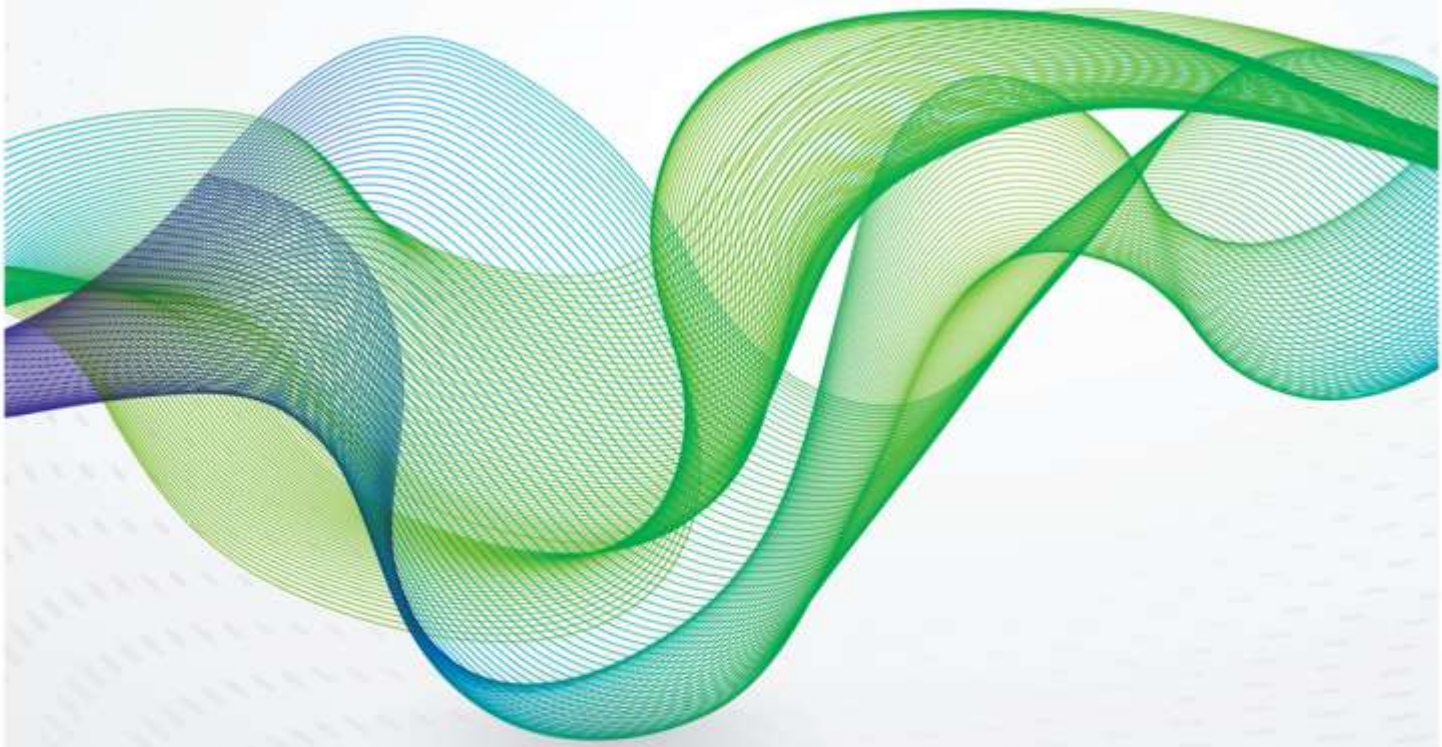
THE OXFORD INSTITUTE FOR ENERGY STUDIES

July 2023

A New Global Gas Order? (Part 1): The Outlook to 2030 after the Energy Crisis



OIES PAPER: NG 184

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ISBN 978-1-78467-212-6

Executive Summary

The recovery from Covid-19 in 2021 and the Russian invasion of Ukraine, tipped the world into a full blown energy crisis, with the global gas markets being especially badly hit. Now, at the time of writing (July 2023), although the world appears to be emerging from the energy crisis, the global gas market remains tight. A key question remains as to what type of gas market will emerge? This paper looks at the outlook to 2030 and is focused on the medium-term gas demand outlook. We are considering an EXPECTED outlook to 2030, based broadly around countries' stated policies in terms of the energy transition, but assuming such policies are implementable within the 2030 timeframe. As an expected outlook, this is not a forecast based on the targets and aspirations of many governments and organisations, and is explicitly not a scenario which is on a path to achieve either net zero by 2050 or to limit the rise in global temperatures to 1.5 degrees C. This is Part 1 of the analysis being undertaken by OIES on the outlook for the global gas market, with the intention of publishing a further paper (Part 2) later in 2023, which will explicitly consider more rapid energy transition scenarios to 2050, designed to materially reduce greenhouse gas emissions, focused on the implications for gas demand.

Global gas demand growth between 2021 and 2030 is projected at some 400 bcm, equating to around 10 per cent in total or 1 per cent per annum. China and the Middle East account for over 80 per cent of the growth. Looked at another way. the wider "import reliant" Asian markets account for two-thirds of the growth, and, although European gas demand declines by over 70 bcm, European LNG import requirements rise.

Prior to the Russian invasion of Ukraine and the subsequent energy crisis, expected demand growth between 2021 and 2030 was some 300 bcm higher than current forecasts. This loss of growth cannot all be attributed to the energy crisis. In particular, North American gas demand growth to 2030 is some 200 bcm less than previously projected, principally due to the impact of the Inflation Reduction Act (IRA) in the US. The other key changes, which can largely be attributable to the energy crisis are Europe (45 bcm less growth), China (25 bcm less growth) and marginal reductions in other regions, partly offset by higher Middle East demand which is expected to grow by some 30 bcm.

A total of 80 per cent of the growth in demand between 2021 and 2030 comes from the Power and Industry sectors. Growth in demand for gas in power generation is heavily weighted outside the OECD economies. In volume terms the Middle East and China show the biggest growth, followed by ASEAN and South Asia. Gas demand in the power sector declines in North America – largely the impact of the Inflation Reduction Act in the US – and in Russia. In Europe, gas demand in power largely remains flat between 2021 and 2030, as renewables grow rapidly but coal declines very sharply, allowing gas to maintain its market share, aided by a slight rise in electricity demand. Gas demand growth in industry is largely seen across the board with the Middle East and China leading the way in volume terms. North America, especially the US, shows growth, while Europe is the only region where gas demand in industry declines.

Global LNG export capacity is expected to grow by over 350 bcm between 2022 and 2030 – a rise of 60 per cent over the 2022 average available LNG export capacity. Almost 75 per cent of this rise has already taken FID, and over half the increase is from North America. Total LNG import growth between 2021 and 2030 is some 275 bcm – a rise of over 50 per cent in LNG trade. Europe and ASEAN have the largest increases of just under 100 bcm, although some 60 bcm of the Europe growth took place in 2022 so for the rest of this decade, growth is less than 40 bcm. Chinese growth over this period is some 30 bcm but this takes into account the 20 bcm decline in 2022 following weak economic activity and lockdowns, so equates to 50 bcm growth from 2023.

The global market eases significantly post 2026 as the LNG supply surge outstrips rising demand and Europe and Asia spot prices fall back to between $7-8/MMBtu by 2029/2030. LNG export capacity utilisation falls to low levels in 2029/2030, below those seen in 2020, when spot prices were below $3/MMbtu in Europe and Asia. If prices reverted to short-run rather than long-run marginal cost pricing then prices might fall to the $5-6/MMbtu range for both Europe and Asia. In reality, pricing is unlikely to be either wholly LRMC or SRMC based, but a mixture of the two, with prices somewhat below $8/MMBtu, but above $5/MMbtu, in both Europe and Asia, by 2030.

IEA STEPS (Stated Policies Scenario)[1] has total global gas demand in 2030 just over 100 bcm lower than the OIES New Order scenario – a difference of 2.5 per cent. However, there are significant differences in some regions. Notably in North America, where IEA STEPS is some 79 bcm higher than OIES. It is mainly in China and Japan that IEA STEPS demand is much lower than in the OIES New Order scenario. However, the growth in the OIES New Order scenario for demand between 2021 and 2030 is in the middle of the range of comparable demand growth forecasts. Apart from IEA STEPS, the lower demand growth forecasts are from large industry players such as Shell, BP and Equinor.[2] However, when it comes to LNG imports the OIES New Order LNG import growth is very similar to the Shell and BP scenarios, despite their much lower global demand growth, possibly reflecting different views on production, pipeline trade and/or different regional demand.

A key uncertainty for gas is in the trilemma between coal versus gas versus renewables. Prior to the energy crisis, the consensus was that gas would benefit in any regions where coal was phased out and renewables, together with gas, gained market share. This was especially the expected situation in Asia. However, the energy crisis has seen coal make a comeback in 2022 and investment in coal continues in some Asian countries, and, if gas is seen as not being affordable, it may face an uphill struggle not to be crowded out by coal and renewables. The Asian regions, are also expected to see strong demand growth for imports of gas and LNG.

A key conclusion of the OIES New Order scenario to 2030, is that a combination of the energy crisis and the IRA in the US, will lead to a small 'one-off' loss in global gas demand of around 6 per cent. A number of uncertainties, however, still remain, notably the growth in gas demand in China, Europe and the ASEAN countries, which are very important to the growth of LNG imports needed to absorb the expected record rise in LNG export capacity over the next four to five years. The level of demand in the OIES New Order scenario in 2030 is not enough to absorb rising LNG supply, leading to lower utilisation rates at export plants. However, if prices respond, as they have previously done in periods of supply gluts, then lower prices may stimulate more gas demand in price sensitive sectors and regions.

[1] World Energy Outlook 2022, International Energy Agency, Paris, France

[2] https://www.shell.com/energy-and-innovation/the-energy-future/scenarios.html, https://www.bp.com/en/global/corporate/energy-economics/energy-outlook.html, https://www.equinor.com/sustainability/energy-perspectives.

Acknowledgements

I would like to thank all those at the OIES for their assistance in developing the scenario and providing key assumptions and analysis for different countries and regions, as well as providing comments and insights on the paper itself. There was also excellent feedback from sponsors of OIES Gas Programme. In particular thanks go to Jim Henderson, Jonathan Stern, Anouk Honore, Martin Lambert, Ieda Gomes, Mostefa Ouki, Vitaly Yermakov, Michal Meidan and David Ledesma, Finally, thanks also to Harvey Grazebrook and Liz Henderson for preparing the paper for publication.

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Preface

In this first of two analyses of the future of the global gas market, Mike Fulwood looks at the prospects for gas demand – and supply, trade and prices – to 2030. In undertaking this research, we believe that, although it is important to consider what needs to happen to achieve energy transition targets it is also vital to look at what we expect to be the actual outcomes, especially in the period to 2030. Although it is clear that hydrocarbon demand will need to fall significantly over time if environmental goals are to be, this analysis reveals that current expectations are for gas demand to continue to grow for the next decade at least, and perhaps for longer. The subject of the period post-2030 will be the topic for the second part of this analysis, when we will consider the likely impact of decarbonisation policies and the trends in gas demand that will be needed, if net zero targets are to be met. It should be underlined that this is not the goal of this first analysis – as Mike Fulwood asserts in his opening paragraphs the scenario outlined in this paper is not one that puts the world on target for a net zero goal. As such we are not arguing for this outcome, nor suggesting that it is necessarily positive. We simply believe that it is vital to be realistic about likely outcomes in the short-to-medium term in order for policy-makers and companies to make informed decisions about the long-term future.

Another important element of this research is its global nature. When one is based in Europe, where decarbonisation and energy transition are a key priority, it is easy to take a euro-centric view of the global energy economy. In reality, views on the future of natural gas vary widely across the world, and this paper highlights how the coal-gas-renewables trilemma is playing out with different priorities in different regions. As a result, although the view on gas is somewhat negative in Europe, the sum of global expected outcomes can appear rather more positive, especially in the period under analysis.

Nevertheless, the view of gas has been altered by the impacts of the energy crisis in 2022, which was catalysed by the Russian invasion of Ukraine and the interruption of pipeline gas flows to Europe which this caused. Europe was prepared to pay whatever price was needed to secure alternative supply, and this meant bidding aggressively for LNG in the global market. Although some new supply was available and was largely sent to Europe, another consequence was that many non-OECD countries faced shortages as they could not pay the high prices that have emerged. Mike Fulwood's analysis acknowledges this point and considers whether it will undermine the case for gas in the medium to long term or whether it is just a blip in an otherwise positive story.

Finally, we should underline that this paper outlines an expected scenario, as we see it, to 2030. We do not claim to have a crystal ball, though, and the outcome clearly depends on a number of assumptions which can be challenged and debated. We welcome this debate and look forward to discussing our conclusions with our sponsors and benefactors over the coming months. The goal of the paper is not to present a definitive outcome but to catalyse a conversation about the realistic future for gas over the next decade. Please do contact the author or the Gas Programme with your thoughts.

James Henderson

Head of Gas Research, OIES

1. Introduction

After the impact of Covid-19 on global gas markets in 2020, gas demand was recovering strongly in 2021 as lockdowns ended and economic activity rebounded. This was especially true in China. Towards the end of 2021, Russia had already started reducing pipeline flows to Europe, in part by withdrawing from selling spot gas through the Gazprom platform, which with rising gas demand and restricted global LNG supply, led to sharply rising gas prices.

The Russian invasion of Ukraine tightened the market even further, as prices rose rapidly on the fear of large curtailments of Russian pipeline flows to Europe. As actual pipeline flows from Russia began to decline, demand in Europe and other parts of the world fell, leading to a full-blown energy crisis. In the first half of 2023, demand in Europe has continued to decline and has also been weak in the main LNG importing countries in Asia, outside the ASEAN region.

At the time of writing (July 2023) it appears that the world is emerging from the energy crisis, although the global gas market remains tight. A key question remains as to what type of gas market will emerge? The IEA's World Energy Outlook (WEO) 2022[3] includes, as usual, their Stated Policies Scenario (STEPS). The 2022 STEPS has much lower gas demand post-2025 than in the previous year's WEO (2021), notably in China, with weakness in other Asian markets, especially Japan, which impacts LNG imports. The WEO 2022 demand forecast is also much lower than the OIES medium-term scenario to 2030, which, at a global level at least, has typically been aligned with the IEA's STEPS.

Part of the reduction in demand between the 2022 and 2021 WEOs may well have been a response to the impact of the Russian invasion of Ukraine, which emphasised the need for more energy security, often at the expense of the energy transition, hence the upsurge in coal use, including in Europe. Have the high prices and volatility in the global energy markets, led to a possible permanent structural shift in global gas demand, with demand in some sectors and regions being lost forever? If so, this would have longer term implications for gas demand in many countries, as well as pipeline and LNG suppliers and projects around the world.

At OIES, we have undertaken a detailed review of the medium-term gas demand outlook to 2030 at a sectoral and regional level, drawing on the wide expertise of the research fellows, referred to as the 'New Order' scenario. The underlying assumption in reviewing country and regional gas demand was that the outlook should be an EXPECTED outlook to 2030, based broadly around countries stated policies in terms of the energy transition, but assuming such policies are implementable within the 2030 timeframe. Many countries and regional bodies, such as the EU, have announced multiple objectives and targets to 2030 in response to the Russian invasion of Ukraine, but many of these, such as REPower EU,[4] do not contain realistic implementable plans to achieve these targets, and are largely wishful thinking. This New Order scenario, therefore, which only runs to 2030, is explicitly not a scenario which is on a path to either achieve net zero by 2050 or to limit the global temperature rise to 1.5 degrees C.

The paper is entitled A New Global Gas Order (Part 1) and analyses the global gas market to 2030. The intention is to publish a further paper (Part 2) later in 2023, which will explicitly consider alternative energy transition scenarios to 2050, which are designed to materially reduce greenhouse gas emissions, focused on the implications for gas demand.

The report covers the outlook for gas demand by key regions and sectors, including an initial comparison with the WEO 2022 STEPS, supply and infrastructure (particularly the prospects for LNG supply), implications of the supply-demand balance on trade flows and spot prices, and comparisons with other published scenarios.

A key baseline assumption is that at the end of 2024, when the current transit deal between Gazprom and Naftogaz Ukraine expires, it will not be renewed and flows of Russian pipeline gas into the EU via Ukraine will cease. The only flows of Russian gas into the EU will be via Turkstream, since it is assumed that neither Nordstream nor the Yamal pipeline via Belarus, will be available to flow Russian pipeline gas to the EU.

[3] World Energy Outlook 2022, International Energy Agency, Paris, France

[4] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en

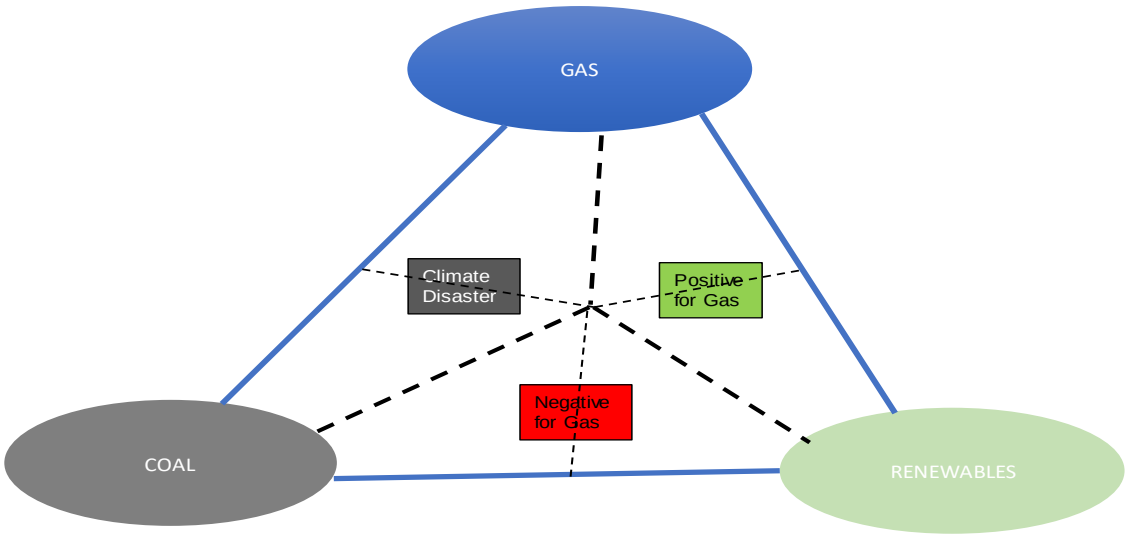
2. Coal versus gas versus renewables – the trilemma

Before the Russian invasion of Ukraine, there was a consensus that gas demand would grow in regions where coal was heavily used in power generation, as countries sought to reduce emissions through a combination of increased use of gas and a larger role for renewables. In China, the scope for the displacement of coal with gas was also significant in the industrial and building sectors. In the short-term at least, the energy crisis has led to an increasing focus on energy security and, in many regions, this has conversely increased the use of coal leading to rising emissions.

