How can gas drive a resilient energy transition?

Assessing the outlook for gas and what the industry can do to respond.

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> "Gas has seen four dramatic and volatile years – growing environmental pressure, the pandemic slump, a rapid demand rebound leading to record prices, and the appearance of an energy-centred geopolitical crisis."
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> Slava Kiryushin, Partner, Co-Head of Energy

How can gas drive a resilient energy transition?

In the midst of wide-ranging market volatility from Covid-19 to the conflict in Ukraine, how does the Gas sector position itself as a vital component in the drive towards net zero?

The future of gas is a critical agenda for many energy stakeholders and it has been brought into sharp focus due to recent economic, social and political events. We are delighted to have worked with clients and colleagues to produce this report, which complements the recent reports we have produced on Liquified Natural Gas (LNG), Hydrogen and the impact of ESG on the energy sector.

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Executive summary

- Gas companies face an unprecedented quadruple challenge: to deliver energy that is clean, affordable, reliable and politically acceptable.
- Gas has seen four dramatic and volatile years – growing environmental pressure, the pandemic slump, a rapid demand rebound leading to record prices, and the emergence of an energy-centred geopolitical crisis.
- Gas is the greenest of the fossil fuels, with numerous advantages as a partner to renewables and a replacement for coal and oil. Yet it too is coming under intense environmental pressure.
- Forecasts for future gas use are diverse, creating a major challenge in planning required investments.
- The prospects and drivers for development of the gas industry drastically vary between the major world regions. Europe's decarbonisation push has been accompanied by a drive to substitute Russian gas, as a matter of energy security heightened by the conflict in Ukraine. This will have dramatic ripple effects on the very different gas markets in Asia and Africa.
- LNG is expected to grow strongly, with new international pipelines struggling to advance. However, overall LNG demand is also very uncertain, particularly in key wildcard India.
- To succeed in this challenging landscape, gas-related companies need to combine four approaches: **Get flexible, clean up, offer solutions,** and **build roads to net zero**.

Disruption brings gas into focus

The past four years have been tumultuous for all energy sources, and perhaps most of all for gas.

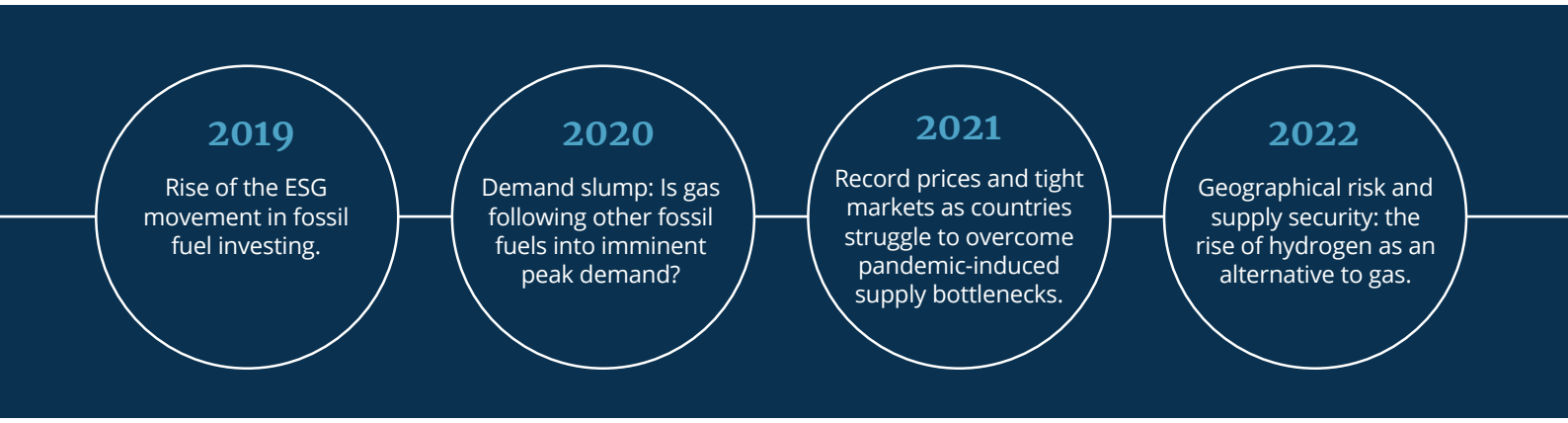


Figure 1 Gas' four dramatic and volatile years

1 **2019** brought the rise of the Environmental, Social, Governance (ESG) movement, heightening concern about the climate impact of gas and methane leakage. Asset managers have been under significant pressure to exclude gas from ESG funds, particularly in Europe, where activists have slammed the EU Taxonomy's classification of the fuel as "sustainable" in the context of transition.

2 **2020's** pandemic-induced demand slump fuelled concerns that gas might be following the other fossil fuels into imminent peak demand. Price differentials between regional gas benchmarks declined dramatically, helped by increasing availability of LNG, and demand reduction in the Commercial and Industrial (C&I) sectors.

3 **2021** witnessed demand revival and record high gas prices as EU and Asia-Pacific countries rushed to replenish stocks. Upward price pressures during the last few days to contract expiry were also more common for producers with hedging exposure, adding to the volatility.

Meanwhile, talk around COP26 that the supply and demand transitions are out of sync led countries to sign off on a number of anti-fossil fuel pledges, including the Global Methane Pledge and ending international public finance for fossil fuels.

4 **2022** so far has brought geopolitical risk and supply security dramatically back into the picture. The conflict in Ukraine threatens disruption of supplies and intensifying sanctions. Europe has responded with plans to eliminate dependency on Russian gas entirely.

The take-off of hydrogen as an alternative to gas has transformed from interest to a concerted push, particularly from gas importing countries. The EU Commission's plan to phase-out dependency on Russian gas, dubbed *REPowerEU*, suggests accelerating plans to adopt hydrogen and urgently scale the technology.

Gas is still the greenest fossil fuel

Gas has emerged as the most environmentally debated of the three fossil fuels, even though it has considerable advantages over its counterparts.

1. It has advantages over oil and coal because of its clean-burning nature, lower carbon and aerial emissions (SO2, NOx, particulates), and abundance.
2. It offers greater flexibility and (in the longer term) reasonable costs. It benefits from shorter construction times and capital costs than nuclear.
3. It can be dispatched on demand (compared to variable renewables), easily stored over long periods, and provides high-temperature industrial heat and feedstock.

This makes it an important player in the **energy transition**, at least in the short- to medium-term. Lower up-front capital costs, lower pollution and greater flexibility make it a better partner for variable renewables than other fossil fuels such as coal or diesel.

In countries where the inertia of retrofitting or replacing fossil fuel-based, decades'-old energy infrastructure is significant, this is particularly advantageous. In the least developed countries, quick, practical and affordable access to LNG can be enabled through short-term floating storage and regasification units (FSRUs). Gas infrastructure can also support the uptake of renewables and other clean energies, like hydrogen.

This is also true for countries that want to diversify supplies from pipeline gas only, or supplement declining local gas production. New LNG importing entrants over the past decade or so include UAE, Bahrain, Kuwait, Egypt (which has now become self-sufficient again), Croatia, Panama, Jordan, Lithuania, Malta, Pakistan, Malaysia, Indonesia and Bangladesh. In the near future, others such as Cyprus, Lebanon, Morocco, Sudan, South Africa, Benin, Côte d'Ivoire, Ghana, Ireland, Vietnam, Myanmar and the Philippines may join them.

Recent developments also point increasingly to the future of gas being led by LNG, with a declining role for pipelines. More flexible supply from a wider range of players, shorter-term and smaller contracts, the end of "destination clauses" restricting resale, and the availability of a wider range of pricing mechanisms make LNG attractive to new markets. In contrast, new international pipeline developments have been relatively limited, and recent geopolitical events put a question mark over their realisation.

For example, Germany has suspended certification of the Nord Stream II pipeline in response to the conflict in Ukraine. The pipeline bypasses Ukraine, Poland, and other transit states to Germany, and would have increased the total capacity of the Nord Stream system from 55 billion cubic meters (BCM) to 110 BCM/y.

