CENTRE FOR
INTERNATIONAL
ENERGY POLICY

CIEP

BRIEFING PAPER

LOOKING INTO THE FUTURE OF NATURAL GAS DEMAND

EXPLORING RECENT FORECASTING AND BACKCASTING EFFORTS OF A SELECT GROUP OF INTERNATIONAL OIL AND GAS COMPANIES

CENTRE FOR
INTERNATIONAL
ENERGY POLICY

CIEP

CIEP acts as an independent forum for governments, non-governmental organizations, the private sector, media, politicians and all others interested in changes and developments in the energy sector.

CIEP organizes lectures, seminars, conferences and roundtable discussions. In addition, CIEP members of staff lecture in a variety of courses and training programmes. CIEP's research, training and activities focus on two themes:

- European energy market developments and policy-making;
- Geopolitics of energy and climate policy-making and energy markets

CIEP is endorsed by The Netherlands Ministry of Climate Policy and Green Growth, Air Liquide Industrie B.V., BP Nederland, Coöperatieve Centrale Raiffeisen-Boerenleenbank B.A. ('Rabobank'), Eneco Holding N.V., EBN B.V., Esso Nederland B.V., GasTerra B.V., N.V. Nederlandse Gasunie, ING Wholesale Banking N.V., Vattenfall NL, TenneT TSO B.V., One-Dyas B.V., Orsted Wind Power Netherlands Holding B.V., Havenbedrijf Rotterdam N.V., RWE Benelux., Shell Nederland B.V., Koninklijke Vopak N.V.

Find CIEP publications at ciep.energy/publications.

The content of all CIEP publications is the sole responsibility of CIEP and cannot be attributed to the partner organisations.

TITLE
Looking into the future of natural gas demand

SUBTITLE
Exploring recent forecasting and backcasting efforts of a select group of international oil and gas companies

AUTHOR
Ard Verhaar

COPYRIGHT
© 2025

NUMBER
2025 I 01 briefing paper

EDITOR
Iris Börger

DESIGN
Studio Maartje de Sonnaville

PUBLISHED BY
Centre for International Energy Policy (CIEP)

ADDRESS
Breitnerlaan 299, 2596 HA The Hague, The Netherlands

TELEPHONE
+31 70 374 67 00

EMAIL
contact@ciep.energy

WEBSITE
ciep.energy

LOOKING INTO THE FUTURE OF NATURAL GAS DEMAND

EXPLORING RECENT FORECASTING AND BACKCASTING EFFORTS OF A SELECT GROUP OF INTERNATIONAL OIL AND GAS COMPANIES

TABLE OF CONTENTS

INTRODUCTION

Each year, many energy outlooks, scenarios and backcasting exercises are published. They show the boundaries of what may or should happen to the world energy mix. The models for outlooks are fed with the best techno-economic knowledge and/or standing energy policies and investigate how these might change over time. In forecasting scenarios, certain assumptions on the rate of change and future policymaking are tested, while backcasting scenarios show potential routes to a hypothetical outcome (often net-zero), based on current techno-economic insights. Globally well-known examples are IEA (International Energy Agency) scenarios such as the *Stated Policies Scenario* (STEPS), *Announced Pledges Scenario* (APS), and *Net Zero Emissions by 2050* (NZE).

Other international organisations have their own projections, creating a plethora of ideas on what to change or expect. International organisations use their projections as a way to achieve impact on international negotiations and national policymaking, while companies use their projections for their investment strategy. All these assessments of today's and future energy mixes in the world weigh a variety of available information in different ways. Yet, in the public discussion, only a few of these scenarios take centre stage. One example is the IEA's NZE scenario which features prominently in many energy discussions. Although such a scenario can guide policy makers, very often these scenarios assume a harmonious world in which all countries collaborate in fighting climate change. The reality is that the world is often less harmonious than assumed, which poses a problem for the modelling.

The outlooks and scenarios of large international oil companies also make interesting reading. For example, they often reflect the fact that the world population will grow, the impact of the behaviour of new middle classes on energy demand, and the availability and maturity of new energy technologies and energy efficiency. At times, they also include reflections on aspects that might need a reconsideration or re-evaluation, for example, when a certain energy transition approach might not align with aspects of a just transition. In addition, they sometimes provide reflections on a less open and collaborative world, on the growing importance of (groups of) countries for security of supply and the importance of domestic production versus imports. The latter is important, because a country that has ample coal production may not easily switch (completely) to an imported low-carbon energy carrier, or may

opt for a more expensive domestic alternative to manage import dependence. Diversity of supply, domestically and of imports, helps to mitigate these energy transition issues.

In many countries, natural gas forms part of the transition strategy. Despite ambitious targets, natural gas may stay in the mix longer, when alternatives do not materialise fast enough or competitively enough. Over the course of 2024, a new trend appeared when oil and gas corporations and international organisations (gradually) revised their gas demand forecasts upwards, and also underlined the long term importance of natural gas as a key factor in the energy transition.[1] For these reasons the focus in this paper is on the corporate projections on natural gas demand.

Recent projections of a selected group of oil and gas companies are analysed with a focus on natural gas demand. The reason why this analysis of corporate projections is interesting, is not only because of the vast experience of these companies in dealing with a wide array of countries, or because they shed some light on the hybrid period of the energy transition, but also because they are signalling to policymakers that recent setbacks may lead to delays in reaching targets. For instance, the uneven playing field and the lack of demand for new energy products in Europe is a major hindrance to investments in low-carbon molecules, while it is increasingly apparent that there are limits to the rate of change that electricity grids can absorb. Policy measures for the security of gas supply should not only be based on desired future expectations, but rather on a complete set of possible developments in global gas demand. In this way, unpleasant surprises can be avoided. This paper does not pretend to know the future, but hopes to contribute to a sufficiently broad picture of possible gas demand scenarios. Some caveats are noted in Appendix A. A description of the essence of the scenarios can be found in Appendix B.

1 BP. (2024). *Energy Outlook 2024*. p. 6; Equinor. (2024). *Energy Perspectives 2024*, p. 22; Financial Times. (2024). *BP raises forecasts for oil and gas demand as clean energy switch slows*. Retrieved from https://www.ft.com/content/38d03e16-6954-4589-aae1-94af7fbef23f; GECF. (2024). *Global Gas Outlook 2050*, p. 36; IEA. (2024). *World Energy Outlook 2024,* p. 134; Shell. (2024). *LNG Outlook 2024,* p. 7.

UNDERSTANDING SCENARIOS

This chapter introduces scenarios of several oil and gas producing companies (BP, Equinor, ExxonMobil, Shell, and TotalEnergies) which explore future gas demand developments. These companies take an active interest in where the world economy is heading. They shape their investments in a way that allows them to capture economic value and stay ahead of the competition. Before turning to the various scenarios of the companies, some clarifications about the various types of scenarios are discussed.

LOGIC AND AIM OF SCENARIOS

It was Herman Khan at the American thinktank RAND Corporation in the 1950s/60s who first started building scenarios to analyse the impact of a possible nuclear war during the Cold War. Khan's philosophy centred around 'future-now' thinking, using both detailed analysis and imagination to write a report as if it were written at some future date. During the 1960s/70s, General Electric was one of the first companies to apply this technique. Yet, it were Pierre Wack at Shell and Peter Schwartz at the Stanford Research Institute International (SRI), who further developed scenario thinking and introduced scenario planning to management as a strategy tool.[2] Through Shell's Group Planning department, Pierre Wack and his scenario team alerted Shell's management in advance to some of the confounding events of those times, like the oil price shocks of 1973 and 1979, and the fall of the Soviet Union.[3]

Scenarios are not predictions about what will happen in the future. Rather, they are built on the premise that the future is uncertain and unknowable, which aligns with thinking the unthinkable. This approach, often called the intuitive style, was further developed by Shell and SRI, and mirrored Khan's philosophy.[4] Scenarios could be defined as a set of plausible stories of how the world might develop, and provide a deep understanding of the forces that potentially push the future along different

2 Bradfield, R. et al. (2005). The origins and evolution of scenario techniques in long range business planning. *Futures, 37(8)*, pp. 795-812; Chermack, T. (2017). *Foundations of scenario planning: The story of Pierre Wack.* Routledge; Verity, J. (2003). Scenario planning as a strategy. *European Business Journal, 5*(4), pp. 185-195.

3 Kleiner, A. (2003). *The man who saw the future.* Retrieved from https://www.strategy-business.com/article/8220

4 Curry, A., Galviz-Lopez, C. & Spiers, E. (2021). A critical history of scenario planning. *The Handbook of Social Futures, Abingdon: Routledge;* Kleiner, A. (2003). *The man who saw the future.* Retrieved from https://www.strategy-business.com/article/8220; Verity, J. (2003). Scenario planning as a strategy. *European Business Journal, 5*(4), pp. 185-195.

paths.[5] Through different scenarios – alternative pictures of the future – and challenging strategies for resilience in these different possible outcomes, managers and companies try to acquire a better context for developing long-term strategies and short-term contingency plans.[6]

There is an essential difference between the two main categories of scenarios, namely backcasting and forecasting scenarios. In forecasting scenarios, the idea is to use current knowledge and analyse ongoing trends to investigate potential futures and explore how various fundamentals[7] might develop. This logic is often called the bottom-up approach. In backcasting, as the name suggests, the scenario works backwards from a hypothetical or desired outcome, to identify factors that are needed to achieve that outcome.[8] It is a target-seeking scenario that establishes the end target, after which the analysis starts on a variety of factors to seek how these variables need to change over time to achieve the hypothetical target that was set.

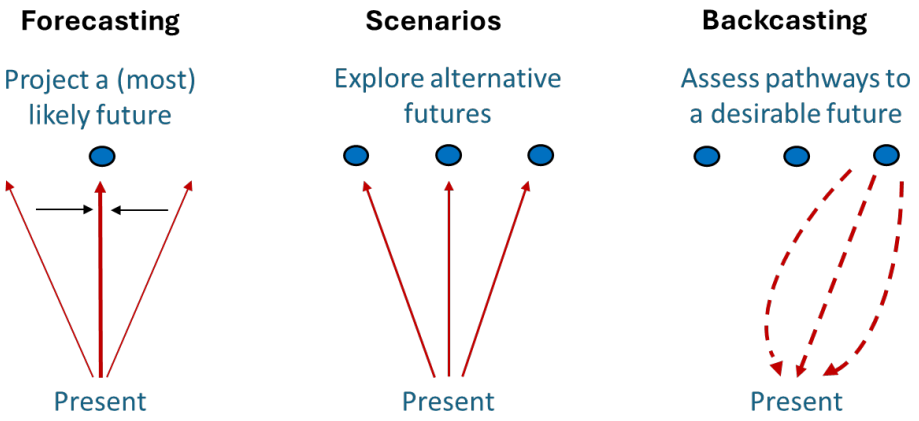

FIGURE 1 SCENARIO LOGIC AND DIFFERENCE BETWEEN FORECASTING AND BACKCASTING APPROACH.

