# Outlooks for gas markets and investment

International Energy Agency

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# Abstract

In the midst of a global energy crisis, fundamental questions are now being asked about natural gas: how can supply be assured, now and in the future, and at what price? This paper explores the uncertainty around natural gas using insights from the scenarios underpinning the World Energy Outlook 2022, as well as a selection of other global scenario-based assessments.

# Introduction

In the midst of a global energy crisis in which shortages of natural gas have played a central role, fundamental questions are now being asked about the long-term future of natural gas. The crisis has reminded policy makers and energy consumers of the immediate importance of stable and affordable natural gas supplies. The traditional arguments in favour of gas – its role as a reliable partner to the clean energy transition and its ability to step in to fill the gap left by declining coal and oil – are also being tested. Gas is a versatile fuel used widely across the energy economy, but this means that in the current context higher prices and tight supplies are affecting a wide range of energy services and industrial supply chains, such as food, textiles and raw materials.

Natural gas prices in importing countries in Europe and Asia are likely to remain increasingly volatile and in relatively high ranges over the next few years, as Europe's drive to reduce reliance on Russian imports keeps global gas markets tight during a relatively barren period for large new gas export projects. A rebalancing is expected from the mid-2020s, when a slate of new LNG supply projects come online. But the "golden age of gas" that the IEA posited in 2011 is now appearing in the rear-view mirror: gas remains a major part of the global energy mix, but today's crisis has undercut momentum behind natural gas expansion in some large potential markets in South and Southeast Asia. Whether today's crisis leaves an enduring dent in the idea of natural gas as a transition fuel is a crucial uncertainty for global energy.

The near-term effects of today's tight gas markets are accelerating pre-existing trends in Europe that have been dampening momentum for natural gas in recent years. Renewables are increasingly cost-competitive in the power sector, there is greater policy support for electrification of heat demand in both buildings and industry, especially in advanced economies, while growth in manufacturing capabilities for batteries and hydrogen electrolysers are set to challenge the role of gas as a provider of short- and long-term flexibility. However, it is not axiomatic that bad news for gas is good news for energy transitions: looming large in the backdrop is the risk that receding enthusiasm for natural gas, in practice, leads to a revival in coal demand, as developing markets look to more competitive and reliable domestic coal supplies. Strong climate policies and international support for financing cleaner energy are essential to mitigate this risk.

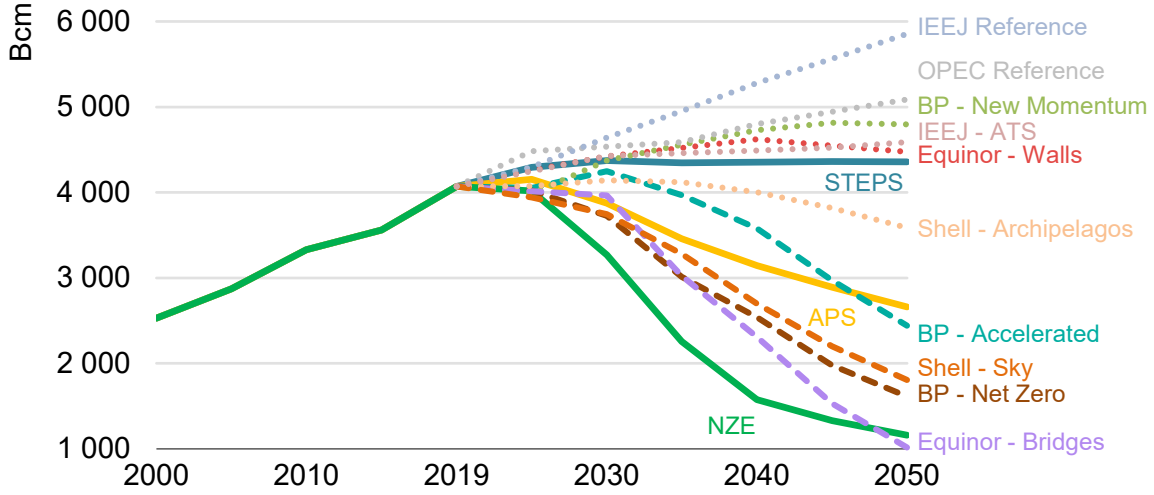
In this paper we explore the role of natural gas using insights from the scenarios underpinning the World Energy Outlook 2022: The **Stated Policies Scenario** (STEPS) shows the trajectory implied by today's policy settings. The **Announced Pledges Scenario** (APS) assumes that all aspirational targets announced by governments are met on time and in full, including their long-term net zero and energy access goals. The **Net Zero Emissions by 2050 Scenario** (NZE) maps out a way to achieve a 1.5 °C stabilisation in the rise in global average temperatures, alongside universal access to modern energy by 2030. We also benchmark IEA scenarios against those from other institutions, notably from the Institute of Energy Economics of Japan (IEEJ), with whom we have cooperated on this paper.

# Global gas trends

The starting point of this study is to compare the trajectory for natural gas demand across several recent scenario-based assessments. Such assessments involve different assumptions regarding macroeconomic conditions, underlying energy service demand as well as technologies, costs, policy evolution and commodity prices across different geographies, timeframes and scenarios. This naturally leads to different scenario outcomes. Scenario design is a key parameter: exploratory scenarios fix some key starting conditions and examine what they imply for the future. Normative scenarios fix the end point and work out how to get there.

