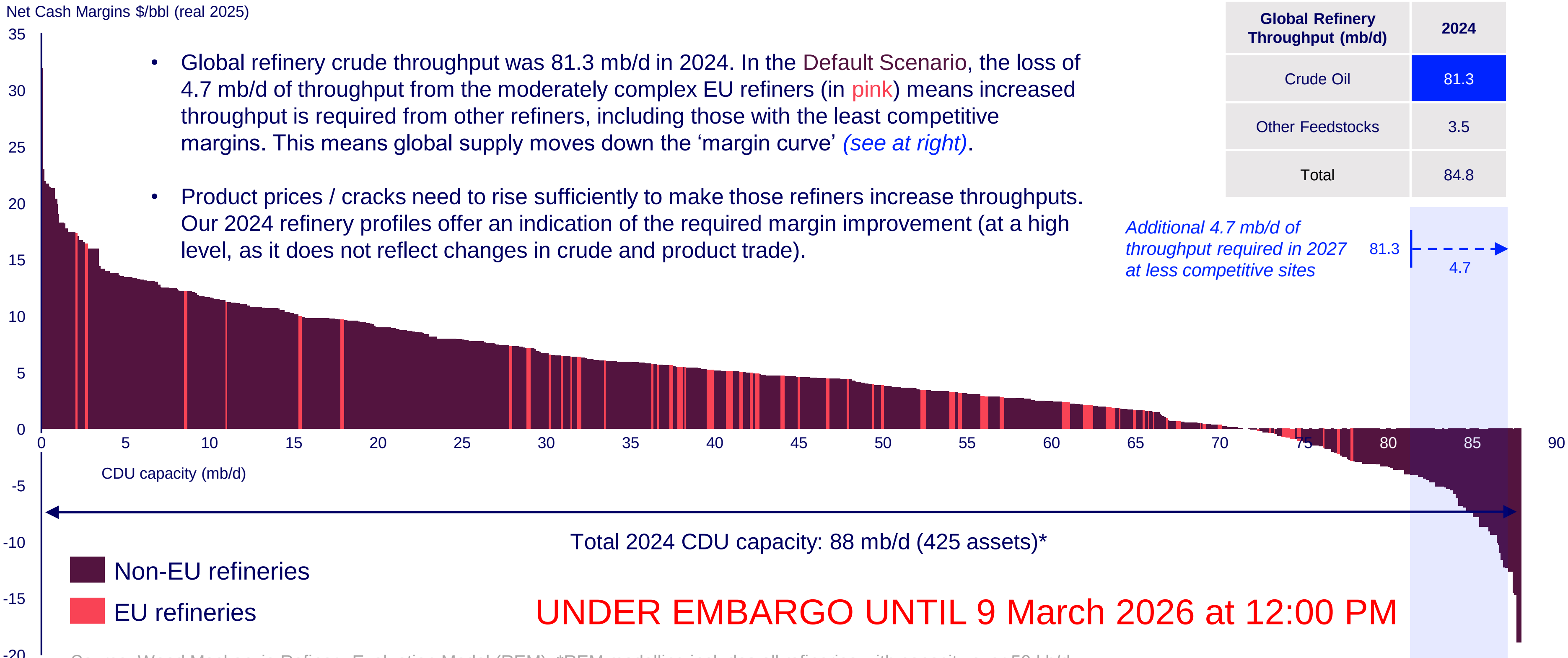
Wood Mackenzie

# Loss of EU throughput requires higher throughputs in other locations, requiring higher product cracks and refining margins

## 2024 Refinery Net Cash Margins vs. Capacity (Global)

- Global refinery crude throughput was 81.3 mb/d in 2024. In the Default Scenario, the loss of 4.7 mb/d of throughput from the moderately complex EU refiners (in pink) means increased throughput is required from other refiners, including those with the least competitive margins. This means global supply moves down the 'margin curve' *(see at right)*.
- Product prices / cracks need to rise sufficiently to make those refiners increase throughputs. Our 2024 refinery profiles offer an indication of the required margin improvement (at a high level, as it does not reflect changes in crude and product trade).

| Global Refinery Throughput (mb/d) | 2024 |
|---|---|
| Crude Oil | 81.3 |
| Other Feedstocks | 3.5 |
| Total | 84.8 |

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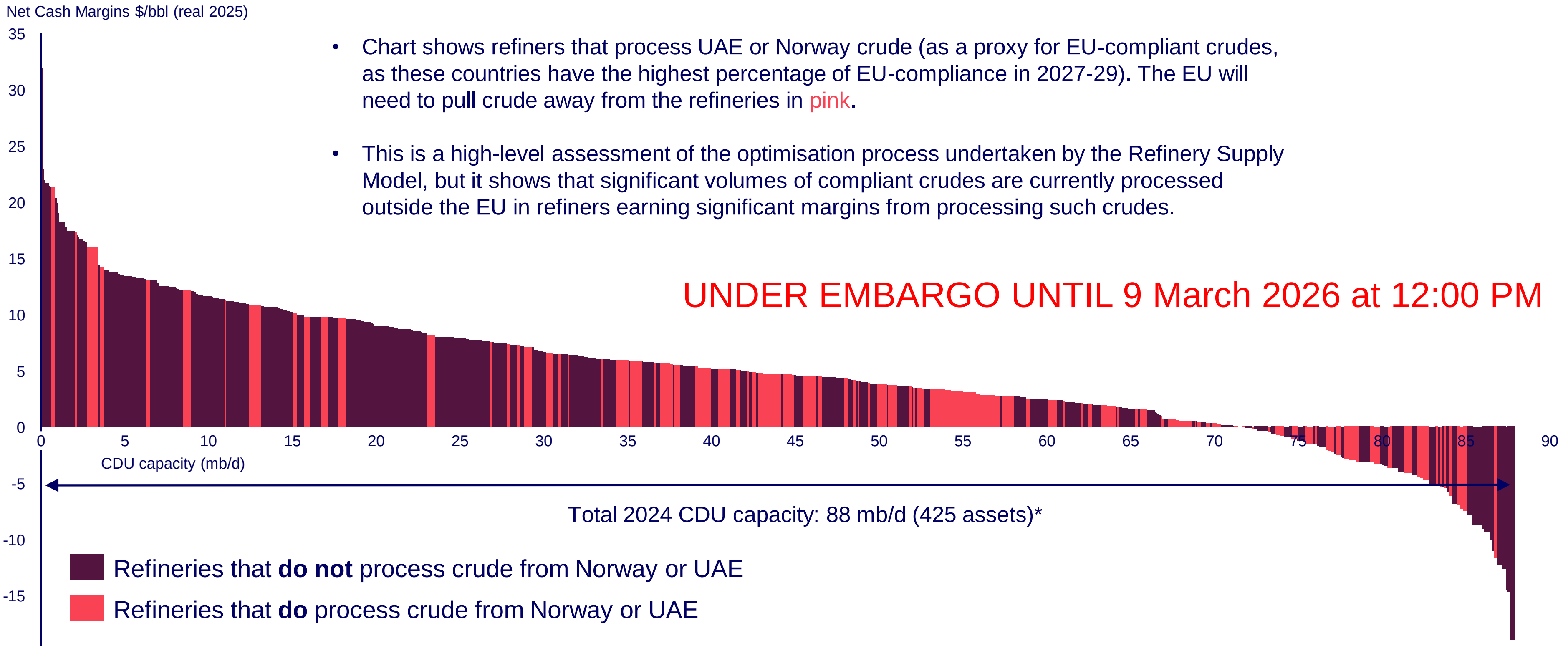
Source: Wood Mackenzie Refinery Evaluation Model (REM). *REM modelling includes all refineries with capacity over 50 kb/d.

Default Scenario – Crude Oil

Adaptive Scenario – Crude Oil

# Prices of EU-compliant crudes increase as such crudes needs to be “priced out” of non-EU highly competitive assets, and drawn into the EU instead

## 2024 Refinery Net Cash Margins vs. Capacity (Global)




- Chart shows refiners that process UAE or Norway crude (as a proxy for EU-compliant crudes, as these countries have the highest percentage of EU-compliance in 2027-29). The EU will need to pull crude away from the refineries in pink.
- This is a high-level assessment of the optimisation process undertaken by the Refinery Supply Model, but it shows that significant volumes of compliant crudes are currently processed outside the EU in refiners earning significant margins from processing such crudes.