A key question for natural gas is whether 2022 is a blip in the move away from coal to gas and renewables, or whether there has been a structural change such that the actual and perceived future high and volatile price of gas accelerates the move to renewables, combined with coal remaining longer in the energy mix, potentially with higher emissions than would otherwise have been the case.

Different countries and regions have been moving at different paces and directions. In the EU (and UK) coal is being pushed out of the mix at differing rates. In Asia, some countries, notably China, are still investing in coal, while Korea and Chinese Taipei are planning to significantly reduce coal burn in power generation. In Japan, the speed with which nuclear power returns will impact both coal and gas. Vietnam has recently announced[5] an increased push for gas, especially LNG, in the power sector. The IRA in the US, if effectively implemented, is likely to negatively impact coal and gas in the power sector, although gas is expected to gain in the industrial sector.

Figure 1: The trilemma for gas



The analysis and the results outlined below will focus largely on regions and some of the key larger countries. The regions, used by OIES, are as outlined in the figure below.

[5] https://www.nasdaq.com/articles/vietnam-bets-big-on-lng-south-china-sea-gas-fields-amid-supply-security-risks?utm_source=substack&utm_medium=email

Figure 2: Regional definitions

Note: Other Eurasia is Ukraine, Belarus, and Moldova – sometimes referred to as UBM

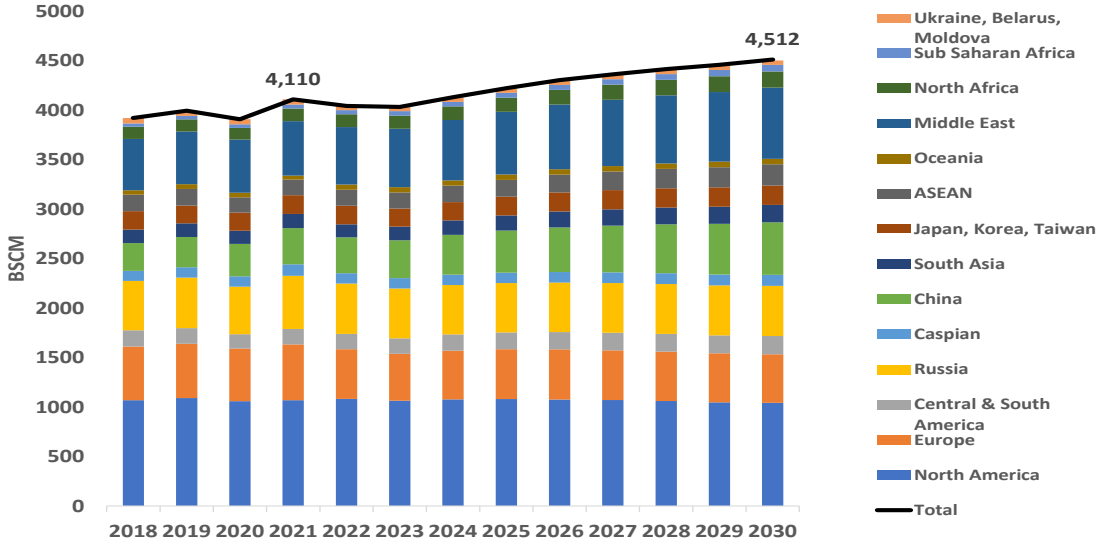
3. Demand

Note: The level of demand projected in the scenario is, in part, dependent on the level of prices. The spot prices coming out of the modelling are discussed in more detail later. To aid understanding of the projected demand the spot prices decline steadily, in real terms, from 2024 onwards to around $8/MMBtu for Europe and Asian prices and to a low of $3/MMBtu for Henry Hub by 2030.

3.1 World Demand

As noted in the Introduction, the focus of this paper is on the period to 2030 – the medium-term outlook. Global gas demand growth between 2021 and 2030 is projected at some 400 bcm, growth of some 10 per cent or 1 per cent per annum. China and the Middle East account for over 80 per cent of the growth. If the wider "import reliant" Asian markets are considered, these account for two-thirds of the growth, and, although Europe declines by over 70 bcm, European LNG import requirements rise. In percentage terms, Africa and Central and South America also show strong growth.

Figure 3: World demand



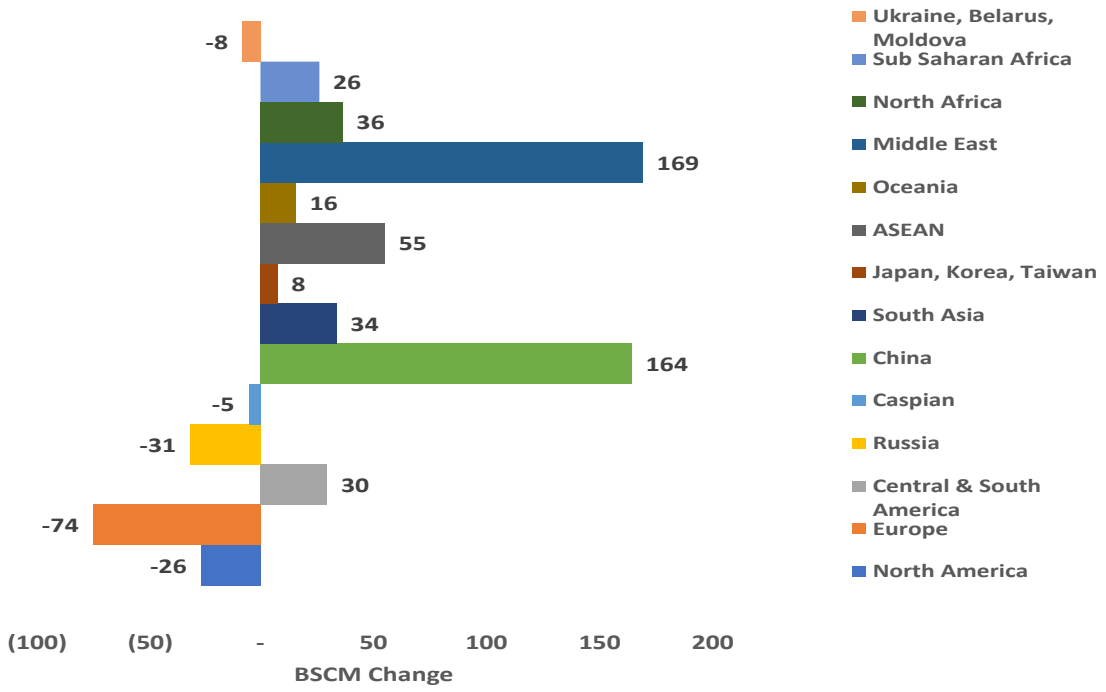
Source: IEA, NexantECA WGM, OIES Projections

Prior to the Russian invasion of Ukraine, the OIES base case projection[6] was for growth of almost 700 bcm between 2021 and 2030. Expected growth is now some 300 bcm less, and not all of this loss of growth can be attributed to the energy crisis. The New Order projection for 2030 is now some 4,512 bcm, whereas the end-2021 base case projection for 2030 was just over 4,800 bcm. The key differences between the two cases for the year 2030 are:

- North American gas demand is some 200 bcm less in 2030, principally as a result of the impact of the Inflation Reduction Act in the US (gas demand is now expected to decline by some 45 bcm between 2021 and 2030, rather than growing by 160 bcm).
- European demand is around 45 bcm less in 2030;
- Demand in China will be approximately 25 bcm less in 2030 and there will be marginal reductions in other regions;
- These are partly offset by higher Middle East demand in 2030 of some 30 bcm – particularly in industry.

At a global level, over 80 per cent of the growth in demand between 2021 and 2030 comes from the power and industry sectors – even more if non-energy use and energy industry use are added. Residential demand declines, although part of that reflects the fact that 2021 was a cold winter year which boosted heating demand.

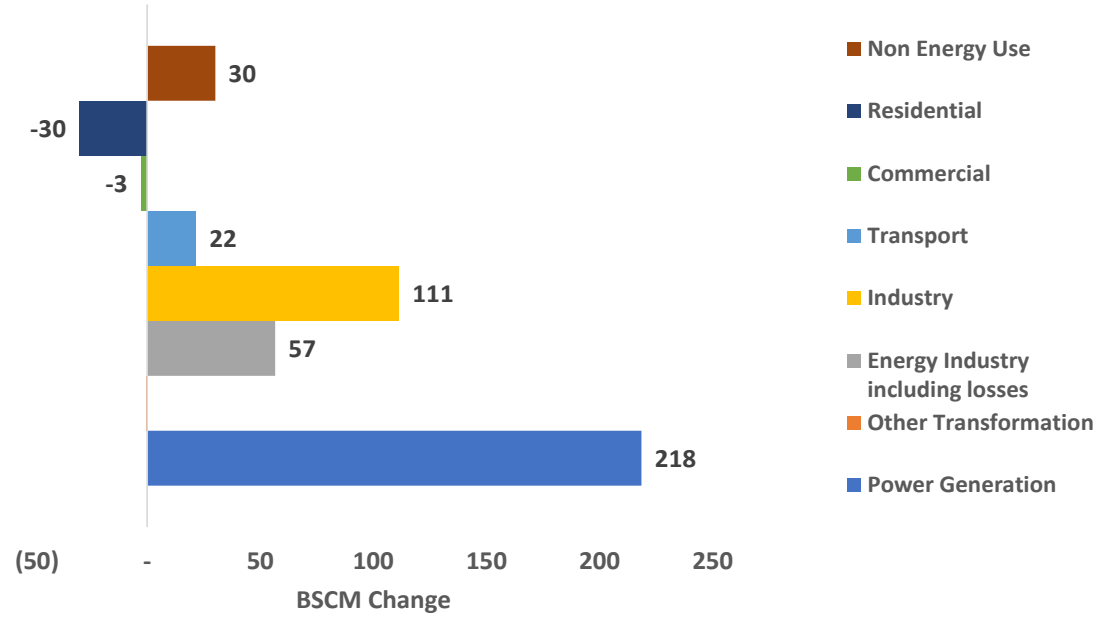
Figure 4: World demand growth – change 2021 to 2030



Source: IEA, NexantECA WGM, OIES Projections

[6] Base case as at the end of 2021. This was not published in any paper but presented at Sponsors' meetings and conferences.

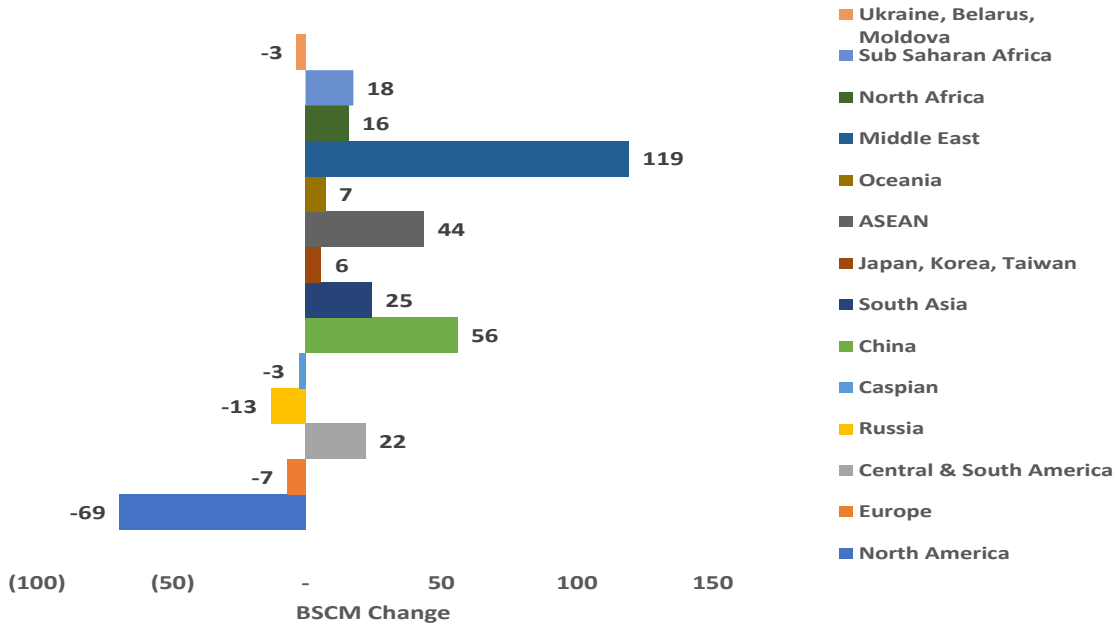
Figure 5: World demand growth by sector – change between 2021 to 2030



Source: IEA, NexantECA WGM, OIES Projections

Power generation growth in gas demand is heavily weighted outside the OECD economies. In volume terms the Middle East and China show the biggest growth, followed by ASEAN and South Asia. Growth is also strong in percentage terms in Africa and Central and South America. Gas demand in power declines in North America – largely the impact of the IRA in the US – and in Russia. In Europe, gas demand in power largely remains flat between 2021 and 2030, as renewables grow rapidly but coal declines very sharply, allowing gas to maintain its market share – see below for a more detailed discussion.

Figure 6: Power generation gas demand growth – change 2021 to 2030

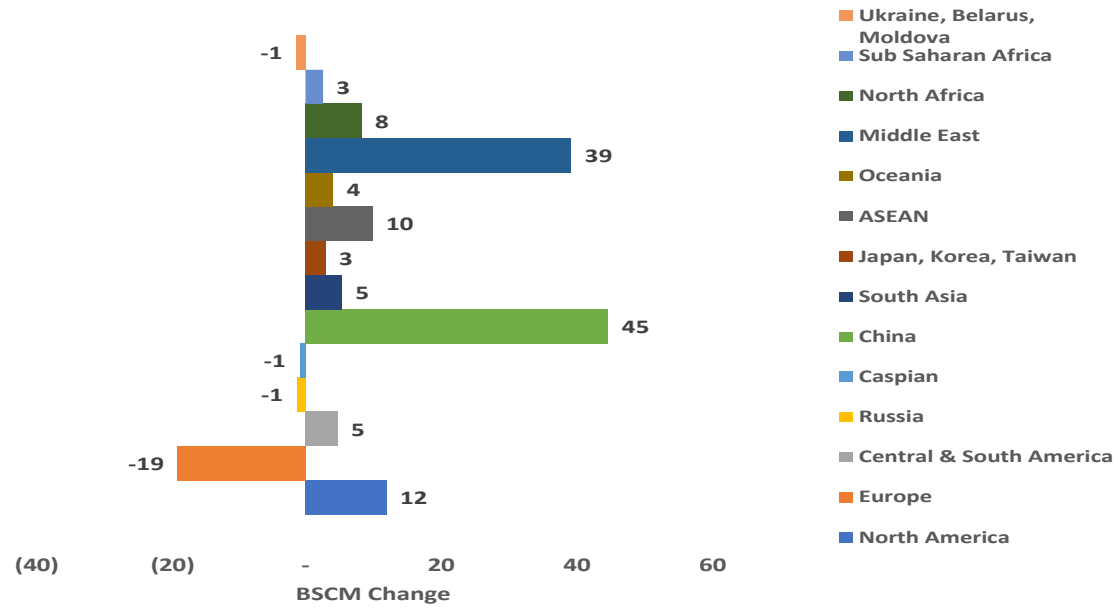


Source: IEA, NexantECA WGM, OIES Projections

Gas demand growth in industry is largely seen across the board with, as for power generation, the Middle East and China leading the way in volume terms. Demand in North America, especially the US, grows in the heavier industries, and Europe is the only region where gas demand in industry declines. 2022 saw a large reduction in industrial gas demand following the sharp rise in prices, and a proportion

of this is not forecast to return, partly reflecting more efficient use of gas but also industries moving their operations to lower energy cost regions such as the Middle East, and also possibly the US, attracted by the large subsidies offered in the IRA. The prospects for industrial growth in the higher energy cost OECD countries look less optimistic than before the energy crisis.

Figure 7: Industry gas demand growth – change 2021 to 2030



Source: IEA, NexantECA WGM, OIES Projections

3.2 Selected Regional Demand

Much of the discussion in respect of gas demand, in part because of its impact on LNG trade, surrounds Europe and the Asian markets. Figure 8 includes the demand growth charts for Europe, the four Asian regions and North America. Annex 1 includes the demand growth charts for the remaining regions.

Demand is compared between 2021 and 2030, caveated by the fact that in Europe 2021 was a cold winter which boosted heating demand above normal winter levels, compared to 2022 which was relatively mild. Additionally, demand fell during 2022 in some regions, especially Europe, due to high prices and restricted gas supplies.