Pipeline gas cannot offer a different perspective at the margin, unlike LNG. Once on water, LNG can be diverted to whichever market is the most profitable or needy. This offers greater flexibility in terms of supply management, and is particularly relevant in tight premium markets like Asia because of their dependence on LNG.

In loose markets, LNG can be diverted to whichever market is available and has space for it, at a price. This has historically tended to be Europe, where competition between LNG and piped Russian gas becomes the most obvious when the flexibility of LNG flows clashes with the flexibility inherent in Russian export contracts at the market price in Europe[i].

Regardless of these advantages, gas is still critiqued for emitting carbon dioxide when burnt (at about half the rate of coal or oil per unit of useful energy), and methane (its main constituent), a powerful greenhouse gas when it leaks – with a global warming potential per tonne equivalent to 21 tonnes of carbon dioxide over 100 years, or 56 tonnes over 20 years (since methane is rapidly oxidised in the atmosphere)[ii]. For climate activists, therefore, its use still perpetuates dangerous levels of global warming.

This perspective, though, misses the point. Major reductions in methane leakage are possible with good operating procedures and new equipment, already achieved in areas such as Norway and parts of the Middle East. Creating and expanding gas markets and infrastructure, including LNG export plants, in remoter parts of North America and Middle East and North Africa (MENA) will end the perceived need for flaring.

In this way, gas can offer major and rapid emissions reductions by phasing out coal and oil in power and industry across Eastern Europe, the Middle East, South and East Asia in the medium-term. Carbon pricing would cement this advantage, and has proved very effective in rapidly driving out coal from the power system in the UK.

However, carbon pricing at a sufficiently stringent level is currently mostly confined to Europe, Canada and a few subnational jurisdictions. Compared to European prices around US$ 70-100/tCO^2, prices in the newly-introduced Chinese carbon trading scheme may reach about US$ 10/tCO^2 this year[iii].

Insufficient or absent carbon prices reduce environmental pressure to decarbonise and lead to infrequent allowance trading.

Longer-term, natural gas could kick-start hydrogen ambitions in regions like the Middle East, the US, and parts of Africa in the near-term when coupled with carbon capture and storage (CCS), since producing zero-carbon hydrogen from electrolysis is still costly.

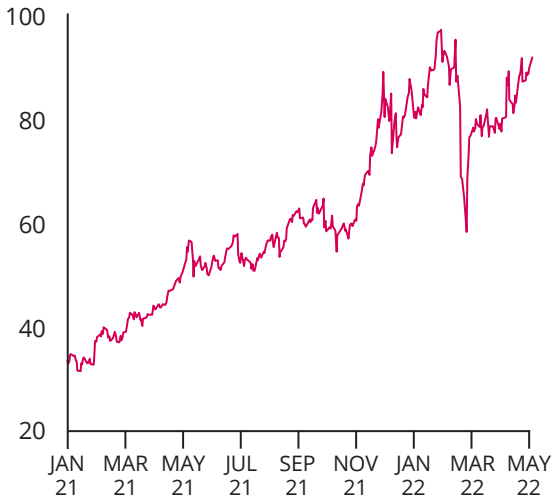


Figure 2 EU Emissions Trading System (ETS) Prices, €/tonne

> "Our community successes and sound governance on natural gas projects is helping to shift away from coal and heavy oil fuels with success across each ESG criterion. And yet, a cloud hangs over fossil fuel developments."
>
> Energy Company participant
> at DWF / Energy Council roundtable on ESG

Demand forecasts vary hugely and lag behind the new reality

The complexity of the challenges facing the gas industry is shown in Figure 3. Scenarios of global gas demand from three major forecasters (DNO, IEA, and BP) cover everything from **continued robust growth**, to **near-term growth with a peak around 2030**, and, **stagnation or imminent steady decline.**

Over the decade-long timescale for initiation of a major new LNG or pipeline project through to the start of operations, world gas demand in these scenarios varies by 25%. By 2050, well within the lifespan of such a project, they differ by 60%.

These forecasts do not include the impact of the Russia-Ukraine crisis. Updates will have to incorporate the effects of a period of very elevated gas prices, the European imperative to diversify from Russian supplies, and the impact of sanctions against key new infrastructure, such as Nord Stream II. In the short-term (12-18 months), the options for Europe to reduce use of Russian gas, and respond to lower flows because of sanctions, interruptions or deliberate Russian cut-offs are limited. They include: minor expansions of domestic production and pipeline imports; expanded LNG imports (but at high cost); refilling storage; boosting utilisation of non-gas power generation (nuclear, coal, oil and biomass, some with negative environmental consequences); speeding up energy efficiency and renewable deployment; and planning rationing or support for vulnerable consumers.

EU policymakers have now started seriously considering ideas previously proposed by buyers in eastern Europe who were heavily-reliant on Russian gas:

- joint gas purchases to reduce prices and leverage buyer power against concentrated sellers;
- tariffs on imported Russian gas;
- construction of many more LNG import terminals;
- mandated minimum levels of gas storage;
- new intra-European connectivity, such as Baltic Pipe from Norway to Poland, the Greece-Bulgaria Interconnector, MidCat between Spain and France, and the Poland-Lithuania connection.

In the medium-term, gas demand and trade patterns will be sensitive to key market factors, including:

- rates at which global gas storage levels replenish and decline, particularly in Europe and Asia;
- increases in flows of Russian gas towards non-OECD Asia, such as China, which could potentially reduce Chinese LNG demand, freeing up supply to Europe; and
- acceleration of policies away from natural gas in an attempt to meet carbon net zero commitments.

Already, in 2021, actual demand was 2.7% above the highest scenario. The late-pandemic rebound in demand has been much stronger than anticipated, contributing to market tightness, which has in turn intensified the economic impact of the geopolitical crisis.

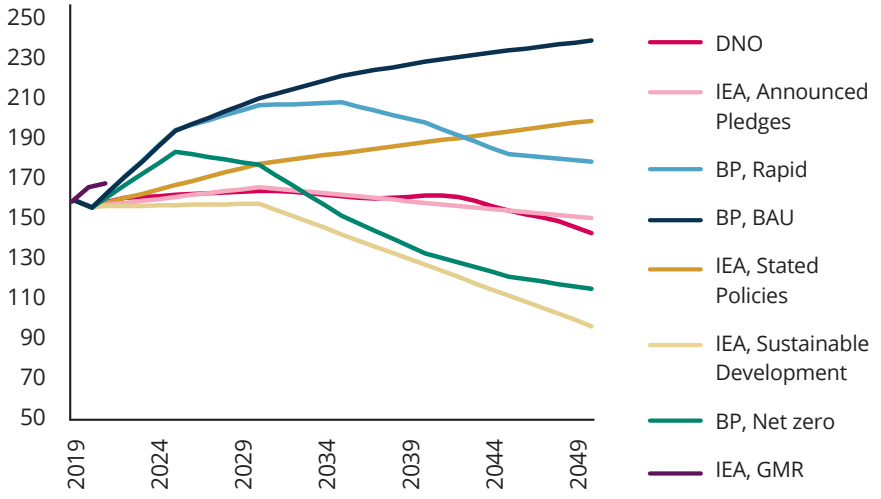


Figure 3 Global gas demand 2019-50, various scenarios, Exajoule (EJ)/year[iv]

Other radical shifts can be expected in the **longer-term**. These include:

- Rapid gas demand growth in emerging non-OECD Asia, making it essential for the region to master technology (liquefaction) and markets (for trade). Countries like China will likely persist with their own domestic unconventional gas development;
- An increase in global unconventional gas production, at least in countries with supportive geology and regulation. Beyond shale, resources such as hydrates may be commercialised by energy-poor states, such as Japan;
- Cost-effective gas Carbon Capture Utilisation and Storage (CCUS) technologies, which will play an important role in power and industry, but whose large-scale deployment depends on climate policies, electricity markets, geography, and competition from concurrent advances in energy storage and nuclear; and
- Hydrogen, which may overtake LNG as the preferred fuel for shipping, and also be used as an energy storage medium, in industry, in aviation, and in heating. This will have considerable implications for the global gas balance.