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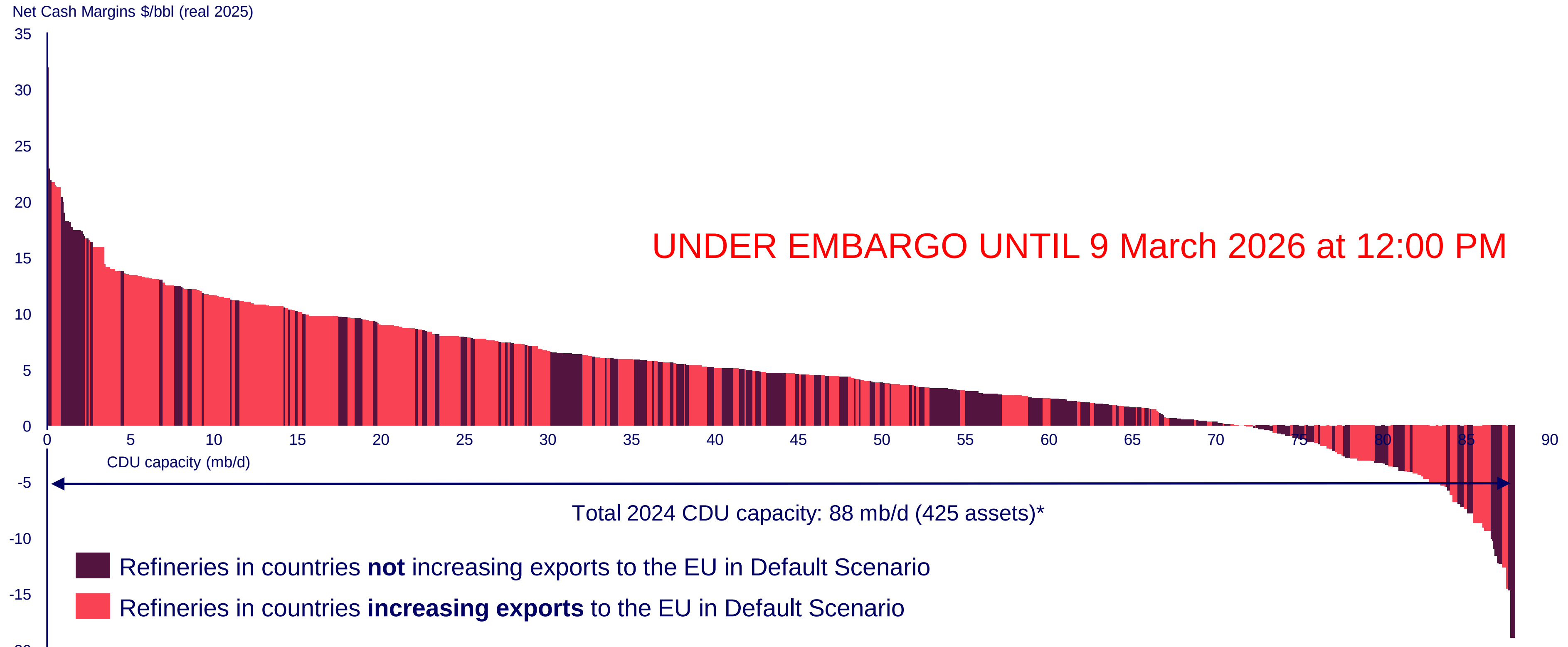
Source: Wood Mackenzie Refinery Evaluation Model (REM). *Refiners with capacity under 50 kb/d are excluded from REM modelling.

Default Scenario – Crude Oil | Adaptive Scenario – Crude Oil

Wood Mackenzie

# Higher throughputs are required globally to replace lost European supplies. Many of these are sites with weaker margins, requiring much higher product crack spreads

## 2024 Refinery Net Cash Margins vs. Capacity (Global)



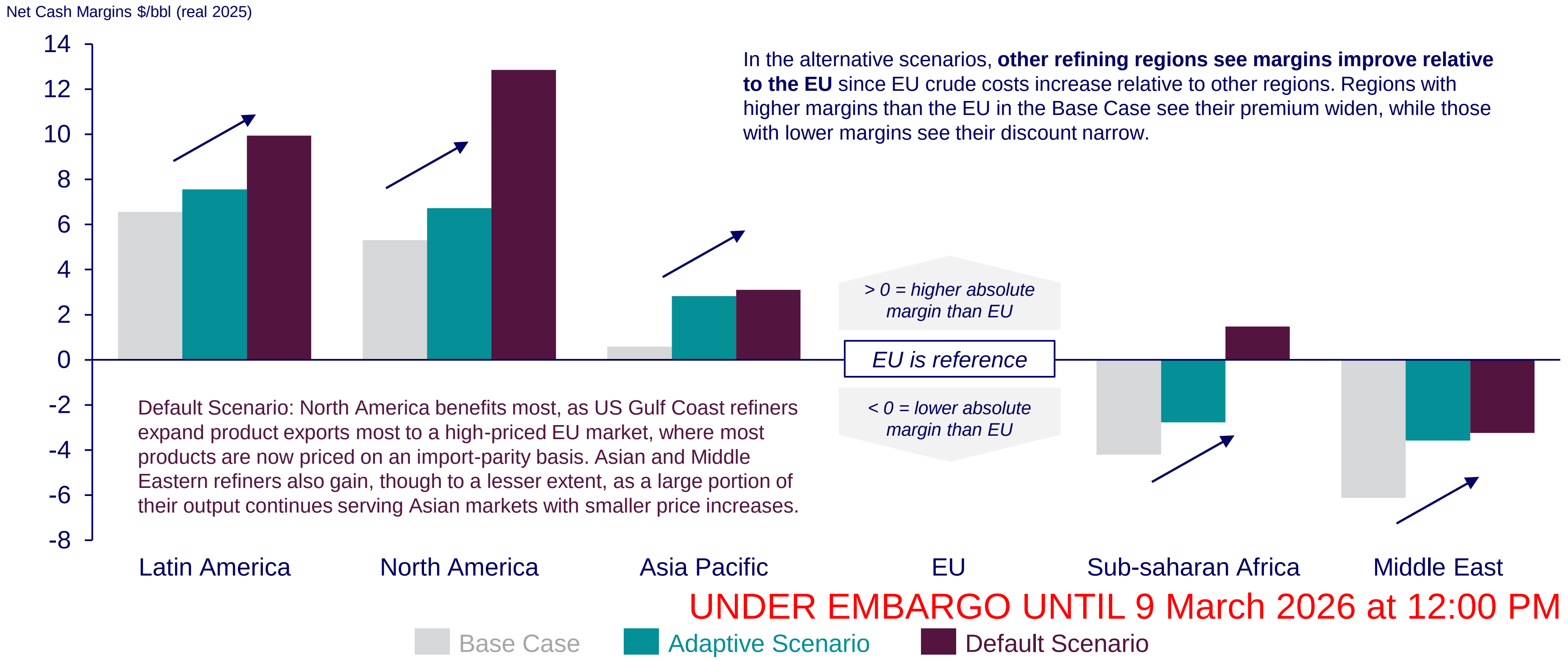

Source: Wood Mackenzie Refinery Evaluation Model (REM). *Refiners with capacity under 50 kb/d are excluded from REM modelling.