Comparing growth projections across a sample of global assessments, the consensus view is that natural gas fares moderately well in the coming decade, but there are large divergences beyond that. From a starting level of 4 200 bcm in 2021, two scenarios anticipate natural gas to rise above 5 000 bcm by 2050, four scenarios see demand in a range between 4 000 – 5 000 bcm, another four fall in a range between 2 500 – 4 000 bcm, while the remaining four scenarios see demand below 2 500 bcm by 2050.

**Natural gas demand in the World Energy Outlook 2022 compared to other scenario-based assessments**






Note: values for external projections are growth rates normalised to an IEA historical baseline. Extrapolations were made in cases where specific years were unavailable. External scenarios are grouped according to 'reference' or 'accelerated technology' cases (small dotted lines) and climate-focussed scenarios (large dotted lines).

Sources: IEA (2022), World Energy Outlook 2022. BP (2023); Equinor (2022); IEEJ (2022); OPEC (2022); Shell (2023)

The primary factor explaining the difference is the level of climate ambition. But within this there are a number of key assumptions about sectoral and technological trends. In the near-term to 2030, scenarios differ regarding the pace and scale of renewables deployment in the power sector and the extent to which coal-to-gas

switching is utilised for the energy transition. Over the long-term, scenarios differ regarding the rate of industrial heat decarbonisation, the role of natural gas as an input to hydrogen production, and the extent to which natural gas will play an enduring role in providing flexibility to power systems. Broader energy system transformations are equally likely to affect the outlook for gas, such as the extent to which carbon capture, utilisation and storage (CCUS) and negative emissions technologies play a large role. Assumptions about gas prices and the overall cost-competitiveness of alternative technologies can also change the level of natural gas demand in subsequent decades.

Below we take a closer look at these drivers using the IEA scenarios presented in the World Energy Outlook 2022.

## Natural gas demand

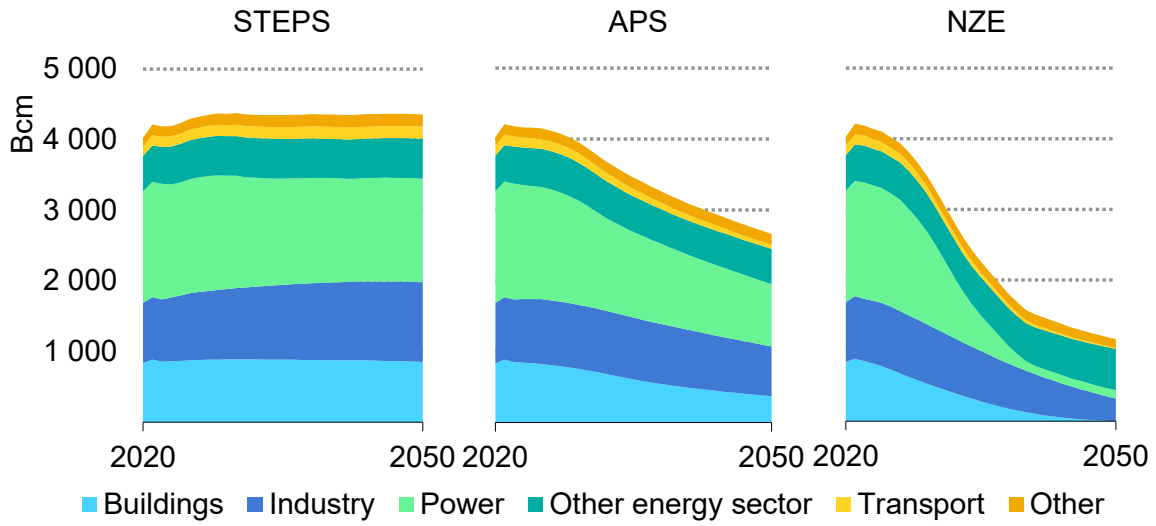
In the Stated Policies Scenario (STEPS), global natural gas demand rises at an average rate of 0.4% per year between 2021 and 2030, well below the 2.2% average rate of growth seen between 2010 and 2021. Demand reaches 4 400 bcm in 2030 and stays at that level to 2050. In the Announced Pledges Scenario (APS), global natural gas demand soon peaks, and by 2030 is nearly 10% lower than it was in 2021. By 2050, demand is 40% below 2021 levels. In the Net Zero Emissions by 2050 (NZE) Scenario, natural gas demand falls further and faster than in the STEPS and APS, declining to 3 300 bcm in 2030 and 1 200 bcm in 2050.

**Industry** is the most resilient sector for natural gas demand across all scenarios. In the STEPS, growth in natural gas demand in subsectors such as manufacturing, fertilisers and petrochemicals accounts for 90% of overall natural gas demand growth between 2021 and 2030. However, many industrial sectors are sensitive to changes in gas prices; we estimate that industrial gas demand in 2022 fell by 30 bcm or 3.3% compared to 2021, with Europe bearing the brunt of the adjustment as fertiliser producers in particular curtailed their production. In the APS, natural gas demand in industry globally falls by 2% between 2021 and 2030 and by 7% in the NZE Scenario.

In the STEPS, a rapid acceleration in efficiency improvements and broad-based adoption of heat pumps reduces use in **buildings** by 65 bcm in advanced economies between 2021 and 2030. In the APS, the rate of decline triples, with gas use in buildings falling by 170 bcm between 2021 and 2030, or 30% of demand in 2021. These reductions however are partly offset by increases in emerging market and developing economies. Between 2030 and 2050, natural gas use in buildings falls a further 4% in the STEPS, 50% in the APS, and falls to zero in the NZE Scenario.