> "For the first time in a long time, people have started listening to suggestions regarding joint purchases of gas."
>
> Przemysław Zaleski PhD, gas expert, Wrocław University of Technology

Net zero ambitions will have LNG playing a major role between 2021-30

LNG will benefit from the changing gas market in general, and specifically geopolitical and net zero ambitions, at least in the **medium-term**. This is driven by four considerations:

1 LNG is the most immediately available large-scale option for Europe to reduce reliance on Russian pipeline gas. The US will initially fill part of the gap, with Qatar and other growing suppliers playing a bigger role from the mid-2020s.

2 Traditional anchor markets, notably Europe, may decline in the 2030s given strict climate polices and high prices, while others such as south-east Asia grow with coal-to-gas switching. LNG allows exports gradually to shift destination.

3 Numerous emerging producers and consumers are either too far apart or divided by geographic or political barriers. Many new end-user markets, dependent on oil-fired generation, are too small or isolated for dedicated pipelines. For instance, Malta, Gibraltar, Jamaica and Panama are all relatively recent entrants to the club of LNG importers.

4 Major cross-border pipelines face growing challenges of geopolitical risk, environmental and community opposition, and bans on financing. Their long construction times raise market uncertainty for proponents. This is illustrated by the varying challenges faced by the Arab, East Med, TAPI, Kurdistan, Nord Stream II (as mentioned above) and Maghreb-Europe pipelines.

More liquid and flexible supply, with more buyers, sellers and intermediaries, lowers barriers to entry even for smaller purchasers. Until recently, there has been a gradual move away from long-term contracts with destination clauses and oil-linked prices, towards shorter terms and spot purchases, with flexible redelivery and prices based on hubs (e.g. the UK NBP, European TTF or East Asian JKM for delivered prices, or input cost-based contracts using US Henry Hub).

However, recent price rises and supply security risks have encouraged buyers to prefer long-term contracts and be less keen on indexation to volatile gas-on-gas indices (NBP, TTF, JKM and others). Gas-on-gas indices are typically more sensitive to market forces due to their exposure to events like weather, logistics, transportation constraints, and market sentiment unlike long-term contracted gas indexed to oil. As the LNG market returns to being better-supplied, likely in the later 2020s, buyer preference will return to shorter-term contracts and gas-on-gas pricing.

From the environmental point of view, the energy and carbon cost of liquefaction, transport and regasification is also under increasing scrutiny, especially if pipeline suppliers make some relatively straightforward improvements to cut their own emissions. LNG as a shipping fuel faces challenges of 'methane slip' from engines, and this leakage needs to be curbed to make it a viable lower-carbon option. Converting existing gas pipelines to carry hydrogen will likely be more economically attractive than transporting hydrogen or derivatives by ship.

The future of gas varies sharply by region

The future of gas in each region depends on:

- **Perceptions and reality of supply security** – is gas available when required, or is it vulnerable to interruptions, particularly by political adversaries?
- **Economic competitiveness** – how does the delivered price of useful energy to the end-consumer from gas compare to that from relevant competitors, whether coal, oil, renewables or nuclear power?
- **Installed infrastructure** – does the region already have a large base of LNG import terminals, pipelines, gas power plants, distribution networks and end-users, or would large investment be required?
- **Local resources** – is the region a net importer or exporter of gas, and what are the costs and production outlook for domestic gas resources?
- **Popular and political attitudes to gas** – is gas considered favourably, is there a strong anti-gas environmental movement or lobbies for coal or alternative fuels?
- **The stage of decarbonisation** – does the region have strong and active climate policies? Is it dependent on coal and oil (so that gas brings immediate emissions reductions), or does gas too require CO^2 abatement?

As a consequence of historic policies, geography and resource endowment, countries' energy mixes and specifically their share of gas vary enormously (Figure 4). Trinidad meets a remarkable 89% of primary energy use from gas; South Africa only 3% with virtually all the balance from coal and oil, while; Sweden uses only 1.6% gas and 68% low-carbon energy sources (nuclear and renewables). Canada, with 29% gas, is closest to an even balance among the major economies.

Decarbonisation policies suggest that all countries would have to migrate rapidly towards the bottom-left of the chart (Figure 5). This can be achieved by phasing out oil and coal (in power generation, buildings and industry) in favour of gas, then by replacing gas with renewables. Or, a country could replace oil, and coal use with renewables while holding gas steady, then eventually replace gas.

However, countries could also retain a significant share of gas in the mix by employing CCUS and/or blue hydrogen. Gas in some form will remain vital in most large economies for balancing variable renewables seasonally, and providing industrial heat and feedstock.

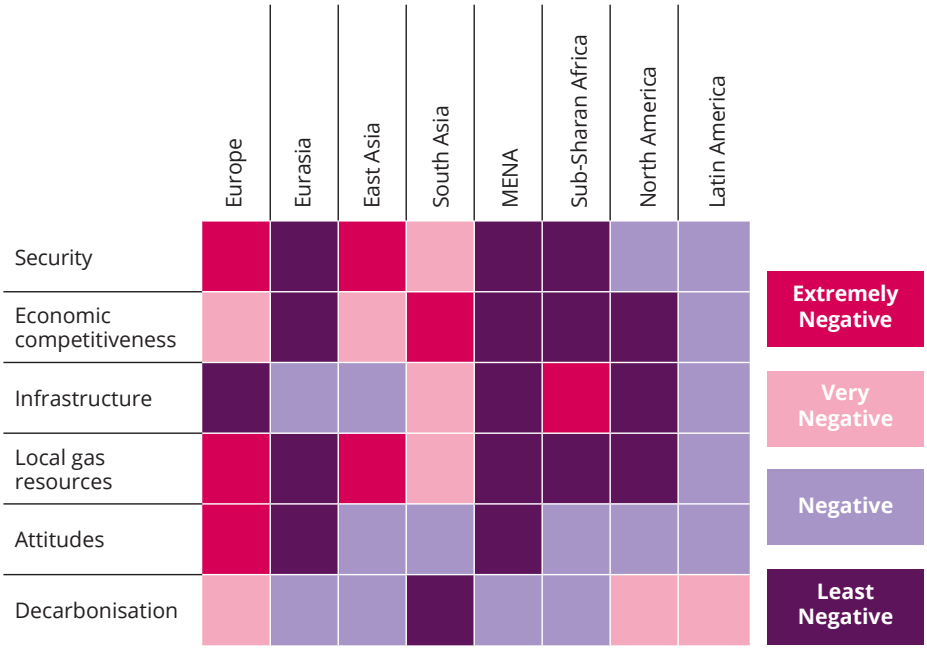


Table 1 Gas future drivers by region

The colours from dark red, light red, light purple to dark purple indicate that issue is increasingly negative for gas use in the given region.

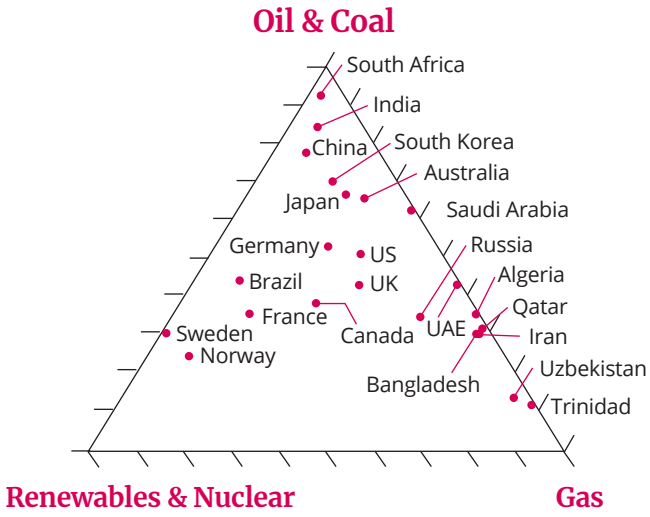


Figure 4 Share of gas, other fossil fuels and low-carbon in primary energy by country (each point represents a country; each apex represents 100% of primary energy from that source)[v]

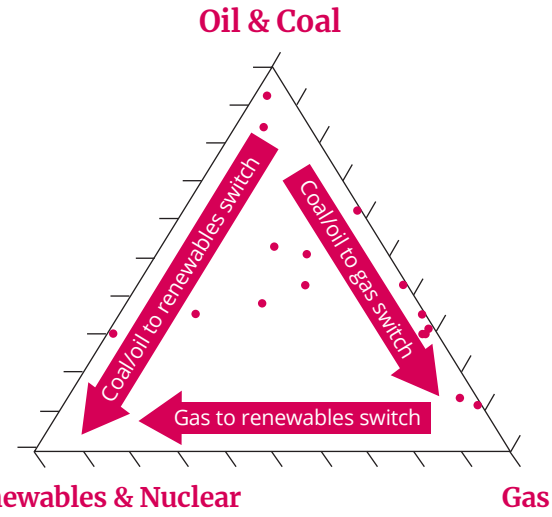


Figure 5 Primary energy decarbonisation paths

The choice for each country will be strongly influenced by its starting point, as well as the strength of domestic lobbies and public opinion, and the relative suitability of different low-carbon options available to it. For instance, a highly-gasified country could make major progress by installing CCUS or hydrogen on a relatively small number of large industrial and power plants.