Default Scenario – Crude Oil | Adaptive Scenario – Crude Oil

Wood Mackenzie

# EU refineries' margin competitiveness deteriorates against other refining regions

## 2027 Refinery Net Cash Margin Differentials (diff. = Region X minus EU, throughput-weighted avg. basis)




Source: Wood Mackenzie Refinery Supply Model

Wood Mackenzie

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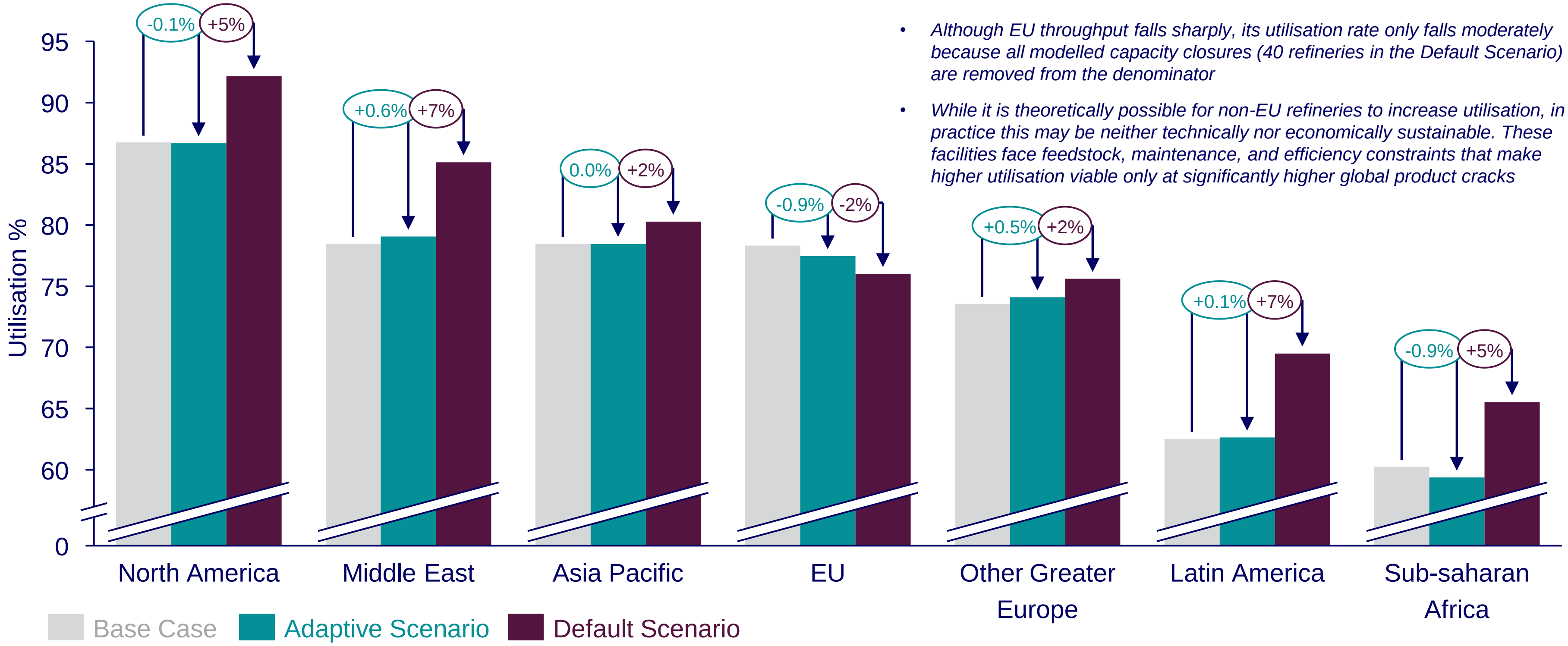
# EU utilisation rates fall because of restricted crude availability. Non-EU regions increase utilisation in response to lower EU throughputs, requiring higher margins

**2027 Average Refinery CDU Utilisation (throughput divided by capacity)**




- *Although EU throughput falls sharply, its utilisation rate only falls moderately because all modelled capacity closures (40 refineries in the Default Scenario) are removed from the denominator*
- *While it is theoretically possible for non-EU refineries to increase utilisation, in practice this may be neither technically nor economically sustainable. These facilities face feedstock, maintenance, and efficiency constraints that make higher utilisation viable only at significantly higher global product cracks*

Source: Wood Mackenzie Refinery Supply Model. 'Other Greater Europe' includes UK, Norway, Turkey, and North Africa

Default Scenario – Crude Oil | Adaptive Scenario – Crude Oil

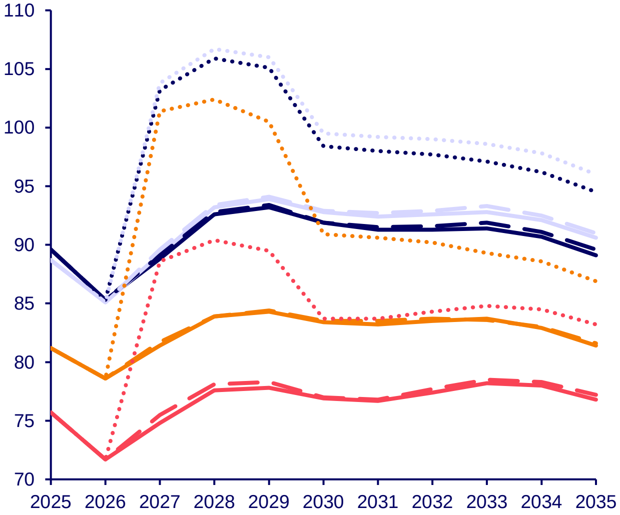
Wood Mackenzie

# Assuming no change in oil demand, global product crack spreads increase sharply due to lower EU regional supply. This promotes higher utilisation rates elsewhere

*Oil product prices climb in NW Europe, reflecting higher prices in export hubs and greater import volumes*

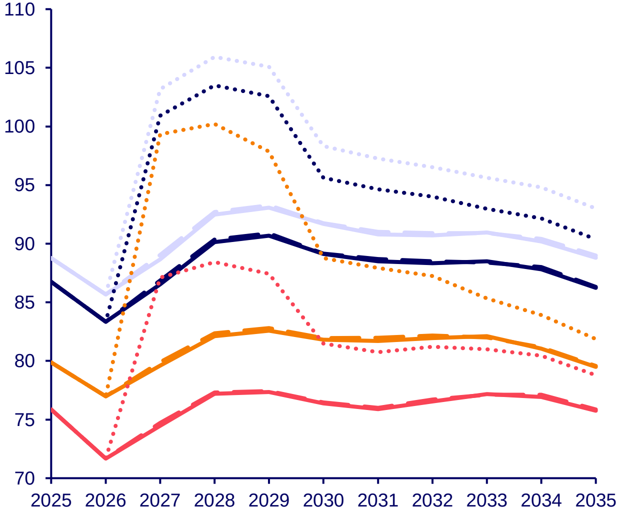
## NW Europe Oil Product Price

$/bbl (real 2025)



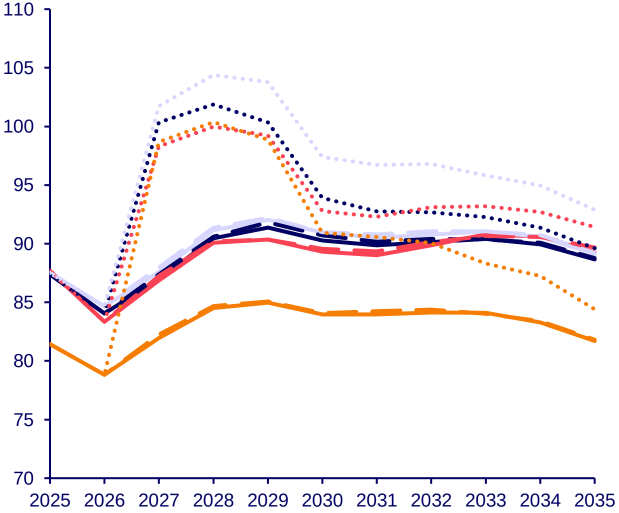

## US Gulf Coast Oil Product Price

$/bbl (real 2025)




## Singapore Oil Product Price

$/bbl (real 2025)




Dsl-10 Base Case
Dsl-10 Adaptive Scenario
Dsl-10 Default Scenario
FO-05 Base Case
FO-05 Adaptive Scenario
FO-05 Default Scenario
Jet Base Case
Jet Adaptive Scenario
Jet Default Scenario
Mogas-87 Base Case
Mogas-87 Adaptive Scenario
Mogas-87 Default Scenario

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Source: Wood Mackenzie Refinery Supply Model

Default Scenario – Crude Oil | Adaptive Scenario – Crude Oil

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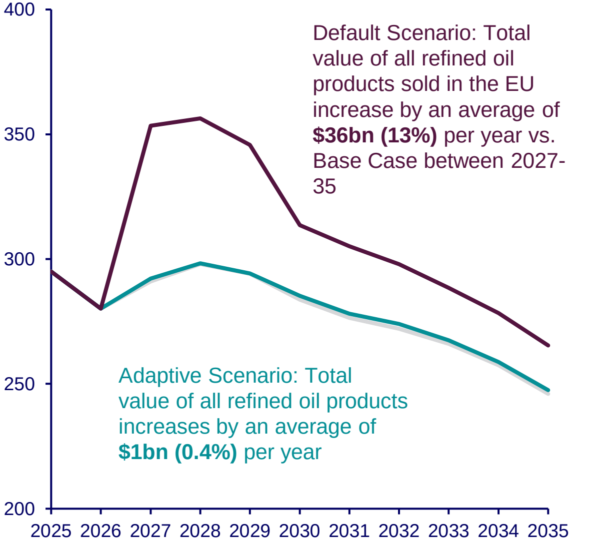
# Higher global fuel prices translate to higher consumer costs everywhere. In the Default Scenario, EU direct fuel costs for consumers rise by $36bn per year in 2027-35

*Consumers also face higher indirect costs via inflationary pass-throughs in the cost of goods and services*

## EU Total Value Refined Oil Products

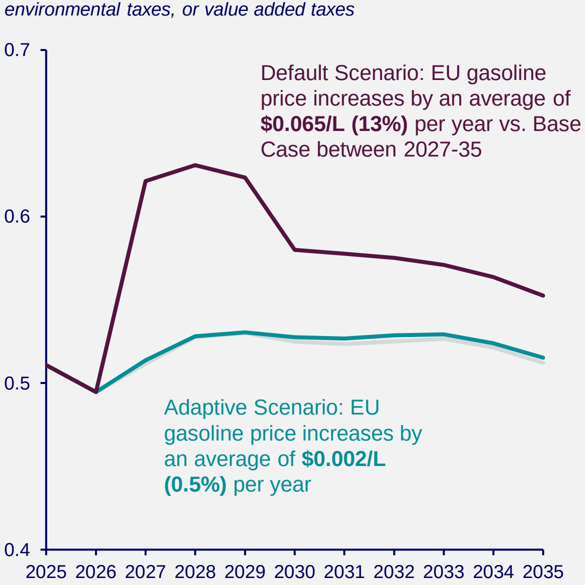
$bn (real 2025). *EU Gross product worth * EU total demand. This is a proxy for total direct costs to EU consumers*