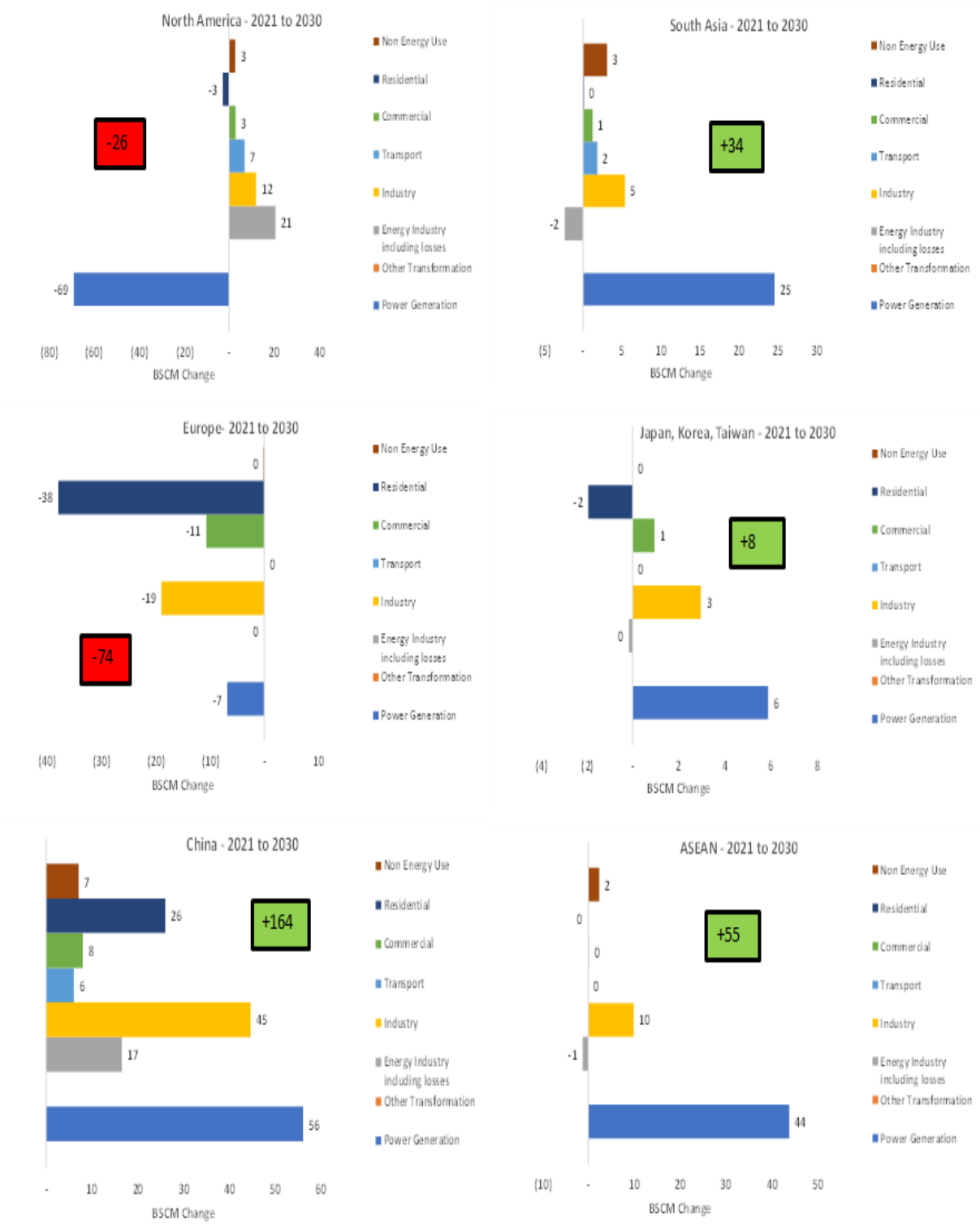
In North America, there is marginal growth in all sectors apart from power generation, which declines on the back of strong renewables growth. Residential demand declines marginally but this weakness reflects the impact of normal versus cold weather. North American demand overall declines by some 26 bcm, with the decline in the US being larger at some 44 bcm or 5 per cent, between 2021 -2030. The latest US EIA outlook[7] has a slightly larger decline of some 8 per cent, on the back of the IRA.

In Europe, there is a sharp fall in residential and commercial demand, partly due to the weather effect but also the result of the expected switch to more electrification and greater use of heat pumps. The overall expected decline in European demand of some 74 bcm from 2021 to 2030, largely, all took place during 2022, so in effect demand is expected to be flat in this region from now on until 2030.[8]

[7] https://www.eia.gov/outlooks/aeo/

[8] With the early months of 2023 showing further declines in demand, this implies a small recovery in demand in 2024 and beyond as prices potentially stabilise at a lower level.

Figure 8: Selected regional demand growth – change 2021 to 2030



For China the growth in demand is across the board. Overall growth between 2021-2030 is 45 per cent or just over 4 per cent a year. Growth is higher than this in power and non-energy use. Expected GDP growth in China between 2021 and 2030 is some 4.7 per cent per annum, so gas demand growth is slightly lower than GDP growth. However, energy intensity does fall significantly in China over the period, with overall energy supply only growing by 0.66 per cent per annum and electricity demand by

3 per cent per annum.[9] The growth in gas demand, therefore, does suggest an increase in market share – this is discussed further below.

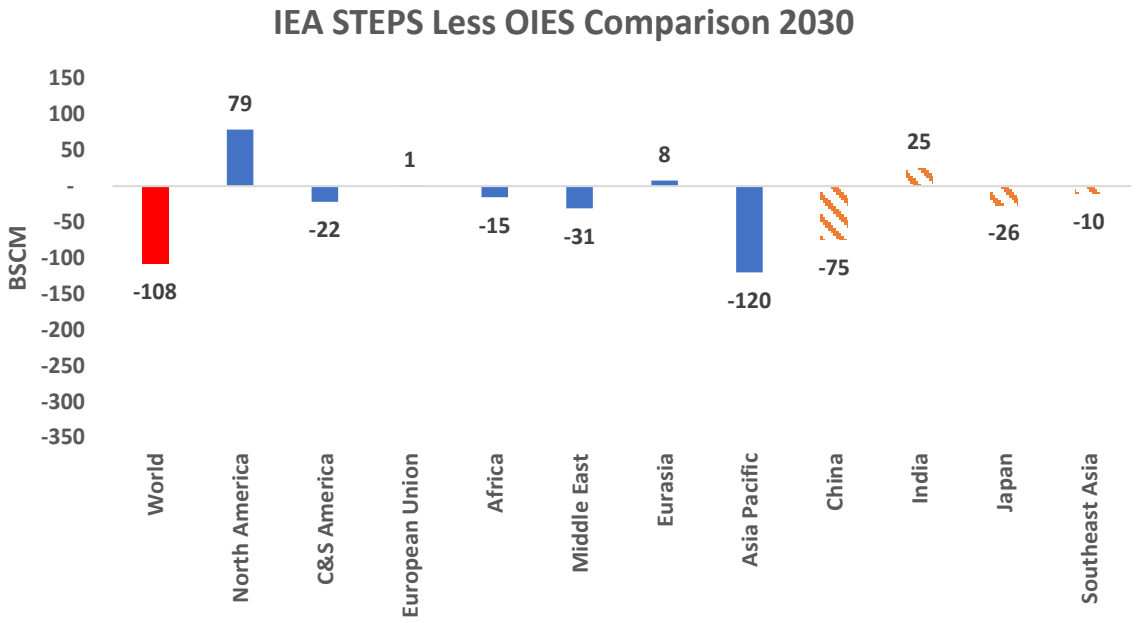
For the mature LNG importers of Japan, Korea, and Taiwan, there is a small increase in overall demand but Japanese demand declines by some 15 per cent as the nuclear plants come back onstream. This is offset by a slight rise in Korean demand and strong growth in Taiwan, especially in power, as coal and nuclear plants are closed.

In both South Asia and ASEAN regions the growth in gas demand is dominated by the power sector and in almost all the countries there is potential displacement of coal by gas and also by renewables.

3.3 Comparison with IEA STEPS

Note: Forecast OIES world gas demand is 4,512 bcm in 2030, while the IEA STEPS published 2030 demand is 4,372 bcm – a difference of 140 bcm. The IEA treat biomethane as alternative demand to natural gas, while the NexantECA WGM has biomethane as production to satisfy demand for methane. The 2030 global biomethane production in the OIES scenario is 32 bcm so the differences in Figure 9 have been adjusted for this.

Figure 9: OIES / IEA STEPS comparison



Source: IEA, NexantECA WGM, OIES Projections

IEA STEPS has total global gas demand by 2030 just over 100 bcm lower than the OIES New Order scenario – an overall gap of around 2.5 per cent. However, there are significant differences in some regions, notably in North America, where IEA STEPS is some 79 bcm higher than OIES, where our projection is more impacted by the IRA in the US (although not as big an impact as the US Energy Information Administration (EIA) are projecting).

IEA STEPS is lower in Central and South America, mainly due to its assumption of a much lower natural gas share in the power sector, falling from 26.4 per cent in 2021 to 18.5 per cent in 2030 (with renewables growing very strongly), whereas OIES has a rise in the natural gas share to 31.5 per cent. There is a similar story in Africa, with the IEA projecting a doubling of the renewables share, mainly at

[99] Part of this decline in energy intensity in China is statistical as the measured quantity of PJ to generate 1 TWh is around 4.3 for renewables (wind is lower at 3.6 and solar around 4.3 to 4.5), while the PJ/TWh for natural gas is 9 or below and for coal 10.5 or above. Therefore, as renewables displace fossil fuels there will automatically be a decline in energy intensity. Note this is not a measure of energy efficiency or losses in the generation process but just the assumptions made on converting a notional PJ of wind and/or solar into a TWh of electricity.

the expense of natural gas. The higher OIES gas demand in the Middle East reflects higher industrial activity.

There is no difference between OIES and IEA on EU gas demand but this hides the fact that OIES has a higher share in gas demand in power than IEA, but a much weaker industrial energy demand forecast. This is a result of increased energy efficiency and industry closures, and hence weaker gas demand, exacerbated by some switching to renewables and heat pumps for lower temperature processes. The IEA has the gas share in power falling to 15 per cent in 2030 from 18.7 per cent in 2021, while OIES has a slight increase to 19 per cent. These differences are almost wholly the result of assumptions made regarding the load factor for wind power in the EU. The IEA has it rising from the 24 - 25 per cent average between 2015 and 2021 to 31 per cent in 2030. This either assumes a large increase in offshore wind in the EU and/or much more efficient turbines. As the EU numbers do not include the UK or Norway, the scope for a lot more offshore wind may be more limited, however. OIES has assumed some rise in the load factor for wind but not as much as the IEA, with the difference being transferred to gas demand, with the shares of coal and nuclear broadly the same.[10]

The big differences in the scenarios lie in the Asia Pacific region. IEA has higher gas demand in India than OIES, principally reflecting the assumptions for higher shares for gas in industry and buildings, while we are much less optimistic on the ability of natural gas to gain market share in a highly price sensitive market. China and Japan are the main countries – and also key LNG importing countries – where IEA STEPS demand is significantly below the OIES demand. In Japan, this is all due to the assumptions on the share of nuclear. The IEA assumes the share of nuclear will rise back to over 30 per cent in 2030, compared to 8 per cent in 2021 (pre-Fukushima the share was 32 per cent). As a result, with renewables rising by over 10 percentage points, natural gas's share falls to 18 per cent in 2030 from 36 per cent in 2021. Coal demand in IEA STEPS also falls as well by 12 percentage points. OIES assume the share of nuclear in the region only rises back to 21.5 per cent in 2030, with slower renewables growth as well,[11] resulting in a natural gas share of 31 per cent in 2030, which is still a fall of 5 percentage points from 2021. In our view, the IEA's estimate of recovery in the share of nuclear in Japan, almost back to pre-Fukushima levels, is over-optimistic with a lower recovery in share from the 8 per cent in 2021 seeming more reasonable.

In China, the differences between IEA STEPS and OIES are down to relatively small assumptions in market shares in the key sectors, but given the size of China's energy demand, these can translate into significant differences in gas demand. In the power sector, growing renewables and nuclear largely displaces coal, but there is still a rise in the gas share (IEA STEPS) from 3.4 per cent in 2021 to 3.7 per cent in 2030. OIES has a slightly larger rise to 5.4 per cent, with marginally lower shares for coal, nuclear, and renewables. In industry, the IEA has a rise in the gas share from 7.5 per cent in 2021 to 8.7 per cent in 2030, while OIES has a slightly higher 2030 share of 9.2 per cent, at the expense of less coal. In buildings, the IEA has a rise in the gas share from 12 per cent in 2021 to 14.7 per cent in 2030, while OIES has a rise to 16.7 per cent. The differences are less to do with reducing shares of coal and rising electrification and more to do with increasing urbanisation in China and lower biomass use as the population moves away from rural areas to cities.

Finally, OIES has higher gas demand in ASEAN countries. This is wholly down to a higher share in power, with greater displacement of coal in countries like Vietnam, where a greater emphasis on gas was recently announced.

Full charts on the IEA/OIES comparison of market shares of fuels in the power, industry, and buildings sectors for key countries and regions are in Annex 2. Some of the differences in market shares relate to a different view of coal share versus gas share, but also the share of renewables against gas in power. The growth in the share of renewables in all regions is a function of the growth in GW capacity additions but also an assumption about possible rises in the load factors for wind and solar. Even where OIES and the IEA have the same assumptions on growth in renewables capacity, a difference in load

[10] The share of coal in power in the EU falls to less than 8 per cent in 2030, compared to 20 per cent in 2021 according to both OIES and the IEA. The nuclear share is down slightly.
[11] In Japan the IEA also assume a rise in the wind load factor from 23 per cent in 2021 to 28 per cent in 2030.

factor assumptions can lead to significant differences in the relative shares, and consequently gas demand, as noted in the discussion on EU gas demand.

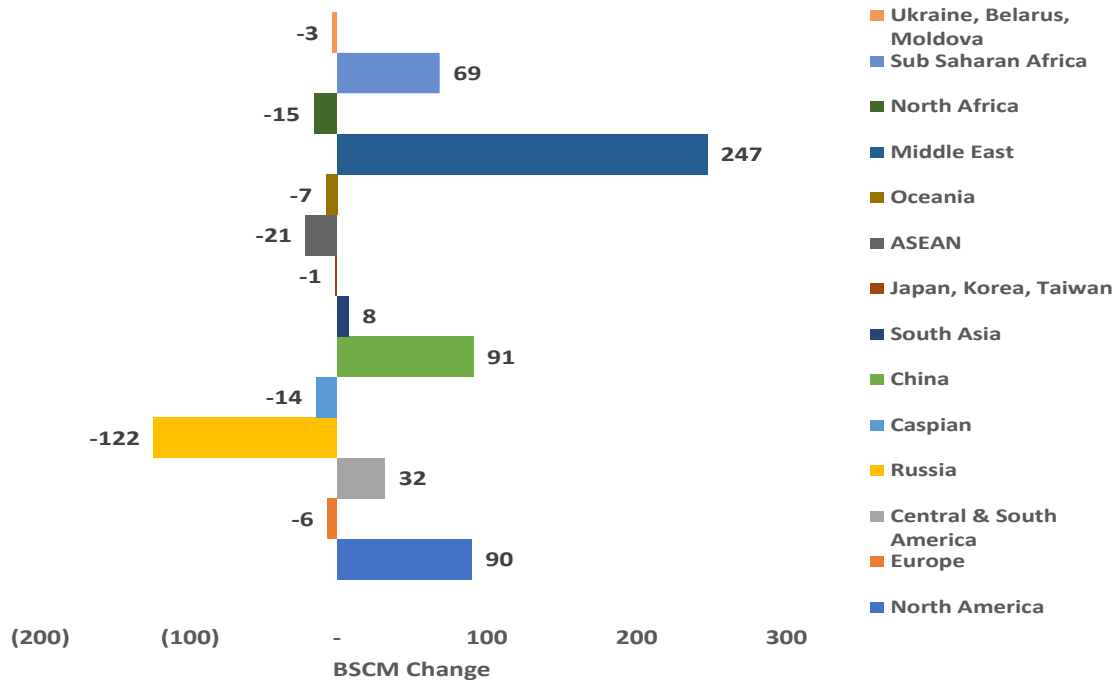
4. Supply and Infrastructure

Growth in natural gas supply is led by the Middle East, China, North America, and Sub-Saharan Africa. Russia sees a sharp decline in production as a result of much lower pipeline exports to Europe. There are also declines in production in ASEAN countries, increasing their need to import LNG, and in North Africa, specifically lower Algeria and Egypt.[12] Europe has a relatively small decline as rising production from Turkey's Black Sea field and higher biomethane production partly offset lower production from Norway, UK and the Netherlands.

The growth in production in China supports domestic demand growth, and is in shale, coalbed methane, and conventional production. Most of the rise in production in the Middle East is consumed locally, but some of the latter supports the Qatari LNG expansion. North American and Sub-Saharan Africa production growth supports rising LNG exports. Sub-Saharan African production growth is principally in Mozambique and Nigeria.

As far as pipeline and LNG infrastructure are concerned, most of the key expansions are in LNG export capacity. On the pipeline side, it now seems likely that Power of Siberia 2, from Russia via Mongolia to China, will not be operational before 2030, and we assume that any expansion of Power of Siberia 1 or the Sakhalin to China pipeline will also not happen before 2030, if at all, since decisions on any expansion or new builds would need to be taken very soon. Outside any new projects to export gas from Russia, the only other significant inter-regional pipeline project before 2030 is likely to be the expansion to facilitate more gas flows from Azerbaijan into Europe, specifically the expansion of TAP into Italy.

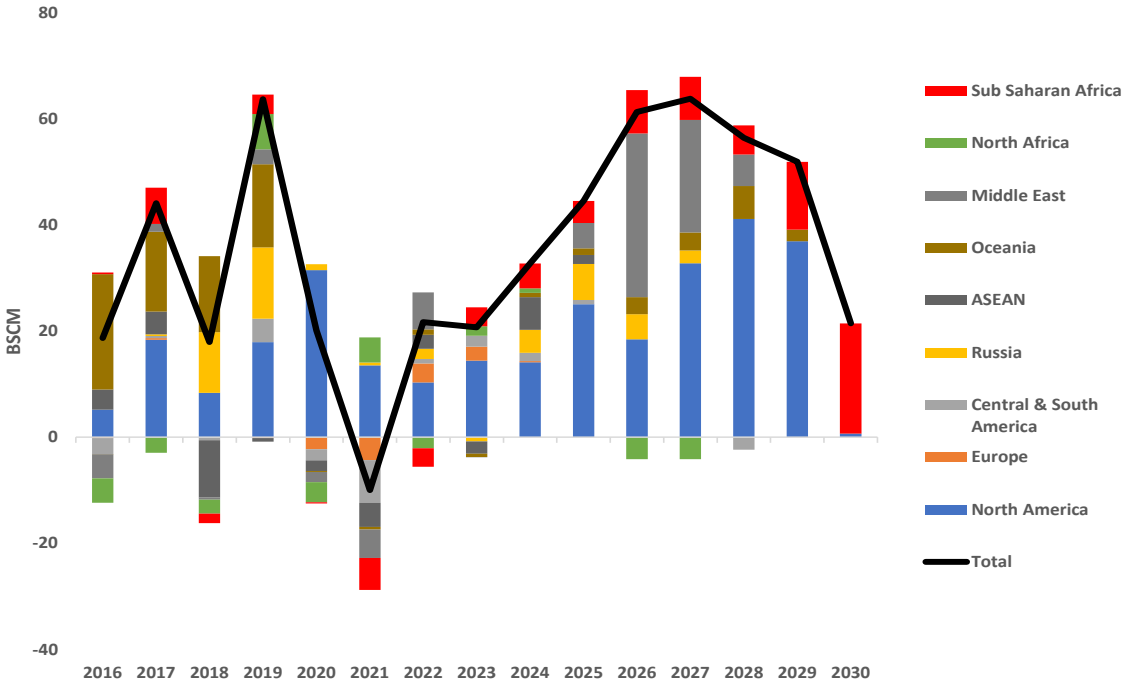
Figure 10: World supply growth – change 2021 to 2030



Source: IEA, NexantECA WGM, OIES Projections

[12] Libya remains uncertain – in the event of a cessation of the conflict, production and exports could rise, but this would require additional investment and would be more likely post-2030.

