Global Voice of Gas

BY THE INTERNATIONAL GAS UNION

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How Gas will Fuel the Path from Glasgow

A sustainable flame: the role of gas in net zero
Clean technologies that will make gas and gas use emission-free
The US Gulf Coast is poised for rapid methane and CCS development
Providing natural gas

Investing in natural gas to reduce the carbon footprint of the global energy mix
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Learn more at www.atlascopco-gap.com
Dear reader,

Welcome to another issue of the Global Voice of Gas, the digital magazine of the International Gas Union.

As we all emerge from our COVID driven isolation, the gas value chain has many reasons to be positive. This is because, as we near the end of 2021, gas in its broadest sense – whether that is natural gas or a portfolio of decarbonised and renewable gases – has never been as important to global society.

We are all in the midst of multiple challenging interconnected global dynamics, all of which require timely action and significant resources to be resolved:

1. Energy access – every human on the planet should have reliable, secure, affordable energy access
2. Socio economic development – all societies must have the right to develop their economies to enhance the life of their people

We believe that natural gas today – and in the future a portfolio of decarbonised and renewable gases – are a major solution to all of these challenges. One could argue that importance is reflected by strong demand today, which is projected to continue. There is, of course, an ongoing debate about the energy transition but at the same time, the world understands the unique value of natural gas, continuing to invest, transport and utilise the blue fuel.

This edition however is focused on how our industry can help support global society in managing just one of these dynamics. This edition is dedicated to one of the most important shared challenges of our time. Global warming and climate change are real – and we cannot ignore the major contributing role of the energy value chain. It is not the only cause, but we must recognise that we have an obligation to publicly be part of the solution – or offer a range of solutions.

I want to be very clear in stating that the IGU fully supports the Paris Agreement, the urgent need for action to reduce GHG emissions, and the need for significant decarbonisation of the global energy system to meet these goals.

We recognise the challenge of global warming and can demonstrate that we are an inherent part of the solution, based on proven technology and viable return on investments. We believe that natural gas today and a portfolio of decarbonised gases, including hydrogen, biomethane, and abated natural gas tomorrow are the catalyst for and foundation of a more sustainable energy future.

The combination of gas and renewables has already removed or reduced more polluting fuels from multiple markets, cleaned the air in cities, and cut CO₂ emissions. Natural gas-powered electricity generation produces less than half of the GHG emissions than that of coal and up to a third less than oil and is a perfect combination with currently intermittent renewable installed capacity.

This is a trend which will continue and develop as technologies in both gas and renewables are enhanced – for instance wide scale adoption of CC(U)S to ensure that there is as little unabated gas in the system as possible, and existing natural gas infrastructure that can be used for a more sustainable future – for instance with blending of molecules for a lower carbon solution, or even fully switching to hydrogen.

It is through the use of available and new gas technologies that the great challenge of our time will be managed – and managed in a just manner.

The IGU is committed to being an important contributor to climate, energy transition, and sustainable future discussions, both as a forum for inter-industry engagement and as the Global Voice of Gas, engaging with a range of global partners and stakeholders. I hope you find this edition of Global Voice of Gas informative and engaging.

—Professor Joe M Kang
President, International Gas Union
Welcome to the fifth issue of Global Voice of Gas (GVG), an International Gas Union magazine produced in collaboration with Natural Gas World – setting a new standard in communication for the gas industry and its stakeholders worldwide.

Ahead of the crucial UN Climate Change Conference (COP26) in November, the IGU has dedicated this issue to the environmental and economic value of natural gas, making the case for its founding role in the energy transition, in sustainable development, and in improving lives and livelihoods around the world.

That case grows stronger with the ongoing development of low-carbon gas technologies, which help to position gas as a vital second pillar in decarbonisation, alongside renewables – the pathway envisioned by IHS Markit in their recent Sustainable Flame report.

Gas is already driving emissions reductions across the world, most evidently in Asia, by replacing more polluting fuels such as coal – but also in Europe and the Americas. An expansion in gas supply and the infrastructure to import and distribute it has also been instrumental in increasing access to modern, reliable and sustainable energy in developing nations, helping to eliminate energy poverty, clean up the air people breathe and bringing back blue skies to where they were black before.

It is therefore critical to avoid a one-size-fits-all approach to addressing climate change, safeguarding reliable energy supply. Different nations may pursue different transition paths toward the Paris Agreement, depending on their starting positions, available resources and the needs of their populace. And in many countries, gas will serve as an indispensable source of energy enabling the increasing use of renewable energy.

In developed countries, the role of gas in keeping energy affordable and driving economic growth must also be recognised. Investment in new gas supply must continue, to prevent a spike in energy costs and a resurgence in dirtier energy sources, such as coal.

In further driving down emissions, great progress can be made by deployment of clean technologies, such as renewable gases, low-and-zero-carbon hydrogen, and carbon capture, utilisation and storage. Existing gas infrastructure will be critical for that, as it is a key conduit for scaling renewable gases and hydrogen sufficiently to decarbonise entire energy systems. The costs for these technologies are coming down, but prudent policy support, access to financing, and a great entrepreneurial spirit from both the incumbent and new industry players are needed for these technologies to reach the required deployment levels.

This issue shines a spotlight on several key developments in low-carbon gas technologies.

For instance, we examine the potential for CCUS deployment in the US Gulf Coast, as well as the incentives required to scale it up into a multi-trillion-dollar industry. We also discuss the state of play in methane pyrolysis technology, used to produce low-emission hydrogen and solid carbon, as well as how the global market for various hydrogen types will take shape.

The IGU is proud to include contributions from the IHS Markit’s Michael Stoppard on the key role of gas in the energy transition as the second pillar of decarbonisation, the Gulf Coast Carbon Center researchers, the European Biogas Association, and the Gas Exporting Countries Forum.

The issue also explores several key recent developments affecting the global gas market, including: how the energy transition strategies of international oil companies have affected investment in Africa; Nigeria’s passing of a long-awaited petroleum bill; shortages in energy supply in Pakistan; and the European Commission’s unveiling of its Fit for 55 climate package.

— Paddy Blewer
Director of Public Affairs, IGU

— Joseph Murphy
Editor of Global Voice of Gas, Natural Gas World
As the global gas industry’s trusted partner in strategic planning, IHS Markit can help your flame burn its brightest.

From the wellhead to pipelines, from factories to homes, gas is crucial for fuel, heating, power, chemicals, fibers, consumer goods and countless other uses. Shipped, distributed, marketed and stored internationally and domestically, gas quite literally helps fuel the world economy.

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Learn more about partnering with us: ihsmarkit.com/globalgas-2
The Pathway to Serendipity

As we look forward to gathering again in person, starting with the World Gas Conference in May 2022, I am reminded of one of my favourite words that describes the benefits of meeting face to face – “serendipity”: the occurrence and development of events by chance in a happy or beneficial way. Whether it’s the unexpected introduction, the industry gossip that helps you “join the dots” on how things really work, or the depth of knowledge gained through several days of focused involvement, you have to be in the room to create your own serendipity.

Momentum is gathering for the IGU’s Flagship Events portfolio and all our host National Organising Committees are taking the opportunity to travel and engage with the industry around the world. Our teams will be in St Petersburg, Abu Dhabi, and Houston soon so if you would like to meet up with them contact me on rodney.cox@igu.org.
WGC2022

While the WGC2022 Call for Papers has already received hundreds of insightful submissions from over 25 countries across the 60+ topic sessions, there is still the opportunity to make your contribution and submit an abstract. We invite you to submit your success stories, engaging case studies, projects, strategies, technical research, or expertise you want to share with the gas and energy industry.

Don’t miss your opportunity to present your commercial and technical knowledge to industry professionals from across the entire gas value chain and inspire the global audience. Submit your abstract for the Call for Papers by January 28, 2022 and speak at the world’s largest face-to-face industry conference in Daegu, Korea on May 23-27, 2022. Details at wgc2022.org or contact the conference team at papers@wgc2022.org.

There is also exciting news on the exhibition and sponsorship as WGC2022 continues to add key industry leaders as supporters of the event. Just confirmed in the last month are Venture Global, TotalEnergies, Woodside & SK among many others. For a closer look at the opportunities available, the organising team have provided a video briefing which includes a tour of the conference facility, an outline of the conference programme and details of the exhibition pavilions including an area dedicated to hydrogen technologies. Check it out at wgc2022.org/exhibitor-briefing or contact the exhibition and sponsorship team now: exhibition@wgc2022.org.