The path and level of decarbonisation has a profound effect on global LNG demand (Figure 6). LNG use by 2035 could more than double by 2050. The difference between BP's Rapid Transition and business as usual scenarios is an extra 174 Billion cubic metres (BCM) of LNG use in 2035 in the case of a Rapid Transition (more coal switching), but 58 BCM less in 2050 (replacement with renewables).

The 2035 difference is equivalent to 40% of today's entire global market – while greenfield LNG projects proposed today will only be in their early years of operation by 2035. However, demand growth from 2035-50 is relatively modest even in the business-as-usual scenario, suggesting a window of opportunity for major resource holders and new exploration aspirants to launch projects.

Europe's policy, broadly speaking, has for some years been to shrink the use of gas and other fossil fuels. The transitional use of gas is considered sustainable under the Green Taxonomy, but only with strict limits on emissions (which would necessitate the use of CCUS or blending with non-fossil gases). This has severely limited the prospects for major new pipeline infrastructure into Europe (e.g. from the East Mediterranean or through Turkey), unless intended for hydrogen.

Now, the conflict in Ukraine means Europe also intends to substitute all of its use of Russian gas by 2030, but LNG terminals, rather than new pipelines, seem the favoured solution.

Europe's LNG imports are expected by BP to grow in any case, due to declining indigenous production and desire for supply diversification. The increase by 2035 could be between 40-100%. Interconnectivity and LNG import capacity has improved significantly and some remaining weaknesses are being addressed.

However, there are differences of opinion within Europe. Eastern Europe tends to be more open to gas to substitute its coal-heavy generation mix. District heating, usually coal- or gas-fired, is more common. Germany will require gas to enable its nuclear phase-out. 'Fossil' gas will gradually be supplemented with biogas and biomethane. But Western Europe in general intends to replace gas in power with renewables, in buildings with improved efficiency and heat pumps, and in industry with electrification and green hydrogen.

The UK and Norway, outside the EU, have their own decarbonisation ambitions, but intend to continue developing their domestic gas resources. For Norway, which consumes virtually no gas itself for power and residential use, the questions relate to reducing the carbon footprint of its offshore oil and gas industry, and becoming a hub for CCUS. The UK, Denmark and the Netherlands are also progressing major CCUS hubs, while it appears unlikely any CO^2 storage will take place in Germany. Offshore hydrogen production from wind has emerged rapidly as a major push for all the North Sea neighbours.

In the long-term, these policies should improve the continent's supply security. Recent events, although mostly not related to decarbonisation policies, have shown that the transition period could involve significant risks of high prices, constrained supply and vulnerability.

North America shows some of the same trends as Europe, but with much less consensus on policy. Gas and renewables have grown together at the expense of coal. As a major gas exporter, supply security is much less of a concern, and energy resources are a diplomatic as well as an economic tool. The US government does not direct LNG supplies, but it has shown its support for Europe's aim of substituting Russian gas.

Latin America sees a growing role for gas, both domestic and imported, to balance climatically-unreliable hydropower. By 2035, net LNG imports may double.

Eurasia (Russia and Central Asia) is a heavily gas-dependent region and a major exporter. Coal and nuclear are important, but non-hydro renewables are negligible (though starting to grow in places such as Uzbekistan and the Caucasus). Hydrogen, mostly blue, is a stated strategic goal, and could be exported to Europe through existing pipelines.

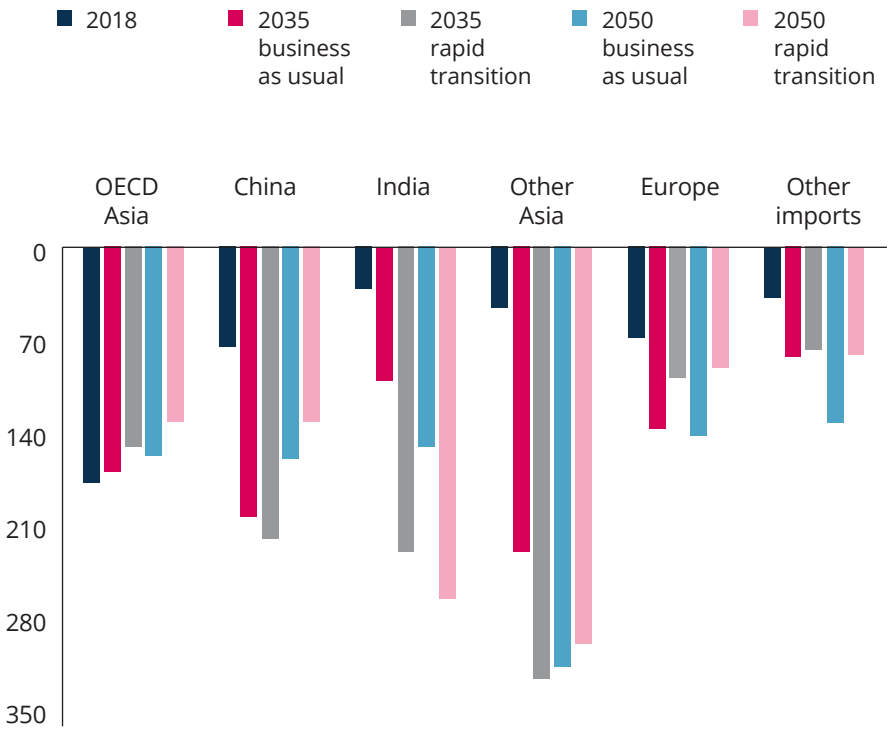
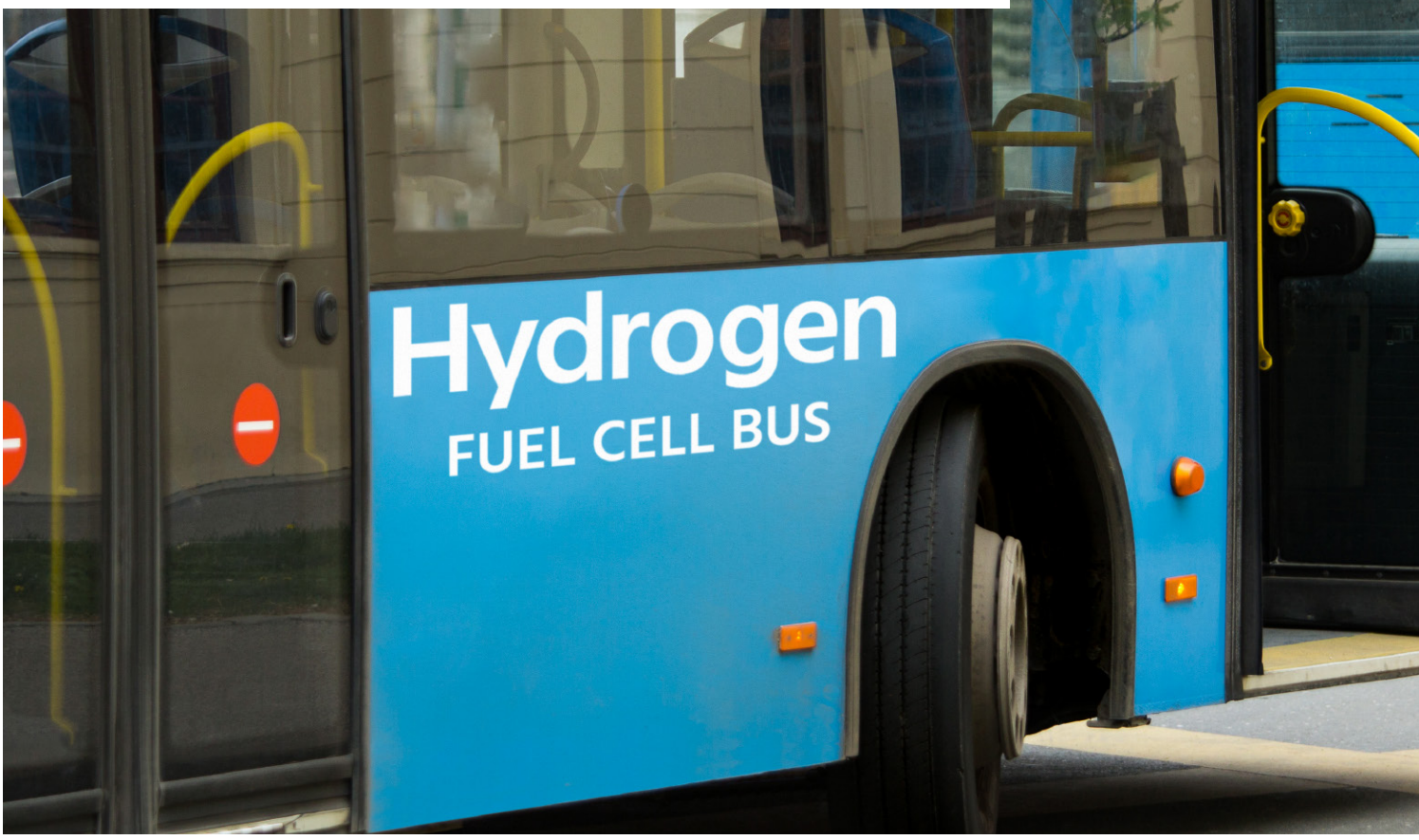