5 Schwartz, P. (1997). *Art of the long view: planning for the future in an uncertain world*. John Wiley & Sons.
6 Verity, J. (2003). Scenario planning as a strategy. *European Business Journal,* 5(4), pp. 185-195.
7 Fundamentals in this case refers to social, economic, technological, environmental, and political trends and developments.
8 ExxonMobil. (2024). *The energy transition: signposts and scenarios.* Retrieved from https://corporate.exxonmobil.com/what-we-do/energy-supply/global-outlook/energy-transition-signposts

SELECTED SCENARIOS

This report uses scenarios of some corporations active in the oil and gas industry to analyse the future natural gas demand developments. Before delving further into the discussion about natural gas demand in the different scenarios, it is essential to note that these scenarios may possibly have an inherent bias. Although companies argue that their outlook does not endorse a specific outcome[9], their perspective on the world, particularly on oil and gas, could differ from other organisations like the IEA or other companies and institutions. While a company like ExxonMobil may have a technological-economic bias, an organisation like the IEA may have some inevitable policy or political bias. Therefore, it is essential to remember that these different perspectives could translate into different views on demand and the role of oil and natural gas in future energy mixes. Figure 2 illustrates the factors that play a role in the different scenarios.

In the next chapters the following scenarios are explored: ExxonMobil's *Global Outlook 2024*, Equinor's Energy Perspectives 2024 (*Walls* & *Bridges*), BP's Energy Outlook 2024 (*Current Trajectory* & *Net-Zero*), TotalEnergies' Energy Outlook 2024 (*Trends, Momentum & Rupture)* and Shell's Energy Security Scenarios 2023 (*Archipelagos* & *Sky 2050*). ExxonMobil's *Global Outlook 2024*, Equinor's *Walls*, BP's *Current Trajectory*, TotalEnergies' *Trends & Momentum*, and Shell's *Archipelagos* are forecasting scenarios that use a bottom-up approach based on current factors and macroeconomic fundamentals.[10] The other four scenarios – *Bridges, Net Zero, Rupture,* and *Sky 2050* – represent normative backcasting scenarios that are broadly in line with climate ambitions like the Paris Agreement.[11] First, global natural gas demand towards 2050 is examined to highlight the different trajectories of the forecasting and backcasting scenarios in the coming 25 years. The next section goes into more detail on natural gas demand up to 2035, to explore factors that might shape the pathway along which global and regional gas demand could move in the coming ten years. This medium-term outlook discusses the forecasting (bottom-up) and backcasting (top-down) scenarios in two different sections.

9 ExxonMobil. (2024). *Global Outlook 2024,* p. 3.

10 BP. (2024). *Energy Outlook 2024;* Equinor. (2024). *Energy Perspectives 2024*; ExxonMobil. (2024). *Global Outlook 2024;* Shell. (2023). *Energy Security Scenarios 2023*; TotalEnergies. (2024). *Energy Outlook 2024.*

11 BP. (2024). *Energy Outlook 2024;* Equinor. (2024). *Energy Perspectives 2024*; Shell. (2023). *Energy Security Scenarios 2023*; TotalEnergies. (2024). *Energy Outlook 2024.*

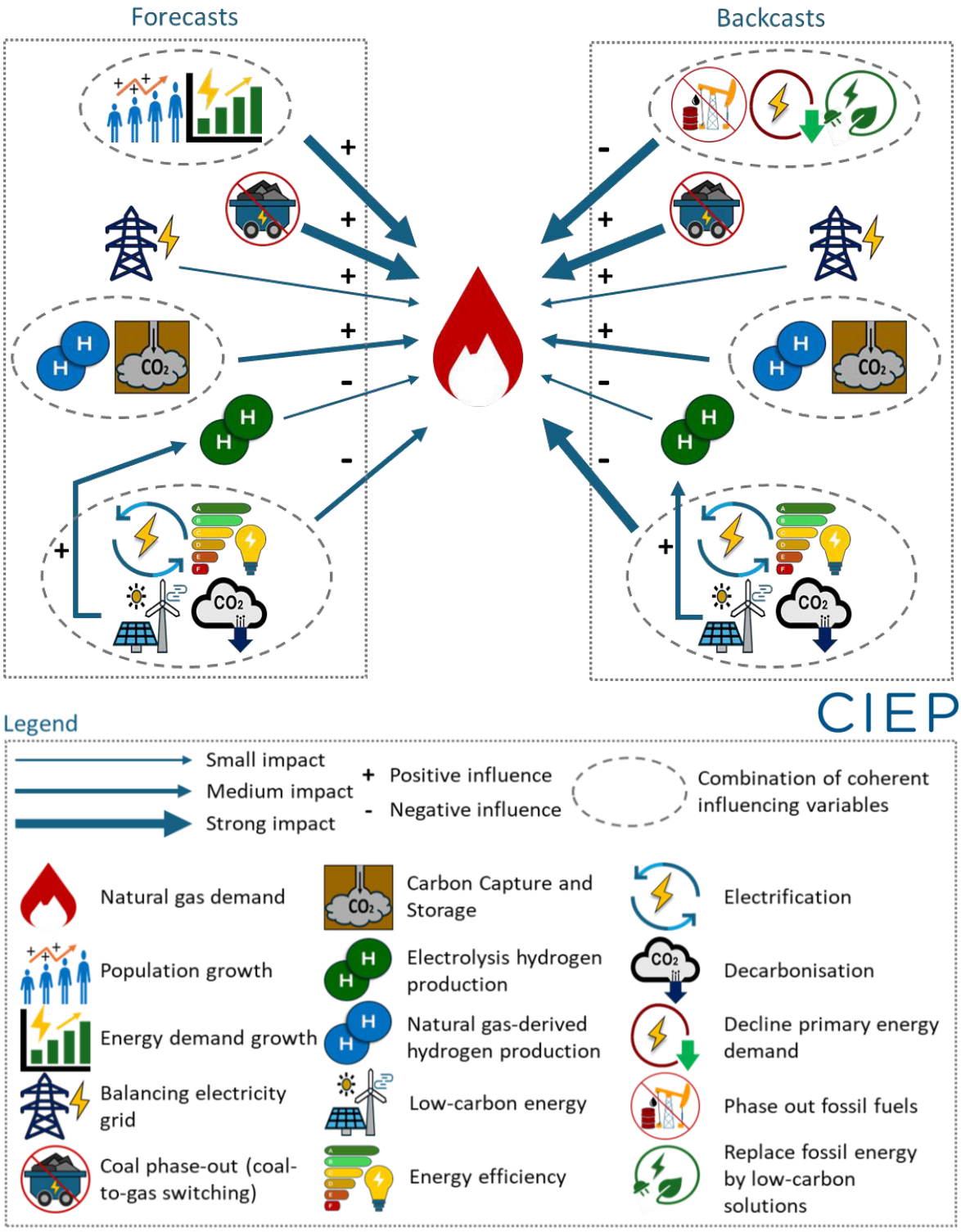

FIGURE 2 OVERVIEW OF KEY VARIABLES INFLUENCING NATURAL GAS DEMAND IN FORECASTING AND BACKCASTING SCENARIOS.

CORPORATE GAS DEMAND OUTLOOKS TOWARDS 2050

The further one tries to look into the future, the greater the range of uncertainty and outcome becomes. Figure 3 below illustrates how the range in gas demand outlooks diverges up to 2050. However, it is essential to note that within the two categories of scenarios, backcasting and forecasting, it is possible to see relative similarities regarding 2025 and 2050 levels, as well as similar rends in the trajectory.

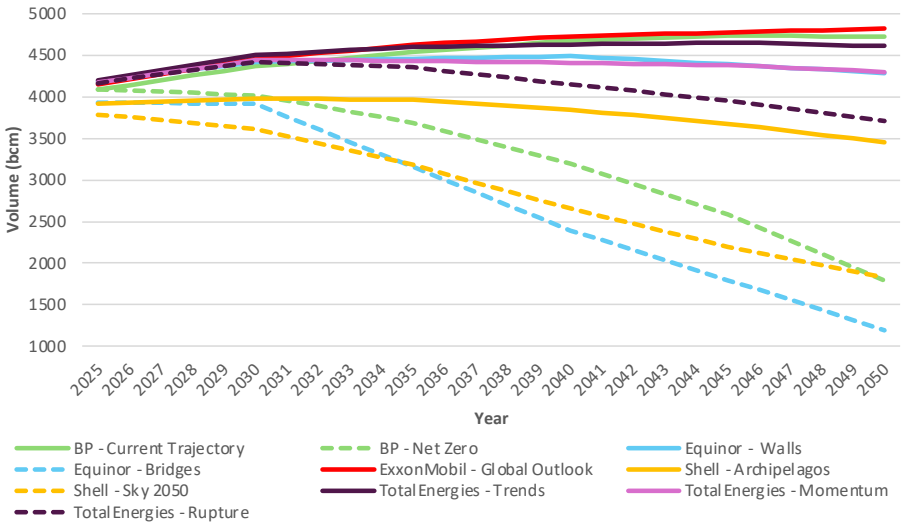

FIGURE 3 GLOBAL NATURAL GAS DEMAND TRAJECTORIES IN THE DIFFERENT SCENARIOS.[12] THE SOLID AND DOTTED LINES REPRESENT THE FORECASTING AND BACKCASTING SCENARIOS, RESPECTIVELY.

For example, Shell's *Archipelagos* scenario uses a different starting level in 2025 than Equinor's *Walls* scenario does (a difference of +/- 270 bcm[13], equivalent of two-thirds of the current EU gas market). However, they show a relatively similar trajectory up to 2050. Both scenarios see gas demand continually grow in the coming years, although *Archipelagos* sees gas demand peaking half a decade earlier than *Walls*. *Walls* experiences a temporary uptick in gas demand with an additional growth of

12 Based on data from: BP. (2024). *Energy Outlook 2024*; Equinor. (2024). *Energy Perspectives 2024*; ExxonMobil. (2024). *Global Outlook 2024;* Shell. (2023). *Energy Security Scenarios 2023;* TotalEnergies. (2024). *Energy Outlook 2024.*

13 Equinor. (2024). *Energy Perspectives 2024 extended data file* [Dataset]. Retrieved from https://www.equinor.com/sustainability/energy-perspectives#downloads; Shell. (2023). *Energy Security Scenarios 2023 underlying data* [Dataset]. Retrieved from https://www.shell.com/news-and-insights/scenarios/the-energy-security-scenarios.html.

around 300 bcm from 2025, to its peak demand in 2035 (+/- 4460 bcm).[14] In *Archipelagos,* gas demand growth decelerates after 2035 and ultimately dampens as decarbonisation intensifies, due to energy efficiency and significant growth of renewable energy. In Equinor's *Walls,* gas demand starts to decline after 2040. By 2050, the difference between the two scenarios is roughly 830 bcm, with *Walls* and *Archipelagos* at respectively around 4300 and 3460 bcm in 2050.[15] In certain aspects, TotalEnergies' *Momentum* scenario is also comparable to both *Archipelagos* and *Walls*. Like *Archipelagos*, *Momentum* sees growing gas demand up to 2030 and then a turning point with decelerated growth towards declining demand. Like *Walls, Momentum* sees a decline in global gas demand*,* after 2030, albeit at a slower pace, to ultimately end up at comparable levels of around 4300 bcm by 2050.[16]

The main underlying factors concern the role of gas and how peak gas demand is defined. In both *Walls* and *Momentum,* gas is rather seen as a transition fuel, to phase out more polluting forms of energy like unabated coal.[17] However, after 2030, *Momentum* sees a decline of the role of gas in decarbonising the power sector in combination with renewables, as it only plays a more balancing role for the grid, which translates into systemic relevance but smaller volumes being consumed.[18] Whereas *Walls* sees the unabated coal phase-out taking longer, and predicts growth of new drivers for gas demand, like low-carbon hydrogen production from natural gas with Carbon Capture and Storage (CCS)[19]. In *Archipelagos*, the rapid growth of renewables (solar and wind) causes a turning point for gas demand at an earlier stage, around 2030, after which natural gas stops growing as a source of additional power generation.[20] Regarding the description of peak gas demand, in *Walls,* Equinor describes that peak demand could occur in 2035. However, in their forecasts, total gas demand in 2040 is slightly higher, which means a distinction is necessary between peak demand growth in absolute or percentage terms and peak total

14 Equinor. (2024). *Energy Perspectives 2024 extended data file* [Dataset]. Retrieved from https://www.equinor.com/sustainability/energy-perspectives#downloads.