In the **power sector,** natural gas demand declines by about 3% in the STEPS between 2021 and 2030, with gains in emerging market and developing economies more than offset by declines in advanced economies. In the APS, faster growth in renewables means that more natural gas-fired power plants move from baseload to flexible providers of electricity generation, meaning less gas is consumed in the power sector even as additional capacity is added for flexibility purposes; there is limited coal-to-gas switching as demand shifts directly to renewables or other low-emissions options. This effect is more pronounced in the NZE Scenario, where power sector gas demand falls by 450 bcm, or 25% of 2021 levels, by 2030.

**Natural gas demand by sector and scenario, 2020-2050**

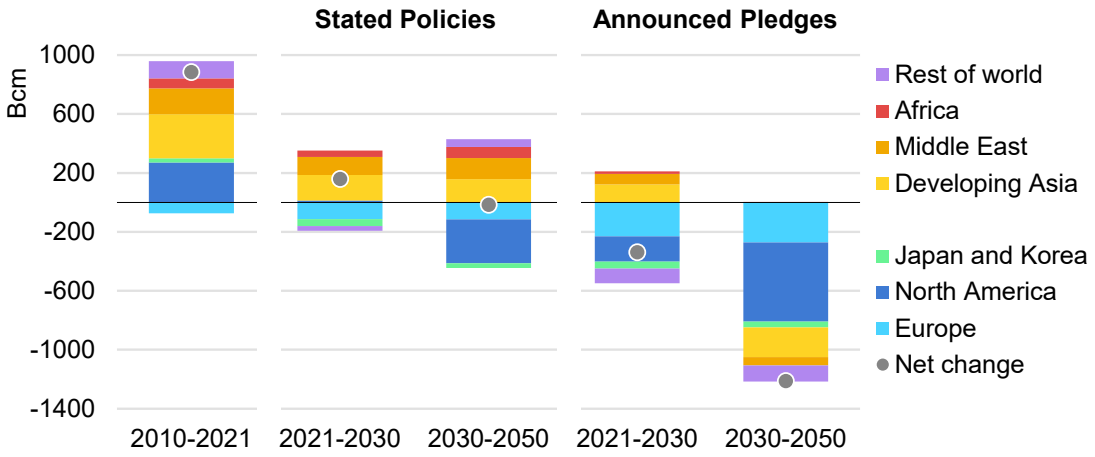





Note. Other includes agriculture and other non-energy use.

Across all three scenarios, natural gas is anticipated to decline in advanced economies. This is in large part thanks to growing policy support and incentives for clean energy and efficiency, both of which erode natural gas' market share in all sectors. In the United States, the Inflation Reduction Act gives significant tax incentives and other forms of support to renewables, nuclear and biogases – alongside efficiency and heat pumps. In Japan, the long-term focus on low-emissions fuels such as ammonia and hydrogen, alongside the mid-term planned restart of nuclear, translates into a relatively rapid reduction in LNG demand, to as much as 40% below 2021 levels by 2030, with the pace of reduction dependent on the pace of deployment and implementation of new energy and nuclear energy initiatives. In the European Union, the full implementation of Fit for 55 and additional ambitions in the RePowerEU communication means natural gas demand falls 20% below 2021 levels.

**Change in natural gas demand by region and scenario**

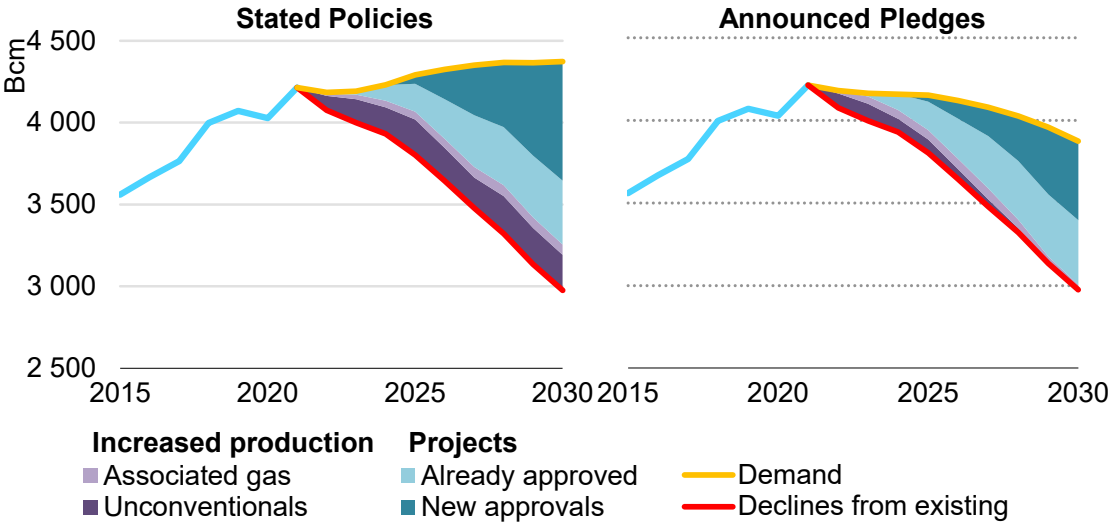





In emerging market and developing economies, natural gas demand in the STEPS rises by 110 bcm between 2021 and 2030, at around one-fifth of the growth rate seen in the previous decade. China's annual demand growth in particular decelerates sharply, from an average of 12% per year between 2010 and 2021 to 2% per year between 2021 and 2030. There is less scope for coal-to-gas switching and increased use of electricity in industry compared to the STEPS in the World Energy Outlook 2021. Affordability concerns in some parts of Asia, particularly Pakistan and Bangladesh, alongside maturing domestic production and persistent hurdles to building import infrastructure in Southeast Asia, all dampen momentum behind gas.