LNG2023

Ahead of the launch of our Call for Papers you can take the survey at ClubLNG to add value in shaping the LNG2023 Conference Programme. Plus, you will receive free access to the 1000+ papers presented at every LNG Event Series since LNG 1 in 1968.

For a comprehensive video tour of our venue, Expo Forum in St Petersburg, go to lng2023.com/venue-video-tour. For exhibitor and sponsoring inquiries please contact the team at exhibition@lng2023.com.

IGRC2024

September 29 saw the official launch by the Canadian Gas Association of IGRC2024 during the Canadian Gas Dialogues Conference – a major Canadian industry event. Despite COVID restrictions over 100 participants came to Calgary for the event. This included accredited media from leading Canadian papers including The National Post and The Calgary Herald, and trade paper coverage from the BoE Report, Natural Gas World and Natural Gas Intelligence. Plus, the IGRC2024 team had the opportunity to brief various Government of Alberta officials, including Dale Nally, Alberta’s Minister of Natural Gas and Electricity, about our programme of activities to promote gas innovation and to deliver a successful IGRC2024.

Later this year will see the launch of the IGRC2024 website which will include our plans on developing a series of activities to profile innovation and technology leadership across the entire natural gas value chain. Contact the IGRC2024 Executive Director, Julie Gaudreau, for more details at JGaudreau@cga.ca.
KOGAS is fully prepared to become a competitive H₂ provider, ushering in a hydrogen economy.
Regional Update

The Middle East & Africa

KHALED ABUBAKR
Chairman, Egyptian Gas Association. 
Executive Chairman, TAQA Arabia and 
IGU Regional Coordinator

» Natural gas is one of the pillars of global energy. Where it replaces more polluting fuels, it improves air quality and limits emissions of CO₂. Since 2010, coal-to-gas switching has saved around 500mn metric tons of CO₂ – an effect equivalent to putting an extra 200mn EVs running on zero-carbon electricity on the road over the same period.

» Major power crises are developing around the world with capacity shortages, forced industry shutdowns and the restarting of coal-fired generation in some parts of the world. With the help of its huge state-of-the-art gas-fired power stations, though, Egypt has been able to emerge from the crisis and has an abundance of electricity. It is now a major energy and electricity hub with connections to neighbouring countries and a great potential for electricity exports.

» South Africa, which is reliant on coal and is the world’s 12th-biggest source of greenhouse gases, is turning to gas-fired generation as well. It plans to use natural gas to produce at least a quarter of almost 12,000 MW of additional power it envisages by 2030. These plants will generate less than half the greenhouse gases that coal-based capacity does.

» Leading Sub-Saharan Africa building solutions company, Lafarge Africa, has launched a new fleet of 52 LNG-fuelled trucks. In partnership with Ecologique, the new trucks will contribute far less CO₂ to the environment than fuel oil (30% less) and coal (45% less). The focus on the increased utilisation of LNG has seen CO₂ emissions being reduced globally and data from the Energy Information Administration has shown that, since 2006, increased use of natural gas has driven CO₂ savings.

» The area of coastline shared between Mauritania and Senegal is rich in hydrocarbons, after lucrative gas basins were discovered six years ago on the edge of the world’s largest cold-water coral reef, a discovery which set in motion the $4.8bn Greater Tortue Ahmeyim (GTA) project led by UK oil and gas giant BP, in partnership with US deepwater exploration company Kosmos Energy and other firms.

» The Iraqi Gas Master Plan will rapidly increase development of Iraq’s associated gas resources, most of which are being burned off. The Basra gas gathering project costing around $17.2bn forms a major part of this project and will help provide gas to the domestic power industry as well as for export as LNG via a floating liquefaction facility off Basra. The project is looking to produce 2bn ft³/day of gas flared primarily from three oilfields in the south of the country: Rumaila, Zubair and West Qurna Phase 1. The three fields currently produce 1.05bn ft³/d of gas, but only 450mn ft³/d is utilised while the rest is flared.

» The Hail and Ghasha sour gas fields, located offshore Abu Dhabi, are being developed by ADNOC with the intention Abu Dhabi, are being developed by ADNOC with the intention of producing up to 1.5bn ft³/d of sour gas plus additional condensate. The project is intended to increase the UAE’s domestic gas production by 18%.
Russia, Black Sea and the Caspian Area

MARCEL KRAMER
President, Energy Delta Institute,
IGU Regional Coordinator

Strong demand for Russian gas in Europe

Demand for Russian gas has been strong in Europe this year due to a colder winter and a recovery in energy consumption as economic activity has increased. Gazprom’s pipeline exports to Europe and Turkey totalled 131bn m³ in the first eight months of the year. This represents an almost 20% increase over the same period in 2020. Domestic supply rose by some 11% in the same period.

Deliveries to China through the Power of Siberia pipeline infrastructure repeatedly set new records this year and exceeded contractually planned levels by more than 5%.

Yamal LNG exports also grew again, by some 5% in the first half of the year, according to Novatek. A fourth LNG train was reportedly put into full operation around the middle of the year.

Pipeline infrastructure development

The Nord Stream 2 pipeline system will be able to deliver gas to European customers via the German landfall this year, according to Gazprom’s senior management. The Nord Stream company applied for a ‘precautionary certification’ from the Federal Network Agency (German regulator) as an Independent Transmission Operator (ITO).

Trans Adriatic pipeline (TAP), which links gas from Azerbaijan to Southern Europe via Turkey, launched its Market Test in July. This process aims at gathering additional interest in shipping gas through TAP. Depending on the outcome, TAP may eventually expand its capacity.
South & Southeast Asia

HAZLI SHAM KASSIM
President, Malaysian Gas Association,
IGU Regional Coordinator

Natural gas vital for clean energy transition in Southeast Asia

Southeast Asia requires energy to prosper

On average, the GDP per capita of Southeast Asian Nations or ASEAN is approximately $4,742.

Data from 2018 shows that nearly 30mn people are without access to electricity and approximately 219mn people do not have access to clean cooking in Southeast Asia.

In order to expand energy access, grow its economy and ensure shared prosperity, ASEAN is expected to double its total primary energy needs by 2040.

Natural gas to fuel economic growth in ASEAN

According to the ASEAN Energy Outlook, under the Sustainable Development Goal (SDG) scenario to fulfil SGD7 in providing access to affordable and reliable energy, the region requires 32% coal, 24% oil and 21% gas in its total primary energy supply in 2040.

With both utilities and financial institutions committing to no longer be involved in new coal plant projects, the responsibility is left to natural gas to take over the role vacated by coal as baseload energy towards 2040.
With natural gas featuring more prominently in the energy mix, CO₂ emissions are expected to reduce in tandem with a reduction in coal consumption.

Natural gas to support carbon neutral ambition: the Malaysian Example

In March 2021, the Energy Commission Malaysia released its Report on Peninsular Malaysia Generation Development Plan 2020-2039.

According to the plan, a total of 14.2 GW of new combined cycle gas turbine (CCGT) plants will be commissioned between 2021 and 2039, whilst a total of 9.8 GW of gas-fired power plants will be retired. The plan also considered a total of 2.8 GW new coal-fired plants to be commissioned and 7 GW to be retired during the same period. The plan envisages a total of 7GW of renewable energy (RE) and battery storage being added to the capacity by 2039.

As Malaysia transitions towards a low-carbon economy, a combination of RE and gas is expected to enable the power sector to play its part by reducing its carbon intensity by more than 60% by 2039. During the same period, demand for natural gas is expected to increase from 643mn ft³/day in 2021 to 1,656mn ft³/d in 2039.

Natural gas a vital enabler in ASEAN hydrogen roadmap

In October 2021, ASEAN Centre for Energy (ACE) released a study entitled Hydrogen in ASEAN: Economic Prospects, Development and Applications, which aims to support ASEAN in improving the coherence between its energy and climate policies and contribute to more climate-friendly development of the energy sector.

Natural gas is expected to be the critical enabler as outlined in the following general roadmap for hydrogen energy development in ASEAN as recommended by the study:

- **Phase I**: (2020-2025) Develop grey hydrogen production and export capabilities and capacities at countries with existing natural gas resources and infrastructure, so as to achieve economies of scale and prepare for the next phase of hydrogen energy development.

- **Phase II**: (2026-2030) After the capacity and infrastructure are built for grey hydrogen production, shift to blue hydrogen production and exports.