Figure 11: LNG export capacity growth



Source: NexantECA WGM, OIES Projections

Global LNG export capacity is expected to grow by over 350 bcm between 2022 and 2030, a rise of 60 per cent over the 2022 average available LNG export capacity. 80 per cent of this rise has already taken FID, and over half the increase is from North America. The key projects, which have already taken FID and are coming online prior to 2030 are as follows:

2023 – Tangguh T3 (Indonesia), FLNG Exmar (Congo)

2024 – Tortue FLNG Phase 1 (Senegal/Mauritania), Golden Pass (US), Arctic 2 LNG T1 (Russia), New Fortress Fast LNG (US)

2025 – Energia Costa Azul (Mexico), Qatar Additional T1/T2, LNG Canada, Altamira FLNG (Mexico)

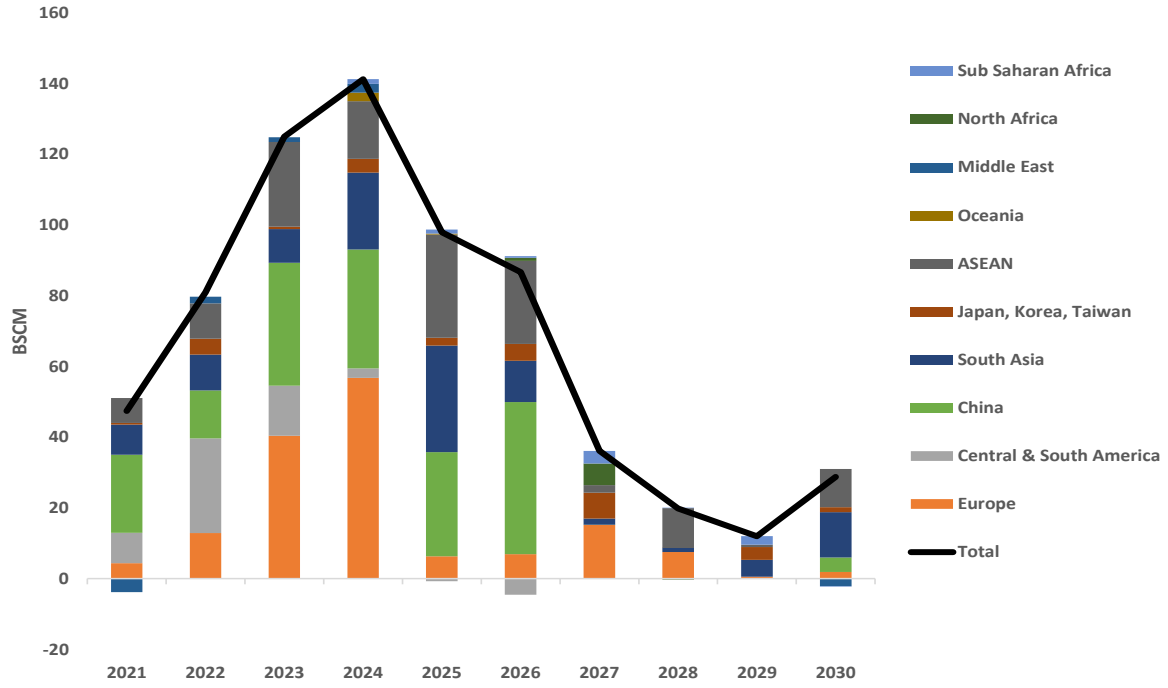
2026 – Arctic 2 LNG T2, Qatar Additional T3/T4, FLNG Congo Brazzaville, NLNG T7 (Nigeria)

2027 – Pluto T2 (Australia), Corpus Christi Phase 3 (US), Plaquemines T1 (US)

2028 – Plaquemines T2 (US), Calcasieu Pass Phase 2 (US), Port Arthur (US), Mozambique T1/T2, Rio Grande (US)

Additional likely FIDs include Cameron Phase 2 (US), two further Qatar trains (T5/T6), Papua LNG T1/T2, and Woodfibre (Canada), all of which could come online by 2028. Additionally, there is potential for Rovuma LNG (Mozambique) but likely only by 2030. Tanzania LNG is also a possibility but 2030 may be too soon. Additional US and Canadian projects also possible but are not included in this analysis.

Figure 12: LNG import capacity growth



Source: NexantECA WGM, OIES Projections

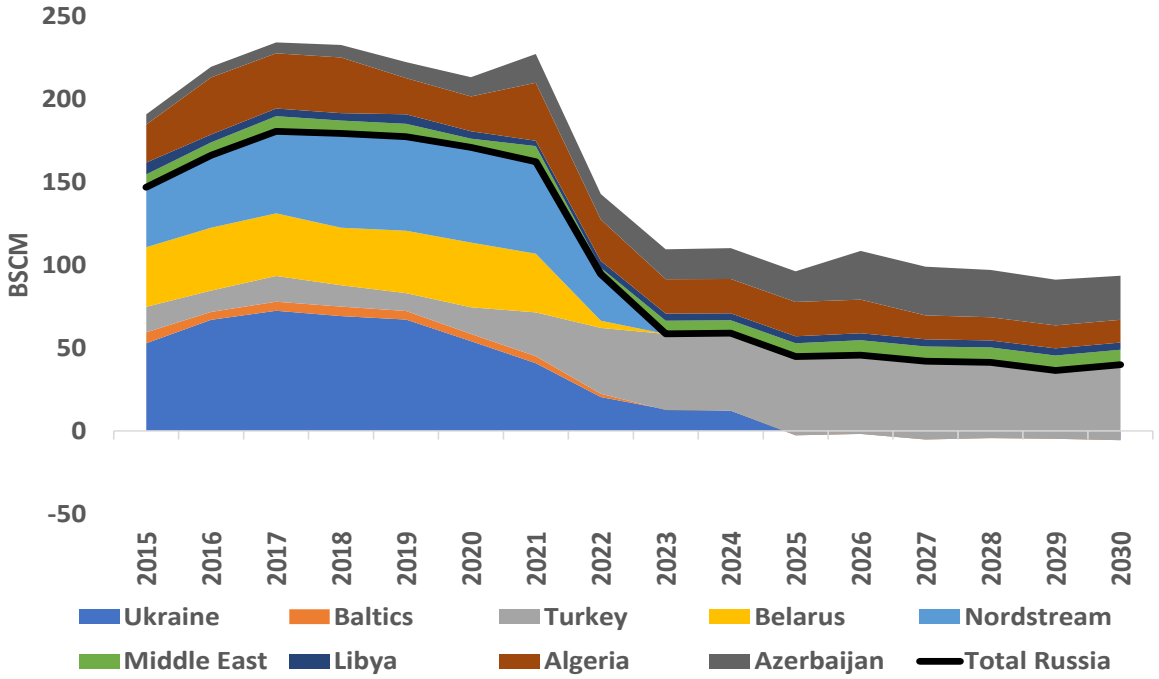
Global LNG import capacity is expected to grow by some 550 bcm between 2022 and 2030. China and Europe lead the way with 145 bcm and 135 bcm, respectively, followed by ASEAN (120 bcm) and South Asia (95 bcm). Europe's growth, predominantly in 2023 and 2024, in response to the Russian invasion of Ukraine, is heavily focused in Northwest Europe, especially Germany.

5. Trade and Prices

The changes in pipeline trade are focused in Europe. With Power of Siberia 2 now not expected until post-2030 and the likely Sakhalin to China project paused, any growth in pipeline exports into China are largely the ramp-up of Power of Siberia to full capacity of 38 bcm in 2025 and additional flows from Central Asia as production constraints are eased, some of which may be imports into Kazakhstan from Russia, which are then re-exported.

Total pipe imports into Europe in 2021 were almost 230 bcm, of which 165 bcm was from Russia. In 2023, pipe imports are expected to be down to some 110 bcm, with a dramatic fall in pipe imports seen from Russia. By 2030, total pipe imports are down to 100 bcm and there would also be the need to export some 5 bcm to Ukraine to support any recovery in domestic gas demand, assuming no gas available from Russia. Further falls in imports from Russia, which post-2024 are only via Turkey, and lower North African imports are only partly offset by more gas from Azerbaijan. The volumes going into Turkey from Russia are around 45 bcm per year in the last half of the 2020s. Less than half of this would be for onward transmission into the EU.

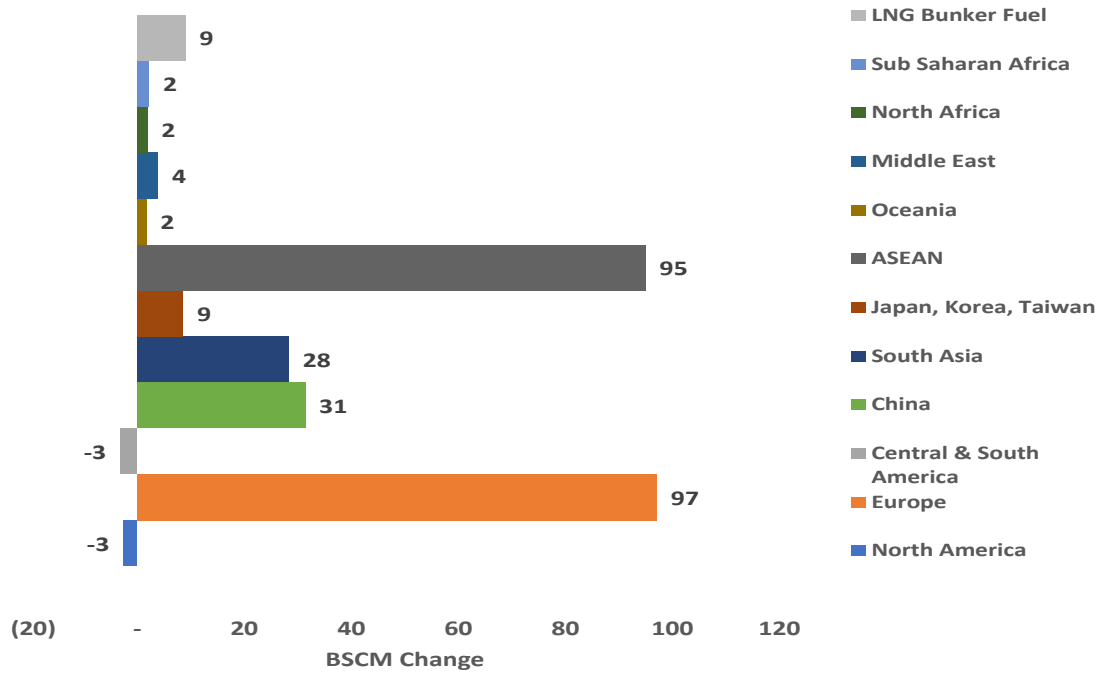
Figure 13: Europe pipe imports



Source: IEA, NexantECA WGM, OIES Projections

With the large rise in LNG export capacity noted in the previous section, global LNG imports are also expected to rise sharply. The global increase between 2021 and 2030 is some 275 bcm – a rise of over 50 per cent in LNG trade.

Figure 14: Change in LNG imports 2021 to 2030



Source: IEA, NexantECA WGM, OIES Projections

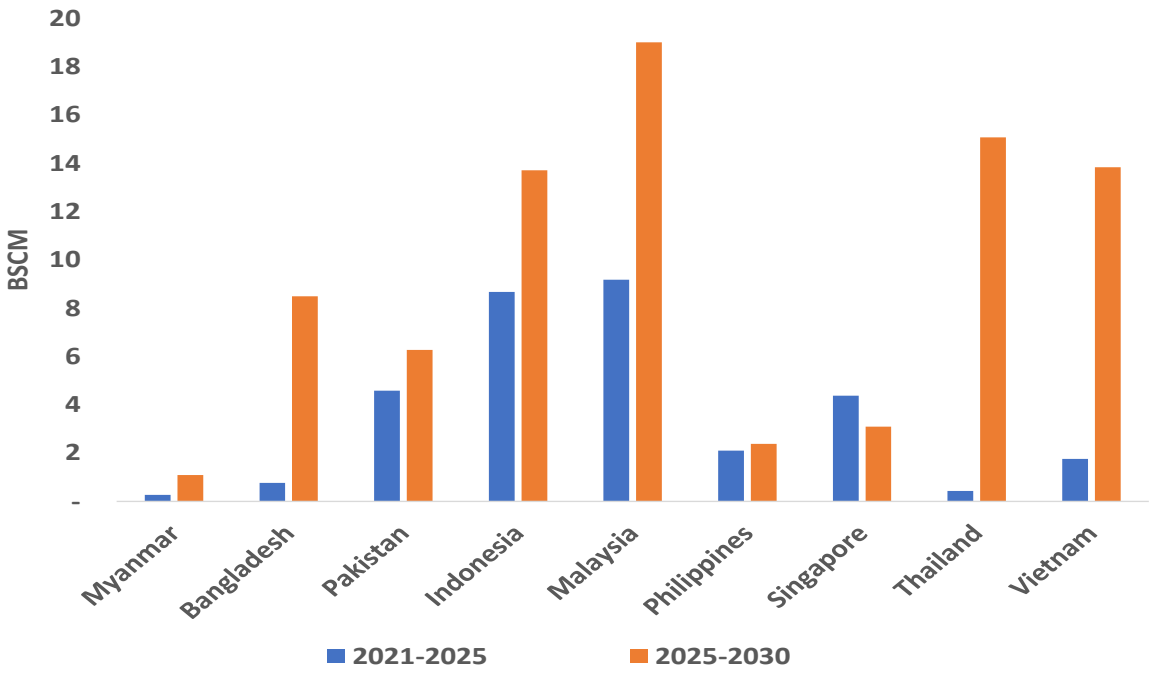
Europe and ASEAN have the largest increases of just under 100 bcm, although some 60 bcm of the European growth has already taken place in 2022 so for the rest of this decade, growth is less than 40 bcm. Total Europe LNG imports exceed 200 bcm in 2026 and remain there for the rest of the decade,

this compares to 2021 when Europe LNG imports were some 105 bcm and 2013/2014 when imports were less than 50 bcm.. Chinese growth is some 30 bcm but this includes the 20 bcm decline in 2022 following weak economic activity and lockdowns, so means effectively 50 bcm growth from 2023. ASEAN shows strong growth as production declines and demand grows. Demand in India, Pakistan, and Bangladesh is projected to pick up as prices ease back – these are price-sensitive markets and demand growth here may depend on prices dropping back to $8/MMBtu or less.

The emerging ASEAN markets show some of the fastest growth in LNG imports in the 2020s, together with Pakistan and Bangladesh (collectively the emerging Asian LNG imprters. The rise is a combination of declining domestic production (Pakistan and Thailand), flat domestic production combined with maintaining LNG exports (Malaysia and Indonesia), reductions in pipeline imports (Singapore and Thailand), and then the new importers (Philippines where domestic production is declining rapidly) and Vietnam (where there is some new domestic production growth but rising demand).

The growth is generally concentrated in the last five years of this decade. This reflects the need for large infrastructure investment – not just in regasification facilities and connecting pipeline but also in many gigawatts of new gas-fired power plants. While financing projects in the region has generally been achievable, those providing the financing may be more cautious as a result of the energy crisis. If this is indeed the case, the necessary infrastructure may not be forthcoming in a timely manner, which would lead to much lower LNG import growth.

Figure 15: Change in emerging Asian LNG imports 2021 to 2030



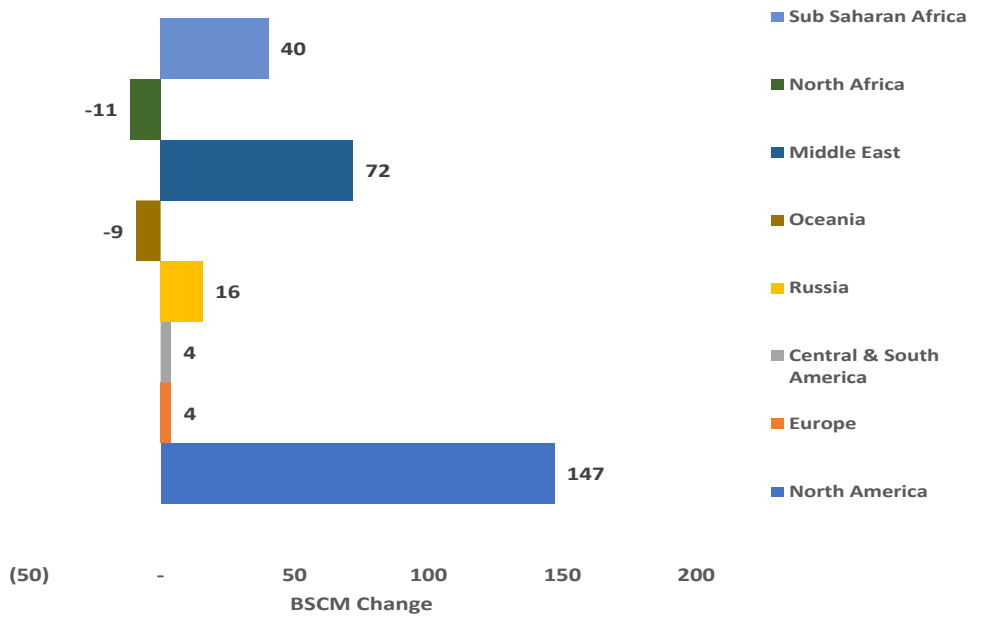
Source: IEA, NexantECA WGM, OIES Projections

Gas pricing in the region is complex: some subsidies remain and many of the emerging markets have gas prices linked to oil so not all the high spot prices have impacted these markets. Many of the markets are well contracted for LNG but Vietnam and Philippines appear to have almost no contracts in place, exposing them to the vagaries of the spot market. If the high prices of 2022 persisted (although as of June 2023 prices are back to more reasonable levels), the very sharp post-2025 growth in LNG imports in the emerging ASEAN markets could be threatened.