# Natural gas supply, trade and investment

**Investment in upstream natural gas supply in the STEPS and APS, 2015-2030**

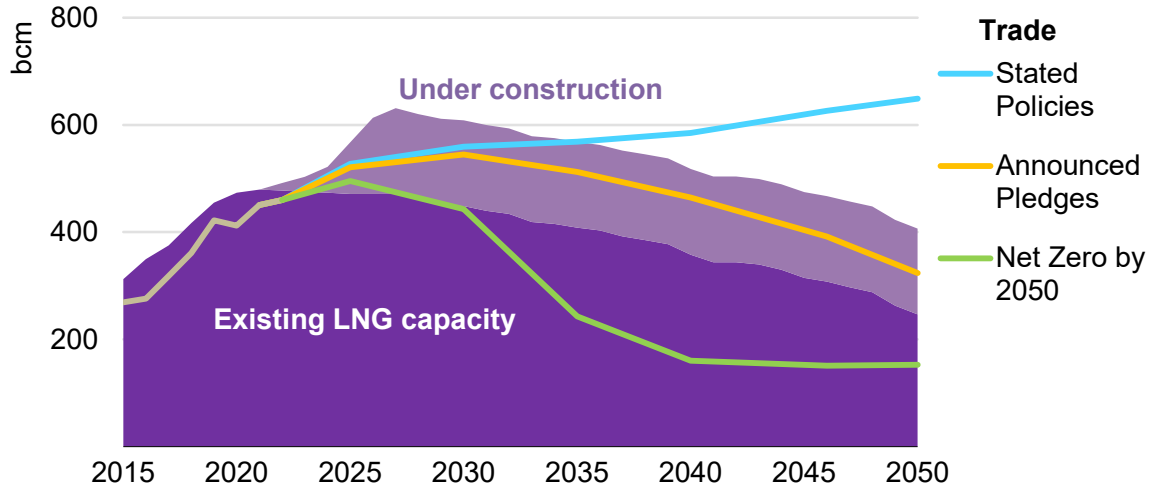


Despite flat or declining natural gas demand in the STEPS and APS, additional upstream investment is nonetheless required to offset declines from existing fields. Recently approved projects add around 400 bcm per year to global gas supply by the end of the 2020s. This leaves around 720 bcm of new upstream supply needed to meet gas demand in the STEPS by 2030. This new supply requirement falls to just under 500 bcm in the APS. In the NZE Scenario, the reductions in natural gas demand are sufficiently steep that it is possible to meet them, in aggregate, by continued investment in existing assets and already approved projects, but without any new long lead time upstream conventional projects.

The total investment requirement in natural gas supply and transport for the remaining decade is USD 280 billion per year, on average, in the STEPS and USD 240 billion in the APS. In the NZE Scenario, around USD 200 billion is required to maintain output at existing and commission already approved fields.

In all scenarios, there is a need to reduce the emissions intensity of gas supply by reducing flaring and methane leaks. More than 260 bcm of natural gas is wasted each year in this way. It is unlikely that all of this can be avoided, but according to the IEA's Methane Tracker an estimated 200 bcm of additional gas could be brought to markets with the right policies and on-the-ground implementation. Stopping this waste of natural gas would also reduce global temperature rise by nearly 0.1 °C by mid-century, with an effect equal to eliminating the GHG emissions from all of the world's cars, trucks, buses and two- and three-wheeler vehicles. According to the IEA's Methane Tracker, around USD 100 billion in investment is required to 2030 to deploy all methane abatement measures in the oil and gas sector, and the majority can be deployed at no net cost given the captured gas can be marketed and sold.

**LNG trade by scenario compared to existing and under-construction capacity, 2015-2050**



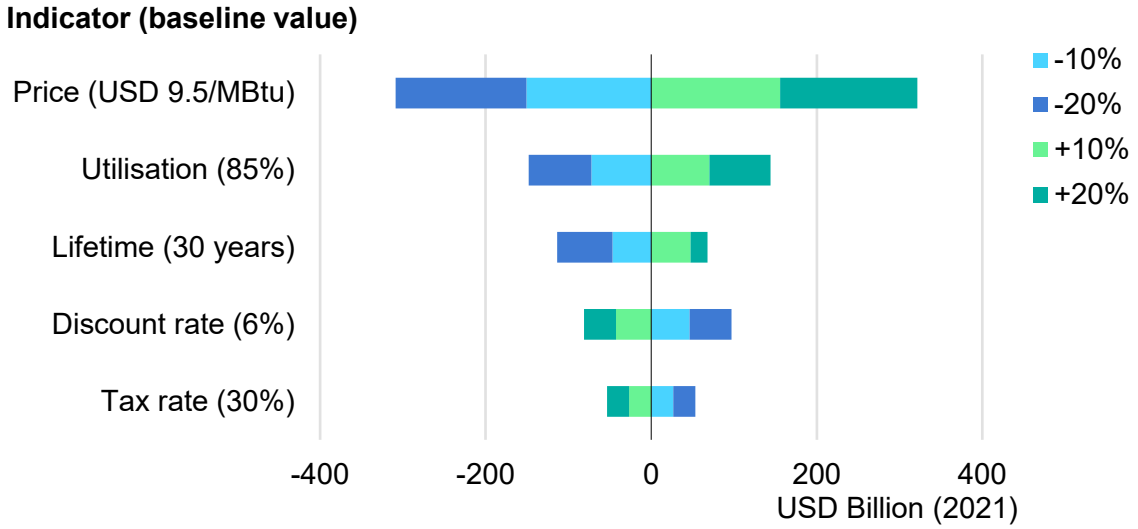



Note. LNG capacity is adjusted to reflect inter-regional trade between regions modelled in the Global Energy and Climate Model, and de-rated to 80% of nameplate capacity.