- **Phase III**: (2030 onwards) After the LCOE of renewables significantly declines and the share of RE power generation has reached high levels, expand green hydrogen production and exports, leveraging on the hydrogen infrastructure developed during earlier phases.
REGIONAL UPDATE

North East Asia & Australasia

GRAEME BETHUNE
Chairman, Australian Gas Industry Trust, IGU Regional Coordinator

Rebounding gas demand in North Asia

» Gas demand rebounded strongly across North Asia in the second quarter of 2021 as economies recovered from the depths of COVID-19 lockdowns in 2020. Chinese gas imports (LNG and pipeline gas) were up by a massive 28% from a year earlier. China imported more LNG than Japan, historically the world’s largest LNG importer. LNG imports by Japan, Chinese Taipei and Korea grew by 4%, 8% and 9% respectively.

Gas playing a critical role in maintaining energy security

» Strong Chinese gas demand has been driven by the strong economic rebound from the coronavirus and power shortages amid extreme summer weather, lower renewable generation and strict limits on coal usage. Only 3.2% of China’s power was gas-fired in 2020, with 63% generated from coal and the remainder from nuclear, hydro and renewables. However, according to Wood Mackenzie, gas-fired power generation jumped 14% year/year in the first four months of this year. Hydro generation in southwest China has been curtailed by lower rainfall and solar output that was lower than expected, with the Guangdong province rationing power. At least nine provinces have said they are dealing with similar issues.

» KOGAS is reported to have signed a long-term contract with Qatargas for annual LNG supplies of 2mn metric tons from 2025 until 2044 amid growing concerns about supply insecurity and the spike in LNG prices that could translate into a jump in electricity bills amid the country’s scheme to wean away from coal and nuclear-powered generation.

» In Australia, east coast gas-use for power generation was up 8% yr/yr in the second quarter on the back of a fire at the Callide coal power station in Queensland and floods affecting the Yallourn coal power station in Victoria.

» In New Zealand, lower generation from renewables due to a dry year and lower gas production have meant record coal imports for electricity generation. On August 10, load shedding left about 20,000 households across the country without power as renewable sources of power generation proved unreliable in cold stormy conditions. The power blackouts illustrate the growing energy shortage New Zealand has been grappling with this year (reflected in high spot electricity and gas prices), and threatens to worsen in future due to a range of government climate change policies designed to aggressively reduce the production and use of natural gas.

Regional gas market transitions to meet Paris goals

» The region’s energy sector is facing an unprecedented transformation because of political, technological and market developments arising from the imperative to achieve net zero by 2050.

» Japan, China and Korea have recently declared their commitment to net zero and are demanding stable and affordable carbon-free energy.

» There are already carbon-neutral LNG cargoes being shipped, mostly to Asian buyers. Between June 2019 and April 2021 there were 14 carbon-neutral cargoes, 12 for Asian buyers, including at least four from Australia.

» LNG projects increasingly have carbon capture and storage (CCS) facilities. The Gorgon LNG project in Western Australia is one of the biggest CCS projects in operation. While the project has suffered delays, the operator Chevron, has said it has injected around 5mn mt of CO₂e since starting injection in

GRAEME BETHUNE
Chairman, Australian Gas Industry Trust, IGU Regional Coordinator
Regional Update

Markets and numerous medium and long-term hydrogen projects of a global scale coming to fruition.

Australia’s first green hydrogen production plant recently opened in South Australia, putting 5% of hydrogen into the gas stream for 700+ households and selling hydrogen to BOC, one of Australia’s biggest industrial gas suppliers.

Meanwhile, the 15-GW Asian Renewable Energy Hub, which is the world’s largest wind-solar hybrid project, plans to generate massive volumes of renewable energy to produce green hydrogen and ammonia for export.

Energy transition must be achievable... just look at Japan

A successful energy transition will deliver clean, secure and affordable energy, and gas is crucial to this.

While the various nations across the region work towards their net zero commitments, gas will still play a central role to meet market demand.

Japan has recently released its Sixth Basic Energy Plan. Japan acknowledged the important role of gas in realising its efforts to decarbonise power generation.

Japan is hoping to expand the use of gas as a major raw material for carbon free hydrogen and ammonia and will use the existing natural gas pipelines and other infrastructure to do this.

Japan will continue to import LNG and expects that in 2030 around 20% of its primary energy supply will still come from natural gas.

Japan also aims to expand its market by trading 100m mt/yr of LNG within Asia.

Gas offers the fastest and most economic path to reduced carbon and air pollutant emissions; helping to meet new energy demand, while improving the environment, air quality, and living conditions across the region.

A stable energy supply is paramount to regional economic growth and development and is a building block for reliable, sustainable and affordable energy systems.

August 2019. The project, reported to have cost $1.5-$2.2bn, is one of the few decarbonisation projects to be largely privately funded. The project received a $45mn Australian government grant but otherwise has been completely funded by Chevron and its two partners, Shell and ExxonMobil.

Hydrogen rising

An important way of achieving the Paris goals is through development and commercialisation of hydrogen, either through blue hydrogen produced from natural gas with CCS or green hydrogen produced from renewables.

There is strong interest in hydrogen throughout the region. For example, plans to use hydrogen as part of future energy systems have seen demand estimates of around 4mn mt of Australian hydrogen by 2030. Hydrogen could be Australia’s next great export, and Australia is in a very strong position to meet market demand.

Strong demand for internationally traded hydrogen is anticipated which has seen Australia fast track many of its hydrogen projects. Australia currently has nearly 50 hydrogen projects being trialed.

Australia has many of the pre-requisites needed to support a large hydrogen export market now and into the future; including an abundance of natural resources, strong industry commitment, advanced capability, existing infrastructure, lots of open space and the right political levers in place to produce blue and green hydrogen. Australia is one of the world’s largest exporters of LNG and can easily leverage this position.

Australia is also well situated to take advantage of CCS technologies to produce low-emissions hydrogen from natural gas. Carbon capture rates of 90% or more will likely be required, and this is technically feasible in Australia.

Hydrogen ready for today and tomorrow

Strong government and industry investment over the past 5 years has seen Australia become a leader in blue and green hydrogen production, the development of new energy markets and numerous medium and long-term hydrogen projects of a global scale coming to fruition.
Delivering for a low carbon future
Deep and fast are becoming the imperatives of environmental policy. Deep, as governments and corporations are setting increasingly ambitious targets for greenhouse gas emission cuts. Fast, as recognition grows that the rate of progress in emission reduction is falling short of what is required to stay within manageable warming levels. To address the challenge, many different technologies and policies will be required, and gas—in its many forms—has an important and unique role to play, a role that needs to be more widely recognised. Gas can help in a variety of forms as regular natural gas, biomethane, hydrogen, ammonia and synthetic natural gas.

The benefits of natural gas have been stated many times—clean burning properties, relatively...
low carbon emissions, proven technology, widespread availability, and relative affordability. Some of its drawbacks are also well documented including most critically the need to manage and minimise methane leakage. No solution is perfect, but too often policymakers are making the perfect the enemy of the good. Policy now needs to recognise that gas can play a critical role in the energy transition becoming the second pillar alongside renewable power toward fast and deep decarbonisation. A new report from IHS Markit seeks to explain the contribution that gas can make towards decarbonisation, and also to highlight its limitations.

**Fast decarbonisation**

Much policy is now focused on 2050 as a target in many developed economies for achieving net zero. Target dates are helpful to frame plans. And it needs to be recognised that the energy complex is not capable of complete overhaul overnight—assets lives, lead times, and the scaling-up of new supply chains are simply too long.

However, speed also matters. The overall carbon budget—the total cumulative amount of emissions—is at least as important as any target end point. The trajectory of emissions cuts determines temperature rise, and early cuts can help later efforts. So, we need to maximise the technologies at our disposal today and not wait for new technologies to scale up. (See Figure 1). This is why most simulations of global energy to achieve the Paris climate goals or net zero show natural gas demand either remaining flat or growing out to 2030, recognising its short term benefits. (See for example the IHS Markit Low Emission Cases “MultiTech Mitigation and Accelerated CCS”)

Natural gas has already demonstrated its effectiveness in reducing emissions quickly and at scale through substituting for high emitting fuels, mainly coal. This was a major driver of cuts in Europe and more recently a similar impact has happened in the US. Yet under-utilised gas-fired power plants exist across OECD markets where substantial coal burn continues—whether in the United States, Europe, Japan, or South Korea. Further substitution is possible quickly and with limited capital investment in downstream infrastructure.