15 Equinor. (2024). *Energy Perspectives 2024 extended data file* [Dataset]. Retrieved from https://www.equinor.com/sustainability/energy-perspectives#downloads; Shell. (2023). *Energy Security Scenarios 2023 underlying data* [Dataset]. Retrieved from https://www.shell.com/news-and-insights/scenarios/the-energy-security-scenarios.html.

16 Equinor. (2024). *Energy Perspectives 2024 extended data file* [Dataset]. Retrieved from https://www.equinor.com/sustainability/energy-perspectives#downloads; TotalEnergies. (2024). *Energy Outlook 2024 – DataBook* [Dataset]. Retrieved from https://totalenergies.com/investors/investors-presentations.

17 Equinor. (2024). *Energy Perspectives 2024,* p. 22*;* TotalEnergies. (2024). Energy Outlook 2024, p. 17.

18 TotalEnergies. (2024). *Energy Outlook 2024*, p. 20.

19 In order not to make it unnecessarily complicated, this article will not make any further distinction between all the different ways to deal with residual CO2. Where CCS is mentioned in this article, it may refer to Carbon Capture and Storage (CCS), Carbon Capture and Sequestration (CCS) or Carbon Capture Utilization and Storage or Sequestration (CCUS).

20 Shell. (2023). Energy Security Scenarios 2023, pp. 36 *& 58.*

demand. When Equinor refers to 2035 as the year of peak gas demand, it likely refers to the peak in gas demand growth in percentage terms, as global gas demand growth decelerates, up to its peak in 2040, to just below 4500 bcm.[21] In Figure 3, a further comparison can be made with ExxonMobil's *Global Outlook,* TotalEnergies' *Trends* and BP's *Current Trajectory* scenario, which project similar trajectories for global gas demand, driven by a comparable underlying logic. The underlying fundamentals mainly have to do with the increasing role of natural gas to support growth of energy demand caused by population growth and higher standards of living. These three scenarios align closely in terms of starting points and reach approximately 4800 bcm, 4600 bcm and 4700 bcm by 2050, respectively.[22] ExxonMobil's *Global Outlook* shows the biggest growth of total gas demand, growing up to 2035, after which it reaches a phase of lower growth and then almost a plateau phase. [23] In the first half of the outlook, BP's *Current Trajectory* anticipates gas demand growth, followed, in the second half of the outlook, by a slower growth rate after 2035 and a slight decline after 2045.[24] TotalEnergies' *Trends* shows growth of gas demand towards 2045, after which it starts to decline.[25] BP, ExxonMobil, and TotalEnergies expect that natural gas will play an essential role in meeting energy demand in emerging countries, which will add significantly to global gas demand. Both TotalEnergies and ExxonMobil expect that for the major growth regions, natural gas will be vital to reduce greenhouse gas emissions via coal-to-gas switching and CCS.[26] Like ExxonMobil, BP and TotalEnergies expect that the rise in gas consumption will mainly be driven by increasing use in the power and industrial sectors. Also, BP's *Current Trajectory* and TotalEnergies' *Trends* see the production of low-carbon hydrogen (natural gas with CCS) as a new driver for gas demand. Figures 4, 5 and 6 below highlight these drivers behind gas demand growth for ExxonMobil's *Global Outlook*, BP's *Current Trajectory*, and TotalEnergies' *Trends*.

21 Equinor. (2024). *Energy Perspectives 2024 extended data file* [Dataset]. Retrieved from https://www.equinor.com/sustainability/energy-perspectives#downloads.

22 BP. (2024). *Energy Outlook 2024 – summary tables* [Dataset], Retrieved from https://www.bp.com/en/global/corporate/energy-economics/energy-outlook/energy-outlook-downloads.html; ExxonMobil. (2024). *Global Outlook 2024* data [Dataset]. Retrieved from https://corporate.exxonmobil.com/sustainability-and-reports/global-outlook#ExploretheGlobal Outlook; TotalEnergies. (2024). *Energy outlook 2024 – DataBook* [Dataset]. Retrieved from https://totalenergies.com/investors/investors-presentations.

23 ExxonMobil. (2024). *Global Outlook 2024*. Retrieved from https://corporate.exxonmobil.com/sustainability-and-reports/global-outlook/energy-mix-projections.

24 BP. (2024). *Energy Outlook 2024*, p. 41.

25 TotalEnergies. (2024). *Energy Outlook 2024* – DataBook [Dataset]. Retrieved from https://totalenergies.com/investors/investors-presentations.

26 ExxonMobil. (2024). *Global Outlook 2024*, p. 2; TotalEnergies. (2024). *Energy Outlook 2024*, p. 12.

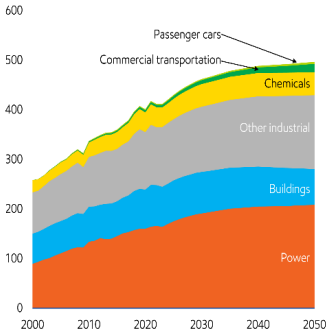

FIGURE 4 SECTORAL GLOBAL GAS DEMAND (BCF/DAY).

SOURCE: EXXONMOBIL, GLOBAL OUTLOOK 2024.

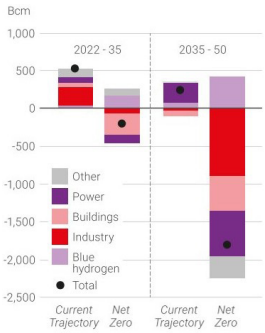

FIGURE 5 SECTORAL GLOBAL GAS DEMAND (BCM).

SOURCE: BP, ENERGY OUTLOOK 2024.

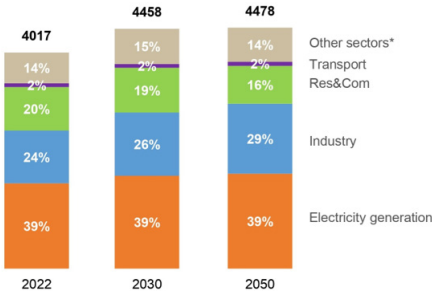

FIGURE 6 SECTORAL GLOBAL GAS DEMAND (BCM).

SOURCE: TOTALENERGIES, ENERGY OUTLOOK 2024.

Comparing the backcasting scenarios with a target of net-zero emissions around 2050, some differences are noticeable in Figure 3 – BP's *Net Zero*, Equinor's *Bridges*, TotalEnergies' *Rupture,* and Shell's *Sky 2050*. In Equinor's *Bridges,* natural gas demand peaks around 2025, declines relatively slowly until 2030 and then decreases more sharply to approximately 1200 bcm by 2050.[27] In BP's *Net Zero* scenario, global gas demand also declines from 2025 onwards and accelerates its decline after 2030. By 2050, in *Net* Zero, global gas demand has declined from around 4100 bcm in 2025 to around 1800 bcm in 2050.[28] A level that is similar to Shell's *Sky 2050* scenario volume by 2050 (+/- 1800 bcm).[29] The adoption of low-carbon energy, increased electrification and accelerating efficiency gains are the three main factors that cause a decline in gas demand in those three backcasting scenarios. TotalEnergies' *Rupture* differs from the three previously mentioned scenarios, as it sees a more significant role for natural gas, due to phasing out unabated coal, balancing power grids, CCS adoptions, and the medium-term dominance of natural gas-derived hydrogen production over electrolysis hydrogen production. Like the previously mentioned three backcasting scenarios, *Rupture* sees a global gas demand trajectory change around 2030, with demand starting to slowly decline towards 2035 and after that accelerate its decline down to 3700 bcm by 2050.[30]

27 Equinor. (2024). *Energy Perspectives 2024 extended data file* [Dataset]. Retrieved from https://www.equinor.com/sustainability/energy-perspectives#downloads.

28 BP. (2024). *Energy Outlook 2024 – summary tables* [Dataset], Retrieved from https://www.bp.com/en/global/corporate/energy-economics/energy-outlook/energy-outlook-downloads.html.

29 Shell. (2023). *Energy Security Scenarios 2023 underlying data* [Dataset]. Retrieved from https://www.shell.com/news-and-insights/scenarios/the-energy-security-scenarios.html.

30 TotalEnergies. (2024). *Energy Outlook 2024 – DataBook* [Dataset]. Retrieved from https://totalenergies.com/investors/investors-presentations.

It is necessary to remember, once again, that these scenarios and their trajectories do not state or describe what may happen but sketch an alternative but plausible picture of the future and what could happen regarding global gas demand. Summarising, the natural gas demand outlook towards 2050 illustrates some key features. First, on average, the forecasting scenarios see global gas demand growth towards 2030-2035, after which the growth in demand decelerates or, for some, turns into declining global gas demand. Second, the main growth engines for natural gas demand are phasing out coal and supporting rising energy demand levels, primarily concerning the power and industry sectors. In addition, most scenarios identify a new driver for gas demand as natural gas-derived hydrogen production (with CCS) dominates over electrolysis hydrogen production in the medium term. Last, the backcasting scenarios project, on average, a steep decline of gas demand, which accelerates around 2030-2035, driven by intensifying decarbonisation through increased electrification, low-carbon fuel adoption and efficiency gains.

To conclude, there is a clear gap in gas demand outlooks between the forecasting and backcasting scenarios. On average, the forecasts show an increase in global gas demand in the medium term and a plateau thereafter towards 2050, driven by the above-mentioned reasons. The backcasts, however, signal a significant decline in global gas demand towards 2050. There are various explanations for the gap between the two scenario categories. First, backcasts generally assume a decrease in total primary energy demand. Second, backcasts assume that existing and new energy demand will be met with low-carbon energy, instead of, for example, natural gas (as in the forecasts). Third, the backcasts assume that the uptake of renewable energy and energy efficiency will take place at such a pace that most natural gas is also pushed out of the energy mix, just like coal and oil. Fourth, most forecasts see difficulties in some sectors with replacing (fossil) energy sources with low-carbon energy, creating an extended role for gas as a transition fuel. Backcasts, however, assume that low-carbon energy can substitute much more fossil energy in the mix. All in all, this results in two different pictures when comparing the forecasts with the backcasts.