Figure 6 LNG Imports by Region, 2018-50, BCM/year[vi]

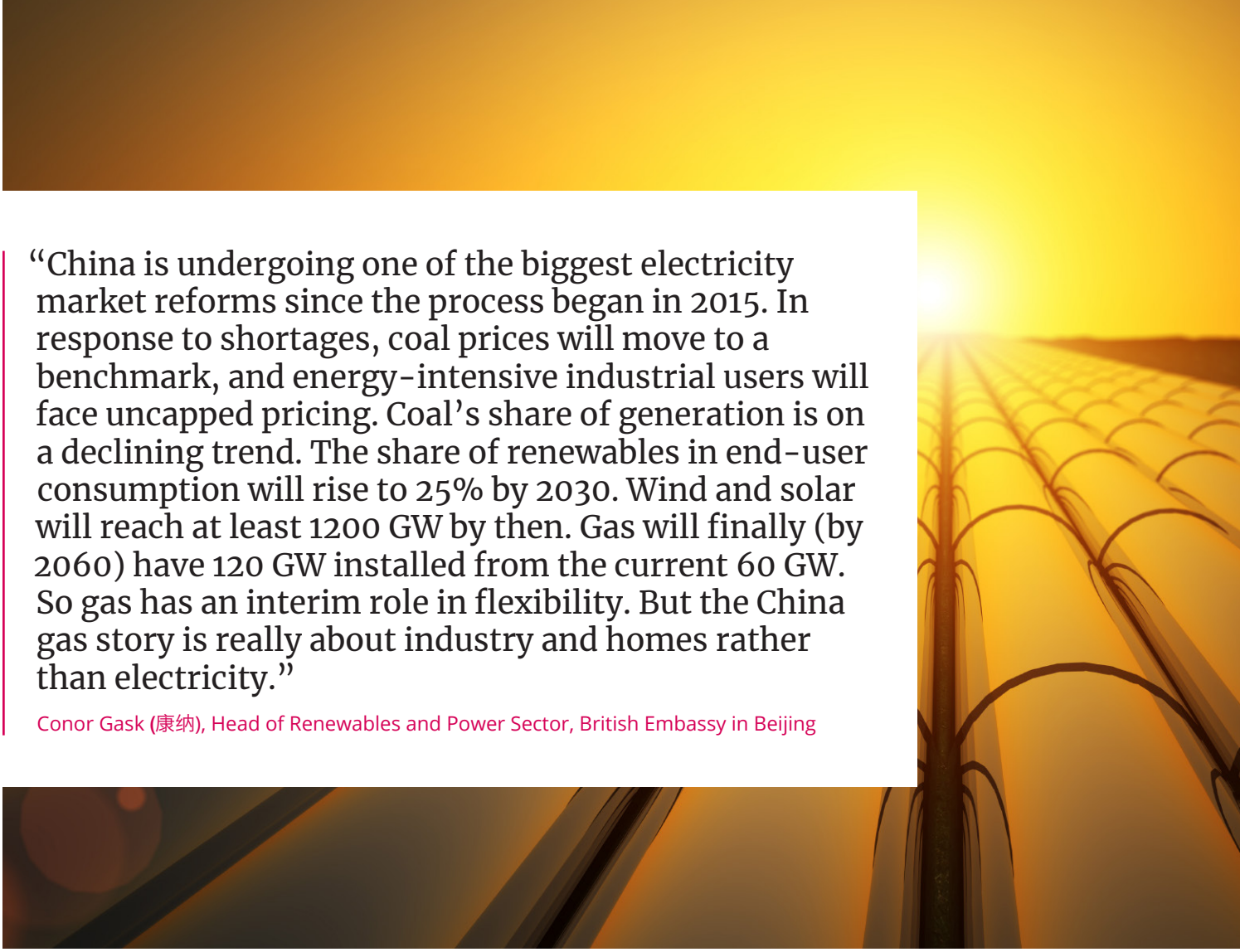
> "Diversifying gas supplies is already well underway. Poland has built a 7.5 BCM gas terminal in Świnoujście. Poland has also built its own Baltic Pipe gas pipeline which will allow for the transmission of another 10 BCM from the Norwegian shelf. Lithuania has also decided to build a LNG import terminal in Klaipėda, and a similar terminal is to be built in Germany."
>
> Przemysław Zaleski PhD, gas expert, Wrocław University of Technology

> "The UK and EU are at a tipping point. Natural gas is still part of the solution to decarbonise, which means these countries cannot simply turn it off, but must simultaneously progress on alternative sources of clean power, electrification and hydrogen. For example, all gas networks in the UK have been upgrading from cast iron to plastic pipes, which by coincidence makes them hydrogen-ready. Other countries can follow, and can save a whole bunch of money with network and collaboration."
>
> David Watson, Head of Energy Transition, Cadent Gas



However, Russian exports of gas and, prospectively, hydrogen now face a major negative factor following the Ukraine crisis, as Europe is trying to reduce imports dramatically by 2030. Moscow has tried to reorient towards China as a market, but this is less profitable given Beijing's bargaining power, the need for long-distance costly new infrastructure, and competition from Central Asia and LNG.

MENA is another crucial region for gas production, use and export. After a period of shortages, strong investment in new production will meet the varied imperatives of domestic demand, oil and coal phase-out and new exports in countries such as Egypt, Israel, Saudi Arabia, the UAE, Oman and Qatar. Others such as Algeria, Iraq and Iran continue to face challenges in meeting domestic needs and contractual export commitments, mainly Iranian exports of gas to Turkey and Iraq, and Algerian gas to Spain and Italy. Subsidy reform and the rise of renewable and nuclear power will slow the need for gas in the power sector. There is strong interest in both blue and green hydrogen as an export commodity.