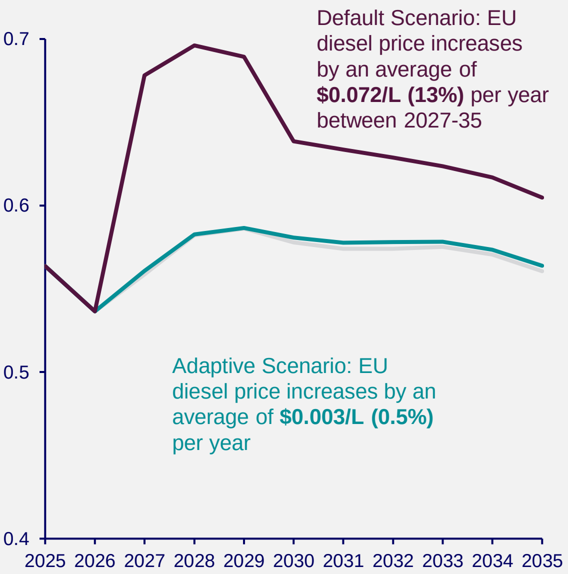



## EU Average Gasoline Price

## EU Average Diesel Price

$/L (real 2025). *Reflects underlying fuel costs only; does not include value of distribution and marketing costs, retail margins, excise duties, environmental taxes, or value added taxes*




Base Case | Adaptive Scenario | Default Scenario

Source: Wood Mackenzie Refinery Supply Model

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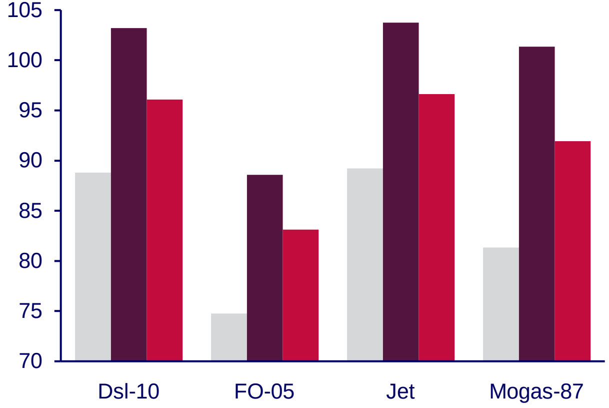
# The price increase is highly sensitive to demand. If oil demand falls in response to the initial price spike, equilibrium price increase in our scenarios could be ~50% smaller

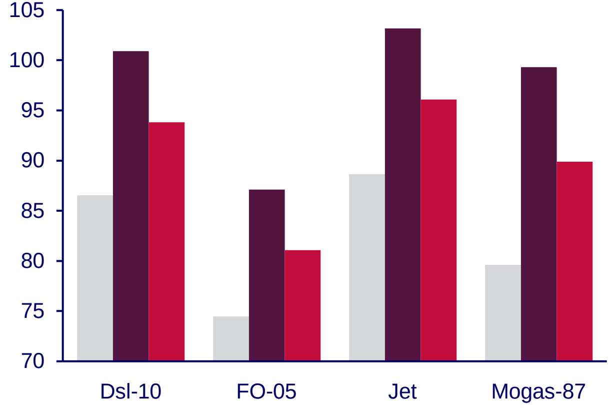
## NW Europe Oil Product Price, 2027

$/bbl (real 2025)



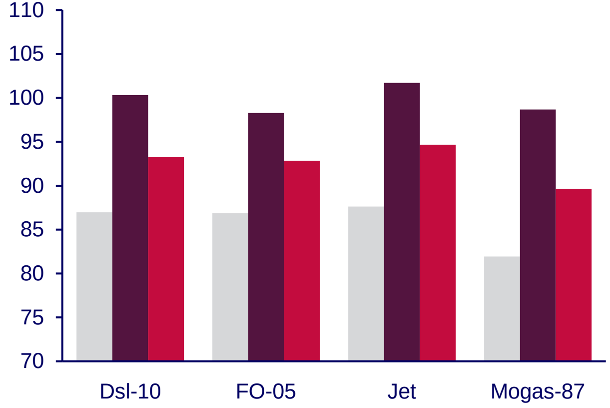

## US Gulf Coast Oil Product Price, 2027

$/bbl (real 2025)




## Singapore Oil Product Price, 2027

$/bbl (real 2025)




Base Case
Default Scenario
Default Scenario (Demand Sensitivity Case)

*In the Demand Sensitivity Case, the refined product price increase is ~50% lower than the original Default Scenario*

Source: Wood Mackenzie Refinery Supply Model

A high-level sensitivity was run in the Refinery Supply Model, assuming the following **price-elasticity of demand**: for every $1 increase in price, oil demand declines by 100 kb/d (0.1%). To run the sensitivity, the model:

- **Reduced EU oil product demand by 2%**, since the gross product value (aggregate price) of oil refined products in the EU increased by $17-20/bbl in the original Default Scenario
- **Reduced Rest of World oil product demand by 1.5%**, since the gross product value of refined products outside the EU increased by $13-15/bbl in the original Default Scenario

Default Scenario – Crude Oil | Adaptive Scenario – Crude Oil

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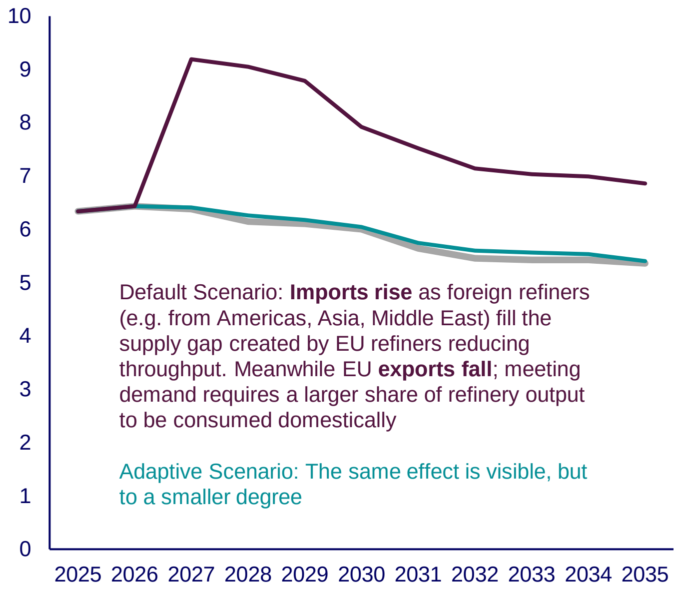
# Higher EU oil product prices attract increased imports from other refining regions, offsetting the loss of domestic supply

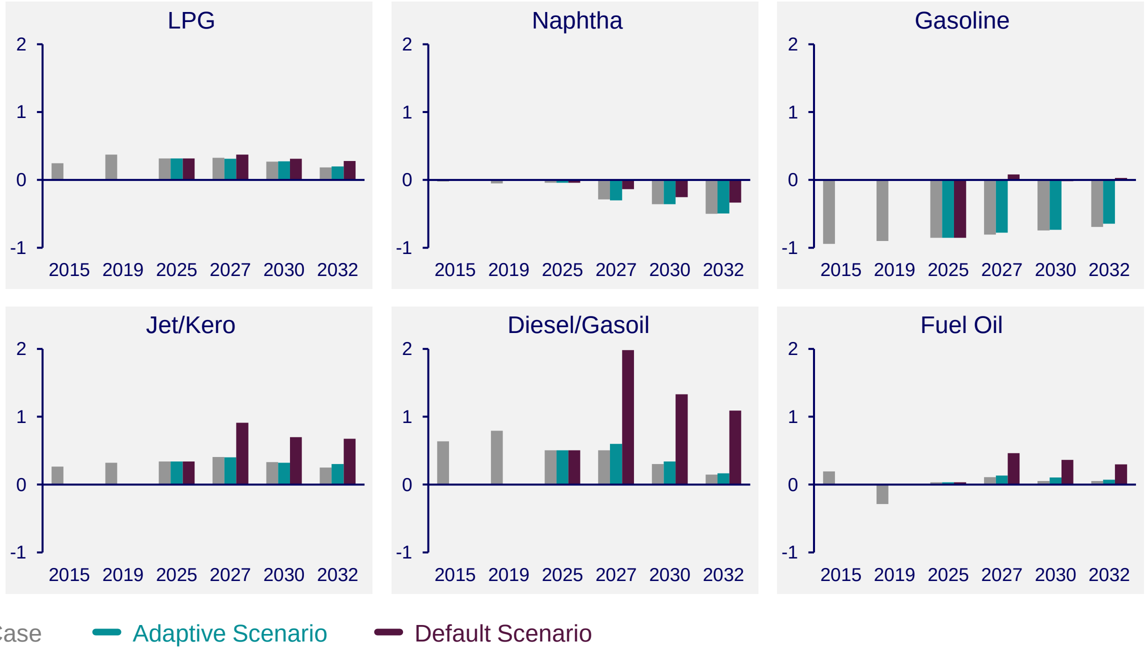
*Diesel and jet imports increase most. In the Default Scenario, the EU becomes a net importer of gasoline*