FORECASTING SCENARIOS GAS DEMAND OUTLOOK TOWARDS 2035

The previous section provided some broad scenario-based insights on global natural gas demand up to 2050. This section, however, explores more in-depth features that underlie the different gas demand trajectories in a medium-term outlook. Although it is always helpful to investigate scenarios and developments towards 2050 – an important year due to the net-zero pledges of many countries – it is equally, if not more, important to consider the short to medium-term timeframe (for security of supply reasons and investments). In addition, this section also analyses the natural gas demand outlooks for four different regions. Namely: the European Union[31], North America, Asia[32], and Latin America, Africa and the Middle East.[33]

GLOBAL GAS DEMAND OUTLOOK

Global gas demand is discussed for all the forecasting scenarios within the 2025-2035 period. The scenarios that belong to the forecasting category are ExxonMobil's *Global Outlook*, Equinor's *Walls*, BP's *Current Trajectory*, TotalEnergies' *Trends and Momentum,* and Shell's *Archipelagos*. Figure 7 illustrates the global gas demand for the medium-term outlook.

Standing out in Figure 7, is the about 200 bcm difference between *Archipelagos* and the other five scenarios. It is relevant to stress here that *Archipelagos* is a slightly older scenario.[34] One explanation could lie in the size of the economies across the different scenarios. For example, BP and Shell illustrate a different size of the world economy regarding primary energy mix (e.g., in 2022, Shell reports 608.55 EJ versus BP's 595 EJ[35]).

31 The European Union includes the countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, and Sweden. BP also includes Gibraltar in the EU region. Norway, Turkey, and the United Kingdom are not included in the EU region. ExxonMobil reports gas demand data only for Europe as a whole.

32 The region Asia represents a combination of the Asia-Pacific, which also includes Oceania.

33 Equinor's Energy Perspectives scenarios *Walls* and *Bridges* are not included in the pictures about the category group of Latin America, the Middle East and Africa, because of data harmonisation challenges of Middle East regional gas demand.

34 *Archipelagos* builds further upon the previous *Islands* scenario, (The Energy Transformation Scenarios, 2021).

35 Shell. (2023). *Energy Security Scenarios underlying data* [Dataset]. Retrieved from https://www.shell.com/news-and-insights/scenarios/the-energy-security-scenarios.html; BP. (2024). *Energy Outlook 2024 – summary tables* [Dataset], Retrieved from https://www.bp.com/en/global/corporate/energy-economics/energy-outlook/energy-outlook-downloads.html.

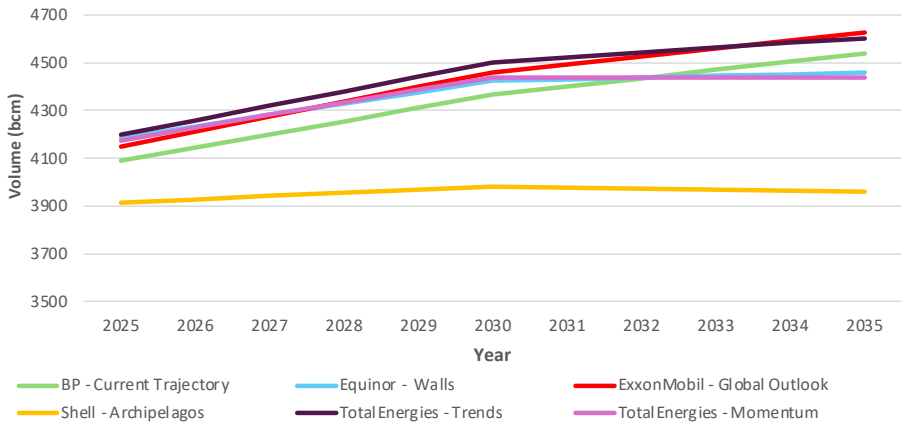

FIGURE 7 GLOBAL NATURAL GAS DEMAND IN FORECASTING SCENARIOS.[36]

Equinor in *Walls* and TotalEnergies in *Momentum* see the petrochemical sector and blue hydrogen production as the only sources of growing demand for oil and gas up to 2040. In addition, *Walls* and *Momentum* see natural gas demand continue to grow towards respectively 2035 and 2030 before starting to plateau, driven mainly by coal-to-gas switching in the power sector. In both scenarios, natural gas plays a vital role in the global energy transition, by helping to phase out more polluting forms of energy and to balance electricity systems increasingly dominated by variable electricity production from solar and wind. In *Walls*, global natural gas demand increases from around 4180 bcm in 2025 to around 4460 bcm by 2035, an increase of about 300 bcm.[37] To put this into perspective, 300 bcm is comparable to the European Union's natural gas imports in 2023.[38] *Momentum* sees global gas demand increase from around 4180 bcm in 2025 to 4440 bcm by 2035[39], a roughly similar increase as in *Walls*.

ExxonMobil's *Global Outlook*, BP's *Current Trajectory,* and TotalEnergies' *Trends* show similar trajectories with comparable gas demand growth to 2030 and a phase of lower growth afterwards.[40] As mentioned earlier for those scenarios, natural gas will be essential in meeting energy demand in developing countries. ExxonMobil, BP, and

36 Based on data from: BP. (2024). *Energy Outlook 2024*; Equinor. (2024). *Energy Perspectives 2024*; ExxonMobil. (2024). *Global Outlook 2024*; Shell. (2023). *Energy Security Scenarios 2023*; TotalEnergies. (2024). *Energy Outlook 2024*.

37 Equinor. (2024). *Energy Perspectives 2024 extended data file* [Dataset]. Retrieved from https://www.equinor.com/sustainability/energy-perspectives#downloads.

38 ACER. (2024). *Analysis of the European LNG market developments: 2024 Market Monitoring Report*, p.7.

39 TotalEnergies. (2024). *Energy Outlook 2024 – DataBook* [Dataset]. Retrieved from https://totalenergies.com/investors/investors-presentations.

40 BP. (2024). *Energy Outlook 2024, p. 41;* ExxonMobil. (2024). *Global Outlook 2024.* Retrieved from https://corporate.exxonmobil.com/sustainability-and-reports/global-outlook/energy-mix-projections.; TotalEnergies. (2024). *Energy outlook 2024 – DataBook* [Dataset]. Retrieved from https://totalenergies.com/investors/investors-presentations.

TotalEnergies illustrate in those scenarios that natural gas plays a significant role in meeting power, residential, and industrial demand. *Walls, Trends,* and the *Global Outlook* envision industrial activity and power generation as the main driver of natural gas demand. In addition, in the major growth regions, natural gas plays a vital role in reducing greenhouse gas emissions via coal-to-gas switching and CCS adoption. ExxonMobil, BP, and TotalEnergies anticipate the highest total increase in gas demand up to 2030, after which it reaches a phase of lower growth.[41] Growing gas demand in the Asian region primarily explains the increase in global gas demand up to 2035. ExxonMobil sees global gas demand growing by around 475 bm from +/- 4150 bcm in 2025 to 4625 bcm by 2035, for which Asia accounts for around 67 per cent (+/- 320 bcm).[42] TotalEnergies' *Trends* sees global gas demand increase with around 400 bcm, from around 4200 bcm in 2025 to around 4600 bcm by 2035, for which Asia accounts for 57 per cent (+/- 230 bcm).[43]

BP's *Current Trajectory* sees a comparable trajectory of global gas demand growth - especially compared with ExxonMobil's *Global Outlook* - as it projects demand increasing from around 4090 bcm in 2025 to around 4540 bcm by 2035. The Asian region accounts for 56 per cent of the demand growth in *Current Trajectory*.[44] Like ExxonMobil's *Global Outlook*, *Current Trajectory* envisages global gas demand increases by around 450 bcm, a rough equivalent of total gas demand in the Middle-East region in 2022.[45] Like ExxonMobil, BP's *Current Trajectory* sees a rise in gas consumption that is driven by increasing use in the power and industrial sectors. Natural gas in developed economies is broadly unchanged as declining gas use in the residential sector is offset by gains in transport and as an industrial feedstock to produce hydrogen with CCS. In the power sector, gas demand declines only marginally, as it supports the ongoing displacement of coal generation alongside the growth in renewables.[46]

41 BP. (2024). *Energy Outlook 2024 – summary tables* [Dataset], Retrieved from https://www.bp.com/en/global/corporate/energy-economics/energy-outlook/energy-outlook-downloads.html; ExxonMobil. (2024). *Global Outlook 2024 data* [Dataset]. Retrieved from https://corporate.exxonmobil.com/sustainability-and-reports/global-outlook#ExploretheGlobal Outlook; TotalEnergies. (2024). *Energy Outlook 2024 – DataBook* [Dataset]. Retrieved from https://totalenergies.com/investors/investors-presentations.

42 ExxonMobil. (2024). *Global Outlook 2024 data* [Dataset]. Retrieved from https://corporate.exxonmobil.com/sustainability-and-reports/global-outlook#ExploretheGlobalOutlook.

43 TotalEnergies. (2024). *Energy Outlook 2024 – DataBook* [Dataset]. Retrieved from https://totalenergies.com/investors/investors-presentations.

44 BP. (2024). Energy Outlook 2024 – *summary tables* [Dataset], Retrieved from https://www.bp.com/en/global/corporate/energy-economics/energy-outlook/energy-outlook-downloads.html

45 BP. (2024). *Energy Outlook 2024 – summary tables* [Dataset], Retrieved from https://www.bp.com/en/global/corporate/energy-economics/energy-outlook/energy-outlook-downloads.html.

46 ExxonMobil. (2024). *Global Outlook 2024;* BP. (2024). *Energy Outlook 2024*, p. 2.

REGIONAL GAS DEMAND OUTLOOKS

This section provides insights into the trajectories of gas demand for the four different regions, based on the same scenarios.

EUROPEAN UNION

Figure 8 below illustrates the gas demand trajectory for the European Union (EU) across the different scenarios. The varying starting positions could be a result of regional harmonisation challenges due to available datasets. Data for the EU is often broken up in regions like West/East, South/North, or Europe in general is used. All scenarios publish gas demand data for the EU separately, except ExxonMobil which only publishes gas demand for Europe as a whole. So, ExxonMobil's data probably also includes some non-EU member states, like Turkey or Norway, which could not be filtered out. Also, differences in assessments on the size of the EU energy mix could play an important role. For example, ExxonMobil, BP, and Shell, differ in their view of the size of the EU primary energy mix with a reported size of 57.32 EJ, 55.97 EJ, and 53 EJ in 2020, respectively.