The growth in LNG exports largely follows the growth in LNG export capacity. Over half the rise in LNG exports is from North America with Canada and Mexico joining the US as LNG exporters. Another quarter of the growth comes from the Middle East with expansions from Qatar, while Nigeria, Mozambique, and Senegal boost sub-Saharan African exports. Much of the Qatari expansion and Mozambique exports are destined for the Asian markets, while North American volumes are largely weighted towards Europe but with some growth into Asia, while Nigeria and Senegal expansions are geared more towards Europe.

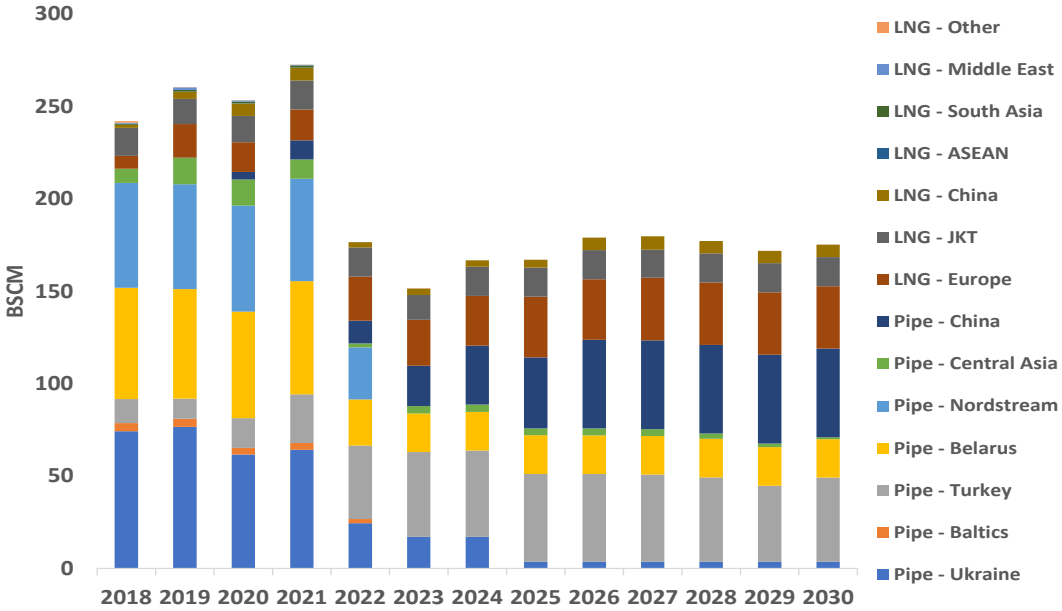
Russia has seen a sharp decline in pipe exports to Europe in 2022 and 2023. The total decline in pipe imports to Europe by 2030, compared to 2021, is some 140 bcm but this is partly offset by increases to China as Power of Siberia 1 ramps up. As noted earlier, it is assumed that the Russia-Ukraine transit deal will not be renewed post-2024, with the very small flows via Ukraine remaining being those to Moldova. LNG exports rise by some 15 bcm between 2021 and 2030, with Europe being the main focus as Novatek's Arctic 2 project comes online. The Sakhalin project continues to supply China, Japan, Korea, and Taiwan and it is assumed that there are no sanctions which might limit the flow of LNG from Russia to the EU. Apart from the first two trains of Arctic 2 coming online, it is assumed that there are no more Russian LNG export projects, including the third train of Arctic 2, Arctic 1 or other recently announced potential projects.

Figure 16: Change in LNG exports 2021 to 2030



Source: IEA, NexantECA WGM, OIES Projections

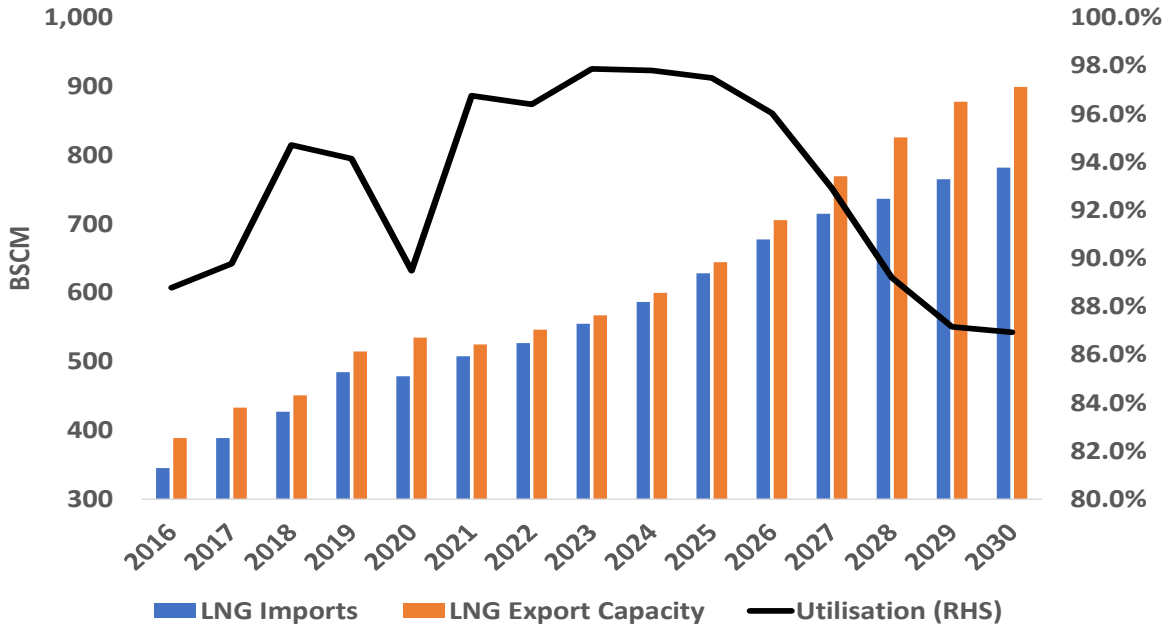
Figure 17: Russia exports



Source: IEA, NexantECA WGM, OIES Projections

Bringing the analysis of LNG exports and LNG imports together, we can look at the utilisation of LNG export terminals. LNG utilisation is calculated as total LNG imports divided by available LNG export capacity. Available LNG export capacity is calculated as nameplate capacity of the export plants, adjusted for planned and unplanned maintenance, feedgas and technical issues plus the ability of many plants to produce in excess of nameplate capacity.

Figure 18: LNG utilisation



Source: IEA, NexantECA WGM, OIES Projections

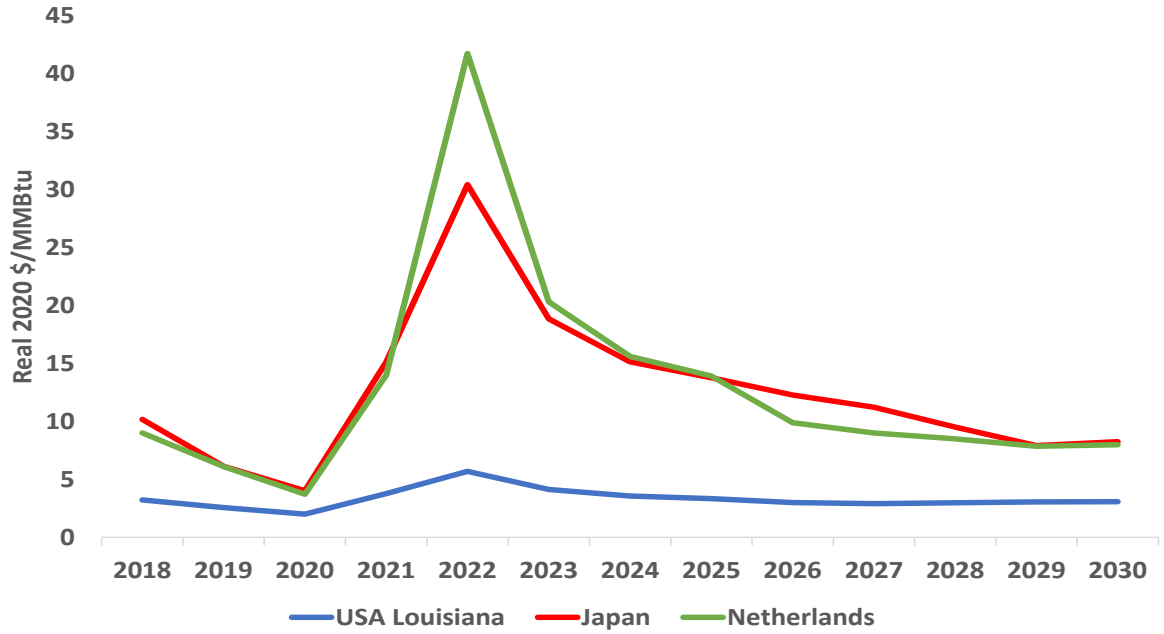
Utilisation reached around 98 per cent after the recovery from Covid-19 and the Russian invasion of Ukraine, effectively full capacity.[13]This followed the sharp fall in utilisation rates during 2020 as Covid-19 hit demand, to below 90 per cent, when low spot prices in Europe and Asia led to the shutting-in of many US LNG cargoes. By comparison, utilisation averaged some 92 per cent between 2010 and 2019.

Utilisation is not expected to begin declining until 2026 as the anticipated surge in LNG supply noted in Figure 11 materialises. The growth in available supply then outstrips the growth in demand for LNG imports and utilisation – based on the projected demand and available supply – falls to below 90 per cent by 2029 and 2030.

The projected level of spot prices is an outcome of the modelling process and is the level which 'clears the market'. The NexantECA World Gas Model spot price module calculates the market clearing spot price taking into account the long-run marginal cost of supply, the level of competing prices and tightness in the gas market. Competing prices can be oil and/or coal prices or long-term contract prices, either pipeline or LNG.

[13] Once the allowance for boil off gas on the LNG tankers is added to the import numbers.

Figure 19: Spot prices



Source: Argus, NexantECA WGM, OIES Projections

European and Asian spot prices decline from the very high 2022 levels to around $15/MMbtu[14] (around €45/MWh) in the mid-2020s, before easing to $8/MMbtu (€25/MWh) or so by the end of the decade, as the LNG oversupply materialises. Henry Hub stabilises in the $3/MMbtu range. However, it should be noted the model is clearing the market based on the long-run marginal cost of supply. With LNG terminal utilisation below 90 per cent, it might be expected that there would be a significant level of short-run marginal cost pricing, as was apparent from the middle of 2019 and into 2020 as Covid-19 hit demand and prices were well below $3/MMbtu in Europe and Asia.[15] Section 7 below looks at the levels of spot prices if the market was pricing on the basis of short-run, rather than long-run, marginal costs.

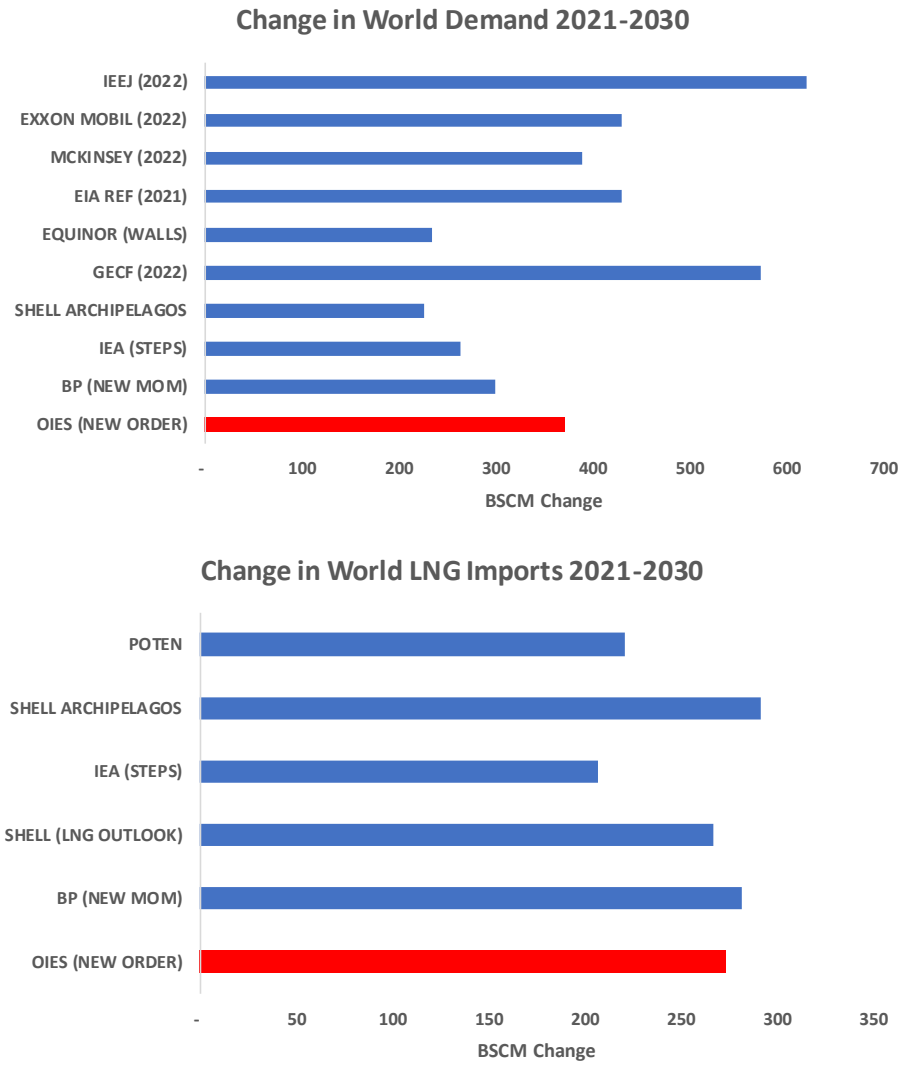
6. Medium Term Outlook Comparisons

In Section 3 on demand a comparison was made between the demand projections for our New Order scenario and IEA STEPS. There are also a few other comparable scenarios that can be looked at. As we are considering the outlook only to 2030, the comparisons are not with net zero scenarios or those limiting the temperature rise to 1.5 degrees C or even 1.8 -2 degrees C.

[14] Spot prices in Europe and Asia fell below $10/MMbtu in June 2023, but have risen slightly in recent weeks. The sharp fall in the first half of 2023 reflects high levels of European storage, weak recovery in demand, especially in China, from 2022 and the relatively warm weather, together with efficiency and behavioural changes as a result of high 2022 prices. The underlying market still remains very tight and, as and when normal weather resumes and demand in Asia picks up as projected, prices in a tight market might be expected to rise back to double digits.

[15] The LNG market is not the only market impacting prices and in 2019 and 2020 the abundance of pipeline gas from Russia was also an important factor.

Figure 20: Medium-term outlook comparisons



Source: Company sources,[16] IEA, OIES

The growth in the OIES New Order scenario for demand[17] of 372 bcm between 2021 and 2030 is in the middle of the range of demand growth, although the lower demand growth scenarios (apart from IEA STEPS) are from large industry players such as Shell, BP, and Equinor. The recent GECF and IEEJ outlooks are significantly higher than the other scenarios.

When it comes to LNG imports the differences in growth are much less, although there are fewer comparisons. OIES New Order LNG import growth is very similar to the Shell and BP scenarios, whereas demand growth in the Shell and BP scenarios is lower than ours. This suggests that the regional make up of gas demand may be significantly different in the Shell and BP scenarios than in the OIES scenario, specifically relatively higher demand in the Asian LNG importing countries compared to the non-LNG importing countries in regions such as the Middle East and North America. The IEA STEPS LNG imports growth is materially lower than Shell, BP, and OIES, most likely reflecting the IEA's

[16] https://www.shell.com/energy-and-innovation/the-energy-future/scenarios.html, https://www.bp.com/en/global/corporate/energy-economics/energy-outlook.html, https://www.equinor.com/sustainability/energy-perspectives, Poten from webinar

[17] This has been adjusted by taking out biomethane growth of 32 bcm to make the scenarios comparable.

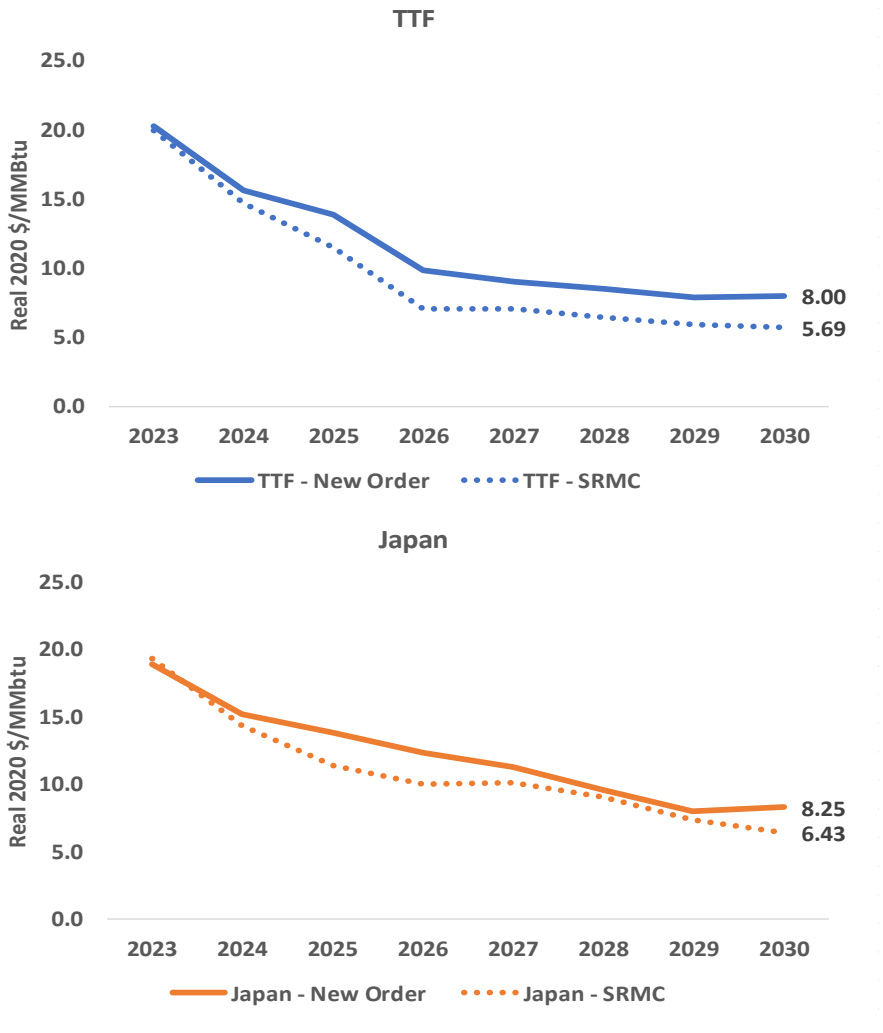
forecast for much weaker China gas demand growth. It is also notable that Poten have much lower LNG imports growth as well, which would appear to be largely as a result of weaker imports into Europe.