And there is a potentially bigger prize to be had in the growing markets of non-OECD Asia. Renewable
No solution is perfect, but too often policymakers are making the perfect the enemy of the good.

Power with its enlarged supply chains and lower costs will play the central role in changing the Asian generating portfolio, but that cannot suffice alone. Substitution from coal toward natural gas can be done relatively quickly, requires limited deployment of capital, and has a significant impact on emissions. The IHS Markit study A Sustainable Flame estimates that a cost-optimal pathway for emission reductions in the Asian power sector would require a combination of renewable power and natural gas. An increase of 420–550bn m³/year of additional natural gas—10–15% of current global consumption—would be required, delivering between 0.9 and 1.2 gigatons (Gt) of annual carbon dioxide (CO₂) reductions. For this to happen, changes are needed in downstream policies and carbon pricing. The high natural gas prices of 2021 highlight the need to encourage development of more supply—resource availability is not the issue.

Deep decarbonisation

Unabated natural gas can take us so far. For deeper decarbonisation both carbon capture, utilisation, and storage (CCUS) and hydrogen have the potential to make a huge contribution. They can support in areas where direct electrification is difficult or impossible.

- Low-carbon hydrogen use is projected in some net-zero outlooks and roadmaps to reach anywhere between 10% and 25% of the global energy mix by 2050 from almost nothing today—an extraordinary undertaking. The hydrogen may be generated from natural gas with carbon capture or from renewable power – the split between blue and green hydrogen is much debated—but either way hydrogen can supplement and ultimately supersede natural gas over time.
- CCUS capacity is projected to capture up to 1.5–8 Gt of annual emissions in 2050, a significant share of the total 37 Gt of energy–related emissions today. A high proportion of the CCUS will be dedicated to factories that run on natural gas. It would enable high process heat industries to continue running on natural gas while generating further deep emission cuts.

Low-carbon gas technologies are at a critical juncture. Both low-carbon hydrogen and CCUS have reached the point where they can be developed commercially where strong carbon pricing incentives exist such as in Europe and California or with the support of policy incentives such as the 45Q tax credit in the US. IHS Markit finds that many applications for these technologies work with carbon price support of $40-60/metric ton, close to levels in some markets today. Early deployment of these technologies will bring costs down as the industry scales up and will start to build up the supply chains required for what are essentially new industries. (See Figure 2)

Infrastructure as the key enabler

While the fuel switching advantages of natural gas are often recognised, some express concern that these investments may embed or lock in future emissions for several decades. But these “lock-in” concerns need not be the case because the infrastructure can be repurposed.
performance standards with limits on the life that the asset can operate before being converted. This is the route both to reap the early benefits of natural gas use and to address the concern of emission lock-in.

The second pillar of decarbonisation

We need to recognise three key take-aways. First, natural gas can make a meaningful impact in the short term; second, low carbon gases will be critical longer term; third, encouraging natural gas in the short-term need not lock-in emissions or jeopardise longer-term targets since natural gas infrastructure can provide the transition from fast to deep decarbonisation. The next step for gas—already under way—is to better our understanding of the technological options and costs throughout the value chain of this transition from unabated natural gas to low carbon gases.

The role of gas as the second pillar of decarbonisation needs to be elevated.

A Sustainable Flame: the role of gas in net zero is a nine-month research programme undertaken by the Climate & Sustainability team within IHS Markit. More than 30 corporations and governments representing all parts of the gas value chain participated in the process. The Summary policy White Paper is available here.
Clean technologies that will make gas and gas use emission-free

Low carbon gas technology costs are coming down, offering an expedient, achievable, and secure route to decarbonisation, but policy support and access to capital are needed to accelerate innovation and scale up deployment sufficiently to meet the Paris Agreement goals.

Low carbon gas technologies – renewable gases (RG), hydrogen and carbon capture and storage (CCS & CCUS) – all deliver major reductions in greenhouse gas (GHG) emissions. They have been featured prominently in nearly all modelled scenarios for achieving the goals of the Paris Agreement on Climate Change.

Moreover, they are all proven and technically viable today and, in some contexts, even cheaper than the electricity-based alternatives. However, further technological innovation and greater scale are required to capture the enormous value of these solutions in a just transition to a sustainable future. That in turn requires government support, addressing gaps where markets fail or haven’t yet developed and introducing market-based mechanisms that facilitate the development, commercialization, and scaled deployment of these clean technologies.

The toolbox of effective policy measures is diverse and well documented, with many successful case studies from around the world. From mandates, like the low carbon fuel standards to production —
promises further efficiencies and cost reductions, if deployed at greater scale. As we show in our 2020 Gas Technology and Innovation Report with BCG, cost projections estimate that scale and learning effects could reduce the capital costs of RG production by 45% to 65% and operational costs by 10% to 20% by 2050.

**Renewable Gas. Its full potential as yet untapped**

Renewable gas, also called biogas, is produced by capturing the methane released from the breakdown of organic material or through thermal gasification processes using solid biomass (i.e. garbage). These technologies show the greatest range of potential net GHG emissions reductions relative to natural gas combustion. When best practices are applied, RG can achieve emissions reductions of 80% and higher. They can even bring a net negative emission balance, as they capture and use the methane that would have otherwise escaped into the atmosphere.

However, the full versatility of RG remains unexploited. Upgrading biogas – the initial product from the decomposition or gasification of organic materials – to biomethane creates a product directly interchangeable with natural gas. As a result, low carbon gas can be fed directly into the existing gas grid, with no additional infrastructure investment nor any changes to end-use appliances.

Six different processes have been developed for biogas to biomethane conversion, all of which promise further efficiencies and cost reductions, if deployed at greater scale. As we show in our 2020 Gas Technology and Innovation Report with BCG, cost projections estimate that scale and learning effects could reduce the capital costs of RG production by 45% to 65% and operational costs by 10% to 20% by 2050.

**CCUS – carbon capture, utilisation & storage**

Renewable Gases’ full emissions abatement potential could be reached through combining with CCUS. This creates two carbon sinks – the use of feedstocks which absorb carbon from the atmosphere, and then long-term sequestration of the carbon released during combustion. Combining bioenergy with CCS is known as BECCs.

Estimates of the potential scale of GHG emissions reductions from CCUS range from 4 to 7 gigatons by 2050, but achieving this will require a step change in investment levels as capacity will need to increase by somewhere between 140 to 216 times.

The CCUS sector is already demonstrating a downward cost trajectory. For solvent-based capture new types of solvents and process designs have improved efficiency by up to 50%. Innovations in carbon capture technology have the potential to reduce the capture costs for more dilute CO₂ streams to less than $50/mt of CO₂ avoided.

In addition, new approaches to oxy-fuel processes – burning natural gas in a high oxygen environment –
Market building policy measures, infrastructure investment and R&D support for core clean hydrogen technologies would stimulate new markets for the fuel, ensuring its viability.

**Cost competitiveness**

Estimates of the costs of low carbon gas technologies vary widely – some forms of low carbon hydrogen and RG are seen to be already competitive with unabated natural gas in particular areas, while others, like CCUS plus natural gas combustion, would require a carbon price of $50/mt or more to be competitive. However, even these higher cost low carbon technologies are more competitive compared with other alternatives of achieving low or near zero emissions.

For example, in high heat applications in industry hydrogen and CCUS have been shown to be the most cost-effective way of reducing GHG intensity. Electrifying high temperature processes in industry is very costly because of the required heat intensity and high energy consumption of industrial applications. All three low carbon gas technologies are suitable outcomes here.

Similarly, in the building sector, low cost sources of RG, produced from waste, are cost competitive with electric heating in cold climates or commercial applications. This is particularly relevant in countries with high power prices and heating requirements and with established gas infrastructure. A lack or underdevelopment of natural gas infrastructure is a barrier to the adoption of low carbon gas technologies.

In transport, RG and hydrogen are already competitive with electrification, particularly in heavy-duty applications, owing to batteries’ ratio of energy output to incremental weight.

**Policy Should Support Gas Clean Tech, Not Undercut It**

Gas technologies are already playing a key role in facilitating a sustainable energy transition – enabling greater shares of renewables, providing the →
“Further technological innovation and greater scale are required to capture the enormous value of these solutions in a just transition to a sustainable future.”

— Tatiana Khanberg, Senior Public Affairs Manager, International Gas Union

necessary flexibility for systems under greater stress from extreme weather events, and dramatically cutting emissions when replacing coal and oil — and further innovation in the sector can significantly enhance benefits for the environment and human development in three ways.