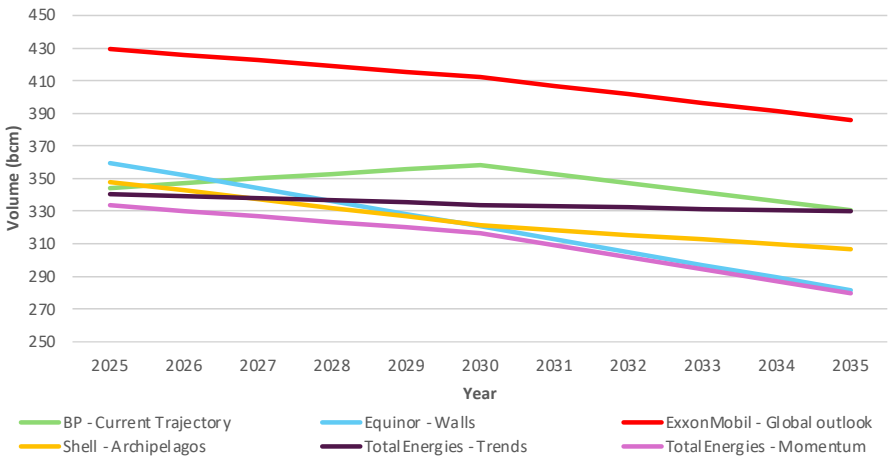

FIGURE 8 EUROPEAN UNION NATURAL GAS DEMAND OUTLOOK.[47]

ExxonMobil's *Global Outlook* sees Europe's gas demand continue to decline, with a slight acceleration of this decline after 2030, driven by decreasing primary energy demand and the increase of biomass, wind and solar.[48] In contrast, BP's *Current*

47 Based on data from: BP. (2024). *Energy Outlook 2024*; Equinor. (2024). *Energy Perspectives 2024*; ExxonMobil. (2024). *Global Outlook 2024*; Shell. (2023). *Energy Security Scenarios 2023*; TotalEnergies. (2024). *Energy Outlook 2024*.

48 ExxonMobil. *Global Outlook 2024 data* [Dataset]. Retrieved from https://corporate.exxonmobil.com/sustainability-and-reports/global-outlook#ExploretheGlobalOutlook.

Trajectory sees a slight gas demand growth towards 2030, as the region transitions from an energy addition to an energy substitution phase.[49] *Walls* and *Archipelagos* see declining gas demand in line with Europe's decarbonisation trend, driven by electrification and increased energy efficiency.[50] Similarly, TotalEnergies' *Trends* and *Momentum* see a decline in European gas demand, with the latter seeing a steeper decline after 2030. The difference between *Trends* and *Momentum* is driven by forces like the acceleration of electrification and the adoption of heat pumps.[51]

NORTH AMERICA

Figure 9 below illustrates the natural gas demand outlooks for North America. It clearly illustrates the diverging view on the trajectory of gas demand for the North American region. Like ExxonMobil, Equinor's *Walls* and TotalEnergies' *Trends* & *Momentum* see natural gas demand growing up to 2030, after which, among other factors, the Inflation Reduction Act (IRA) leads to reduced gas demand for the power, industry and residential sectors.[52] *Archipelagos*, and *Current Trajectory* to a lesser extent, see gas demand declining from 2025 onwards. There are several possible reasons for the diverging trajectory of *Archipelagos*. One reason could be that it has used a slightly older data set for the scenarios (published early 2023).

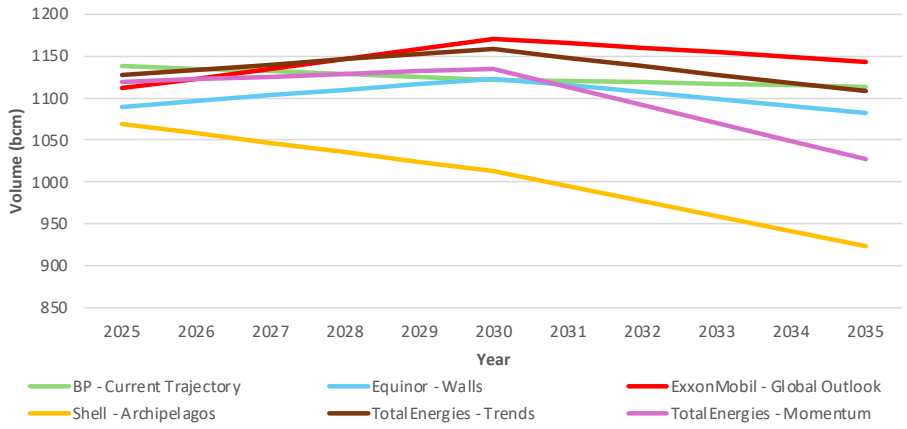

FIGURE 9 NORTH AMERICA NATURAL GAS DEMAND OUTLOOK.[53]

49 BP. (2024). *Energy Outlook 2024*, p. 41.

50 *Equinor. (2024). Energy Perspectives 2024*, p. 22; Shell. (2023). *Energy Security Scenarios underlying data* [Dataset]. Retrieved from https://www.shell.com/news-and-insights/scenarios/the-energy-security-scenarios.html.

51 TotalEnergies. (2024). *Energy Outlook 2024*, p. 16.

52 ExxonMobil. *Global Outlook 2024 data* [Dataset]. Retrieved from https://corporate.exxonmobil.com/sustainability-and-reports/global-outlook#ExploretheGlobalOutlook; Equinor. (2024). *Energy Perspectives 2024*, p. 22; TotalEnergies. (2024). *Energy Outlook 2024 – DataBook* [Dataset]. Retrieved from https://totalenergies.com/investors/investors-presentations

53 Based on data from: BP. (2024). *Energy Outlook 2024*; Equinor. (2024). *Energy Perspectives 2024*; ExxonMobil. (2024). *Global Outlook 2024*; Shell. (2023). *Energy Security Scenarios 2023*; TotalEnergies. (2024). *Energy Outlook 2024.*

Moreover, before the introduction of the Inflation Reduction Act (IRA), such a major role for hydrogen production had not yet been discussed. In Shell's Energy security scenarios, the IRA is primarily presented as a stimulus for electrolysis-based hydrogen. In addition, in *Archipelagos* Shell sees relatively few CCS built, and little usage of carbon pricing mechanisms like the IRA's 45Q system.[54] Another reason could be that although Shell argues that the USA increases gas (and oil) production to reduce pressure on energy prices, this new supply is via LNG primarily destined for foreign markets and not to satisfy domestic demand.

LATIN AMERICA, AFRICA, AND THE MIDDLE EAST

Latin America, Africa, and the Middle East are three developing regions in which almost all outlooks expect natural gas demand to increase, as illustrated in Figure 10 below.[55] As these countries further develop, natural gas fills the gap to satisfy growing energy needs.[56] On average, in all forecasting scenarios natural gas demand growth is higher in Africa than in Latin America. The Middle East region sees significant gas demand growth, on average with 100 bcm in the coming years. However, only *Archipelagos* anticipates a relatively small decline in gas demand growth after 2030 for the Middle East. Figure 10 below illustrates how the forecasts anticipate a steady increase in natural gas demand in the three regions combined.

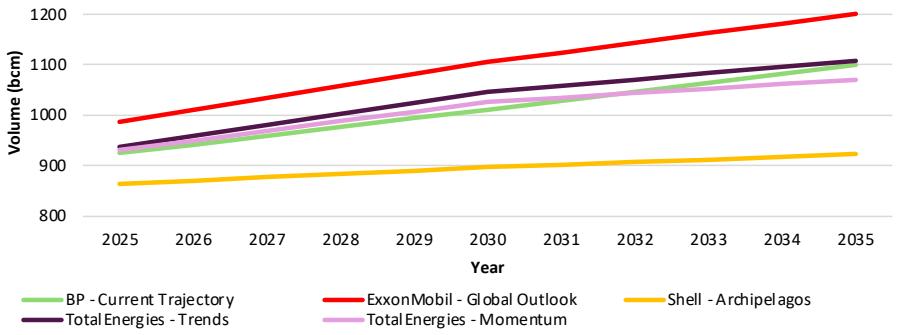

FIGURE 10 REGIONAL NATURAL GAS DEMAND OUTLOOK OF LATIN AMERICA, AFRICA & THE MIDDLE EAST.[57]

54 Shell. (2023). *Energy Security Scenarios*, pp. 42, 88 & 105 .

55 Equinor's *Walls* is not included due to data harmonisation challenges of regional gas demand in the Middle East.

56 BP. (2024). *Energy Outlook 2024*, p. 41; Equinor. (2024). *Energy Perspectives 2024*, p. 22; ExxonMobil. (2024). *Global Outlook 2024.* Retrieved from https://corporate.exxonmobil.com/sustainability-and-reports/global-outlook/energy-mix-projections; Shell. (2023). *Energy Security Scenarios 2023* p. 58; TotalEnergies. (2024). *Energy Outlook 2024*, p. 22.

57 Based on data from: BP. (2024). Energy Outlook 2024; ExxonMobil. (2024). *Global Outlook 2024*; Shell. (2023). *Energy Security Scenarios 2023*; TotalEnergies. (2024). *Energy Outlook 2024*.

ASIA

Towards 2035, Asia is primarily responsible for the growth in global gas demand and for the decelerating growth afterwards, as illustrated in Figure 11 below. The growth in Asian gas demand is caused by increasing demand from the industry and power sectors and coal-to-gas switching in response to clean air concerns and climate neutrality pledges. All six scenarios see significant growth till 2030. Thereafter, demand continues to grow steadily, but at a lower pace. ExxonMobil's *Global Outlook* sees the most significant growth in comparison to the other five scenarios.[58]

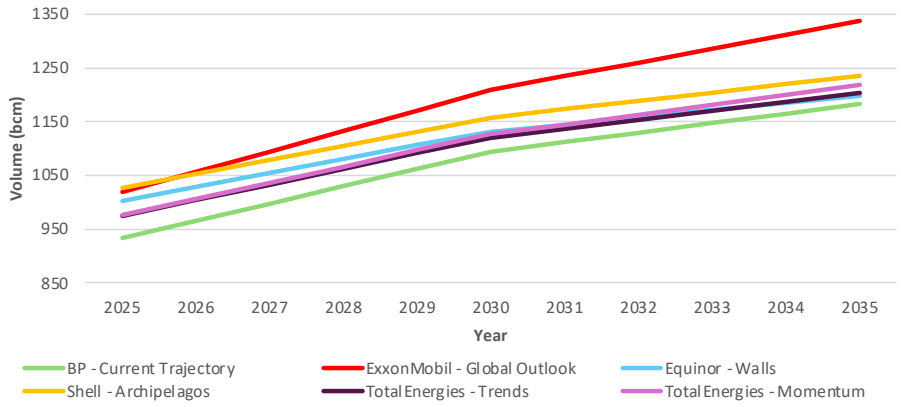

FIGURE 11 ASIA NATURAL GAS DEMAND OUTLOOK.[59]

Concluding: in the medium period of 2025-2035, all forecasting scenarios see an increase in global gas demand. On average, they see significant global gas demand growth up to 2030, after which it decelerates. The different scenarios show how, in general, the Asian region is the growth engine behind the rise of global gas demand. The regional outlooks show differences in trajectories between the region's forecasting scenarios. The European Union sees, on average, an ongoing decline in gas demand driven by Europe's decarbonisation trend. The scenarios show two diverging trends for the North American region. On the one hand, most scenarios see short-term gas demand growth up to 2030 and a decline afterwards. On the other hand, some scenarios see gas demand decline starting from 2025 onwards. The regions of Latin America, Africa, and the Middle East see growth in gas demand, mainly driven by growing energy needs. The significant growth in gas demand in the Asian region is driven by increasing demand from the industry and power sectors.