7. Implications of SRMC pricing

As noted in Section 5, Europe and Asian prices fall to around $8/MMbtu by 2030. However, with LNG supply outstripping demand, utilisation at LNG export terminals falls below 90 per cent. In 2020, reflecting the impact of Covid-19, utilisation fell to just under 90 per cent and spot prices averaged in the $3-$4/MMbtu range. LNG utilisation is not the only variable impacting prices – in the past the availability of pipeline gas from Russia has also been a key factor – but it is clearly an important indicator of the tightness of the market. Prices at the $3-$4/MMbtu level were suggestive of a market in short-run marginal cost mode or close to it.

The NexantECA model can be run in SRMC mode[18] to generate an alternative set of spot price outcomes. Figure 21 compares the base case New Order scenario with the SRMC scenario for TTF and Japan spot prices. In SRMC mode prices are some $2 or more below the base case level by 2030, in the $5-$6/MMbtu range. In reality, somewhere in the range of the LRMC and SRMC pricing may be more realistic.

Figure 21: Spot price comparisons

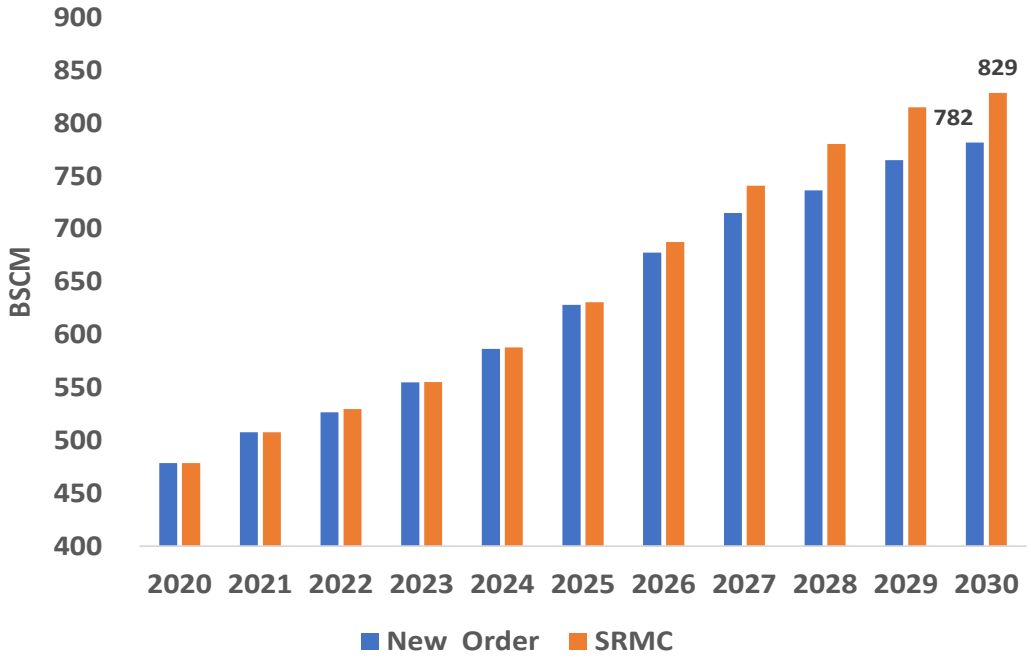


Source: Argus, NexantECA WGM, OIES Projections

[18] Specifically, in the modelling, production, pipelines, liquefaction terminals, regasification terminals, and LNG shipping all only take into account their variable operating costs.

The lower prices under SRMC also generate additional LNG demand as shown in Figure 22.

Figure 22: LNG imports comparison



Source: Argus, NexantECA WGM, OIES Projections

Global LNG imports are some 47 bcm higher under SRMC pricing. This figure mainly comprises higher LNG imports into Europe and China. Part of this is additional demand as a result of lower prices but also displacement of other sources of supply. In Europe, this would particularly be due to a reduction in Russian pipeline imports. In China, the displacement is predominantly linked to stalling the development of higher cost domestic production. The higher level of global LNG imports results in capacity utilisation for LNG export terminals of 92 per cent in the SRMC case compared to 87 per cent in the New Order base case. In reality, pricing is unlikely to be either wholly LRMC or SRMC based, but a mixture, if there is an increase in unutilised LNG export capacity. Based on the assumptions in the modelling, prices somewhat below $8/MMBtu, but above $5/MMbtu could be a likely outcome, in both Europe and Asia, by 2030.

In addition, the demand responses to much lower prices are highly uncertain and likely to be significantly different between countries and regions, and even from year to year in the same countries and regions. The perception that natural gas prices might fall to $6 or less in the next four to five years, in a new “equilibrium”, could materially change the outlook for gas demand especially in more price-sensitive emerging markets.

8. Conclusions

Global gas demand growth between 2021 and 2030 is projected at some 400 bcm. This is growth of some 10 per cent or 1 per cent per annum. China and the Middle East account for over 80 per cent of this growth. Prior to the Russian invasion of Ukraine and the energy crisis, expected demand growth between 2021 and 2030 was some 300 bcm higher, although the drop in growth forecast cannot all be attributed to the energy crisis. In particular North American gas demand growth is some 200 bcm less in 2030, principally as a result of the impact of the IRA in the US. The other key differences (which largely can be attributable to the energy crisis) are Europe (45 bcm less growth), China (25 bcm less growth) and marginal reductions in other regions, partly offset by higher Middle East demand growth by some 30 bcm.

A total of 80 per cent of the growth in demand between 2021 and 2030 comes from the power and industry sectors. Power generation growth in gas demand is heavily weighted outside the OECD economies. In volume terms the Middle East and China show the biggest growth, followed by ASEAN

and South Asia. Gas demand in power declines in North America – largely the impact of the IRA in the US – and in Russia. In Europe, gas demand in power largely remains flat between 2021 and 2030, as renewables grow rapidly but coal declines very sharply, allowing gas to maintain its market share. Gas demand growth in industry is seen largely across the board with the Middle East and China leading the way in volume terms. North America, especially the US, grows, and Europe is the only region where gas demand in industry declines.

Global LNG export capacity is expected to grow by over 350 bcm between 2022 and 2030 – a rise of 60 per cent over the 2022 average available LNG export capacity. 80 per cent of the rise has already taken FID, and over half the increase is from North America. Total LNG import growth between 2021 and 2030 is some 275 bcm – a rise of over 50 per cent in LNG trade. Europe and ASEAN have the largest increases of just under 100 bcm, although some 60 bcm of the Europe growth has already taken place in 2022 so for the rest of this decade, growth is less than 40 bcm. China growth is some 30 bcm but this includes the 20 bcm decline in 2022 following the weak economic activity and lockdowns, so 50 bcm growth from now. ASEAN shows strong growth as production declines and demand grows. Growth in India, Pakistan, and Bangladesh is projected to pick up as prices ease back. The growth in LNG exports largely follows the growth in LNG export capacity.

The global market eases significantly post 2026 as the LNG supply surge outstrips rising demand and Europe and Asia spot prices fall back to between $7-$8/MMBtu by 2029/2030. LNG export capacity utilisation falls to low levels in 2029/2030, below those of 2020, when spot prices were below $3/MMbtu in Europe and Asia. If prices reverted to short-run rather than long-run marginal cost pricing then prices might fall to the $5-$6/MMbtu range for both Europe and Asia. In reality, pricing is unlikely to be either wholly LRMC or SRMC based, but a mixture, with prices somewhat below $8/MMBtu, but above $5/MMbtu, in both Europe and Asia, by 2030.

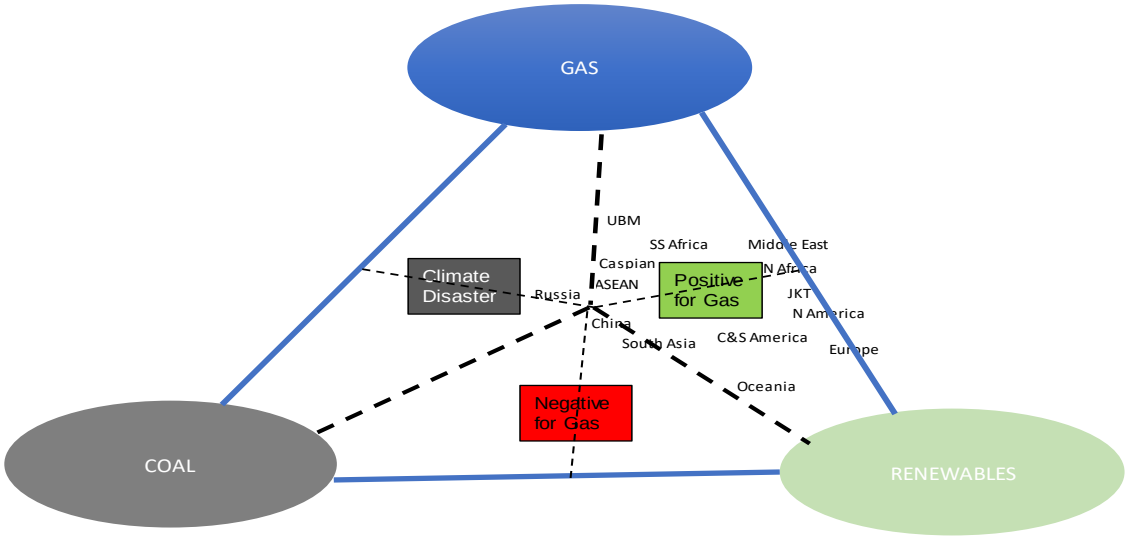
The growth in the OIES New Order scenario for demand between 2021 and 2030 is in the middle of the range of demand growth forecasts, although the lower demand growth scenarios, apart from IEA STEPS, are from large industry players such as Shell, BP and Equinor. When it comes to LNG imports the differences in growth are much less, although there are fewer comparisons. OIES New Order LNG import growth is very similar to the Shell and BP scenarios, whereas demand growth in the Shell and BP scenarios was lower than ours.

With regard to the coal versus gas versus renewables trilemma to 2030, regions across the world are in very different phases. Some, such as the Middle East and North Africa, have high gas shares and little or no coal, and are therefore seeing a gradual move from gas to renewables. Others – North America, Europe, and Japan, Korea and Taiwan – are phasing coal out and gas will remain an important part of the mix, depending on how rapid renewables growth is.

In contrast there are Asian regions – China, South Asia, ASEAN – where coal has high shares. These are the regions where the expectation is for strong demand growth for gas and for LNG imports, as coal share declines and gas share increases. However, investment in coal continues in some countries, and, if gas is seen as unaffordable, it may face an uphill struggle not to be crowded out by coal and renewables. Russia and the Former Soviet Union countries are generally coal and gas focused with slow progress on renewables. Oceania (Australia mainly) has a large share of coal but is planning to phase this out rapidly with renewables taking over the lion's share of demand, although gas may also benefit. Sub-Saharan Africa only has coal in three southern countries,[19] so gas and renewables both have the opportunity to grow. Coal also has a relatively small share in Central and South America, so there is scope for both gas and renewables to grow there too.

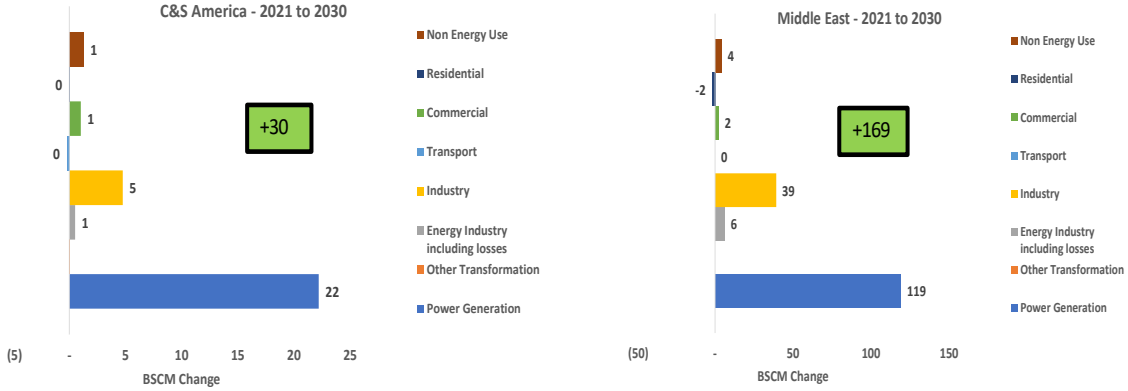
[19] South Africa, Botswana and Zimbabwe

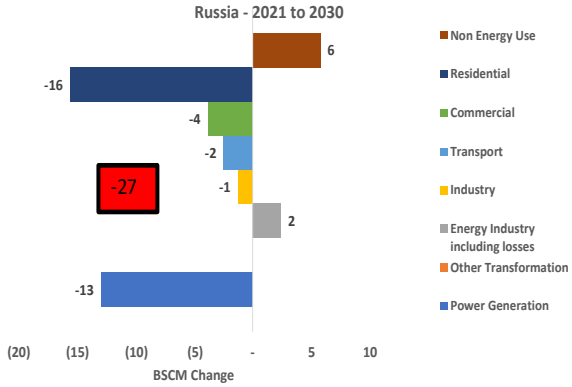
Figure 23: The trilemma for gas by region

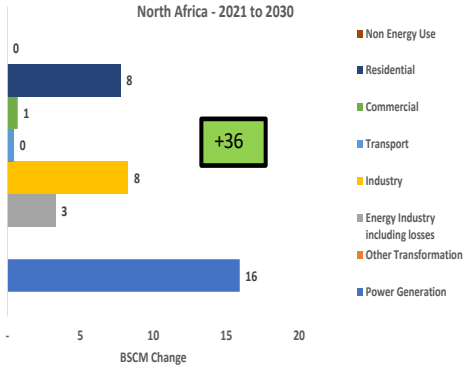


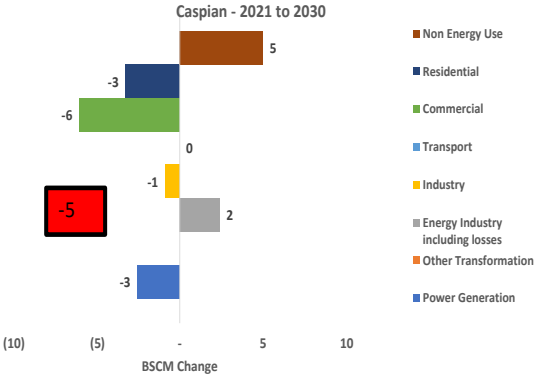
A key conclusion of the OIES New Order scenario to 2030 is that a combination of the energy crisis and the IRA in the US, will lead to a small 'one-off' loss in global gas demand of around 6 per cent. A number of uncertainties, however, still remain, notably the growth in gas demand in China, Europe, and the ASEAN countries. We have undertaken a thorough review of the prospects for gas demand, but these regions and countries are very important to the growth of LNG imports needed to absorb the expected record rise in LNG export capacity over the next four to five years. Much of the rise in LNG export capacity is contracted, especially to portfolio players, so this rise in supply will be looking for buyers in importing countries. The level of demand in the OIES New Order scenario in 2030 is not at a level to absorb the rising LNG supply, leading to lower utilisation rates at export plants. However, if prices respond, as they have previously done in periods of supply gluts, then lower prices may stimulate more gas demand in price sensitive sectors and regions.