1. Today, switching to natural gas from coal or oil products would immediately reduce emissions, both in the form of GHG emissions and localized air pollutants. At the same time, gas technologies can improve global access to clean, modern energy, including for the world’s poorest.

2. Continuously into the future, gas technologies through continued development and deployment of cost-effective and highly efficient technologies, natural gas can continue to facilitate bigger and faster integration of renewables, while further reducing both the emissions and costs. In areas of the world where energy systems are developing in a decentralized manner, natural and low carbon gas technologies can enable distributed energy systems and increasing efficiency of energy consumption. (think CHP, small scale LNG, micro turbines, etc.)

3. Progressively deeper into decarbonisation, low- and zero-carbon gas technologies— including renewable gas, hydrogen, and carbon capture, utilization, and storage (CCUS) provide an efficient and cost-effective pathway to dramatically reduce GHG emissions. These technologies are particularly relevant for sectors where emissions are difficult or very costly to abate through other means. They can also capitalise on the use of existing gas infrastructure to minimise capital investment.

There are undeniable benefits and a robust case for continued investment in sustainable natural gas development and infrastructure, along with clean gas technologies that provide a solid pillar for the decarbonisation of the energy system – from power to heating/cooling and industry and transport, and cooking.

Last year, together with the BCG, we produced an in-depth analysis of the specific gas technologies, the cost-effective deployment of which to their economic potential would cut energy sector’s emissions by a third by 2040. Much of that analysis remains highly relevant today, and the investment case has only grown stronger in today’s environment of a growing inequity in the world, cost pressures, and the risk of falling back on coal when gas becomes unaffordable from lacking investment, with renewables only able to deploy at a given rate and meet a given portion of demand.
A head of the crucial UN Climate Change Conference (COP26) this November, HE Yury Sentyurin, General Secretary of the Gas Exporting Countries Forum (GECF), discusses with Global Voice of Gas the role that natural gas should play in delivering on the net-zero emissions goal.

What are the GECF’s views on the IEA’s recent net-zero emissions scenario?

It is a fact that worldwide emissions have skyrocketed in recent years. Between 2000 and 2019, greenhouse gas (GHG) emissions have grown by 39%. In 2020, due to the COVID-19 lockdowns, emissions dropped by almost 2.6bn metric tons of CO₂ compared to the 2019 level. In 2021, as we witness success in vaccination programmes around the world and recovery in consumer demand, the expectation is that GHG emissions will rise by 2% compared to last year. It should be noted that 75% of GHG emissions are related to the energy sector, prompting many governments and major energy companies to commit to be carbon-neutral over the next three to four decades.

In this light, there is no arguing that doubling down on efforts to reduce GHG emissions and shifting toward sustainable use of our world’s natural resources are paramount to humanity’s survival and...
This is an issue of a one-size-fits all approach to mitigating climate change.

— Yury Sentyurin
renewables fail to explain how and when the world-at-large can access all this clean and affordable energy.

In addition, the current level of technology is not yet sufficient to achieve the proposed targets by 2050, especially for developing countries, and we do not condone energy policies and directing investment resources towards expensive decarbonisation options and technologies, some of which are yet to be proven. Therefore, it is premature to accept the IEA’s resounding statements as an indisputable plan toward carbon neutrality.

I should add that in our view any successful discussion on promoting decarbonisation initiatives rests in finding a balance between achieving GHG emission reduction targets and energy security and economic growth. We should not write off hydrocarbons due to their availability, affordability and remarkable contribution to improving energy access and economic conditions. Specifically, natural gas is one of the global enablers for reducing emissions uninterruptedly and steadfastly by replacing carbon-intensive fuels and backing up intermittent renewables. At the same time, the emission mitigation potential of natural gas will increase with a larger deployment of decarbonisation options, including carbon capture and sequestration technologies, production of hydrogen and ammonia from natural gas.

This is an issue of a one-size-fits-all approach to mitigating climate change. One size does not fit all. Nations utilise their available resources to meet the energy needs of their populace, ensure energy security, affordability, and an environment that will nourish its communities. Recent short-term events point to the need for integration between energy sources to ensure a stable energy supply. For example, overreliance on wind complicated the energy system in some countries as the backup was not available when the wind stopped. However, reliable integration with natural gas and other sources could have fixed the shortfall. The only way to de-risk the consequences of hurriedly rolled out energy systems is to explore the available energy options, reassess their development, and apply in the right context. This should be followed by discussion with international partners to optimise and learn.

To what extent can gas be viewed as a solution to the climate change problem?

Any fuel or technology has its own positive and negative impact on climate change, but the magnitude of the impacts are different. For example, even renewable energies such as wind and solar that are assumed to have a tremendously positive effect on reducing climate concerns have certain emissions associated with the manufacturing of the materials and instruments to manifest these energies. However, in
such cases that the best example is renewable energy carriers, the advantages outstrip the disadvantages.

Natural gas is the cleanest fossil fuel that offers varied benefits for sustainable future energy systems. Renewable energies, and the electricity produced from them, have not been and will not be adequate to meet the global energy demand. And in varied sectors such as heavy transport and high-grade temperature industries, they cannot meet the convenience and standard of being a proper energy carrier. So molecule energy carrier is an undeniable need of the future energy landscape, and natural gas emerges as a key player. Substitution of coal and oil products for natural gas can bring many advantages and abate a high level of emission as we have witnessed in countries such as China.

Hydrogen too can play a role in providing the molecule energy carrier and reduce emissions. It can be extracted from natural resources as is being done for oil and natural gas. Hydrogen can be produced in different ways, of which two promising pathways are blue and green hydrogen. Blue hydrogen refers to the technology of natural gas reformation with the implementation of CCUS. In other words, the carbon content of the fuel is captured before the combustion. In our opinion, blue hydrogen is a pathway that reduces any perceived disadvantages of natural gas whilst offering other advantages to the world’s energy future.

Is there a risk of under-investment in natural gas supply?

The risk of under-investment in natural gas supply is one of the key topics of current global debate and one of the core concerns of suppliers as well as of consumers of natural gas.

The IEA’s Net Zero by 2050 report argued a very challenging and controversial statement of no new investment in new fossil fuel supply – including oil and gas – after 2021. The IEA assumes to counterbalance such moves with substantial investments in renewables; in clean energy investments from the last five years’ average of $1 trillion up to $5 trillion annually by 2030. The major advanced economies are showing positive results on this trend by aligning the relevant policies and financial institutions’ capabilities. At the same time, for developing Asia and Sub-Saharan Africa this poses a serious challenge. On one side, we see the divestment moves by global oil and gas majors from fossil fuels, and on the other side we are witnessing the reluctance of global financial institutions to invest in renewables in Sub-Saharan Africa and developing Asia.

Combating global energy poverty by 2030, especially on the African continent and elsewhere, will require developing countries to embrace a balanced, inclusive and perhaps differentiated approach to tackling the climate change agenda and to secure natural gas supply investment on a sufficient scale to support the sustainable levels of growth.

Restricting investments into Africa’s natural gas industry will have a limited impact on the global carbon emissions as, for example, Sub-Saharan Africa accounts for the smallest share of global energy-related CO₂ emissions at 3% only. On the contrary, it may adversely impact the continent’s economic prospects and future as natural gas is one of the central energy pillars to eradicate energy poverty within the continent and expand its LNG exporting potential to support the budgets and the economies of the most vulnerable nations.
Let us make an attempt to distinguish two separate phenomena: market seasonality and market fundamentals. The market seasonality and the short-term supply disturbance events were and will drive the market up and down. However, the fundamentals of the gas market are indicating that more consumers are getting into the market and the design of country-specific energy transition is pushing countries to increase their demand for natural gas. For example, the LNG demand in the first half of 2021 is higher than that of 2020 and 2019. These facts compel the need for sustainable natural gas investment to meet the demand growth that is happening and will likely continue in the future. We see natural gas investment is picking up with IOCs entering areas where they did not operate before in Africa and the Asia Pacific while NOCs are showing determination to expand their existing natural gas investment and liquefaction facilities to supply their consumers. Marketing for the idea of under-investing will harm both consumers and producers and could drive energy prices to historical levels.

**What risks do you envision if the IEA’s net-zero roadmap will be followed?**

First of all, there is no practical way to force any country to stop producing or consuming fossil fuels, in particular oil and gas, which are an indivisible part of the world energy mix. However, it might be possible that only the OECD countries – barring, for instance, Turkey, Italy, and Greece – will consider some of the steps mentioned in the IEA’s 2050 roadmap.