58 ExxonMobil *Global Outlook 2024 data* [Dataset]. Retrieved from https://corporate.exxonmobil.com/sustainability-and-reports/global-outlook#ExploretheGlobalOutlook; Equinor Energy Perspectives 2024 extended data file [Dataset]. Retrieved from https://www.equinor.com/sustainability/energy-perspectives#downloads.; BP Energy Outlook 2024 – summary tables [Dataset], Retrieved from https://www.bp.com/en/global/corporate/energy-economics/energy-outlook/energy-outlook-downloads.html; Shell Energy Security Scenarios 2023 underlying data [Dataset]. Retrieved from https://www.shell.com/news-and-insights/scenarios/the-energy-security-scenarios.html.

59 Based on data from: BP. (2024). *Energy Outlook 2024*; Equinor. (2024). *Energy Perspectives 2024*; ExxonMobil. (2024). *Global Outlook 2024*; Shell. (2023). *Energy Security Scenarios 2023*; TotalEnergies. (2024). *Energy Outlook 2024*.

BACKCASTING SCENARIOS GAS DEMAND OUTLOOK TOWARDS 2035

The previous section discussed the forecasting scenarios to provide some scenario-based insights on global gas demand up to 2035. This section discusses the same period and regions, but instead of the forecasting scenarios, it focuses on the backcasting scenarios. Like the previous section, global gas demand is discussed first, after which the section analyses the outlooks for the different regions.

GLOBAL GAS DEMAND OUTLOOK

The backcasting scenarios are normative top-down scenarios and highlight how specific factors – including natural gas demand – may need to change to achieve a hypothetical outcome, in this case, net zero emissions. Therefore, it is not a forecast of the gas demand trajectory, but more of a mirror of how gas demand may need to change to follow the net zero pathway of different scenarios, depending on the assumptions in national energy mix choices. Figure 12 shows the selected scenarios for the period up to 2035.

Three backcasting scenarios – BP's *Net Zero,* Equinor's *Bridges*, and Shell's *Sky 2050* – highlight a significant decrease in natural gas demand, especially after 2030. The main underlying drivers are the rapid uptake of renewables and the phase-out of fossil fuels, which occur so quickly that the role of gas as a transition fuel is limited. The change in gas demand is most significant in developed regions. This global demand reduction accelerates after 2030. The only sectors with slight gas demand growth are low-carbon hydrogen production and the petrochemical sectors, although they also peak by 2040, before declining towards 2050. *Bridges* sees that this decline will happen when enough renewable capacity/production makes electrolysis hydrogen the preferred choice.[60] Another important element of backcasting scenarios is the significant decrease in total primary energy demand in *Net* Zero and *Bridges*.[61] *Sky2050*, however, sees an increase of primary energy demand by around 11 EJ between 2025-2035.[62] A combination of accelerated gains in energy efficiency, electrification, and adoption of low-carbon solutions cause the world economy to shift into a phase of energy substitution from 2030 onwards.[63]

60 Equinor. (2024). *Energy Perspectives 2024*, p. 22.

61 BP. (2024). *Energy Outlook 2024 – summary tables* [Dataset], Retrieved from https://www.bp.com/en/global/corporate/energy-economics/energy-outlook/energy-outlook-downloads.html; Equinor. (2024). *Energy Perspectives 2024 extended data file* [Dataset]. Retrieved from https://www.equinor.com/sustainability/energy-perspectives#downloads.

62 Shell. (2023). *Energy Security Scenarios underlying data* [Dataset]. Retrieved from https://www.shell.com/news-and-insights/scenarios/the-energy-security-scenarios.html.

63 BP. (2024). *Energy Outlook 2024*, p. 19.

Hence, even as gas demand decreases significantly in these three backcasting scenarios, it still represents a significant share of the total energy mix.

TotalEnergies' *Rupture*, however, sees gas demand grow with around 250 bcm to 2030, and decline relatively lightly with around 60 bcm towards 2035.[64]. In *Rupture*, natural gas has a more vital role in the transition. *Rupture* anticipates an increase of global primary energy demand and a rapid phasing out of coal and fuel oil by renewables, combined with natural gas. In the power generation sector, the use of gas is seen as essential for balancing electricity systems, which are increasingly dominated by variable electricity production from solar and wind. In the industry, gas is anticipated to replace almost all coal and produce low-carbon hydrogen, when abated. Like in *Bridges,* low-carbon hydrogen production with CCS dominates in the short term until 2040, when electrolysis hydrogen becomes the preferred choice.[65]

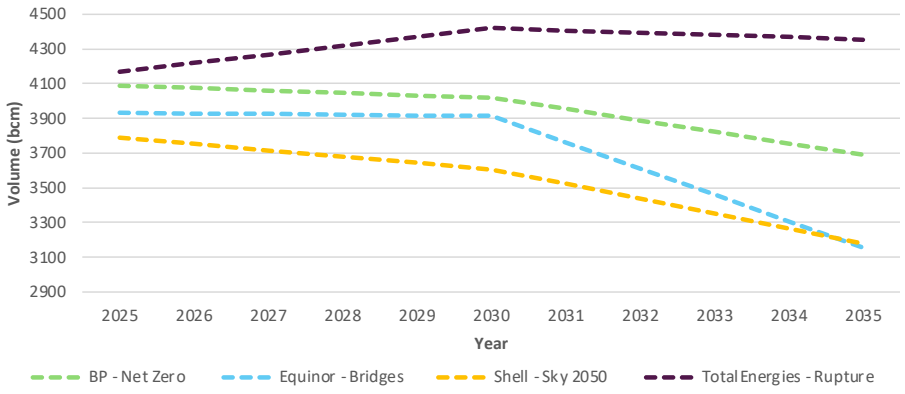

FIGURE 12 GLOBAL GAS DEMAND OUTLOOK.[66]

REGIONAL GAS DEMAND OUTLOOKS

EUROPEAN UNION AND NORTH AMERICA

In the backcasting outlook the European Union and North America will see significant gas demand reductions, as shown in Figures 13 and 14. Regarding the European Union, *Net Zero, Bridges,* and *Sky 2050* illustrate a steeper decline in natural gas demand than their forecasting counterparts. In 2035, the volume in BP's *Net Zero* is almost half of the volume of its forecasting counterpart, *Current Trajectory.*[67] In *Bridges*, the demand reduction accelerates after 2030, as renewables begin to capture market share in the power and heat sectors quickly.[68] *Rupture* sees a

64 TotalEnergies. (2024). *Energy Outlook 2024 – DataBook* [Dataset]. Retrieved from https://totalenergies.com/investors/investors-presentations.

65 Equinor. (2024). Energy Perspectives 2024, p. 24; TotalEnergies. (2024). *Energy Outlook 2024*, p. 30.

66 Based on data from: BP. (2024). *Energy Outlook 2024*; Equinor. (2024). *Energy Perspectives 2024*; Shell. (2023). *Energy Security Scenarios 2023*; TotalEnergies. (2024). *Energy Outlook 2024*.

67 BP. (2024). *Energy Outlook 2024 – summary tables* [Dataset], Retrieved from https://www.bp.com/en/global/corporate/energy-economics/energy-outlook/energy-outlook-downloads.html.

68 Equinor. (2024). Energy Perspectives 2024, *p. 22*.

comparable trajectory towards 2030 as its counterpart *Momentum*, as both see a decline of around 15 bcm towards 2030.[69] Like the EU, the North American region sees substantial gas demand reductions in the backcasting scenarios. The shift away from natural gas happens earlier and with greater force in the developed economies. Increased electrification and the gradual introduction of low-carbon fuels are key drivers of the decline in gas demand. Around 80% of natural gas consumption in *Net Zero* is abated with CCS by 2050.[70] *Net Zero* and *Sky 2050* see gas demand declining similarly. *Rupture* and *Bridges* present a comparable trajectory, but the difference with the former two could be that they foresee a bigger short-term role of gas for low-carbon hydrogen production with CCS in the latter two scenarios.[71]

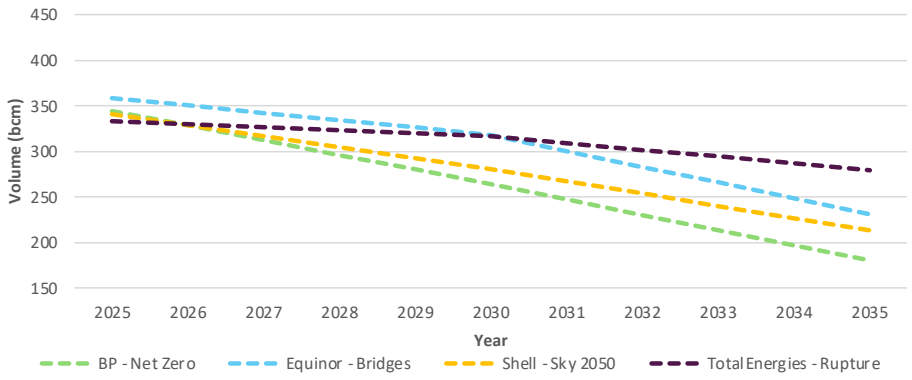

FIGURE 13 EUROPEAN UNION NATURAL GAS DEMAND OUTLOOK.[72]

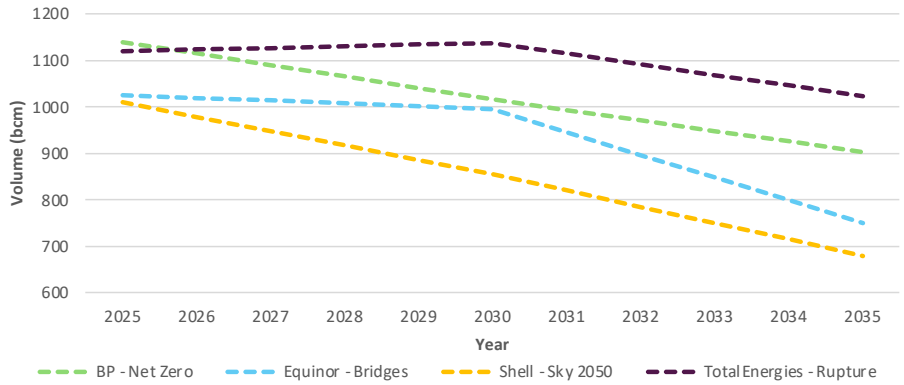

FIGURE 14 NORTH AMERICA NATURAL GAS DEMAND OUTLOOK.[73]

69 TotalEnergies. (2024). *Energy Outlook 2024 – DataBook* [Dataset]. Retrieved from https://totalenergies.com/investors/investors-presentations.

70 BP. (2024). *Energy Outlook 2024*, p. 41.

71 BP. (2024). *Energy Outlook 2024*, p. 41; Equinor. (2024). *Energy Perspectives 2024*, p. 24; Shell. (2023). *Energy Security Scenarios 2023*, p. 71; TotalEnergies. (2024). *Energy Outlook 2024*, p. 30.

72 Based on data from: BP. (2024). *Energy Outlook 2024*; Equinor. (2024). *Energy Perspectives 2024*; Shell. (2023). *Energy Security Scenarios 2023*; TotalEnergies. (2024). *Energy Outlook 2024*.