## EU Refined Product Imports




## EU Net Imports for Major Oil Products

mbd. *Net imports = imports less exports. If >0, EU is net importer. If <0, EU is net exporter*




Source: Wood Mackenzie Product Markets Service (April 2025)(for Base Case) and Refinery Supply Model (for alternate scenarios)

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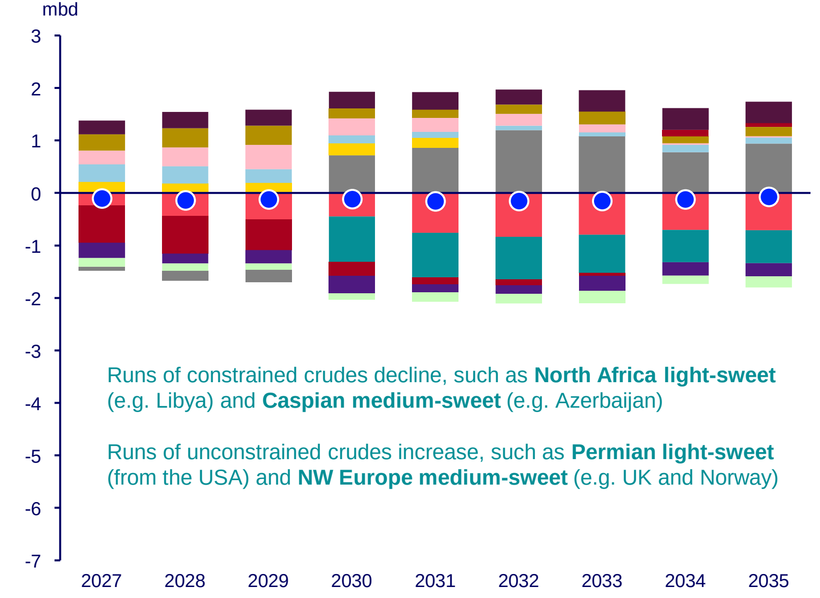
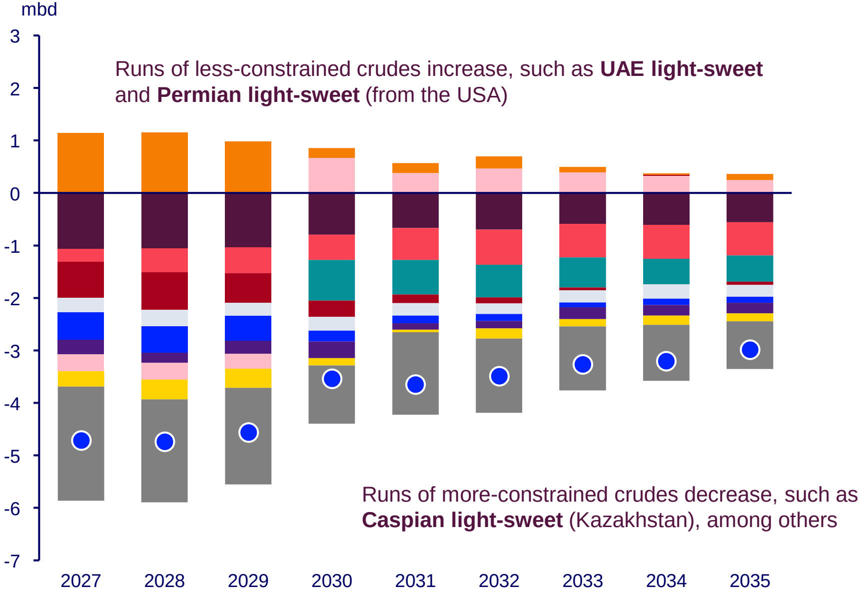
# EU refiners see a significant shift in crude slate. Constraints on imports of light-sweet crudes in Default Scenario limits EU refiners' ability to produce gasoline (1/2)

*Limited EU supply of naphtha and gasoline contributes to larger increase in its crack spread vs. other products*

## Change in EU Refinery Crude Slate by region-quality: Reference vs. Adaptive Scenario




## Change in EU Refinery Crude Slate by region-quality: Reference vs. Default Scenario




caspian_LST, russia_MSO, caspian_MST, permian_orla_LST, permian_midland_LST, Other, nigeria_cr_MST, n_africa_LST, uae_cr_LST, nwe_HST, n_africa_MST, nwe_MST, brazil_MST, saudi_arabia_cr_MSO, Net Change

Source: Refinery Supply Model. SO=Sour, ST=Sweet

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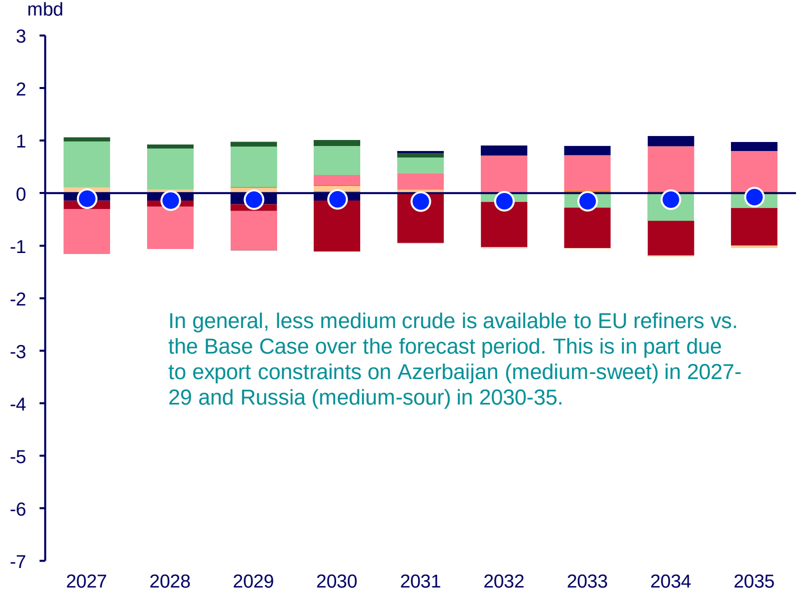
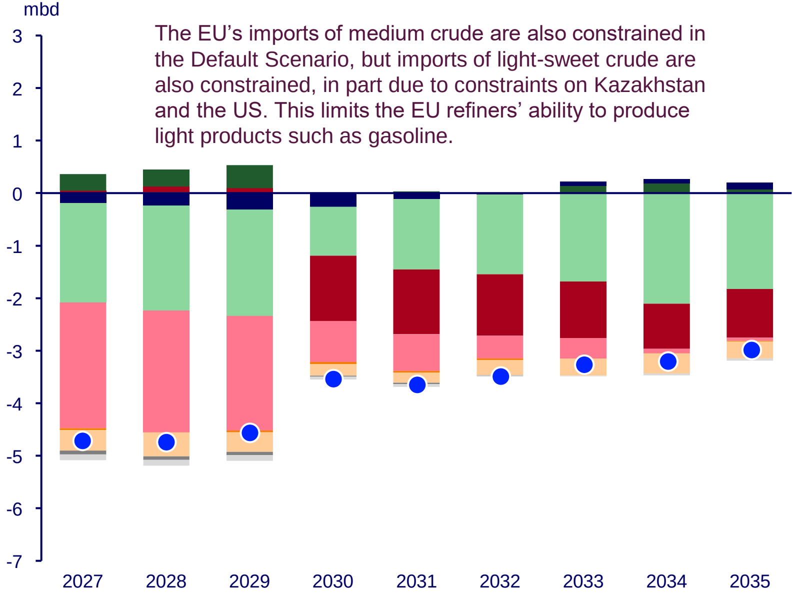
# EU refiners see a significant shift in crude slate. Constraints on imports of light-sweet crudes in Default Scenario limits EU refiners' ability to produce gasoline (2/2)

*Limited EU supply of naphtha and gasoline contributes to larger increase in its crack spread vs. other products*