Around half of all upstream gas projects approved in the last five years have been explicitly tied to LNG export projects. In the STEPS an additional 240 bcm per year of LNG export capacity is needed by 2050 above what currently exists or is under construction (even as the rate of growth in LNG trade between 2021 and 2030 falls to one-fifth of the levels of the last five years). In the APS, only projects currently under construction are required. In the NZE Scenario, a sharp decrease in natural gas demand globally means that even these projects are in many cases no longer necessary. This wide spectrum of LNG requirements creates a dilemma for sponsors of new LNG projects, where the risk of unrecovered capital increases with greater climate ambition. The main exposure is via lower equilibrium gas prices. In some cases, this risk is mitigated by long-term contracts offering stable pricing conditions; however, for importers there is a risk of exposure to relatively high gas prices for decades, in a broader context of demand uncertainty.

In the APS, the long-run average gas price in Europe is around USD 7/MBtu and around USD 8/MBtu in importing countries in Asia, around 20% lower than in the STEPS. This would bring the sum of the net present value of recently-sanctioned LNG export projects with capital yet to recover close to zero, from around USD 320 billion in the STEPS. In the NZE Scenario, the price averages USD 4.5/MBtu in Europe and USD 5.5/MBtu in Asia. Along with sharply lower LNG demand compared to the STEPS, the NZE Scenario implies even more challenging economics for projects currently under construction. As LNG exporters jostle for diminishing market share, the utilisation rates of individual plants become uncertain; there is a case that only the lowest cost producers are left standing, but security of supply concerns may encourage governments to support higher-cost projects.

**Sensitivity analysis on the net present value of recently-sanctioned LNG projects**



The different trajectories for gas demand in WEO scenarios highlights a key dilemma for investors considering large, capital‑intensive LNG projects: how to reconcile strong near-term demand growth with uncertain but possibly declining longer term demand. One way of resolving this difficulty would be to shorten the contract tenure for new LNG projects, however this would increase the break-even price needed to fully recoup investment costs by more than 25%. Another way to increase the compatibility of such investments with energy transitions would be to integrate low-emissions technologies into the value chains, for example through CCUS on the final uses or through the use of infrastructure for low-emissions gases.

# Focus on key growth markets for natural gas in Asia

Emerging market and developing countries in Asia have been one of the main engines of natural gas demand growth over the last decade. However, the strains on global natural gas supply that have emerged since 2021 have challenged the case for natural gas as a transition fuel in Asia. The surge in LNG spot prices arising from high demand in Europe has pulled supply away from price-sensitive markets such as Pakistan and Bangladesh, leading to shortfalls in the power sector and industrial demand destruction in those countries. Although some markets have been somewhat shielded from volatility thanks to long-term supply contracts with fixed volume commitments and prices that are linked to oil, the import price of gas for end-users in emerging markets in Asia is estimated to have risen by about 55% in 2022 compared with the five-year average.

Net zero emissions pledges announced in some of the major growth markets in Asia – China, India, Malaysia, Singapore, Thailand and Viet Nam – also have implications for the future role of natural gas. The near-term need for securing gas supplies is complicated by the relatively short timeframe during which natural gas demand is expected to grow in these markets. The standard operational lifetime of new gas infrastructure is often 30 years or longer, raising questions about how it is to be financed and operated in scenarios pursuing a 1.5 °C stabilisation.

Conversely, there is a risk that declining prospects for gas may mean that emerging market and developing economies in Asia hold on to their coal-fired power generation for longer, which – unless there is a historic acceleration in investment in CCUS – would result in unfavourable emissions outcomes. This has happened before. In energy-hungry India and Southeast Asia, for example, a challenging environment for domestic gas production between 2010 and 2021 meant natural gas became less competitive with coal. The result was around

30 bcm of natural gas demand lost to gas-to-coal switching, leading to a 50 Mt $CO_2$ increase in emissions which would have been avoided if natural gas had been used instead.

## Demand

In both the STEPS and APS, there are strong macroeconomic drivers for growth in natural gas consumption in emerging market and developing economies in Asia over the next decade, despite the near-term risks brought about by the recent supply squeeze. As prices are projected to come down from the mid-2020s, these markets see a big increase in natural gas use by 2030. Some of this is driven by coal-to-gas switching (accounting for around 10% of demand growth in STEPS and 20% in APS). This helps countries with net zero emissions targets accelerate the transition away from coal, even if renewables are the major source of emissions reductions in both scenarios. Industry remains the anchor for demand growth and the focal point for large-scale infrastructure investment in LNG import capacity, storage and onshore transmission and distribution grids. In the APS, gas demand in industry in emerging gas markets in Asia, excluding China, is over 60% higher in 2050 than in 2021.