> "China is undergoing one of the biggest electricity market reforms since the process began in 2015. In response to shortages, coal prices will move to a benchmark, and energy-intensive industrial users will face uncapped pricing. Coal's share of generation is on a declining trend. The share of renewables in end-user consumption will rise to 25% by 2030. Wind and solar will reach at least 1200 GW by then. Gas will finally (by 2060) have 120 GW installed from the current 60 GW. So gas has an interim role in flexibility. But the China gas story is really about industry and homes rather than electricity."
>
> Conor Gask (康纳), Head of Renewables and Power Sector, British Embassy in Beijing

East Asia has cemented its position as the world's most important LNG-importing region, with China overtaking Japan. China has the most diversified supply, with growing unconventional output of its own joining pipeline imports from Russia and Central Asia, and LNG.

Gas is critical to replace coal – in the case of China, more for residential and industrial use than power. Beijing plans to raise gas to 15% of the energy mix by 2030 from 8% in 2020[vii]. China is already the world's largest gas importer and its LNG demand could triple as soon as 2035 in BP's scenarios (from 74 BCM in 2018 to 197-213 BCM in 2035), though falling thereafter. But despite commitments on decarbonisation and air pollution, the affordibility of gas remains crucial. China is the only target worldwide for major new international pipelines, from Russia and/or Central Asia. If these go ahead, the requirement for LNG would be reduced by 30 BCM/year.

Developed Asian countries are likely to be the only major world region seeing declining LNG imports, due to renewable growth, nuclear restarts and Japan's sluggish economic growth. Japan and South Korea are strong advocates for hydrogen, most of which they would import.

South-east and South Asia see affordability as an even more crucial factor, given that gas competes against cheap coal. Domestic gas output is in decline and growth in use will be met mostly with LNG. Australia, one of the world's top three LNG exporters, and an aspiring hydrogen superpower, sees some of the same political divisions as in the US over use of its fossil fuels.

India is the key global wildcard for LNG demand: BP's scenarios show that it could overtake China by 2035, in the case of a rapid transition away from coal, but in a business as usual case, its demand would triple but remain about a third of that of its northern neighbours.

Collectively, the rest of developing Asia will be a significantly larger LNG importer than China or India by 2035, but the range of uncertainty in BP's scenarios is less than for India.

Sub-Saharan Africa (SSA)'s gas use is growing strongly at 8.2% annually over the past decade, from a small base. Alongside increasing deployment of renewables, gas is important for reliable power and for industry in some areas. Gas markets depend on local resources in countries such as Senegal, Ghana, Nigeria and Tanzania, rather than imports. Major LNG developments in north-west Africa and Mozambique could also reserve some gas for local use. Ghana is set to become SSA's first LNG importer soon. The emissions impact of increased gas use is minor on a global scale, and often displaces oil and coal.

Will gas lose out to renewables in the medium-term?

The balance between gas and renewables depends on the tension between economics and supply security.

Security depends on the ability to meet unexpected changes in supply or demand – which can be due to weather, technical breakdowns, economic booms, market power of dominant players, geopolitical concerns and other factors. As David Watson of Cadent Gas points out, "Peak heat demand in the UK is four to five times peak electricity demand (200-225 gigawatts versus 50-60 gigawatts). Within-day, the peaks are even more. Wind will be available in winter, solar not so much, and what happens in periods of low wind supply? We need to build for the twenty-year winters."

Figure 7 shows the interplay between factors favouring gas and renewables.

Higher gas prices may be required to incentivise upstream investment and **improve supply quantity and diversity through cross-border gas market integration.** This is particularly so if large volumes of low-cost Russian gas are removed from the market by sanctions or European diversification policies. However, these higher prices may then damage the long-term competitiveness of gas.

On the other hand, **fossil fuel divestment** campaigns can make renewables more favourable in lieu of gas (by implicitly raising gas' cost of capital), but diminish supply security.

Gas' economics and environmental acceptability can be improved by technologies such as **cost-effective and dependable CCUS,** co-combustion in modern turbines of natural gas with up to 50% hydrogen or ammonia, or innovations in LNG liquefaction. This in turn would maintain a more diverse and therefore more secure and less volatile energy mix.

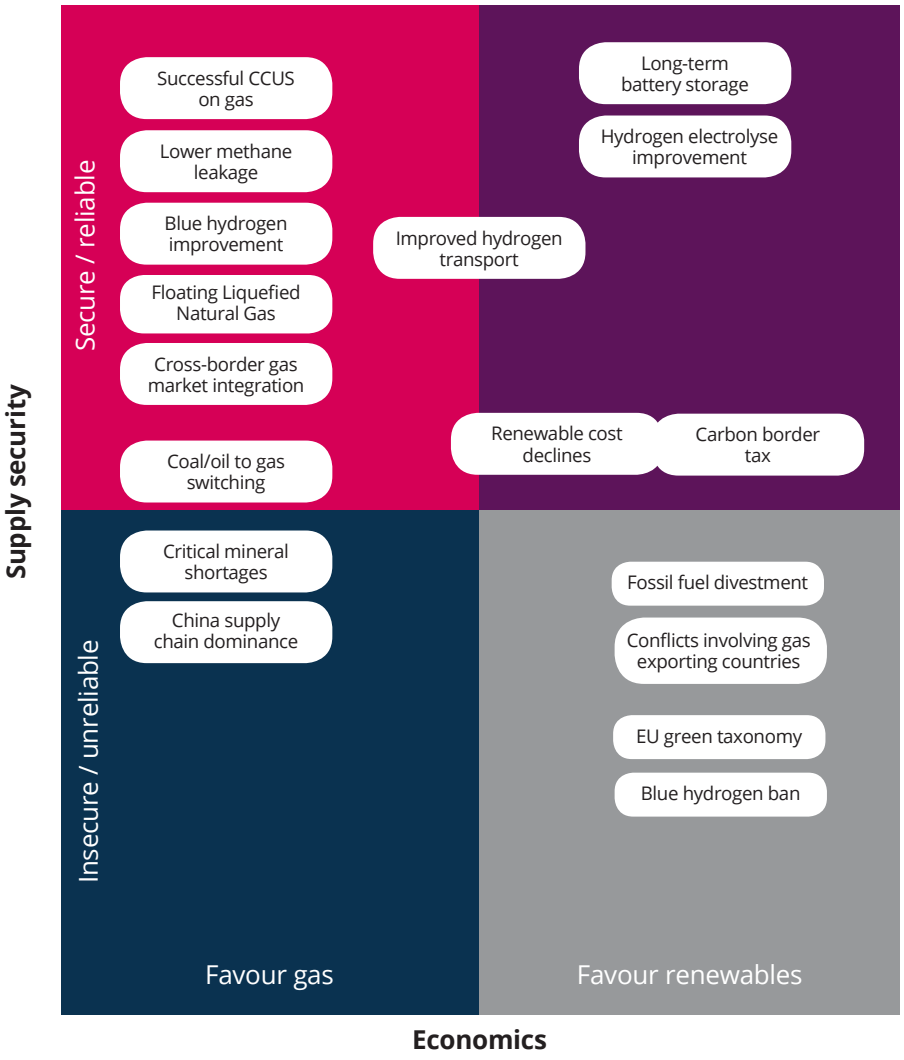


Figure 7 Factors favouring gas and renewables

> "Currently, it's not impossible to get funding for hydrocarbon projects, but it will increasingly come from non-traditional sources unlike bonds in US or Europe. Raising bonds in environments with significant liquidity like MENA will become increasingly important. It would be more difficult to raise funds for exploration and upstream development. Infrastructure will be less controversial, especially LNG import – particularly if the gas is going to displace coal. Interest was very high when Saudi Aramco bundled their pipelines and sold them off, including huge interest from Western firms."
>
> Patrick Allman-Ward, CEO, Dana Gas

However, technological advances that improve the reliability of renewables, particularly extended **duration storage technologies such as hydrogen or advanced batteries**, improve both their economics and supply security, and this poses the greatest threat to long-term gas demand.

Some technologies, such as **better transport of hydrogen**, improve overall supply security while being neutral between gas and renewables on economics.