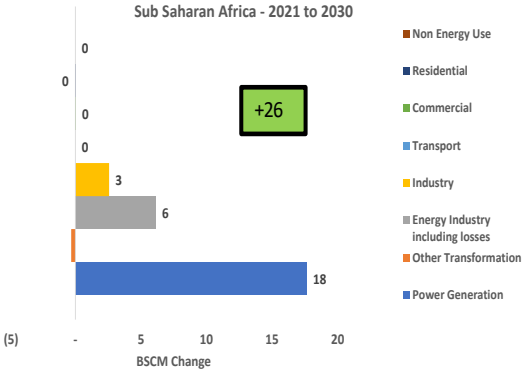
Annex 1: Selected regional demand growth

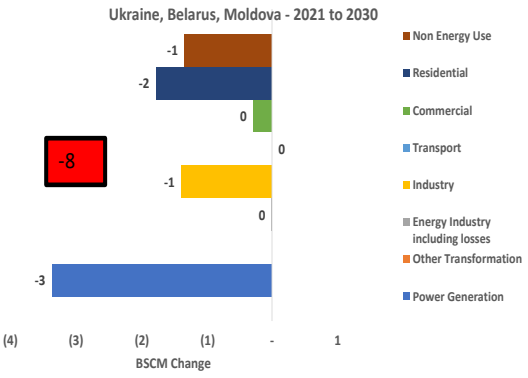


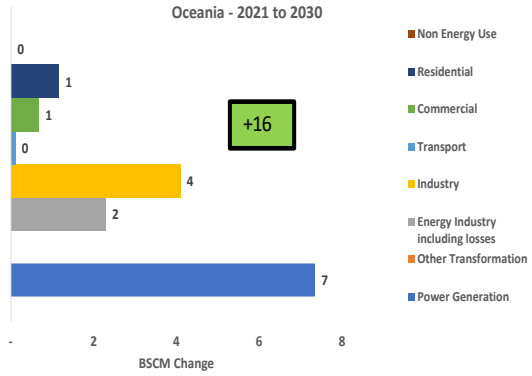






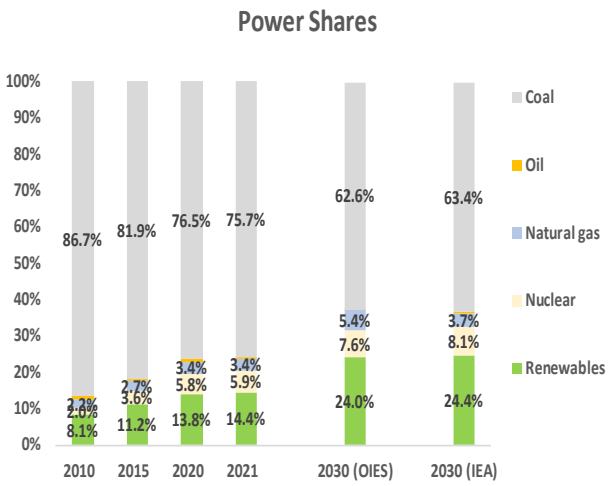


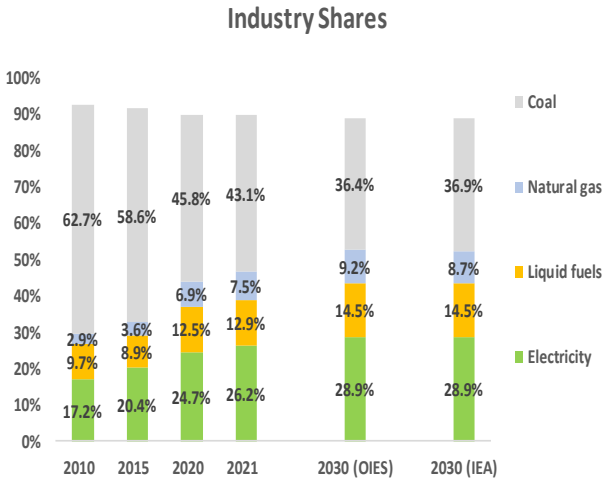


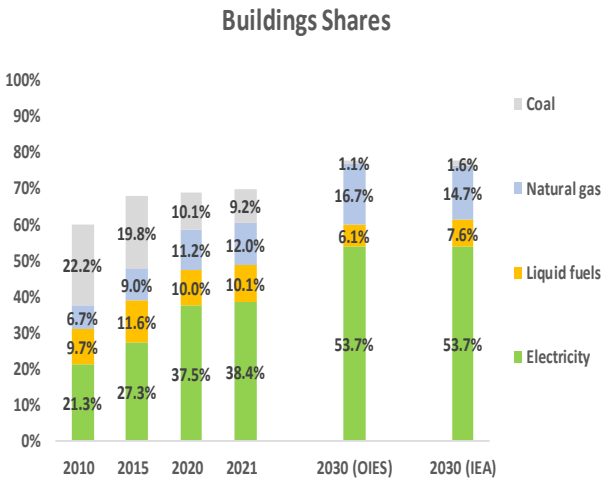


Annex 2: Fuel market shares by sector – selected countries and regions

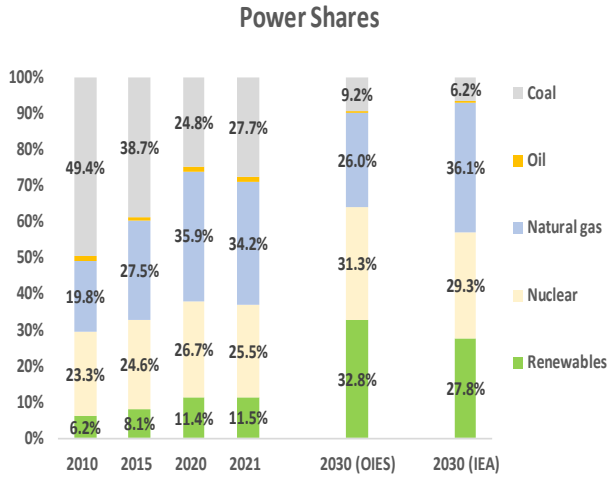
CHINA

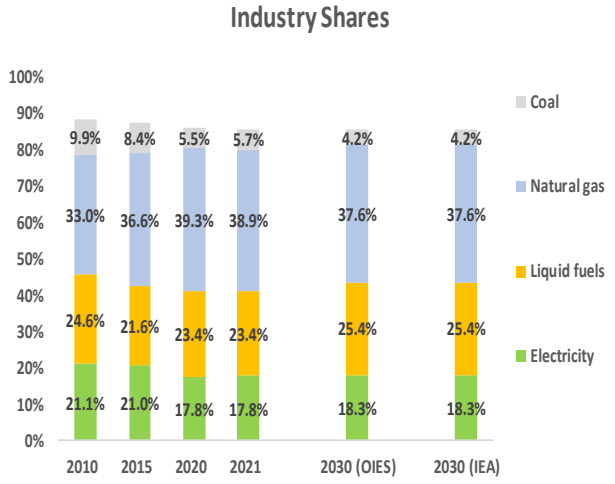


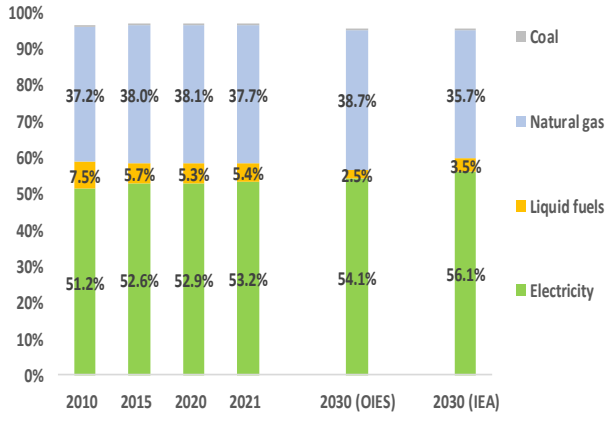




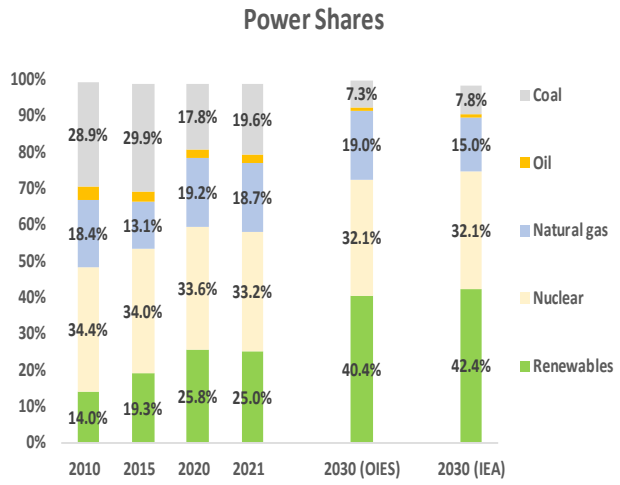
USA







EU


Power Shares
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33.6%
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19.3%
25.8%
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2010
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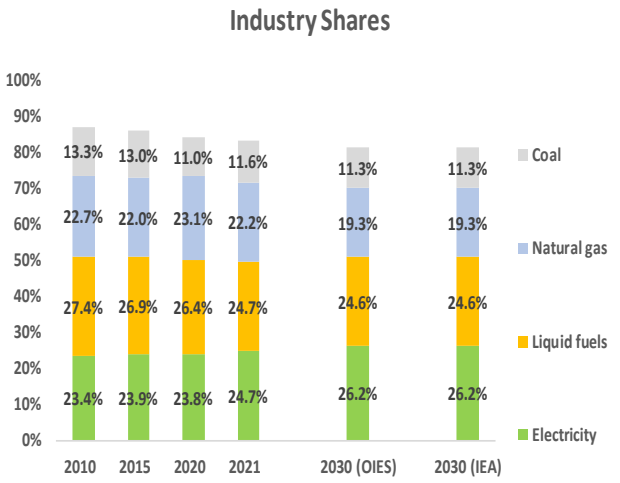
2030 (IEA)
Coal
Oil
Natural gas
Nuclear
Renewables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Coal
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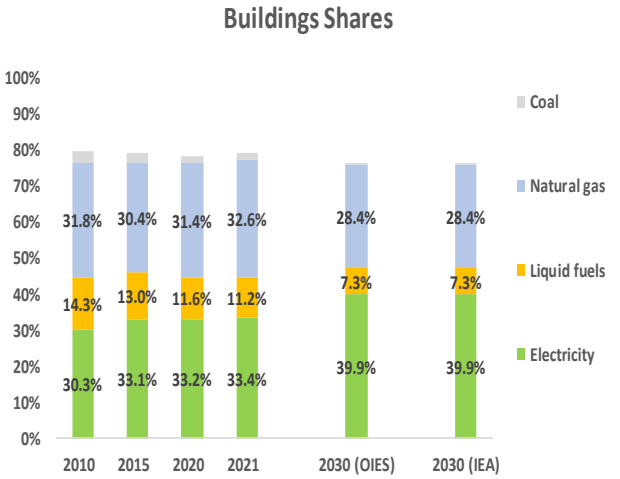
Electricity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Coal
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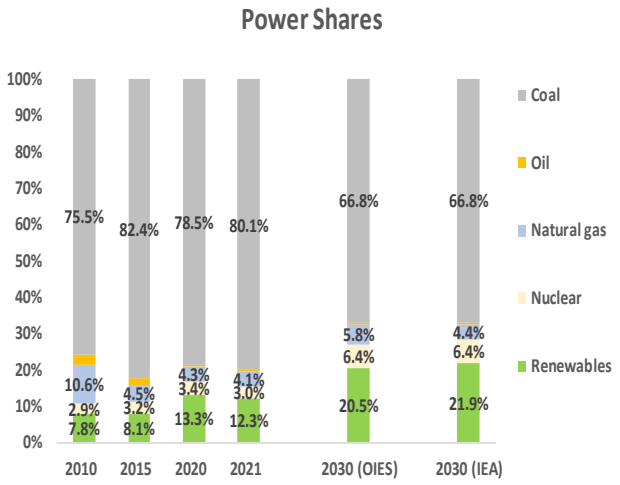
Liquid fuels
Electricity

INDIA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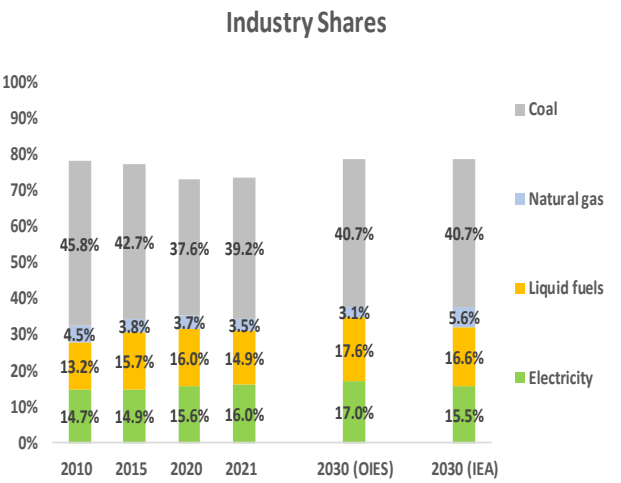
Nuclear
Renewables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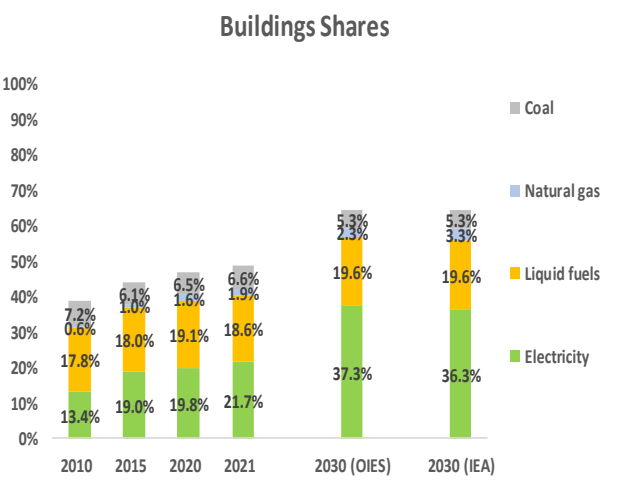
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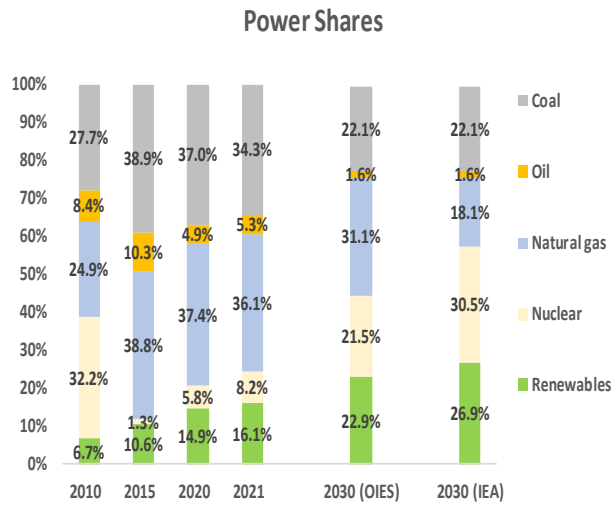
Liquid fuels
Electricity

JPN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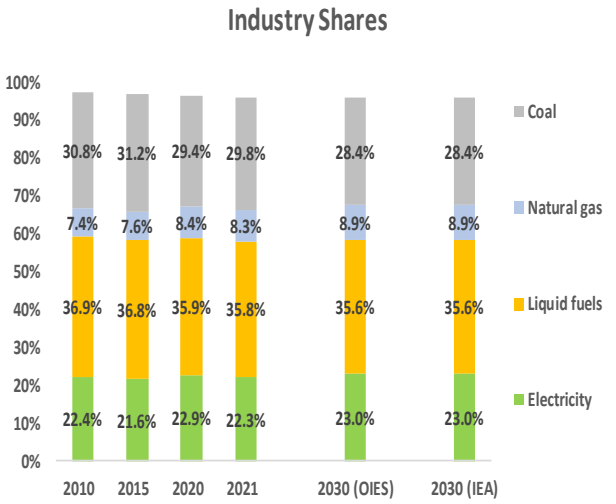
Renewables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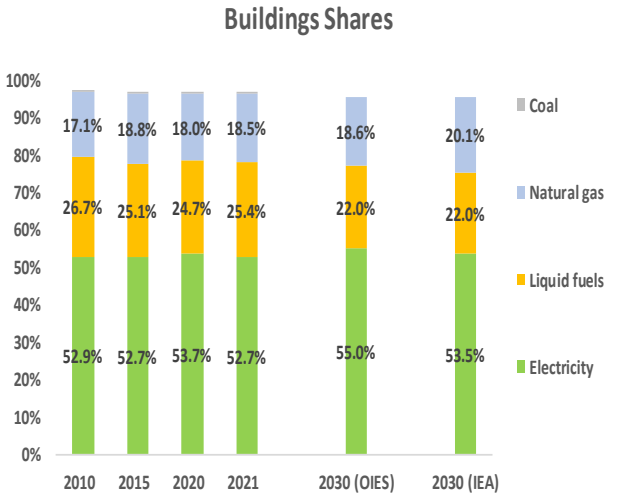
Natural gas
Liquid fuels
Electricity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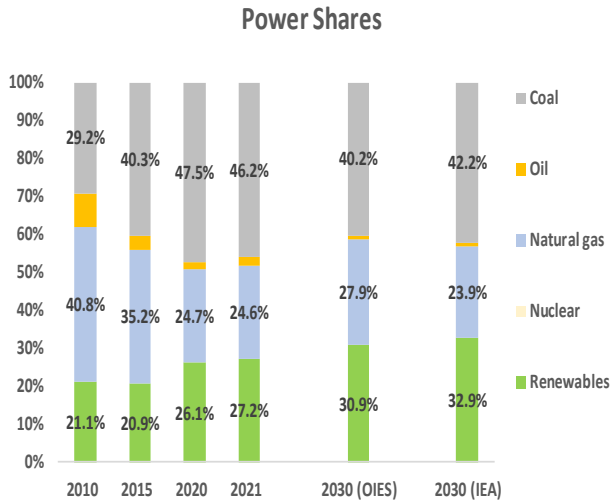
Coal
Natural gas
Liquid fuels
Electricity

ASEAN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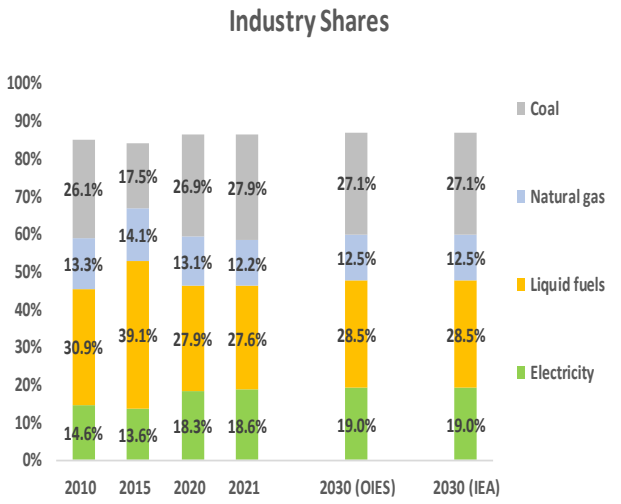
2030 (OIES)
2030 (IEA)
Coal
Oil
Natural gas
Nuclear
Renewables


Industry Shares
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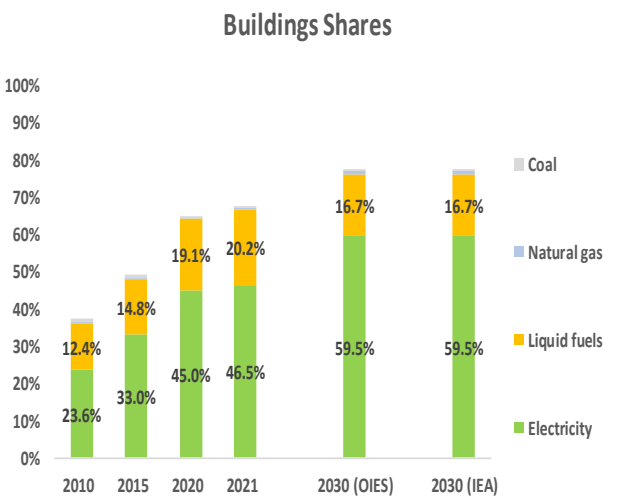
Coal
Natural gas
Liquid fuels
Electricity


Buildings Shares
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46.5%
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59.5%
2010
2015
2020
2021
2030 (OIES)
2030 (IEA)
Coal
Natural gas
Liquid fuels
Electricity