**Change in EU Refinery Crude Slate by quality: Base Case vs. Adaptive Scenario**




**Change in EU Refinery Crude Slate by quality: Base Case vs. Default Scenario**




XLST LSO LST MSO MST HSO HST XHSO XHST Net Change

*Extra-Light* *Light* *Medium* *Heavy* *Extra-Heavy*



Source: Refinery Supply Model. SO=Sour, ST=Sweet

# RSM defines around 150 crude types based on region of origin and quality. These crude types can be mapped onto actual marketed crude streams

## Crude types used in RSM

| Property | Range | Category Codes | Descriptor |
|---|---|---|---|
| Country / region of origin | | | |
| API Gravity | < 20 | XH | Extra Heavy |
| | 20 – < 28 | H | Heavy |
| | 28 – < 38 | M | Medium |
| | 38 – < 51 | L | Light |
| | ≥ 51 | XL | Extra Light |
| Sulfur Content | ≥ 1 wt% | S / SO | Sour (High S) |
| | < 1 wt% | ST | Sweet (Low S) |

## Examples of RSM crude types

| RSM crude type |
|---|
| caspian_MST |
| permian_midland_LST |
| nigeria_MST |
| brazil_HSO |
| saudi_arabia_MSO |

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# MER Impact Assessment and Scenario Modelling

*Comparison of 2025 vs. 2024 OGMP 2.0 data release*

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# Assessment of 2025 OGMP 2.0 data release and comparison with 2024 data

- The original analysis conducted under the Study modelled the impact of constraints on the volume of crude oil and natural gas imported into the EU, based on exporters' assumed equivalency with MER requirements. These constraints were developed using the 2024 OGMP 2.0 dataset as a key input.
- After completion of this analysis in summer 2024, UNEP published the 2025 OGMP 2.0 dataset in October 2025. An initial review indicated an increase in the number of reporting companies achieving Level 5 (the highest level in the OGMP reporting framework), suggesting that exporter equivalency with MER may now be higher than previously assumed.
- Wood Mackenzie analysed the 2025 OGMP data to assess whether the reported Level 5 achievement, and any new OGMP members, would materially affect import constraints for each exporting country, and consequently the security of supply and price impacts modelled in the study's scenarios. This assessment informed discussions with project sponsors to determine whether differences were sufficient to justify re-running the full scenario models.

**Summary of findings**

- The 2025 OGMP dataset showed an increase in Level 5 achievement in 2024—up to an estimated 7% of global oil and gas production, compared with 3% in the previous data—and included several new participant companies, including from Bahrain and Oman. The largest changes occurred in Bahrain and Oman, with slight increases elsewhere. Most of the country-level compliance changes appeared in 2027–2029, after which impacts plateaued, as most OGMP members were already assumed to achieve 100% Level 5 by the early 2030s in the original linear forecast.
- For both gas and crude oil, the analysis found only a modest increase in product available to the EU under the 2025 OGMP assumptions versus 2024, primarily because OGMP membership accounts for a finite share of global production:
  - **Gas**: Approximately 24 bcm more compliant gas was available, representing a 10% increase of compliant supply in the Default Scenario and 1% in the Adaptive Scenario.
  - **Crude oil**: Approximately 640 kb/d more compliant crude was available, equivalent to an 11% increase of compliant supply in the Default Scenario and 2% in the Adaptive Scenario.

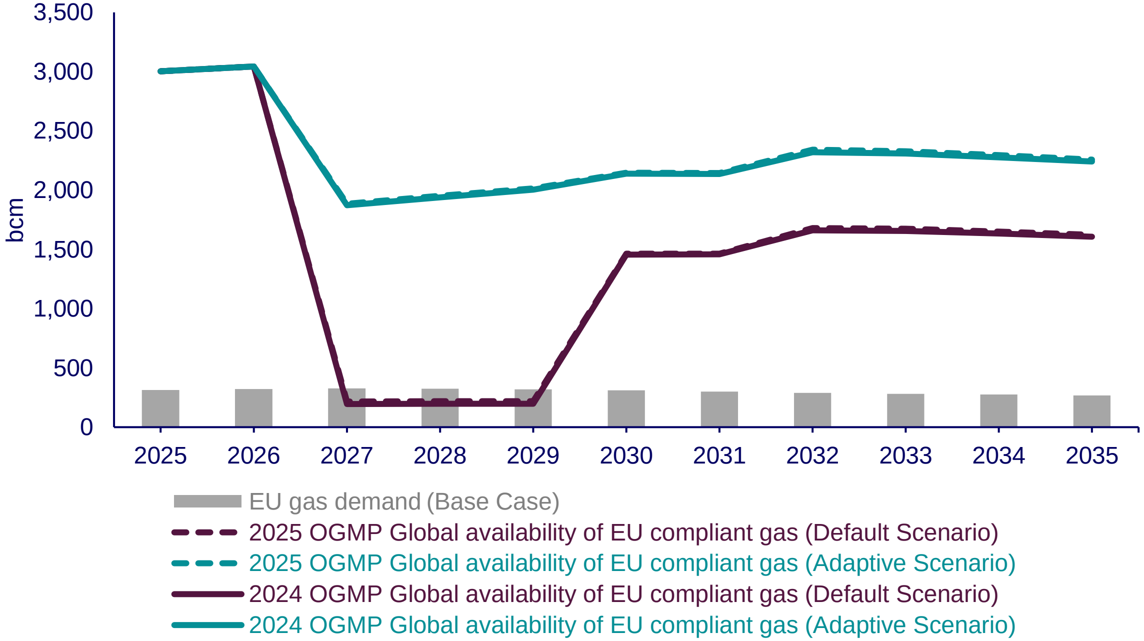
**Overall conclusion**

- Even with the updated OGMP assumptions, in the Default Scenario the quantity of compliant gas and crude remained below the EU's Base Case demand. The reported progress by operators was found to be negligible, which confirms the risk of non-compliant imports from 2027.
- Since the analysis concluded that the new OGMP data would not materially alter the key findings or messages from the original study, it was determined that re-running the scenario models was not required.

# Our analysis of the 2025 OGMP data shows that marginally more **gas** will be available at Level 5 in the 2027-35 period, compared to the 2024 OGMP data

## Even with new assumptions, globally available compliant gas is smaller than EU demand in Default Scenario

### Global Gas Availability vs. EU Gas Demand

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Source: Wood Mackenzie analysis

Approximately **24 bcm** more compliant gas is available to the EU (avg. 2027-35) using assumptions from 2025 OGMP data compared to 2024 OGMP data. This represents in 2027:

- A **10%** increase on the quantity of compliant gas available to EU in Default Scenario
- A **1%** increase on the quantity of compliant gas available to EU in Adaptive Scenario

By comparison, EU gas demand in 2027 is **326 bcm** in the Base Case. In our original modelling using 2024 OGMP data, EU gas demand in 2027:

- Fell by **113 bcm** in Default Scenario
- Fell by **9 bcm** in Adaptive Scenario

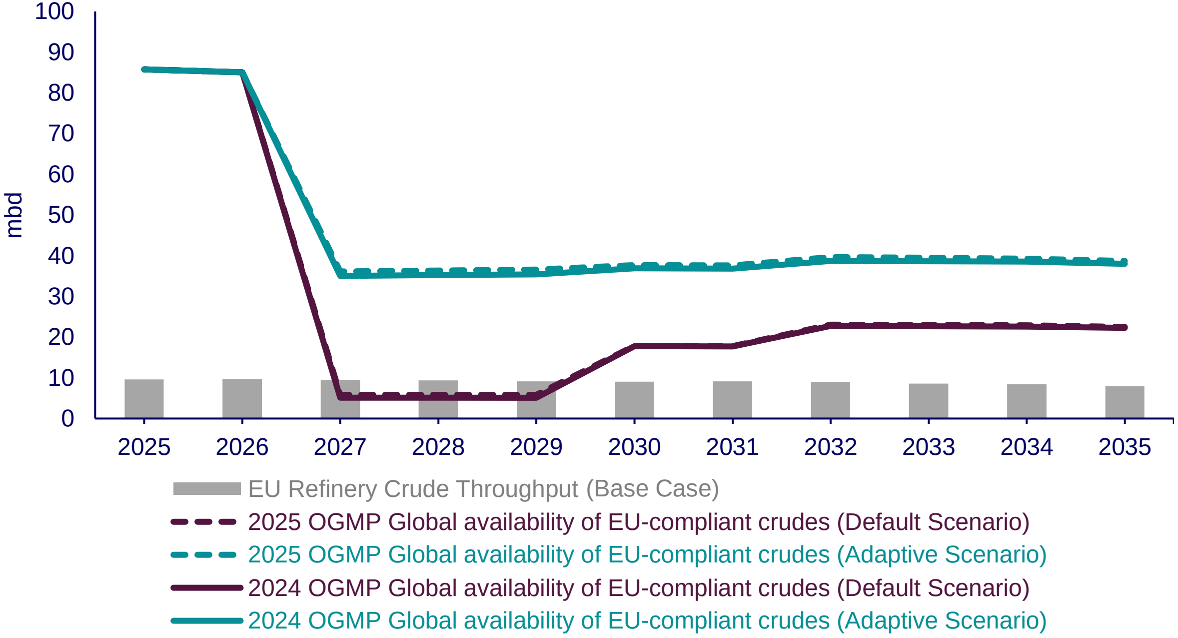
This suggests that any re-running of the model for gas may result in:

- Minimal increase in compliant gas supply in Default Scenario. The model would likely still not balance (still suggesting a historically high gas price)
- Slightly stronger relative increase in compliant gas supply in Adaptive Scenario (due to lower reduction of compliant supply). The price increase may be slightly smaller than originally modelled

# Our analysis of the 2025 OGMP data shows that marginally more **crude oil** will be available at Level 5 in the 2027-35 period, compared to the 2024 OGMP data

## Even with new assumptions, globally available compliant crude is smaller than EU demand in Default Scenario

### Global Crude Oil Availability vs. EU Refinery Crude Throughput




Approximately **640,000 b/d** more compliant crude oil is available to the EU (avg. 2027-35) using assumptions from 2025 OGMP data compared to 2024 OGMP data. This represents in 2027:

- A **11%** increase on the quantity of compliant crude available to EU in Default Scenario
- A **2%** increase on the quantity of compliant crude available to EU in Adaptive Scenario

By comparison, EU refinery crude throughput in 2027 is **9.4 million b/d** in the Base Case. In our original modelling using 2024 OGMP data, EU refinery crude throughput in 2027:

- Fell by **4.6 million b/d** in Default Scenario
- Fell by **150,000 b/d** in Adaptive Scenario

This suggests that any re-running of the model for crude oil may result in:

- Minimal impact on EU refining capacity closures in Default Scenario. The modelled crude and product price increase would be slightly smaller than originally modelled
- Slightly smaller throughput reduction and price increase than originally modelled in Adaptive Scenario



Source: Wood Mackenzie analysis

# Literature review

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# Literature Review

*Challenges of Implementation*

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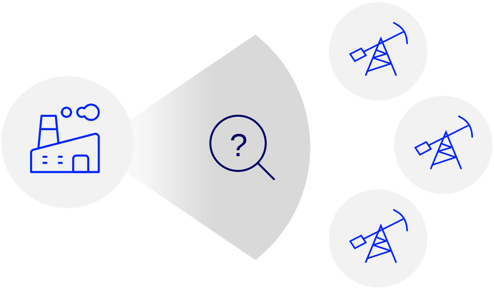
# Importer challenges in traceability and identifying oil and gas producers




Under Annex IX of the EU Methane Emissions Regulation (MER), the ability of importers to demonstrate compliance depends not only on producer performance but also on importers' ability to identify producers in complex global supply chains. This is a requirement that is often technically and commercially challenging to meet.

- For both natural gas and crude oil, EU importers face significant challenges in identifying the original producer and obtaining the required methane emissions data. Even where upstream operators are fully compliant with MRV and reporting requirements, the physical and commercial structure of global commodity markets can obscure origin information before the product reaches the EU. Commingling, blending, and virtual trading mean that the physical cargo received by an importer has no one-to-one correspondence with the contractual or certified origin. This complexity can result in a loss of chain of custody, preventing importers from demonstrating origin-specific compliance, even where the producer itself has met all regulatory requirements.
- In crude oil, multiple ownership changes, blending in terminals or storage tanks, and aggregation from various fields make it difficult to trace a shipment to a specific producing asset. Key trading hubs such as Rotterdam and Fujairah often blend multiple cargoes into fungible grades, erasing direct links to the original source. In piped gas, transit through multiple countries and operators reduces visibility on the upstream origin, while LNG supply chains can involve blending during liquefaction, storage, or "virtual" portfolio trading by intermediaries. These portfolio transactions, including cargoes that draw from multiple countries, can make it impossible for buyers to tie the product to a single compliant field, even if it meets the highest OGMP 2.0 standards.

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# Challenges of emerging systems for traceability of certified products

Several emerging systems are facilitating the shift toward certified low-methane supply chains. The OGMP 2.0 Framework provides the essential high-integrity MRV data required for certification. This data is used by certification schemes to issue certificates for the low-methane attribute.

However, these systems are highly nascent, and their implementation presents varied challenges:

- **Book-and-claim** is the least challenging to implement as it requires only a digital registry and contractual agreements, making it suitable for market-based claims, but it faces integrity challenges due to the decoupling of the physical product from the claim.
- **Constrained book-and-claim** is a medium-term prospect, requiring investment in platforms/registries and audit processes to allow certification of verified production and transport/transit of gas/crude. It offers a balance between feasibility and robust auditing of long/complex supply chains.
- **Full trace-and-claim** for commingled commodities like LNG or crude is a long-term, almost infeasible prospect, as it would require unprecedented, costly physical segregation and verification systems across complex global infrastructure.

| Traceability System | Tracking Method | Physical Segregation | Key Use Case |
|---|---|---|---|
| **Book-and-Claim** | **Contractual / Credit-Based** | **Not required** | The environmental claim (credit) for a certain volume is separated from the physical product and traded/redeemed with (for example) importers. |
| **Constrained Book-and-Claim** | **Credit-based with Verification** | **Not required** | Certification of key steps in chain along commingled systems (production, transport, transit, exits etc.), tradeable certificates from specified regions. |
| **Full Trace-and-Claim** | **Physical Segregation** | **Required** | The certified product (e.g., low-methane gas molecules) is kept separate from non-certified product from source to destination. |

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# Role and limitations of certification schemes

**Example certification process for methane reporting**

***Reporting framework***

OGMP – Oil And Gas Methane Partnership 2.0

*Company reporting is then verified by:*

***Verification service providers***

Bureau Veritas · DNV · Ramboll

*Finally, reporting is certified by:*

***Certification service providers***

Equitable Origin · MiQ · Project Canary

*Illustrative and not comprehensive*

Building on the traceability challenges described above, certification schemes offer one of the most practical tools for bridging the gap between upstream methane performance data and importer compliance obligations under the EU Methane Emissions Regulation (MER). These schemes can provide emissions data and assurance at a batch, portfolio, or book-and-claim level, offering a structured way for producers and traders to demonstrate compliance with methane performance standards, and potentially giving EU importers access to verified data even when direct supply chain traceability is incomplete.

**MRV reporting frameworks** such as OGMP 2.0 (and in future, CEN/ISO) define what to measure and how to report methane emissions. **Verification protocols** currently under development aim to ensure this is done in a consistent manner that allows for independent assurance by verifiers such as Bureau Veritas, DNV, or Ramboll. **Certification service providers** like MiQ or Project Canary then review these verified reports and apply their own scoring systems (e.g., MiQ grades A–F) or labelling criteria to produce a market-facing methane performance certification at the company or asset level.

In doing so, certification can support MER compliance or equivalence demonstration in three main ways:

- Verification – Providing the third-party verification of methane data required by MER.
- Traceability – Certification of oil or gas volumes will help importers to link verified shipments/supplies to producers.
- Standardisation – Applying widely recognised metrics, such as methane intensity, that can act as accepted proxies for compliance.

However, applying such schemes across both gas and crude markets presents several challenges. First, differences in methodologies, standards, and verification practices reduce comparability across schemes. Second, certification coverage remains low and uneven; it will take time before these options are available for gas and crude production in all exporting countries, and participation is likely to grow only gradually. Third, the lack of clarity on which schemes will be accepted by EU Member States continues to limit their broader adoption by market participants.

Overall, certification is an efficient option to allow importers connect with a producer for a verified amount of gas and crude when the producer cannot be identified through the transactional supply chain. For a regulatory framework like MER to function effectively, certification systems would need minimum standards/methodologies, broad participation, and robust processes and platforms/registries capable of securely handling the transfer of methane attributes and reports.