It is also true that many energy policymakers and major oil and gas companies are addressing the IEA’s scenarios as part of their future business plan.

At the heart of many fundamental issues that the IEA’s report fails to address is another unanswered dilemma: the source of investments that are needed to achieve the net zero targets. Because on one hand, the report calls for no new investments in oil and gas projects beyond 2021, and on the other hand the industry which generates capital investment is barred from developing.

So if governments follow the approach outlined in the IEA’s net zero scenario and there is no further final investment decisions (FIDs) for new unabated coal plants, this would create a significant shortfall in production levels over the short- to medium-term, causing high volatility in the oil and gas market and damaging the security of demand and supply. We may end up witnessing high oil and gas prices and the world economy may be severely impacted.

The other aspect worth noting from my point of view is the way that the IEA looked at natural gas and clean fuels. It is common knowledge that natural gas is a viable, low-cost abatement option to provide affordable, reliable, and clean energy to all societies. Therefore, an energy transition without natural gas is impossible to happen, in particular in Asia and Africa, which are highly dependent on cheap fuels. Even if countries would like to follow the IEA’s hydrogen milestone, you would need gas for the transition period of producing by-products such as blue hydrogen and ammonia.

It is unlikely that governments will take IEA’s net zero scenario as a prescribed trajectory, and this could instead create some uncertainty in the energy sector. The potential energy security risk is manifold, for both producers and consumers, whilst a shortfall in investments in the gas and oil industry could affect stability in energy markets, possibly leading to economic insecurity and geopolitical tensions.

According to the latest projections in our flagship *GECF Global Gas Outlook 2050*, which in the reference case implies a more pragmatic approach, global primary energy demand will rise, boosted by cumulative economic and population drivers amidst higher living standards, growing prosperity, and better access to energy in some regions. Natural gas and oil will provide more than 50% of global energy demand in 2050. Thus, a multi-dimension approach should be the way forward to deal with the climate challenge in which the oil and gas industries form the bedrock of the solution, contributing to economic growth and social vectors.
Accelerating the energy transition for a better tomorrow

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A number of countries see natural gas and hydrogen as key components of their decarbonisation strategies, at least in the shorter and medium term, as they pursue net zero.

ANNA KACHKOVA
A growing number of countries are adopting long-term targets for net zero greenhouse gas (GHG) emissions as the pressure to accelerate the energy transition grows. The details of how these countries plan to reach their goals are often just beginning to emerge, and a debate is ongoing about the role of gas in the energy transition. It is already clear, though, that some countries see gas – both methane and hydrogen – as key parts of the puzzle, at least in the short and medium term.

Net zero
Net zero emissions goals are being adopted across countries and major regional players, such as the EU. Within the EU, some countries are aiming to reach net zero faster than others, while all being expected to contribute to the common goal of net zero emissions by 2050. Finland leads the way, with a target of net zero emissions by 2035, followed by Austria and Iceland – 2040 and Sweden and Germany – 2045. Most, though, have opted to keep 2050 as the net zero target year on a national basis, in line with the EU goal.

Many non-EU countries are also targeting net zero emissions by 2050, including the UK, Canada and, unofficially, the US. This year, US President Joe Biden announced that his country would adopt a goal of net zero emissions by 2035, followed by Austria and Iceland – 2040 and Sweden and Germany – 2045. Most, though, have opted to keep 2050 as the net zero target year on a national basis, in line with the EU goal.

Many non-EU countries are also targeting net zero emissions by 2050, including the UK, Canada and, unofficially, the US. This year, US President Joe Biden announced that his country would adopt a goal of net zero by 2050, emphasizing the need to shift from coal to gas. This is particularly apparent in Asia, where demand for LNG is forecast to continue to grow thanks to China – the world’s largest GHG emitter – targeting 2060 for reaching net zero. If the country meets this goal, the impact would be significant, given that China is estimated to account for over 25% of global GHG emissions.

Gas solution
Many of the countries that set net zero targets still need to provide details on how this will be achieved. For several, though, it is already clear that natural gas and hydrogen will play a significant role in their decarbonisation strategies.

This is reflected in broader global trends, which show how gas demand has grown, global pandemic caused disruptions seen in 2020 notwithstanding. Global natural gas consumption fell by 2.3% year on year in 2020 owing to the impact of the COVID-19 pandemic, according to BP’s Statistical Review of World Energy. However, the drop came after consumption had risen by an average of 2.9% per year over the prior decade.

Looking ahead, consumption growth is expected to resume. Management consulting firm McKinsey & Co. said earlier this year that natural gas would be the only fossil fuel whose consumption would grow beyond 2030, peaking in 2037. Beyond that, McKinsey anticipates that hard-to-replace gas use in the chemical and industrial sectors will limit the impact of an accelerating decline in gas used for power generation. It forecast that this would translate into a gas consumption drop of only 0.4% between 2035 and 2050.

While some continue to dispute the role of gas in the energy transition, saying it should not even be a transition fuel, let alone a destination fuel, for others it is an obvious stepping stone to decarbonisation and curbing air pollution, as power generation shifts from coal to gas. This is particularly apparent in Asia, where demand for LNG is forecast to continue to grow thanks to...
Gas will play a significant role in China, which is on course to become the world’s largest importer of LNG, overtaking Japan in large part to coal-to-gas switching in power generation.

China is one of the first among the countries where gas will play a significant role, on course to become the world’s largest importer of LNG. Coal, which still accounted for 58% of China’s total primary energy consumption in 2019, is set to take the largest hit as the country decarbonises, opening up further opportunities for gas. Additionally, China’s overall energy demand is going to keep growing as the country’s economy continues to grow at a high pace, making a rapid replacement of fossil fuels, that currently play a dominant part in the economy, all the more challenging and unlikely.

In other countries, natural gas is expected to work in tandem with hydrogen as governments target a variety of technologies to deliver on the goals of energy transition and Paris. Many examples can already be seen of hydrogen blending with natural gas in countries with existing gas pipeline networks, such as Italy and the UK.

Additionally, blue hydrogen – produced from natural gas, with carbon capture and storage (CCS) – will play a key part in some countries’ decarbonisation strategies. For example, the UK recently unveiled its hydrogen strategy, which involves a twin-track approach supporting both blue and green hydrogen – with the latter produced in an electrolyser using renewable energy. Norway is also thought to have considerable blue hydrogen potential, and Equinor has said blue hydrogen production could help keep Norwegian gas valuable in a low-carbon future.

Another country embracing blue hydrogen is Canada, which is grappling with the question of how it can sustain its oil and gas industry while pursuing net zero. Leading producers and other players in Canada’s oil sands have begun pursuing initiatives, both jointly and separately, to develop blue hydrogen hubs in Alberta, and have called for federal government support for these plans.

Balancing act
Much could change between now and 2050, but for most countries, net zero remains distant. However, there are intermediate decarbonisation goals to pursue, and the pressure to tackle climate change is ramping up rapidly. The challenge will be to balance goals for shifting to renewables and decarbonising with meeting gas demand, which is set to keep growing, at least in the near and medium term.

For those countries that have yet to move away from widespread coal usage, gas is certain to be necessary over at least the coming decade – it is a quick and cost-effective substitute, as gas plants are overall less capital intensive and faster to build, than coal. And for those that are incorporating blue hydrogen into their plans, natural gas supply has even longer-term potential to keep playing a significant role.
Green energy constantly replenishes itself.

As is the nature of green energy, our commitment to serve is unfailing. It extends into a future where we evolve beyond our gas business to deliver renewable energy to enrich our lives and generations to come.
The US Gulf Coast could establish global leadership in the low-carbon energy transition, given its vast energy infrastructure, concentrated emissions hubs and offshore CO₂ storage potential

It seems that every week there are more announcements of corporate pledges to achieve low carbon goals by some future date (say 2030). These kinds of announcements have extended beyond the typical oil and gas and petrochemical sectors and now include just about every major business and industry sector in the global economy (now upwards of 20% of the largest global companies), including shipping, aviation, IT (think low-carbon cloud storage), LNG, steel, cement, apparel, agriculture, and many others.