73 Based on data from: BP. (2024). *Energy Outlook 2024*; Equinor. (2024). *Energy Perspectives 2024*; Shell. (2023). *Energy Security Scenarios 2023*; TotalEnergies. (2024). *Energy Outlook 2024*.

LATIN AMERICA, AFRICA, AND THE MIDDLE EAST

Figure 15 below illustrates demand growth towards 2030 and a slight decline in gas demand afterwards for Latin America, Africa, and the Middle East. All three backcasts anticipate, to varying degrees, growing demand for gas over the next five years, as it rapidly replaces coal in the energy mix. For Latin America, in *Rupture*, the stronger short-term growth towards 2030 is mostly explained by demand growth in the first five years, in contrast to declining demand in *Net Zero* and *Sky 2050*, reaching a plateau thereafter.[74] The African region, in all three scenarios, sees an increase in gas demand in the timeframe towards 2035. In BP's *Net Zero*, Africa is the only region that sees gas demand growth.[75] Emerging African countries increase their reliance on natural gas as they replace coal and try to counter growing energy needs.[76]

The main reasons for the slight decline in gas demand after 2030 are the uptake of renewable energy and a decrease in the total primary energy demand.

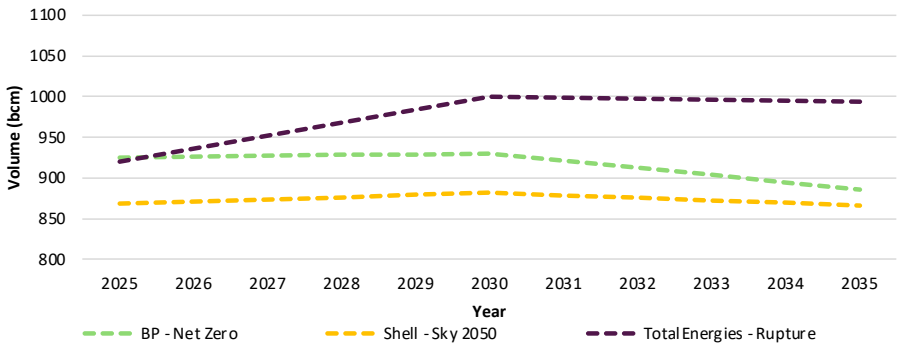

FIGURE 15 REGIONAL NATURAL GAS DEMAND OUTLOOK OF LATIN AMERICA, AFRICA & THE MIDDLE EAST.[77]

74 Shell. (2023). *Energy Security Scenarios 2023 underlying data* [Dataset]. Retrieved from https://www.shell.com/news-and-insights/scenarios/the-energy-security-scenarios.html; TotalEnergies. (2024). *Energy Outlook 2024 – DataBook* [Dataset]. Retrieved from https://totalenergies.com/investors/investors-presentations.

75 BP. (2024). *Energy Outlook 2024 – summary tables* [Dataset], Retrieved from https://www.bp.com/en/global/corporate/energy-economics/energy-outlook/energy-outlook-downloads.html.

76 BP. (2024). *Energy Outlook 2024*, p. 41; Shell. (2023). *Energy Security Scenarios 2023*, p. 39.

77 Based on data from: BP. (2024). *Energy Outlook 2024*; Shell. (2023). *Energy Security Scenarios 2023*; TotalEnergies. (2024). *Energy Outlook 2024*.

ASIA

In the forecasting scenarios, the Asia-Pacific region was seen as the growth engine behind most of the increase in global gas demand. In the backcasting scenarios, the Asian region is again of major influence through a significant share of the global gas demand growth up to 2030, as well as for the decline of global demand after 2030, as Figure 16 below illustrates. Asia's role in gas demand growth up till 2030 is visible in *Rupture*, as it represents 64 per cent (around 160 bcm) of the growth in global gas demand (around 250 bcm).[78] In all four scenarios, this is mainly due to the replacement of coal in electricity generation. Next to phasing out coal, BP's *Net Zero*, Equinor's *Bridges*, and TotalEnergies' *Rupture* anticipate a significant increase in CCS adoption, contributing to some gas demand growth up to around 2030. However, significant growth in solar, wind, and bioenergy gain market share at the expense of natural gas, resulting in a declining role for natural gas in the energy mix after 2030 and towards 2035.[79]

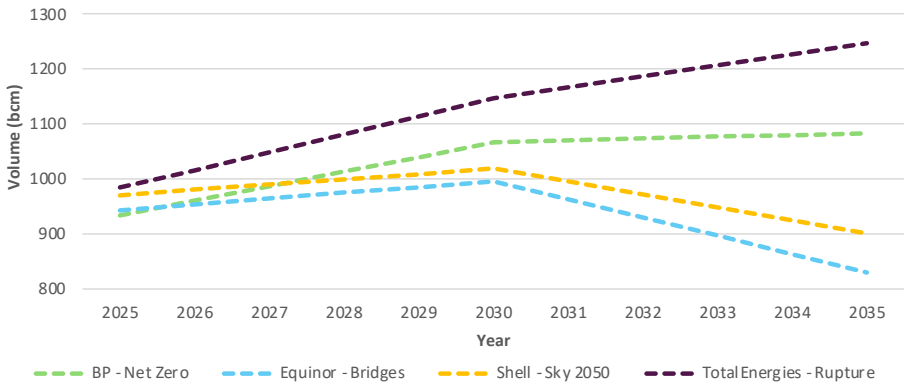

FIGURE 16 ASIAN NATURAL GAS DEMAND OUTLOOK.[80]

In summary, the four backcasting scenarios paint a different picture regarding medium-term gas demand development compared to the forecasts. Most backcasting scenarios (*Net Zero*, *Bridges*, and *Sky 2050*) highlight a significant decline in global gas demand, especially after 2030. The rapid uptake of renewable energy and the phase-out of fossil fuels limit the role of natural gas as a transition fuel. Gas-derived hydrogen production and the petrochemical sector are the only sources of growing gas demand, although they peak around 2040 before declining, as electrolysis-based hydrogen becomes the preferred choice. The world economy

78 TotalEnergies. (2024). *Energy Outlook 2024 – DataBook* [Dataset]. Retrieved from https://totalenergies.com/investors/investors-presentations.

79 Shell. (2023). *Energy Security Scenarios 2023*, p. 49.

80 Based on data from: BP. (2024). *Energy Outlook 2024*; Equinor. (2024). *Energy Perspectives 2024*; Shell. (2023). *Energy Security Scenarios 2023*; TotalEnergies. (2024). *Energy Outlook 2024*.

shifts into a phase of energy substitution from 2030 onwards, through accelerated gains in energy efficiency, changes in the primary energy mix and adoption of low-carbon solutions. *Rupture* sees gas demand growth up to its turning point around 2030, and a more vital role for natural gas as a transition fuel to phase out coal and decarbonise the power sector.

At the regional level, greater electrification and low-carbon solutions create a significant force behind the decline of demand in North America and the European Union. The emerging regions – Latin America, Africa and the Middle East – see a short-term uptick in gas demand growth to counter growing energy needs and to phase out coal. Later on, the uptake of renewables causes a slow decline in gas demand. In the Asian region, there is significant substitution of coal and therefore substantial growth in gas demand compared to other regions. However, after 2030, vast increases in solar, wind and bioenergy decrease the role of natural gas in the energy mix towards 2035.

CONCLUSION

Scenarios and their trajectories regarding gas demand in this paper are not predictions about what will happen, but rather sketches of an alternative (plausible) picture of the future. Scenario exercises encourage us to recognise that the world is an uncertain place with a wide array of variables which are subject to change, while the consistency of the system as a whole has to be maintained. Scenarios aim to be helpful, but are not meant to be (fully) accurate. Through different scenarios and fitting strategies for resilience, an attempt is made to provide a better context for long-term strategies and policies.

Through two categories of scenarios, namely forecasts and backcasts, this paper analyses medium- and long-term natural gas demand at a global and regional level. The forecasts - a bottom-up approach - use current knowledge and analyse ongoing trends to investigate a potential future and explore how various fundamentals[81] might develop. Backcasts – a top-down approach - works backwards from a hypothetical outcome to identify factors that are needed to achieve that outcome. This paper's analysis of recent corporate projections reveals some key elements, sheds light on the current hybrid period of the transition, and paints part of a (plausible) picture of the future trajectory of natural gas demand.

Where the forecasts see global gas demand grow up till 2030-2035, the backcasts anticipate, on average, a slight decline until 2030, before demand starts to decline significantly. Regarding the forecasts, the anticipated short-term growth involves supporting rising energy demand levels (especially in emerging countries) and phasing out coal, primarily in the industry and power sectors. The backcasts anticipate a rapid uptake of renewables and the phase-out of fossil fuels at such a high pace that the role of gas as a transition fuel is limited. The petrochemical sector and abated low-carbon hydrogen production are the only causes of gas demand growth in the backcasts. Combined with large-scale coal replacement in most backcasts through to 2030, these factors dampen the pace of the overall decline of gas demand in the coming years. Overall, the forecasts point to a decelerating but still growing gas demand, and the backcasts (despite their ambitious targets) anticipate that a significant decline of gas demand will not occur until after 2030. All scenarios combined, this provides a range regarding future global gas demand

81 Fundamentals in this case refers to social, economic, technological, environmental, and political trends and developments

which points towards a potential future in which the current global gas demand may slightly change but not significantly up to 2030. Among other things, this suggests that at least decline rates need to be compensated by investments to sustain current levels of gas demand globally.

Another point is hydrogen, particularly the production of hydrogen based on natural gas in combination with carbon capture and storage (CCS). Both forecasts and backcasts anticipate gas derived-hydrogen production (with CCS) dominating in the medium term over electrolysis hydrogen production. The scenarios - both forecasts and backcasts - anticipate that somewhere between 2040 and 2050 sufficient renewable capacity and/or production makes electrolysis hydrogen the preferred choice. Potentially, this will increase the demand for natural gas in the medium-term, roughly the coming 20 years, after which it will slowly vanish into the background. How long gas-derived hydrogen will be a (growing) driver for demand remains uncertain, but in the short to medium term it is highly likely that it will boost demand.

The following valuable insights come forth when considering the medium- to long-term natural gas demand. After 2030-2035, the forecasts anticipate, on average, global gas demand to reach a plateau phase towards 2040 and start to decline slightly afterwards. The forecasts suggest that global gas demand levels could be relatively stable at a higher level than 2025, suggesting that natural gas might stay with us for a while. The backcasts, however, anticipate a steep decline in gas demand, accelerating around 2030-2035. After 2030, the world may enter an era of energy substitution, in which the addition of low-carbon energy sources will outpace the growth in global energy demand. This will be driven by more intensive decarbonization through accelerated improvements in energy efficiency, electrification, and the adoption of new energy technologies.