# Literature Review

*Methane Intensity Assessment*

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# Key takeaways from the methane intensity assessment

- **Methane intensity (MI)** – the quantity of methane emissions per unit of gas or oil production – is a key metric under the EU Methane Emissions Regulation (MER), particularly in the context of future compliance with reporting and threshold requirements. The denominator of the emissions intensity calculation (production in terms of energy or mass) is not yet defined within MER. Accurate estimation of MI depends heavily on the underlying quantification and measurement approach, which varies widely across producers and jurisdictions.
- **Methane emissions in upstream operations originate from a range of sources**. For both crude oil and natural gas (including LNG), key emission points include venting from compressors and pneumatic devices, fugitive emissions from valves and flanges, leaks during loading and unloading, and emissions from storage tanks and flaring systems. In gas-focused operations, additional emissions may occur during dehydration, gas processing, and liquefaction stages, while in oil production, associated gas handling and reinjection systems are critical contributors.
- **There is substantial variation in reported methane intensity values across different data sources and jurisdictions**. This variation stems from differences in measurement methodology, data granularity, reporting frequency, and the presence (or absence) of third-party verification. For example, some producers report MI based on engineering estimates or national inventories, while others use site-level measurements with independent verification. The lack of standardization in definitions, boundaries (e.g., upstream-only vs. full supply chain), and emissions allocation methods (especially for installations producing both crude oil and natural gas) further complicates comparability.
- As a result, **interpreting and comparing methane intensity data across producers and countries remains challenging**. This variability has important implications for compliance with MER, particularly as importers will be required to report and eventually meet maximum MI thresholds. Establishing a transparent, consistent methodology for MI calculation – as planned by the European Commission by 2027 – will be essential to ensure a level playing field and support credible emissions reductions.
- Given current data gaps and implementation challenges, **it remains uncertain whether MER's objective of obtaining comprehensive, country-level methane intensity data by 2030 can be achieved**. Only once sufficiently robust and representative data are available – covering the majority of export sources, and using a transparent, consistent methodology – can meaningful MI thresholds be established.

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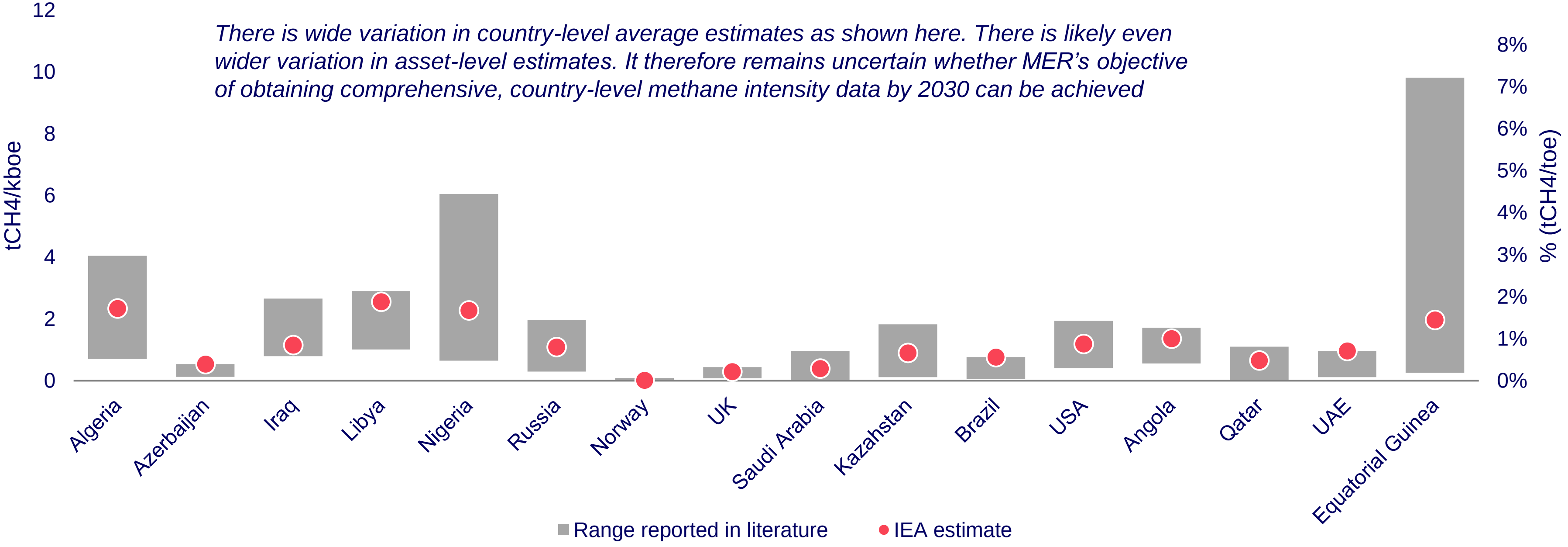
# Country-level methane intensity estimates associated with Upstream Oil and Gas activities vary significantly depending on the source/methodology

## Comparison of total upstream Oil & Gas methane emissions intensity estimates (tCH4/kboe)




*All data points can be read in absolute terms (left axis) or percentage terms (right axis)*

Note: MI estimates are based on total emissions per barrel of oil equivalent production for oil and gas.
"Range" is defined as the range of results from published sources other than IEA, including Wood Mackenzie.

# Country-level methane intensity estimates associated with Upstream Oil and Gas activities vary significantly depending on the source/methodology

## Data quality is a key issue

- Based on published information there are huge differences in the estimates of methane emissions for different countries
- The level of analysis of methane emissions that has been carried out varies considerably between countries
  - Countries where extensive methane analysis has been carried out (e.g. the US, Norway, UK , etc.) typically show considerably less variance in the range of published data
  - Countries which have seen very little methane-emissions analysis (e.g. Algeria, Nigeria and Equatorial Guinea) and where there is very limited data show much higher ranges in the estimates of methane intensities
- Part of the issue is related to the wide range of approaches that have been used to estimate the methane emissions from the oil and gas sectors of specific countries incorporating one or several of the following:
  - Self reported government/company data
  - Methane emissions factors for different types of production based on factors derived in one location and applied globally
  - Methane emissions factors associated with levels of associated gas production and flaring (and assumptions of venting)
  - Specialist satellite/measurement studies and detection of super-emitter events
  - Governance and industry indicators to provide scaling factors relative to better understood countries (ie. the US)
- As a result, it is perhaps not surprising that estimates of methane emissions in many countries vary so significantly

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# However, there are some indicators that can assist in defining relative methane intensities at a high level

- Some characteristics of the oil and gas environment in different countries are likely to lead to higher levels of upstream methane emissions
  - Countries where there is production of oil and higher levels of associated gas
  - Countries with a predominance of onshore production over a relatively wide geographical area
  - Countries with unconventional production of liquids and gas
  - Countries with high flaring intensities
  - Countries with lower levels of governmental oversight regarding emissions
  - Countries with NOC or small independent oil companies as operators
  - Countries with ageing upstream infrastructure
- It is clear that where a combination of these factors are in existence, there is a likelihood of higher methane intensities although the exact level is largely impossible to determine without further detailed analysis/measurement
- As such the published information, in most instances, can only provide a general indication of the likely level of methane emissions in a country

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Wood Mackenzie

# Other sources used in comparison of methane emissions estimates

| Algeria | Azerbaijan | Iraq | Libya | Nigeria | Russia | Norway | UK | Saudi Arabia | Kazakhstan | Brazil | USA | Angola | Qatar | UAE | Equatorial Guinea |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IEA | IEA | IEA | IEA | IEA | IEA | IEA | IEA | IEA | IEA | IEA | IEA | IEA | IEA | IEA | IEA |
| O'Rourke et al. (2021) | O'Rourke et al. (2021) | O'Rourke et al. (2021) | O'Rourke et al. (2021) | O'Rourke et al. (2021) | O'Rourke et al. (2021) | O'Rourke et al. (2021) | O'Rourke et al. (2021) | O'Rourke et al. (2021) | O'Rourke et al. (2021) | O'Rourke et al. (2021) | Sherwin et al. (2024) | Hoglund-Isaksson (2017) | Hoglund-Isaksson (2017) | Hoglund-Isaksson (2017) | Hoglund-Isaksson (2017) |
| Hoglund-Isaksson (2017) | Hoglund-Isaksson (2017) | Hoglund-Isaksson (2017) | Hoglund-Isaksson (2017) | Hoglund-Isaksson (2017) | Hoglund-Isaksson (2017) | Hoglund-Isaksson (2017) | Hoglund-Isaksson (2017) | Hoglund-Isaksson (2017) | Hoglund-Isaksson (2017) | Hoglund-Isaksson (2017) | Omara et al. (2024) | Hoesly et al. (2025) | Hoesly et al. (2025) | Hoesly et al. (2025) | Hoesly et al. (2025) |
| Naus et al (2023) | Hoesly et al. (2025) | Copernicus | Hoesly et al. (2025) | Copernicus | Copernicus | Miljødirektoratet (Norwegian Environment Agency) (2019) | Hoesly et al. (2025) | Hoesly et al. (2025) | Hoesly et al. (2025) | Hoesly et al. (2025) | Williams et al. (2025) | Copernicus | | Copernicus | |
| Copernicus | | Hoesly et al. (2025) | | Hoesly et al. (2025) | Hoesly et al. (2025) | Hoesly et al. (2025) | | | | | Alvarez et al. (2018) | | | | |
| Hoesly et al. (2025) | | | | | | | | | | | O'Rourke et al. (2021) | | | | |
| | | | | | | | | | | | Hoglund-Isaksson (2017) | | | | |
| | | | | | | | | | | | EPA US Inventory (2022) | | | | |
| | | | | | | | | | | | Copernicus | | | | |

# Disclaimer

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