DR. TIP MECKEL  DR. ALEX BUMP  DR. SUSAN HOVORKA
Gulf Coast Carbon Center, Bureau of Economic Geology, University of Texas at Austin
Regardless of how rapidly reliance on fossil fuels may be reduced globally, tools for reducing ongoing emissions are needed, including possibly even direct removal from the atmosphere (DAC). In the US, the shale gas revolution has created new export opportunities for LNG, when a decade ago those facilities were designed for import. So, if there is a defined need to reduce emissions from these existing and future sources, the question then becomes: how?

It is generally agreed by those who think deeply about the topic that few of the low-carbon goals can be met efficiently and, more importantly, cost effectively, without carbon capture and storage (CCS). While there are indeed many ways to make gains in emissions reductions (efficiency, renewables, nature-based solutions, reuse, etc.) there is arguably no single more effective hammer in the emissions reduction toolbox than CCS, and one that is able to address hard-to-otherwise-abate sectors. Furthermore, it seems there may be no more concrete way to defend ESG or corporate low-carbon statements than by permanently storing CO₂ emissions underground that would otherwise have gone into the atmosphere. Stored CO₂ can be credibly documented through wellhead metering and effective monitoring and regulatory compliance.

The rapid development of offshore CCS projects around the North Sea (Northern Lights in Norway, Porthos and Athos projects in Rotterdam, Teesside-Humber and Acorn in the UK) seems to provide some insight into the growing realisation that offshore CCS can provide for, and indeed is likely to outperform, our collective goals for reducing emissions using the technology.

Recent announcements of offshore acreage leases for CCS in Texas and the MoU between the Port of Corpus Christi and the Texas General Land Office reinforces this trend. China has now announced a first offshore CCS project, as has Indonesia, and Brazil (Lula) and Australia (Gorgon) have been active in offshore CCS for years. It is generally apparent now that the offshore basins that were the primary sources of hydrocarbon production will become the workhorses of the nascent CCS industry as well, leading to untold opportunities to re-commission infrastructure and create additional value.

My co-authors and I at the Gulf Coast Carbon Center recently outlined the roadmap for the concept of regional CCS hub development for the Gulf Coast of the US in an open-access article in the journal of Greenhouse Gases Science and Technology, entitled Carbon capture, utilisation, and storage.
The development of CCS will not only facilitate decarbonisation of key energy chains, but can also provide job retention and growth, and increase competitiveness in the rapid ‘greening’ of global energy economy. And blue hydrogen seems to be having its moment in the headlines as well (recall CH₄ → H₂ + CO₂). The consulting firm McKinsey estimates that the market for carbon credits could be worth upward of $50bn in 2030. It is hard to identify other energy markets that could rival the growth that is expected in low carbon solutions including CCS in the next ten years.

Globally, CO₂ is likely to move to the areas where it is most cost effective to conduct giga-ton scale storage where economies of scale can be realized – the basins adjacent to industrial ports on continental margins. This point is elaborated on in another 2019 open-access journal article in *Nature Scientific Reports* by myself and Dr. Phil Ringrose of Equinor. In that paper it is estimated that to achieve global emissions reduction goals by 2050, essentially four to five marine basins globally need to deploy CCS through offshore injection at rates of development consistent with the number of wells.

**hub development on the Gulf Coast.** That article highlights the existing vast energy infrastructure, concentrated emissions hubs, and tremendous offshore deep subsurface geologic storage potential in the Gulf of Mexico (see Figure 1). In short, the Gulf of Mexico can be the end game for abatement of CO₂ emissions from a host of crucial energy chains in the US. Infrastructure includes existing CO₂ and hydrogen pipelines, petrochemical handling facilities, available depleted oilfields for CO₂ enhanced oil recovery, and vigorous development of LNG exports.

There are now multiple examples of successful integrated CO₂ capture, transport, and subsurface injection in the Gulf Coast, such that CCS is quickly moving from demonstration to full commerciality. CCS has been under development for more than 20 years, which is a typical evolutionary path for new technology to reach widespread commerciality. It is demonstrably proven safe and reliable as currently deployed. Handling of CO₂ (transport) is already routine in many industrialised areas. Subsurface geological storage is undertaken in subsurface geology using the same principles, engineering, and fluid physics as those settings that have retained hydrocarbons for millions of years. Thus, the primary barriers are not technical but rather related to policy and economics.

The development of CCS will not only facilitate decarbonisation of key energy chains, but can also provide job retention and growth, and increase competitiveness in the rapid ‘greening’ of global energy economy. And blue hydrogen seems to be having its moment in the headlines as well (recall CH₄ → H₂ + CO₂). The consulting firm McKinsey estimates that the market for carbon credits could be worth upward of $50bn in 2030. It is hard to identify other energy markets that could rival the growth that is expected in low carbon solutions including CCS in the next ten years.

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drilled for hydrocarbon extraction in the Norwegian North Sea since exploration began. Suffice it to say that CCS is likely to be a regional growth industry that rivals the scale of historic hydrocarbon extraction, which makes sense since we are essentially reintroducing the unwanted parts of hydrocarbons (CO₂) back into the same regions they were extracted from. Many see an element of poetry to that.

Most are unaware of the sleeping giant in the global low-carbon energy transition: shipping. Multiple companies in several countries are actively developing low carbon solutions for shipping. It will soon be possible to transport low-carbon fuels (possibly earning a price premium) and energy (LPG, LNG) and energy carriers (ammonia and hydrogen) by ship, power those ships with low-carbon fuels or otherwise capture the emissions from vessel power, and also transport liquefied CO₂ (LCO₂) such that vessel deadheading will be eliminated. The Norwegian Northern Lights project intends to use vessels to transport CO₂ from emitters to offshore storage. Other marine

patents related to CO₂ are in development by multiple entities.

To summarise: CCS is more mature than many realise – all the component technologies are currently available (and many are in development), it is demonstrably safe and effective (as demonstrated through extensive regulatory monitoring) and the financial feasibility is attractive, especially in the US where Section 45Q tax credits lead to baseline $500mn project tax credit value for a 1 mm metric tonne/year injection for 12 years (notwithstanding the potential near-term enhancements currently under consideration). If a company’s business thesis is that the global demand for methane and (blue) hydrogen is likely to grow in coming decades to address various low-carbon energy needs, then CCS is an imperative. The good news is that it can be profitable in the right place (favourable geology adjacent to concentrated emissions hubs, as in the Gulf Coast, etc.). Implementing CCS will drive growth and increase competitiveness in a global market increasingly demanding low carbon energy, especially related to methane development.

### A $100bn Gulf CCS hub

US major ExxonMobil floated the idea in April of a $100bn project that could eventually capture up to 100mn metric tons/year of CO₂ from industry in the Houston area and sequester it beneath the Gulf of Mexico. The US Department of Energy estimates that geological formations along the Gulf coast could sequester as much as 500bn mt of CO₂ – equivalent to more than 130 years of total US industrial and power generation emissions based on the level in 2018.

“Houston has two features that make it an ideal site for CCS: it has many large industrial emission sources, and it’s located near geologic formations in the Gulf of Mexico that could store large amounts of CO₂ safely, securely and permanently,” Joe Blommaert, president of ExxonMobil Low Carbon Solutions, wrote on April 19 in a blog post.

According to Blommaert, the US could establish a “CCS Innovation Zone” along the Houston Ship Channel and the surrounding area, potentially capturing all CO₂ emissions from the petrochemical, manufacturing and power generation facilities there. The CO₂ would then be transported offshore via pipeline for storage.

“It would be a huge project, requiring the collective support of industry and government, with a combined estimated investment of $100bn or more,” Blommaert explained. “But the benefits could be equally big: early projections indicate that if the appropriate policies were in place, infrastructure could be built in Houston to safely capture and permanently store about 50mn mt of CO₂ annually by 2030. By 2040, it could be 100mn mt.”

Lessons learned from the project could eventually be applied to other areas of the US where industrial activity is similarly concentrated near to potential sequestration sites, he said, such as in the Midwest or at other locations along the Gulf Coast.
Making CCUS pay: The US perspective
“What remains is primarily a policy challenge rather than a technical one,” Jessie Stolark, public policy and member relations manager at the Carbon Capture Coalition (CCC), tells Global Voice of Gas (GVG). “Carbon capture requires the same level of federal and state policy support currently enjoyed by other low and zero-carbon technologies such as wind and solar, if we are to scale up deployment, which will in turn spur innovation and bring down costs.”

This positive cycle of private investment in deployment, leading to innovation and cost reductions, followed by greater investment and deployment, has already played out in recent years with wind and solar energy, she says.

“We now need the same level of policy support for carbon management to flourish.”