Nevertheless, natural gas still represents a significant part of the energy mix in the backcasts. This could be explained by the fact that the backcasts assume, on average, a decrease in the total primary energy demand. Although gas demand declines significantly in absolute terms, in terms of energy mix share, it is possible that it may not decline that drastically. This is because the uptake of renewable energy and energy efficiency takes place at such a pace that a significant portion of natural gas is pushed out of the energy mix, just as coal and oil. In addition, in contrast to the forecasts, backcasts assume that much more of existing and new energy demand can be met via low-carbon energy. Most forecasts see difficulties in replacing (fossil) energy sources with low-carbon energy in some sectors, creating an extended role for gas as a transition fuel. However, backcasts assume that low-carbon energy can

substitute much more fossil energy in the mix. It is important to be aware of the underlying assumptions, as a slight change in one or more factors, caused by external or internal forces, could lead to a significantly different picture regarding the decline of natural gas demand. For example, suppose a trade war results in certain countries losing (competitive) access to a specific low-carbon technology. In that case, replacing the demand for natural gas with the corresponding low-carbon solution may be more challenging. Demand may even increase.

Finally, specific trends are visible at a regional level. The Asian region, driven by the industry and power sectors, represents the growth engine for gas demand globally in the forecasts (long-term) and the backcasts (medium-term). The forecasts all illustrate a growing gas demand for the medium term in Latin America, Africa, and the Middle East, mainly driven by growing energy needs. The backcasts anticipate a short-term uptick in natural gas demand to counter growing energy needs and to significantly phase out coal, but a decline in demand afterwards, due to significant growth in renewable energy. The scenarios illustrate a continuing decline of natural gas demand in Europe in all scenarios, driven by Europe's decarbonisation trend. On average, the forecasts anticipate that North America sees short-term gas demand growth up to 2030 and a decline thereafter, driven by lower demand from the power, industry and residential sectors. The backcasts anticipate substantial reductions in gas demand as greater electrification and low-carbon fuels create a significant driving force behind the decline in gas demand. The different visible trends within or across regions will affect the global natural gas market, especially as increasing volumes of natural gas are traded, exported or consumed via, or as liquified natural gas (LNG) to satisfy gas demand in different regions.[82]

Natural gas is part of the transition strategy in many countries. The question remains whether it will remain part of the energy mix for longer than policymakers expect, as alternatives may not be available quickly or competitively enough. This is perhaps the core of the difference between backcasting scenarios on the one hand and forecasting scenarios on the other. Countries that consume gas must take into account developments in supply, especially if global demand for gas turns out to be higher than anticipated. Uncertainties remain regarding the new supply wave of LNG and transit deals like with Ukraine or Azerbaijan. Demand competition between regions remains, especially if Europe and Asia face cold winters simultaneously. Altogether, it is essential to analyse natural gas demand and understand its underlying fundamentals. This starts with analysing credible scenarios, which may not be entirely accurate but provide a better context for long-term strategies and policies.

82 BP. *Energy Outlook 2024*, p. 43; Shell. (2024), *LNG Outlook 2024*, p. 5.

APPENDIX A

A number of caveats should be noted regarding the figures and graphs in this paper.

First, the data used for every figure originates from a collection of data from each corporation's outlook and the corresponding reported data. These datasets are BP's *Energy Outlook 2024*, Equinor's *Energy Perspectives 2024*, ExxonMobil's *Global Outlook 2024*, Shell's *Energy Security Scenarios 2023*, and TotalEnergies' *Energy Outlook 2024*.

Second, when data is missing for some years, a linear development is assumed between the years around the missing data point. For example, if data about gas demand in 2026 is missing, but 2025 and 2030 are known, then a linear trend is assumed between the data points of 2025 and 2030.

Third, data about gas demand is generally derived from the primary energy mixes reported by the corporations for each scenario. Sometimes, they report a separate section for gas demand/consumption, like BP. If the latter is the case and the volume of gas in the primary energy mix is not reported in detail, then the reported consumption/demand is used.

Fourth, most data about gas demand are reported in Exajoule (EJ). This paper converts gas demand in billion cubic meters (bcm) to harmonise data in a European context. A conversion factor of 27.77 is used. This conversion factor is based on TotalEnergies' *Energy Outlook 2024* data, which reports gas demand in both metrics of bcm and EJ. In reality, the amount of energy derived from a specific volume of natural gas depends on the heating value of the gas.

Last, regional harmonisation remains a challenge as it is not entirely clear in detail which countries belong to which specific reported region. For example, the Asia-Pacific as a region presents a data challenge as it is reported in various ways, like South-East Asia and/or East-Asia, while other outlooks only report on China, India, and developing Asia.

APPENDIX B

This paper examines ten scenarios of corporations active in the oil and gas industry. These scenarios are not predictions and do not have a single view on the future of the energy system. The scenarios explore the possible implications of different judgements and assumptions concerning the nature of the energy transition. The essence of each scenario for each corporation is described below.

BP

- **Current Trajectory** is designed to capture the broad pathway along which the global energy system is currently travelling. "It places weight on climate policies already in force and on global aims and pledges for future decarbonization. At the same time, it also recognizes the numerous challenges that come with achieving these goals."[83] CO2 equivalent (CO2e) emissions peak in the mid 2020s and are about 25% below 2022 levels by 2050.[84]
- **Net Zero** explores how different elements of the energy system could change to achieve substantial reductions in carbon emissions. "*Net Zero* can be seen as a 'what if' scenario: what elements of the energy system might change, and how, if the world collectively acts for CO2e emissions to fall by around 95% by 2050."[85] It assumes a significant tightening in climate policies and includes shifts in societal behaviour and preferences that further support gains in energy efficiency and the adoption of low-carbon energy.[86]

Equinor

- **Walls** captures current energy market trends and climate policies, assuming climate action to progress at a slowly accelerating pace in the future. "In *Walls*, the 1.5 °C carbon budget is exhausted by 2033."[87]
- **Bridges** is designed as a normative backcast scenario complying with the 1.5 °C carbon budget, demonstrating the massive and sustained effort required to achieve this goal, above and beyond all the changes in *Walls*. "In *Bridges*, current commitments are met, and further commitments are made that enable emissions

83 BP. (2024). *Energy Outlook 2024*, p. 15.
84 BP. (2024). *Energy Outlook 2024*, pp. 15-16.
85 BP. (2024). *Energy Outlook 2024*, p. 15.
86 BP. (2024). *Energy Outlook 2024*, pp. 15-16.
87 Equinor. (2024). *Energy Perspectives 2024*, p. 5.

to remain within the 1.5 °C carbon budget with the help of carbon removal technologies."[88]

ExxonMobil

- **Global Outlook (2024)** represents ExxonMobil's "view of demand and supply of energy and products through 2050, assuming an aggressive but practical energy transition. It forms the basis for the company's business planning and is grounded in our deep understanding of long-term market fundamentals. In addition to assessing trends in economic development, technology advances, and consumer behaviour, the Outlook seeks to identify potential impacts of climate-related government policies."[89]

Shell

- **Archipelagos** sees the security mindset emerging in 2022 taking hold globally, following Russia's invasion in Ukraine and the energy crisis that followed. Global sentiments are shifting from managing emissions towards energy security. Despite this shift in focus, the push for energy security ultimately drives the greater use of low-carbon technologies. Global emissions stabilise in the 2020s and decline from the mid-2030s onward. Global average surface temperature still increases in 2100 but begins to plateau around 2.2 °C as emissions approach net-zero.[90]
- **Sky 2050** takes a normative approach that starts with a desired outcome - net-zero emissions by 2050 and keeping global warming below 1.5 °C by 2100 – and works backwards to explore how that outcome could be achieved. The security mindset could translate into an uneven start as short-term energy security concerns dominate, but over time, a longer-term perspective on security could emerge, including the need to meet the threat of climate change. Emissions start to fall from 2025 and, by 2040 the goal of net-zero emissions is in sight. "Despite overshooting earlier in the century, the world goes on to bring the rise in global average surface temperatures back below 1.5 °C by 2075 and then to around 1.2 °C by the end of the century."[91]

88 Equinor. (2024). *Energy Perspectives 2024*, p. 5.
89 ExxonMobil. (2024). *Global Outlook 2024*, p. 3.
90 Shell. (2023). *Energy Security Scenarios 2023*, pp. 30-31.
91 Shell. (2023). *Energy Security Scenarios 2023*, pp. 30-31; Shell. (2023). *Energy Security Scenarios 2023*, p. 30.

TotalEnergies

- **Trends** reflects how the energy system transforms, based on current trajectories and anticipated technological development, along with public policies. *Trends* accounts for the recent acceleration in the penetration of mature low-carbon technologies. "However, infrastructure constraints (particular electricity grids) and geopolitical tensions limit their large-scale deployment."[92] In *Trends*, the world falls short of Paris's objectives. NZ50[93] countries fail to achieve their long-term 2050/2060 climate/energy objectives, while China progresses towards net zero by 2060. Developing regions are growing without decarbonising. "*Trends* yields an estimated temperature increase between 2.6 °C and 2.7 °C by 2100."[94]
- **Momentum** is a forward-looking approach that integrates the decarbonisation strategies of NZ50 countries and nationally determined contributions (NDCs) of other countries. "*Momentum* anticipates (i) electrification of final demand in NZ50 countries and China, (ii) phasing out of coal in NZ50 countries and a sharp reduction in China and only slight growth of this energy source in developing countries, (iii) the use of natural gas as a transitional energy source for electricity and industry in all countries, and (iv) the deployment of new energies in non-electrifiable sectors (e.g. decarbonized hydrogen in industry and transport) in NZ50 countries and China."[95] NZ50 countries and China meet their 2050/2060 targets. Developing regions decarbonise to the extent that low-carbon energies meet around half of the growth in energy demand. "*Momentum* delivers an estimated temperature increase between 2.2 °C and 2.3 °C by 2100."[96]
- **Rupture** represents a normative scenario designed to achieve a temperature increase of less then 2 °C by 2100. Low-carbon technologies are deployed globally, based on their merit curve. Global cooperation accelerates and developing regions, through support from other countries, integrate into the race to net zero. Growth in energy demand is mainly met by using low-carbon energies and high energy efficiency gains. "*Rupture* yields an estimated temperature increase between 1.7 °C and 1.8 °C by 2100."[97]

92 TotalEnergies. (2024). *TotalEnergies Energy Outlook 2024*. Retrieved from https://totalenergies.com/news/press-releases/totalenergies-energy-outlook-2024

93 Countries that have committed to net carbon neutrality by 2050

94 TotalEnergies. (2024). *Energy Outlook 2024*. pp. 2-3; TotalEnergies. (2024). *TotalEnergies Energy Outlook 2024*. Retrieved from https://totalenergies.com/news/press-releases/totalenergies-energy-outlook-2024

95 TotalEnergies. (2024). *TotalEnergies Energy Outlook 2024*. Retrieved from https://totalenergies.com/news/press-releases/totalenergies-energy-outlook-2024

96 TotalEnergies. (2024). *Energy Outlook 2024*. pp. 2-3; TotalEnergies. (2024). *TotalEnergies Energy Outlook 2024*. Retrieved from https://totalenergies.com/news/press-releases/totalenergies-energy-outlook-2024

97 TotalEnergies. (2024). *Energy Outlook 2024*. pp. 2-3; TotalEnergies. (2024). *TotalEnergies Energy Outlook 2024*. Retrieved from https://totalenergies.com/news/press-releases/totalenergies-energy-outlook-2024

CENTRE FOR INTERNATIONAL ENERGY POLICY | CIEP

ADDRESS

Breitnerlaan 299
2596 HA The Hague,
The Netherlands

+31 70 374 67 00
ciep.energy
contact@ciep.energy