### Natural gas demand by sector and scenario in selected regions

| | | | Stated Policies | | Announced Pledges | |
|---|---|---|---|---|---|---|
| | 2010 | 2021 | 2030 | 2050 | 2030 | 2050 |
| **China** | | | | | | |
| Buildings | 30 | 82 | 103 | 92 | 97 | 32 |
| Industry and energy sector own use | 45 | 170 | 205 | 219 | 188 | 112 |
| Power sector inputs | 25 | 74 | 90 | 96 | 82 | 84 |
| Other | 10 | 42 | 45 | 35 | 39 | 10 |
| **India** | | | | | | |
| Buildings | 1 | 4 | 9 | 14 | 7 | 8 |
| Industry and energy sector own use | 29 | 28 | 51 | 93 | 52 | 57 |
| Power sector inputs | 29 | 17 | 27 | 29 | 25 | 13 |
| Other | 4 | 17 | 29 | 33 | 27 | 24 |
| **Southeast Asia** | | | | | | |
| Buildings | 0 | 0 | 2 | 3 | 1 | 2 |
| Industry and energy sector own use | 62 | 64 | 71 | 96 | 66 | 87 |
| Power sector inputs | 82 | 83 | 111 | 151 | 108 | 67 |
| Other | 6 | 15 | 19 | 21 | 19 | 20 |

| | | | Stated Policies | | Announced Pledges | |
|---|---|---|---|---|---|---|
| | 2010 | 2021 | 2030 | 2050 | 2030 | 2050 |
| **Other developing Asia** | | | | | | |
| Buildings | 12 | 16 | 20 | 27 | 17 | 26 |
| Industry and energy sector own use | 20 | 28 | 31 | 37 | 29 | 26 |
| Power sector inputs | 34 | 50 | 53 | 73 | 57 | 43 |
| Other | 8 | 6 | 8 | 8 | 7 | 7 |

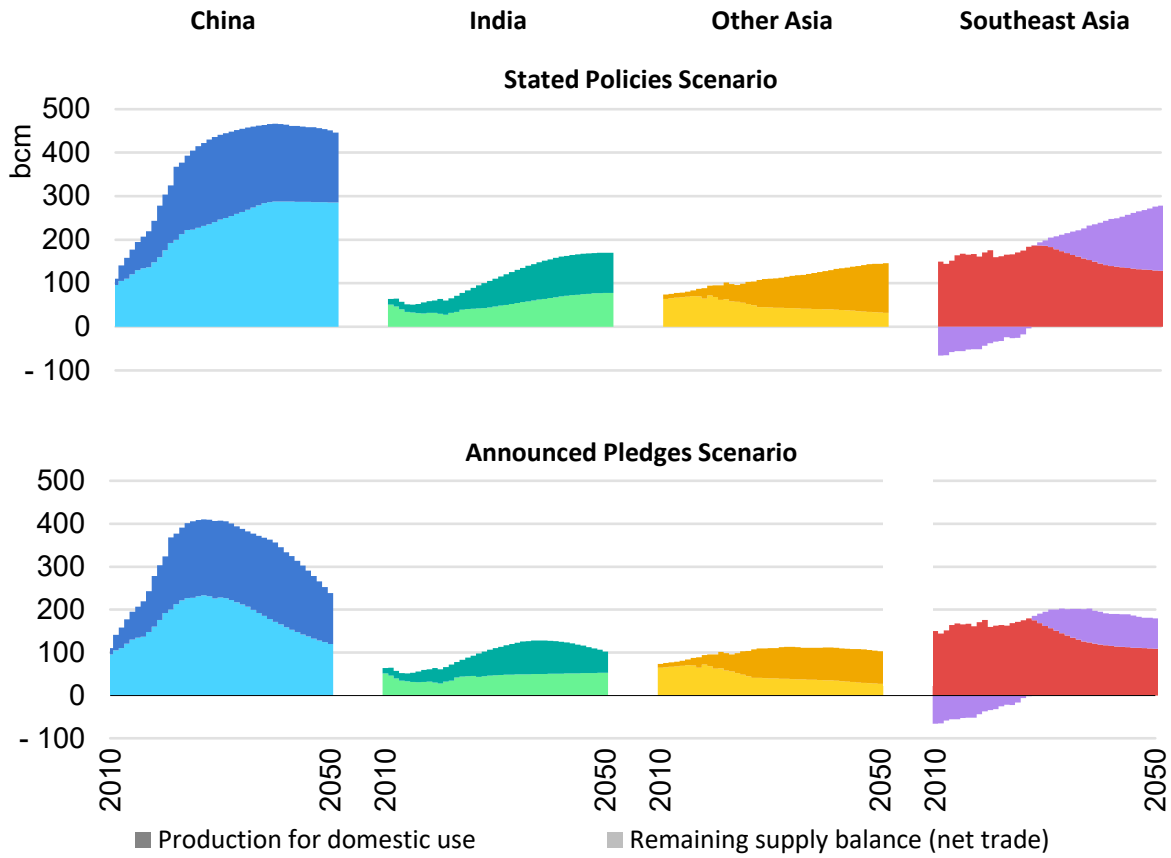
Note: Other includes use in transport, agriculture and other non-energy use.

After 2030, natural gas demand growth in emerging market and developing economies in Asia slows in both the STEPS and the APS. Renewables meet the bulk growth in power generation between 2030 and 2050, while electricity and the direct use of renewables dominate buildings sector energy demand. With the exception of northern China, growth markets for gas in Asia do not have significant need for seasonal heating in buildings, and electricity and solar-based heating offers a cost-competitive alternative to the use of gas in households for cooking and hot water. In industry, natural gas increases its market share of total industrial demand in the STEPS, largely by displacing coal and bioenergy. In the APS, the use of hydrogen and electricity in final consumption in industry holds the share of natural gas flat at around 9% through to 2050.