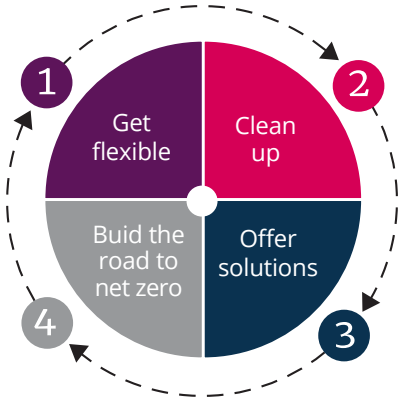
Finally, negative shocks for renewables – such as higher costs because of a **shortage of critical minerals** or an attempt to reshore supply chains to the US and EU from China – would favour gas economically but diminish supply security.

At the moment, this tension is largely a concern in Europe and parts of North America and Canada. As decarbonisation policies advance, other regions will have to find solutions to related dilemmas.

Financing, which has become close to impossible for new coal plants, is growing more challenging for gas, particularly upstream projects. The EU Green Taxonomy does preserve a role for gas as sustainable transition investments, under quite stringent conditions.

Four approaches to enable the gas industry to thrive

To make the maximum sustainable use of gas, companies need to pursue a blend of four approaches.



1 **Get flexible.** International gas will require more supply from more diverse sources to improve supply security and meet political imperatives.

The industry has been typified by long lead-time megaprojects in remote areas. Such ventures risk coming online with a market of declining demand and prices – or, conversely, not entering the market quickly enough if demand and prices are strong. These problems can be countered by a flexible approach to choices of technology, project management and development phasing, commercial structures and financing.

Incremental, flexible and modular projects, and LNG exports from brownfield sites will be key in the near-term and limit company exposure. Floating LNG (FLNG) liquefaction vessels may be preferable over land-based plants, if they can be standardised and initial teething troubles overcome. Shale and tight gas has the advantage of quick responsiveness to market movements.

However, the global market cannot depend solely on growth from North American supplies or brownfield expansions. Unconventional development would have to expand in promising areas elsewhere, including Argentina, China, the Middle East and Australia. In addition, large-scale greenfield projects will be required, with all the familiar challenges of fiscal terms, supply chains and cost inflation, environmental approvals and location-specific concerns.

Business models for gas and power companies will become much more complicated, spanning multiple fuels and conversions between them. Operations may need to switch between delivering blends of electricity, gas, heat, hydrogen and ammonia depending on market fluctuations.

Marketing and trading will be more essential than ever, but also more complex. Higher overall prices for now mean greater exposure and more margin requirements. Sanctions and public campaigns may create a bifurcated market where certain LNG cargoes cannot be delivered to many customers. Sudden supply interruptions mean logistics have to be nimble to re-route them.

Contracts will have to be more legally watertight than ever, particularly in issues such as force majeure, sanctions designations on counterparties, payment currencies, and penalties for failure to supply (when volatility and arbitrage may lead some suppliers deliberately to default in order to redirect cargoes to higher-priced markets).

2 **Clean up.** Cutting emissions from their own operations is essential, ideally reaching net zero (Scope 1 and 2) as soon as possible. This includes:

- minimising methane leaks;
- eliminating routine flaring;
- powering operations from renewable energy;
- electrifying offshore and remote operations and using electric drive for new LNG trains;
- boosting energy efficiency;
- preferring gas resources with lower contaminant CO^2;
- applying CCUS to gas processing, and extending it to other operations where possible; and
- monitoring, reporting and independently auditing all emissions, to recognised standards[viii].

3 **Offer solutions.** Security of supply and steeply-rising energy costs are an intense current concern, particularly in Europe. However, the gas industry is caught between blanket hostility to fossil fuels, and complaints over profiteering. Gas companies should embrace their role in climate challenge, rather than fighting regulation or hoping to avoid scrutiny. They need to campaign intelligently against counter-productive policies, such as those that prevent coal phase-out in favour of gas.

Potential allies include politicians concerned over high energy costs and geo-economic security risks, and heavy industry which risks becoming uncompetitive. Gas firms should target regions with a more gas-friendly outlook, especially those with potential for switching away from coal and oil, and those in South Asia and Sub-Saharan Africa who badly need reliable energy. They may be able to build bridges with some environmental groups, but this will have to overcome substantial mistrust and concerns of 'greenwashing'.

The onus is not just on gas companies. Firms of all types need to make some potentially uncomfortable decisions on decarbonisation (Figure 8). For instance, in Poland, energy-intensive companies and local companies have taken the initiative to invest in small-scale gas combined heat and power systems, biomass firing, and even small modular nuclear reactors. Replacing coal, oil and gas cooking and heating with electric stoves and heat pumps requires local and consumer-focussed action.

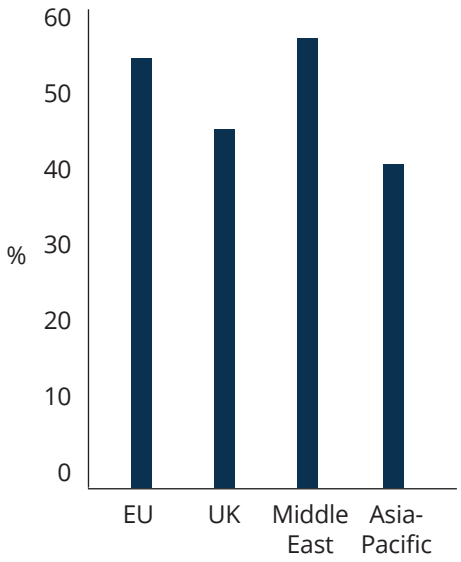


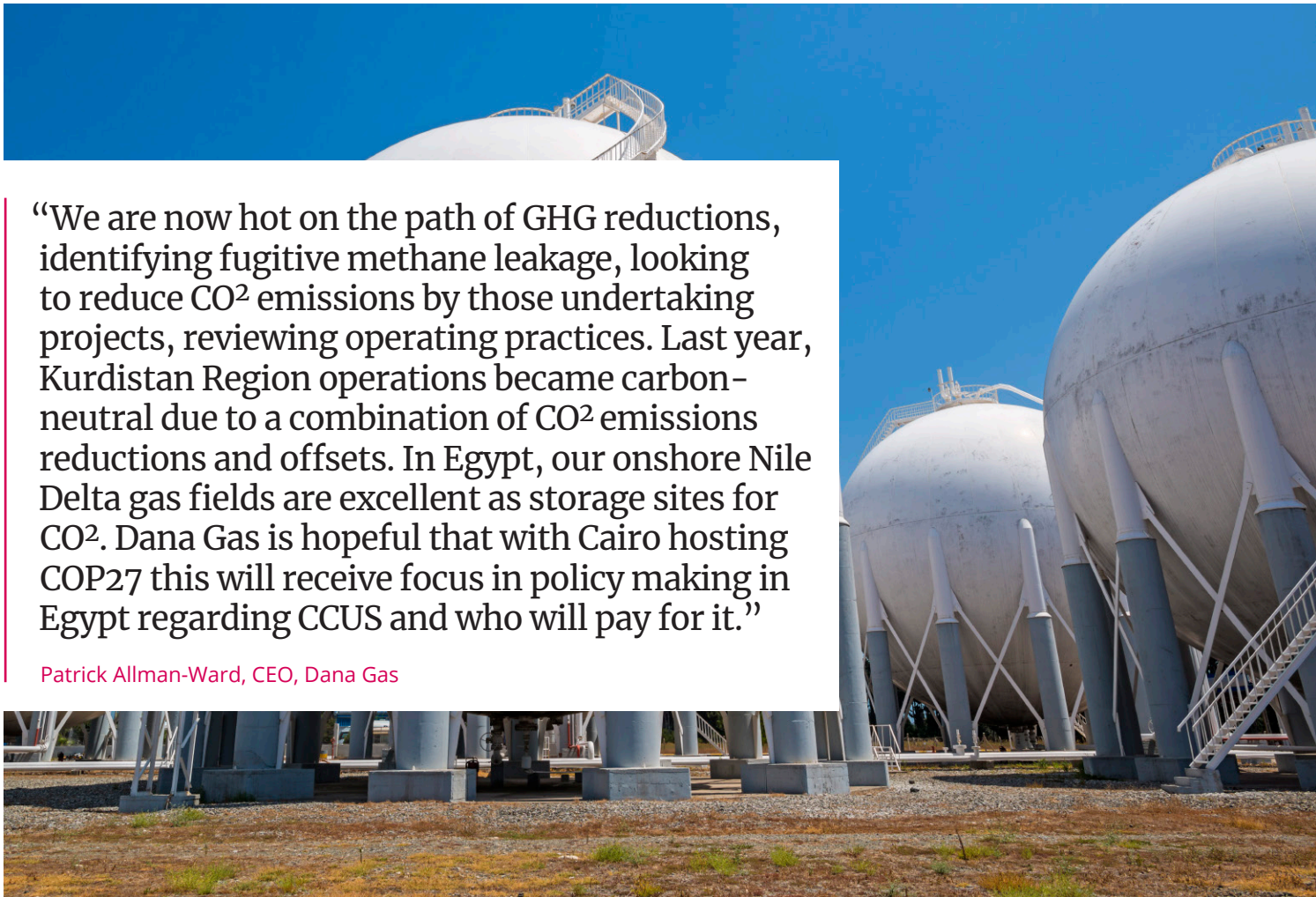
Figure 8 DWF's Global ESG Report. Share of respondents citing "Reducing our impact (e.g. going carbon neutral) would have a detrimental impact on our service offering to clients and potentially a commercial impact.[ix]