Annex 3: Data tables

World Consumption BSCM	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
North America	850.4	873.2	911.2	923.6	941.0	959.8	973.4	973.3	1,069.3	1,091.2	1,059.6	1,069.5	1,082.7	1,065.1	1,078.4	1,081.4	1,076.5	1,071.3	1,061.5	1,048.6	1,043.2
Europe	596.5	550.2	537.3	528.3	482.4	498.1	525.8	553.6	542.0	547.9	532.6	564.2	501.6	473.9	491.6	502.6	507.1	502.6	498.4	494.3	490.1
Central & South America	145.9	147.0	156.3	163.0	168.0	169.8	163.7	164.6	164.5	158.7	143.2	155.2	155.5	156.0	164.7	170.8	174.1	176.9	179.2	181.5	184.8
Russia	465.8	476.2	471.1	465.9	464.6	445.4	444.1	463.0	498.5	510.1	481.3	538.1	509.2	503.7	498.8	498.3	500.2	502.0	503.7	505.4	507.1
Caspian	115.9	120.9	113.7	112.2	96.6	94.9	97.1	101.0	101.5	105.2	104.9	116.4	104.0	104.5	104.8	105.7	106.8	108.1	109.5	110.4	111.2
China	129.3	134.7	150.4	170.5	187.4	195.4	211.5	241.4	282.0	306.3	327.3	365.8	362.1	382.3	402.4	425.7	451.2	473.1	495.1	512.5	530.1
South Asia	112.9	120.9	117.3	113.0	114.0	121.4	130.3	136.6	135.3	137.3	132.7	142.2	132.3	138.1	146.1	152.0	160.2	164.9	168.6	172.3	176.0
Japan, Korea, Taiwan	155.7	176.6	185.4	187.5	184.2	176.8	183.0	183.7	186.3	179.3	182.9	189.8	187.6	183.2	184.8	189.6	193.0	194.1	195.2	196.4	197.5
ASEAN	148.5	144.7	152.2	164.2	168.7	165.6	164.9	155.3	166.6	169.0	155.0	157.9	160.0	162.1	165.2	170.4	179.7	188.0	195.9	203.2	213.0
Oceania	36.9	36.9	38.6	41.0	42.3	42.4	43.5	45.0	45.7	47.2	47.1	39.9	54.1	54.5	54.6	54.9	55.1	55.0	55.3	55.4	55.6
Middle East	374.5	395.8	411.6	424.8	452.1	480.9	501.3	514.0	517.6	532.9	536.8	550.5	580.3	589.8	609.3	632.3	652.8	670.5	687.8	703.6	719.7
North Africa	85.3	90.5	97.4	97.4	96.3	101.1	107.2	118.8	123.4	122.9	117.7	127.2	129.9	133.6	138.4	144.0	148.0	152.0	156.0	159.8	163.6
Sub Saharan Africa	21.6	25.3	27.0	27.2	29.4	31.9	31.7	32.5	33.7	35.4	36.5	40.6	41.7	43.5	45.3	47.3	50.4	54.3	58.9	62.6	66.7
Ukraine, Belarus, Moldova	81.7	82.2	76.9	72.4	64.2	55.1	54.1	53.1	54.6	51.8	51.4	52.7	42.4	41.8	43.0	43.4	44.0	43.9	44.0	44.1	44.6
LNG Bunker Fuel	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0
Total	**3,320.9**	**3,375.0**	**3,446.1**	**3,490.9**	**3,491.3**	**3,538.7**	**3,631.8**	**3,735.8**	**3,921.3**	**3,995.2**	**3,909.2**	**4,110.3**	**4,043.6**	**4,034.0**	**4,130.6**	**4,222.3**	**4,304.3**	**4,362.6**	**4,416.1**	**4,458.1**	**4,512.2**

World Consumption by Sector BSCM	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Power Generation	1,344.8	1,360.3	1,417.7	1,383.6	1,392.8	1,443.6	1,490.9	1,523.6	1,560.8	1,588.4	1,576.2	1,654.2	1,645.3	1,642.8	1,682.7	1,728.3	1,770.8	1,800.9	1,827.7	1,845.2	1,872.6
Other Transformation	15.2	17.1	29.4	32.6	35.3	36.4	35.6	33.9	36.9	48.7	48.5	50.3	49.8	49.7	49.8	49.8	49.9	50.0	50.0	50.0	50.0
Energy Industry including losses	332.2	343.2	349.2	362.1	350.8	351.7	356.6	363.5	396.3	408.1	387.4	405.9	417.9	420.4	426.5	434.1	439.9	445.9	452.4	457.1	462.5
Industry	602.2	621.9	640.2	646.0	656.7	650.5	662.5	684.8	718.2	735.2	732.7	770.7	763.6	767.9	786.8	811.3	833.8	846.9	858.7	870.0	882.0
Transport	108.6	113.7	109.7	116.2	117.2	118.7	123.7	127.8	139.1	141.1	133.3	143.6	143.1	146.1	148.6	150.9	153.7	156.5	159.4	162.3	165.2
Commercial	227.2	224.3	220.3	237.6	235.4	233.3	236.0	243.0	260.3	264.6	246.3	256.4	246.6	241.7	248.2	249.8	250.8	251.7	252.4	253.1	253.7
Residential	520.2	509.6	488.3	521.4	511.3	509.7	524.0	540.2	581.1	576.0	572.0	604.1	553.5	540.8	560.4	566.7	568.3	569.9	571.4	572.8	574.2
Non Energy Use	170.5	184.9	191.3	191.4	191.8	194.8	202.4	219.2	228.6	233.1	212.7	225.0	227.0	227.7	230.8	234.6	240.2	243.8	247.4	250.9	255.1
Total	**3,320.9**	**3,375.0**	**3,446.1**	**3,490.9**	**3,491.3**	**3,538.7**	**3,631.8**	**3,735.8**	**3,921.3**	**3,995.2**	**3,909.2**	**4,110.3**	**4,046.9**	**4,037.2**	**4,133.7**	**4,225.5**	**4,307.4**	**4,365.8**	**4,419.3**	**4,461.3**	**4,515.4**

World Production BSCM	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
North America	811.1	855.7	884.5	889.3	942.7	973.6	974.1	997.0	1,100.5	1,180.6	1,164.4	1,198.1	1,182.6	1,173.3	1,203.9	1,236.0	1,250.8	1,260.6	1,271.0	1,281.8	1,288.0
Europe	317.3	292.4	294.6	287.1	269.5	261.0	260.0	261.2	247.4	229.7	212.8	204.3	214.4	210.3	210.4	210.9	207.4	204.2	203.5	202.8	198.1
Central & South America	160.3	163.7	171.7	176.6	178.6	177.6	175.0	176.5	175.8	173.6	154.4	151.0	156.2	156.9	165.0	165.4	172.2	178.1	178.5	179.2	183.1
Russia	657.3	672.8	658.1	674.5	646.5	638.0	644.2	695.1	738.2	766.1	722.0	792.8	673.7	641.3	651.8	651.1	665.0	668.4	669.4	666.0	670.6
Caspian	149.5	167.7	172.7	182.1	181.6	181.0	180.0	185.1	204.0	204.5	188.7	205.0	168.4	169.4	170.2	170.5	180.9	184.1	185.7	188.3	191.3
China	95.8	105.3	110.6	120.9	130.2	134.6	136.9	148.0	160.2	176.2	192.5	200.1	214.1	219.5	231.8	245.7	261.4	268.7	275.0	282.3	291.3
South Asia	110.0	105.8	100.0	96.0	94.3	94.6	94.1	89.9	98.0	93.3	84.2	89.8	90.5	92.2	92.6	93.6	94.9	96.1	96.5	96.7	97.7
Japan, Korea, Taiwan	4.2	4.1	4.0	3.8	3.4	3.3	3.3	3.5	3.1	2.9	2.6	2.5	2.4	2.3	2.2	2.1	2.0	1.9	1.8	1.7	1.6
ASEAN	215.6	209.8	209.9	220.0	223.7	218.3	218.8	213.0	214.6	212.9	193.6	194.6	202.9	199.9	202.6	199.3	191.6	178.7	176.8	177.5	173.9
Oceania	62.0	65.9	63.2	72.8	81.6	87.8	104.0	126.5	139.5	165.6	175.8	168.9	167.4	172.1	170.6	171.0	170.1	155.9	162.6	161.3	161.6
Middle East	466.6	509.2	533.3	551.3	567.0	584.6	607.0	624.4	634.7	654.1	658.3	676.0	704.7	724.4	743.3	770.2	822.9	861.6	887.6	904.0	923.0
North Africa	161.9	148.7	158.9	149.5	145.3	140.8	155.6	166.1	175.6	175.3	161.9	192.3	180.4	176.3	181.6	186.7	182.9	173.5	172.3	173.7	177.0
Sub Saharan Africa	47.9	54.0	56.9	54.1	61.0	63.0	62.9	70.5	72.3	73.8	75.5	73.1	74.8	79.5	86.5	91.7	99.8	107.0	116.7	132.9	141.6
Ukraine, Belarus, Moldova	20.3	20.5	20.3	21.1	19.9	19.7	19.9	20.3	20.6	20.3	20.0	19.2	20.0	19.5	19.0	18.5	18.1	17.6	17.2	16.7	16.3
LNG Bunker Fuel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**3,279.8**	**3,375.7**	**3,438.8**	**3,499.1**	**3,545.5**	**3,577.9**	**3,635.7**	**3,777.1**	**3,984.4**	**4,128.8**	**4,006.7**	**4,167.7**	**4,052.4**	**4,036.9**	**4,131.7**	**4,212.8**	**4,319.9**	**4,356.5**	**4,414.6**	**4,464.8**	**4,515.0**

World LNG Imports																					
BSCM	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
North America	19.5	16.0	11.4	11.1	10.7	9.8	8.0	11.3	7.7	10.1	4.7	2.8	0.8	0.9	1.3	3.9	3.3	2.5	0.3	0.3	0.2
Europe	87.1	87.1	65.2	46.3	47.7	53.0	52.1	62.1	71.2	118.6	110.1	105.4	152.1	167.2	180.2	190.9	205.8	209.9	205.5	211.1	202.5
Central & South America	9.1	10.2	14.5	18.1	19.2	18.1	14.0	14.0	13.5	14.9	14.6	23.0	15.5	17.3	19.6	26.1	22.6	19.5	19.0	19.2	19.9
Russia	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Caspian	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
China	11.5	16.6	18.6	24.7	26.1	25.8	31.7	50.0	72.1	80.9	92.6	108.2	96.3	99.8	96.2	94.0	102.7	110.3	124.6	133.5	139.6
South Asia	12.9	18.0	17.5	17.4	19.3	24.7	31.0	37.7	41.8	51.4	49.0	50.0	41.9	45.8	53.5	58.4	65.3	68.8	72.0	75.6	78.3
Japan, Korea, Taiwan	161.2	184.1	191.3	182.5	181.1	169.4	172.4	177.8	189.7	179.3	182.1	187.3	185.2	180.9	182.6	187.5	191.1	192.3	193.5	194.7	195.9
ASEAN	-	1.1	1.4	4.9	8.3	11.5	13.4	14.0	16.4	19.3	19.3	20.5	24.0	29.8	36.4	47.3	64.4	85.7	95.4	102.2	115.5
Oceania	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.9	1.7	1.7	1.7	1.7	1.7	1.7
Middle East	2.9	5.1	4.0	4.1	5.0	10.1	14.7	16.1	12.2	14.0	10.2	10.5	10.6	10.9	11.4	12.8	14.0	14.4	14.2	14.5	14.5
North Africa	-	-	-	-	-	7.0	8.1	5.9	2.5	0.1	-	-	-	-	-	-	0.3	1.4	1.6	1.8	1.9
Sub Saharan Africa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	1.0	1.0	2.1	1.4	2.2	2.2
Ukraine, Belarus, Moldova	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LNG Bunker Fuel	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0
Total	304.2	338.2	323.9	309.1	317.4	329.4	345.3	388.8	427.1	488.5	482.6	507.8	526.8	555.1	586.8	628.3	677.7	715.1	736.7	765.1	781.9

World LNG Exports																					
BSCM	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
North America	0.8	0.4	0.3	-	0.3	0.2	4.8	20.2	27.5	50.0	66.7	92.5	101.7	115.7	129.4	153.8	172.0	202.0	211.2	229.9	239.6
Europe	4.4	4.0	4.3	4.3	4.8	6.1	6.2	5.5	6.9	6.2	4.7	0.3	3.1	5.1	4.5	4.5	4.5	4.4	4.4	4.4	4.4
Central & South America	20.1	22.5	25.6	23.6	23.5	22.0	19.8	19.9	20.9	24.3	18.8	14.2	16.3	18.3	19.9	20.6	20.6	20.6	18.3	16.8	18.2
Russia	13.9	15.8	15.1	13.8	14.0	12.8	14.3	14.2	25.8	38.0	38.9	40.9	42.7	42.4	46.7	53.3	55.7	56.9	56.7	56.7	56.7
Caspian	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
China	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
South Asia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Japan, Korea, Taiwan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ASEAN	76.5	72.4	66.3	63.2	63.8	64.7	66.9	69.7	66.2	63.7	60.2	60.1	62.9	63.7	69.9	71.5	71.5	71.6	71.6	71.6	71.6
Oceania	25.8	26.6	32.0	29.9	37.6	47.4	64.7	80.5	101.1	111.2	112.5	116.9	113.2	117.6	117.8	117.9	116.7	102.7	109.1	107.6	107.7
Middle East	106.2	138.3	127.9	129.5	125.9	130.2	125.0	126.4	125.9	130.0	124.1	121.8	130.1	130.8	130.8	135.6	166.5	187.7	193.7	193.7	193.8
North Africa	29.2	25.2	20.7	18.7	17.5	15.8	15.2	16.7	14.9	22.2	16.3	24.1	23.7	25.5	26.4	25.7	19.8	14.6	12.7	12.0	12.7
Sub Saharan Africa	27.3	33.0	31.6	26.1	29.9	30.1	28.3	35.9	37.8	39.0	40.4	36.8	33.1	36.0	41.4	45.4	50.4	54.8	59.2	72.4	77.2
Ukraine, Belarus, Moldova	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LNG Bunker Fuel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	304.2	338.2	323.9	309.1	317.4	329.4	345.3	388.8	427.1	484.5	482.6	507.8	526.8	555.1	586.8	628.3	677.7	715.1	736.7	765.1	781.9

Interregional Pipe Imports																					
BSCM	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
North America	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Europe	201.0	202.5	199.5	214.5	197.4	203.3	232.7	250.3	245.5	237.8	224.5	230.4	145.1	112.3	112.8	103.7	115.8	106.0	104.1	98.2	100.8
Central & South America	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Russia	6.1	15.4	10.9	11.6	11.3	11.2	11.4	11.2	12.0	11.6	11.3	12.0	14.0	14.1	13.7	14.1	13.8	12.8	11.2	11.2	11.2
Caspian	2.9	4.6	4.0	4.0	4.2	5.2	6.7	8.9	9.0	14.9	14.6	10.8	2.5	4.6	4.6	4.9	5.6	5.6	4.8	3.9	2.9
China	3.6	14.3	20.2	27.7	31.8	34.1	38.6	42.0	50.5	50.1	47.7	58.5	54.8	64.4	74.3	81.7	91.3	94.1	95.2	96.8	99.0
South Asia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Japan, Korea, Taiwan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ASEAN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oceania	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Middle East	15.6	14.4	5.5	6.6	7.8	8.6	5.9	3.9	2.1	0.0	0.0	0.0	1.0	1.0	1.0	0.7	-	0.3	1.0	1.0	1.0
North Africa	-	-	-	-	-	-	1.0	1.1	0.4	-	0.3	-	2.4	7.8	8.1	7.9	9.1	10.3	13.1	14.5	15.4
Sub Saharan Africa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ukraine, Belarus, Moldova	181.9	192.5	166.4	167.1	136.4	140.2	153.8	171.4	144.8	149.0	128.5	126.4	49.9	38.8	39.0	30.0	29.9	29.7	29.6	29.6	29.7
LNG Bunker Fuel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**411.1**	**443.7**	**406.6**	**431.5**	**388.9**	**402.6**	**450.2**	**488.7**	**464.4**	**463.4**	**426.8**	**438.2**	**269.8**	**242.9**	**253.6**	**242.9**	**265.6**	**258.7**	**259.0**	**255.2**	**260.1**

Interregional Pipe Exports																					
BSCM	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
North America	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Europe	1.8	2.6	2.9	4.6	7.6	12.6	13.4	16.2	13.0	15.6	11.4	3.4	3.0	3.7	3.5	8.6	9.7	10.2	9.8	10.4	8.6
Central & South America	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Russia	200.2	218.1	202.0	211.8	188.9	191.1	209.7	233.3	216.3	222.4	214.5	231.7	134.1	109.7	120.6	114.2	123.8	123.4	121.0	115.6	119.0
Caspian	21.8	43.2	36.3	46.2	51.0	53.6	55.9	57.7	66.5	64.1	59.9	70.7	66.9	69.5	70.0	69.7	79.7	81.7	81.0	81.8	83.0
China	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
South Asia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Japan, Korea, Taiwan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ASEAN	-	-	-	0.2	3.0	4.0	3.9	3.5	3.1	4.7	4.2	4.2	4.0	4.0	4.0	4.8	4.8	4.8	4.8	4.8	4.8
Oceania	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Middle East	8.0	8.6	8.7	9.1	9.3	8.2	9.4	12.5	9.6	8.1	6.1	9.8	6.0	15.7	15.6	15.9	17.7	18.1	21.4	22.1	25.0
North Africa	50.3	35.8	40.6	35.4	29.6	29.9	39.1	37.9	37.9	27.6	25.4	38.1	29.1	25.0	24.9	24.9	24.5	18.6	18.2	18.1	18.0
Sub Saharan Africa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ukraine, Belarus, Moldova	129.0	135.3	116.1	124.2	99.5	103.1	118.7	127.6	118.0	120.9	105.2	80.2	26.8	15.5	14.9	4.8	5.5	1.9	2.8	2.4	1.7
LNG Bunker Fuel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**411.1**	**443.7**	**406.6**	**431.5**	**388.9**	**402.6**	**450.2**	**488.7**	**464.4**	**463.4**	**426.8**	**438.2**	**269.8**	**242.9**	**253.6**	**242.9**	**265.6**	**258.7**	**259.0**	**255.2**	**260.1**