## LNG imports and infrastructure

Developing markets in Asia are the main recipients of global LNG supplies to 2050, despite the near-term boost to European demand brought about by dwindling Russian gas pipeline exports. In the STEPS, China dominates the growth in LNG demand, while Southeast Asia quickly becomes a net importer of LNG as traditional producing regions such as Indonesia and Malaysia reach maturity and aspiring importers such as the Philippines and Viet Nam enter the market.

**Natural gas supply balance in selected countries and regions by scenario**

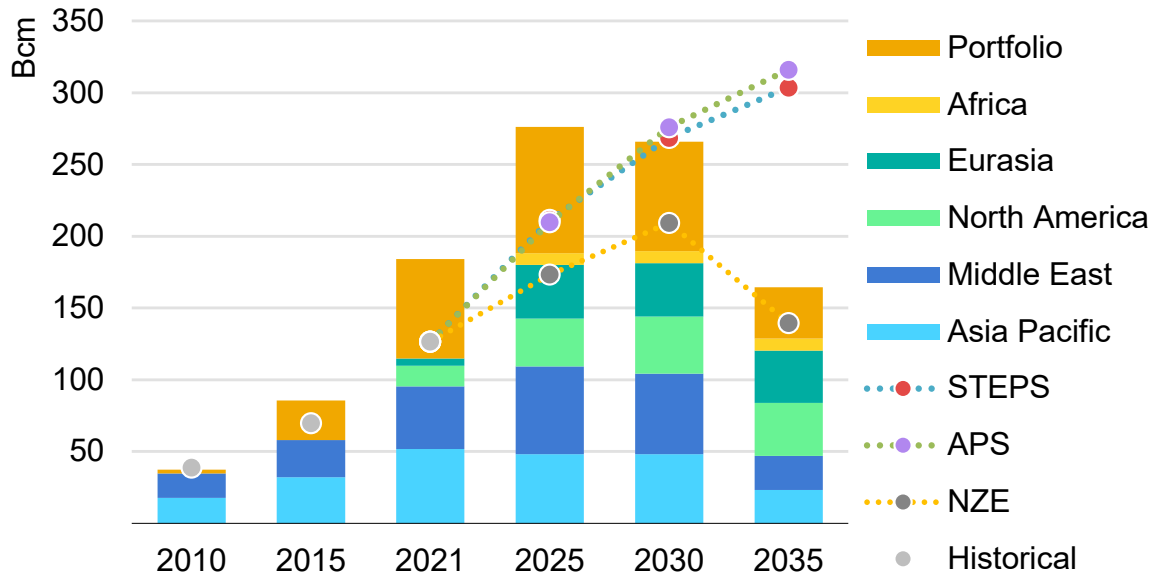





There is around 200 bcm per year of existing LNG import capacity in the region (of which 45% is in China). A further 120 bcm per year is under construction. To meet the requirements of the STEPS and APS, a further 85 bcm per year of import capacity is required by 2030.

Over the next decade, as LNG trade grows, buyers in emerging and developing economies in Asia will need to contract for new volumes. In practice, much of this will be renewal of legacy contracts as and when they expire; by 2035, there is a need for around 150 bcm per year of new contracted supply in the STEPS by 2035. A similar level is required in the APS, where LNG demand in emerging Asian markets continues to grow strongly well into the 2030s.

**LNG import contracts in emerging markets and developing economies in Asia by origin of supplier compared to net LNG imports by scenario**






**Focus: Comparing IEA and IEEJ Scenarios**

The IEEJ's Reference Scenario (REF) is a scenario in which past trend changes continue under existing energy and environmental policies, while the Advanced Technologies Scenario (ATS) is a scenario in which the introduction of low-carbon technologies progresses significantly through the strengthening of energy and environmental policies. Both are exploratory scenarios and do not incorporate the achievement of each country's carbon-neutrality declaration. The ATS assumes a reasonable amount of introduction of zero-emission technology in consideration of cost, potential, introduction speed, and economic and social acceptance, and does not assume early achievement of carbon-neutrality. Developing countries, where the demand for energy is increasing rapidly, continue to need fossil fuels to meet demand in the ATS, and among these, IEEJ assesses that natural gas, which has a lower carbon content, plays a large role.