4 **Build the road to net zero.** This means targeting gas to non-emitting uses and thus laying out a credible path to net zero Scope 3 emissions. The three main non-emitting uses today are:

- long-lived petrochemicals (durable plastics, including metal substitutes);
- combustion with CCUS; and
- generation of blue hydrogen or ammonia.

The industry will have to demonstrate that CCUS can deliver acceptable costs, high reliability and safety, and very high capture rates of 95% or better. Investment decisions today should be made with these considerations in mind. Pipelines, turbines and industrial plants should be built or retrofitted to be hydrogen- or ammonia-capable.

Net zero roadmaps should preserve as much of today's natural gas infrastructure as possible. Intelligent investments in technology development, deployment and scale-up will be essential and can contribute profitably to future industries.



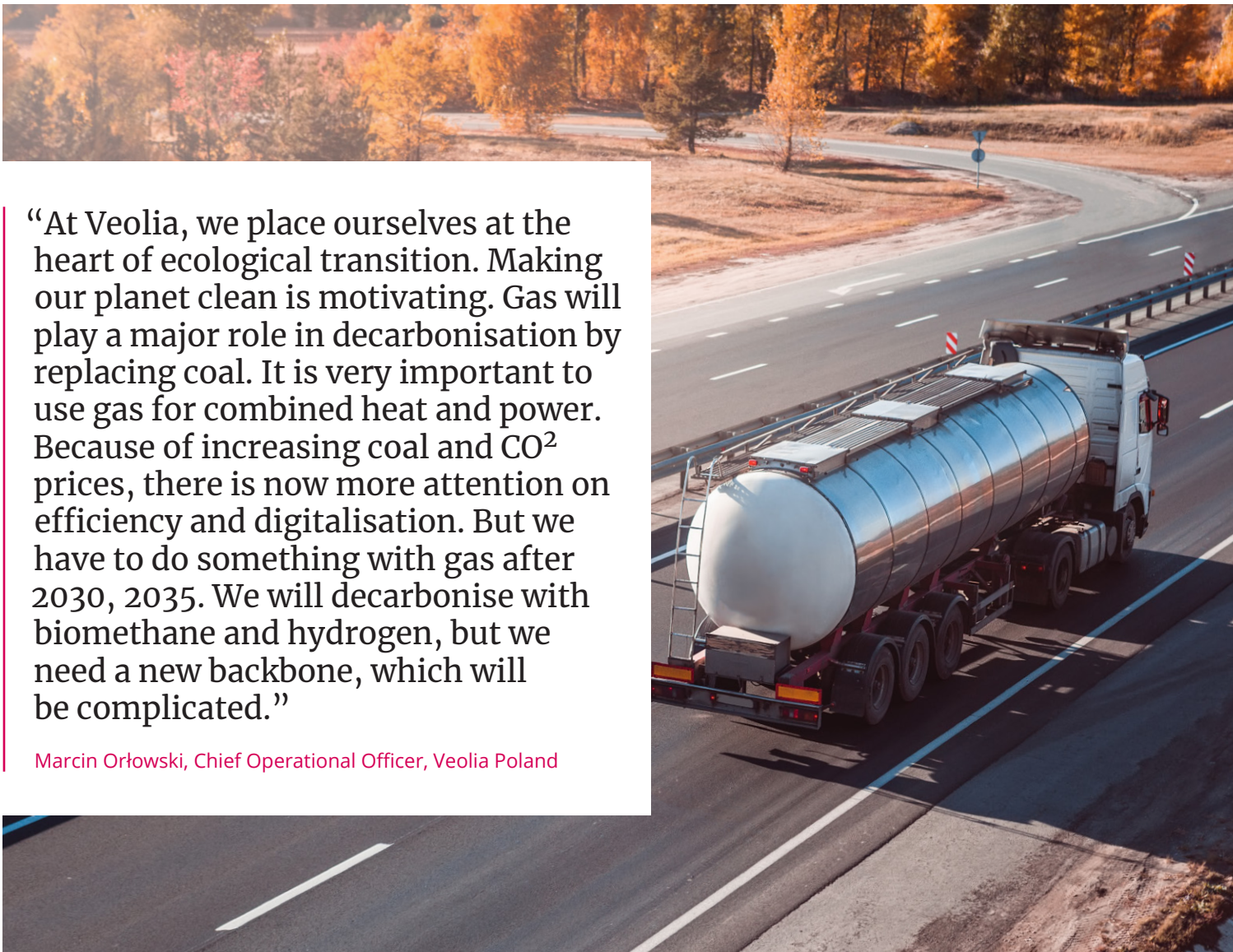
> "We are now hot on the path of GHG reductions, identifying fugitive methane leakage, looking to reduce CO^2 emissions by those undertaking projects, reviewing operating practices. Last year, Kurdistan Region operations became carbon-neutral due to a combination of CO^2 emissions reductions and offsets. In Egypt, our onshore Nile Delta gas fields are excellent as storage sites for CO^2. Dana Gas is hopeful that with Cairo hosting COP27 this will receive focus in policy making in Egypt regarding CCUS and who will pay for it."
>
> Patrick Allman-Ward, CEO, Dana Gas

Conclusion

Gas has a major role to play in a climate-friendly, geopolitically-secure world. However, current market structures and business models fall short on delivering on those imperatives.

Even while supply diversification is urgent, it is increasingly difficult to secure approvals and finance for major investments, particularly in upstream production and pipelines.

Resolving these contradictions demands action along the value chain, from upstream producers and LNG shippers, to gas distribution firms, power generators and heavy industry. This revolves around the four imperatives of: **getting flexible** to avoid being stuck with stranded assets, while meeting near-term market needs; **cleaning up** companies' own operations; **offering solutions** that are sustainable, affordable and publicly-acceptable, building relationships with government, communities and technology providers; and **building a road to net zero** with credible plans for carbon capture, hydrogen, non-emitting gas uses, and other approaches compatible with net-zero. The experience built in Europe and North America can be applied in emerging economies, but with proper respect for their unique environments and immediate priorities. The gas industry has a crucial role to play in global decarbonisation, but to avoid being caricatured as another climate villain, it urgently needs coherent strategies and communications.



> "At Veolia, we place ourselves at the heart of ecological transition. Making our planet clean is motivating. Gas will play a major role in decarbonisation by replacing coal. It is very important to use gas for combined heat and power. Because of increasing coal and CO^2 prices, there is now more attention on efficiency and digitalisation. But we have to do something with gas after 2030, 2035. We will decarbonise with biomethane and hydrogen, but we need a new backbone, which will be complicated."
>
> Marcin Orłowski, Chief Operational Officer, Veolia Poland

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