## Selected global energy and economic indicators in IEA and IEEJ scenarios

| | | IEA-STEPS | | IEA-APS | | IEEJ-REF | | IEEJ-ATS | |
|---|---|---|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2050 | 2030 | 2050 | 2030 | 2050 | 2030 | 2050 |
| Total primary energy demand (EJ) | 592 | 673 | 740 | 636 | 629 | 679 | 749 | 649 | 610 |
| Total electricity consumption (1 000 TWh) | 23 | 30 | 42 | 30 | 47 | 29 | 40 | 30 | 42 |
| Share of renewables in electricity generation | 28% | 43% | 65% | 49% | 80% | 31% | 37% | 39% | 62% |
| $CO_2$ combustion emissions ($GtCO_2$) | 32 | 33 | 29 | 29 | 11 | 36 | 37 | 31 | 17 |
| GDP (USD Trillion 2021) | 91 | 124 | 197 | 124 | 197 | 125 | 207 | 125 | 207 |
| World oil demand (Mb/d) | 89 | 102 | 102 | 93 | 57 | 106 | 111 | 96 | 62 |
| World coal demand (Mt) | 5 347 | 5 149 | 3 828 | 4 539 | 1 613 | 5 635 | 5 272 | 4 920 | 2 723 |
| **World natural gas demand (Bcm)** | **4 027** | **4 372** | **4 357** | **3 874** | **2 661** | **4 641** | **5 855** | **4 426** | **4 588** |
| ***By sector:*** | | | | | | | | | |
| Power | 1 581 | 1 590 | 1 469 | 1 422 | 880 | 1 904 | 2 816 | 1 802 | 1 990 |
| Industry | 741 | 869 | 938 | 763 | 548 | 828 | 927 | 799 | 472 |
| Buildings | 839 | 890 | 852 | 737 | 372 | 828 | 748 | 758 | 327 |
| Other | 867 | 1 023 | 1 097 | 952 | 860 | 1 082 | 1 365 | 1 068 | 1 799 |
| ***By region:*** | | | | | | | | | |
| North America | 1 096 | 1 118 | 820 | 933 | 396 | 1 228 | 1 278 | 1 250 | 1 051 |
| *United States* | 867 | 864 | 575 | 716 | 252 | 948 | 955 | 877 | 680 |
| Asia | 800 | 992 | 1 118 | 930 | 651 | 1 080 | 1 602 | 1 025 | 1 083 |
| *China* | 324 | 443 | 442 | 406 | 238 | 414 | 515 | 396 | 311 |
| *India* | 61 | 115 | 170 | 110 | 102 | 113 | 263 | 116 | 173 |
| *Japan* | 104 | 64 | 43 | 57 | 17 | 99 | 94 | 83 | 39 |
| European Union | 397 | 340 | 235 | 242 | 45 | 401 | 374 | 385 | 233 |
| Middle East | 554 | 689 | 833 | 638 | 582 | 664 | 857 | 649 | 840 |
| Africa | 164 | 215 | 292 | 189 | 193 | 225 | 437 | 246 | 399 |
| Rest of the world | 1 017 | 1 017 | 1 060 | 941 | 794 | 1 044 | 1 308 | 872 | 982 |

Note: Industry includes gas use in blast furnaces and coke ovens. Other includes energy sector own use, agriculture, transport, and non-energy use. IEEJ values are based on growth rates normalised to an IEA historical baseline.

On a sectoral basis, a key difference between IEA and IEEJ scenarios with respect to natural gas is the extent to which there is an enduring role for gas in the power sector. The IEA projects a strong roll out of renewables, which reach nearly two-thirds of total power generation by 2050 in the STEPS, compared to just over a third in the IEEJ's reference scenario. The difference is similar in the IEA APS, where renewables cover 80% of total global power demand against around 60% in the IEEJ's ATS. In the IEA scenarios, there is less room for natural gas in the power generation mix; it's share falls from 23% today to less than 15% by 2050 in the STEPS, and to 6% in the APS.

On a regional basis, the STEPS sees lower growth – and faster contraction – in advanced economies than the IEEJ's reference scenario. In key growth markets such as India and China, the IEEJ and STEPS scenarios have similar rates of growth to 2030, but the IEEJ sees a far stronger pace of growth after 2030 than in the STEPS.

## Conclusions and implications

The future role of natural gas depends on a range of key variables such as prices, policies, investment, the pace of renewables growth and declines in coal, rates of end-use electrification, the industry's record on methane abatement, and growth in low-emissions gases. In WEO scenarios, slower gas demand growth in emerging market and developing economies along with accelerating declines in advanced economies marks the end of an era of rapid growth in global demand. However, even with flat or declining natural gas demand in the STEPS and APS, new investments in upstream gas supply remain necessary in these scenarios to offset declines from existing fields. Projected demand growth in emerging and developing economies also means that investment in new LNG infrastructure is needed in these scenarios, albeit in different amounts. Strategies to future-proof any such investments, for example by incorporating technologies like CCUS at different parts of the value chain or by allowing for the integration of low-emissions gases, is essential to mitigate the risk of stranded assets.

Large variations in the supply and demand outlook in different scenarios and different modelling frameworks highlight the uncertainties affecting natural gas and LNG markets. Moreover, even within individual scenarios, there is no single global story about the future natural gas, as countries and regions respond to market and policy pressures in different ways, based on their national circumstances and stages of development.

As a result of the energy crisis, gas demand projections in the latest WEO scenarios are lower than in previous years. However, it should not be taken for granted that a diminished outlook for gas is good news for energy transitions. Most

of the downward revision in 2030 gas demand in this year's STEPS scenario, compared with the 2021 World Energy Outlook, is due to accelerated switching from natural gas to clean energy, but around one-quarter is because higher-priced gas loses out to coal and oil. These effects vary by country.

In addition, changing patterns of consumption, both of fuels and of electricity, create new dynamics for gas security that have to be closely watched. Gas demand could well become more volatile in some regions as the share of variable renewables increases, as periods of lower utilisation of gas-fired capacity are accompanied by other periods when these plants are essential to electricity security. Ensuring that market designs and infrastructure, including storage, accommodate the changing roles of natural gas are essential to avoid that localised spikes in demand for gas affect the energy security of other countries in unexpected ways.

As ever, policy makers will need to be vigilant to all of these implications, and take a pragmatic and multi-dimensional approach. The IEA is ready to provide all the data, analysis and scenarios that can be helpful for this purpose. Above all, the uncertainties raised by the current crisis and by this analysis call not only for the pursuit of business models that are consistent with decarbonisation, but also for efforts to ensure that individuals, communities and consumers do not face excessive price volatility, especially the most vulnerable countries and consumers. Good data and a deep understanding of energy markets, accompanied by a strong dialogue between producing and consuming countries, including the public and private sectors, remains crucial elements of this process.

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