In the US, the primary mechanism for spurring the development of the carbon management sector has been the incentive-based 45Q tax credit. This tax credit is provided to carbon capture, direct air capture, and carbon utilisation projects that demonstrate either secure geological storage or beneficial use of the captured CO₂ or its precursor carbon monoxide (CO) as a feedstock to produce fuels, chemicals, and products that result in a net reduction in emissions.

The US landscape
The US has more than half a century of experience capturing and storing commercial volumes of CO₂, with 12 sites in operation across the country with a combined capacity of 25mn metric tons/year. These sites are serviced by more than 8,000 km of CO₂ pipelines.

Reaching net-zero emissions by 2050 simply cannot be achieved with significant advances in carbon capture utilisation and storage (CCUS) deployment, as the International Energy Agency and many other respected energy and climate forecasters have concluded.

The scale of this task is daunting, however. What will need to emerge is an industry worth many trillions of dollars, similar in value to the oil and gas industry today, in order for climate targets to be reached. There is an urgent need for largescale investment to flow into this industry, which though widely considered technologically ready for the challenge, is still only at a nascent stage of development. Governments are debating ways of stimulating this development, and it is worth looking at what incentives they could provide to achieve this end.
"What remains is primarily a policy challenge rather than a technical one"

— Jessie Stolark, Public policy and member relations manager, Carbon Capture Coalition

The US expanded and reformed the 45Q credit through the bipartisan FUTURE Act in 2018, and additional bipartisan legislation was passed last December to provide significant federal funding for early commercial demonstration of key carbon management technologies. These changes “provide the foundation for commercial-scale deployment of carbon capture, removal, transport, utilisation, and storage technologies in the US,” Stolark says. “These legislative accomplishments have the potential to position the US with the most significant financing structure in the world for commercial deployment of carbon management.”

The work ahead

However, more legislative improvements are needed. “Enabling truly economywide commercialisation of CCUS technologies and the development and buildout of associated CO₂ transport and storage infrastructure requires further improvements to 45Q and a complementary portfolio of additional federal state policies,” Stolark continues. “If enacted, key provisions in several bipartisan bills before the 117th Congress, and largely mirrored in the Biden administration’s American Jobs Plan, could deliver an estimated 13-fold scale-up of carbon management capacity and 210-250mn metric tons in annual emissions reductions by 2035.”

Adopting a full suite of supportive policies would bring down project costs and give investors the needed certainty and business model flexibility, the CCC believes. “Needed policies include both supply and demand-side policies to drive private investment in commercial technology development,” Stolark says. “On the supply side, this includes enhancements to the 45Q tax credit and complementary measures to ensure adequate CO₂ transport and storage infrastructure. Realising the full market potential for CCUS requires a range of market development measures, including procurement standards and policies as well as additional breakthroughs in carbon utilisation technologies and processes enabled by federal R&D.”

The US needs to close the gap between the current value of the 45Q tax credit and the cost of project development, the CCC argues. “The most important next step is providing a direct pay option for the federal Section 45Q tax credit,” Stolark says. “Direct pay would address the current significant loss of tax credit value to burdensome, costly and inefficient tax equity transactions, creating an urgently needed alternative for most project developers, who otherwise lack sufficient taxable income to fully utilise the credits, or who are exempt from federal tax liability altogether.”

The construction window for the 45Q credit should also be extended by ten years until the end of 2035, according to the coalition, establishing “a critically needed investment horizon to give carbon management projects the time required to scale.”
Another hotspot for CCUS is the North Sea, with Denmark, the Netherlands, Norway and the UK all placing the technology at the heart of their decarbonisation plans. One such project is Northern Lights, led by Norwegian state company Equinor, which aims to store 5mn metric tons/year or more of CO₂ from industries in Norway and elsewhere in Europe under the North Sea bed (see “Europe makes strides in CCS” in Global Voice of Gas Issue 2 for more details).

Norway is also the location of the largest existing CCS facilities in Europe, at the Sleipner and Snohvit fields.

There have been a flurry of CCUS developments recently elsewhere in the world. In July, for example, China’s Sinopec started work on what will be the country’s first large-scale CCUS project. It will capture CO₂ emissions that result from hydrogen production at Sinopec’s Qilu refinery in the east Shandong province. The CO₂ will then be injected into wells at the Shengli oilfield, in order to boost recovery.

In August, Indonesia’s upstream regulator SKKMigas approved a plan to store up to 25mn mt of CO₂ at the offshore Vorwata field, while Australian energy consultancy Codus won a contract to design a CCS project in Malaysia. In South Africa that same month, authorities invited quotes for geological surveys for that country’s first CCUS initiative.

And these are only some of the examples.

**CCUS Goes Global**

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Hydrogen is increasingly at the forefront of the debate on how countries and industries can decarbonise and hit long-term targets of net zero greenhouse gas (GHG) emissions. And indeed, the number of early-stage projects being unveiled is rising rapidly as various players try to put ideas about using hydrogen into practice.

Different types of hydrogen have different target users, but blue hydrogen has the potential to ease the way for green hydrogen.

ANNA KACHKOVA
There are various obstacles to navigate if a global hydrogen economy is to be developed, however. These include the costs involved in both production of the cleanest – and generally most expensive – forms of hydrogen and the infrastructure required to trade it internationally.

Additionally, countries will have to address questions over which form of hydrogen to target, either as an exporter or an importer. Some are well-placed to enter the nascent market for green hydrogen, which is produced via electrolysis, using renewable energy. Others, meanwhile, are better positioned to embrace blue hydrogen, which is produced from natural gas, with carbon capture and storage (CCS) used to address the emissions arising from the process.

Those advocating for a more rapid energy transition and a full exit from fossil fuels believe that blue hydrogen should be bypassed in the pursuit of green hydrogen. However, given the current costs of green hydrogen from many sources, this is not economically feasible. And indeed, there is potential for the more widespread adoption of blue hydrogen to boost overall demand, ultimately encouraging the growth of green hydrogen as more players look at different options for participating in a growing market.

**Finding a fit**

Blue and green hydrogen have different target users and benefits, notes Anise Ganbold, global energy markets lead at analytics firm Aurora Energy Research. The question of how blue and green hydrogen can best complement each other is therefore dependent on country-specific circumstances.

“Blue is advantageous for a country with a large domestic source of natural gas and easy access to CCS sites such as Britain and Norway,” Ganbold tells Global Voice of Gas (GVG). “In contrast, green is excellent for a country with strong renewable generation potential such as Spain, and a country that is large with isolated communities that could decarbonise with electrolyzers, such as Australia.”

However, scale is necessary in blue hydrogen development to make investing in both steam reformers and CCS technology cost-effective, whereas a green hydrogen project can start small with a single electrolyser and build up from there.

This is one of the major challenges relating to blue hydrogen, according to Ganbold, and one that has also been flagged up by others. David Maunder and Zeynep Kurban at professional services firm GHD also identify economics and scale as being two key elements in the discussion over blue versus green hydrogen.

Another challenge is the fact that the combination of CCS with steam reformation is still in its early days, resulting in many uncertainties relating to feasibility and cost.

“The efficacy of the blue hydrogen ‘system’ depends fundamentally on the development and delivery of CCS infrastructure,” Maunder and Kurban tell GVG.

A third challenge for Ganbold is the location and purity requirements of end-users.

“If you are producing blue hydrogen at scale, you are not necessarily close to your offtakers, which means you have to factor in the costs of conversion and transport,” Ganbold says. “Steam reformation also results in a less-pure form of hydrogen compared to electrolyzers. For this to be used in fuel cells, it will need a further purification step, which also adds to costs.”

Nonetheless, she believes that blue hydrogen has many advantages, including lower overall costs versus the green variety, as well as the fact that it provides a market for natural gas.

Maunder and Kurban, meanwhile, note the challenges involved in reducing the overall GHG emissions that come from the production of blue hydrogen, particularly with regard to fugitive methane emissions associated with the natural gas used as feedstock for the process.

“For blue hydrogen to be considered part of an effective transition to net zero, this issue needs to be more rapidly addressed with industry acting faster on implementing abatement options, coupled with strengthening policy and regulatory frameworks,” they say. →
There is potential for the more widespread adoption of blue hydrogen to boost overall demand, ultimately encouraging the growth of green hydrogen as more players look at different options for participating in a growing market.

**Logistics**

As hydrogen developers move forward with their plans, in addition to considering how to produce cleaner hydrogen in an economic manner, they will have to address questions of logistics and infrastructure. Currently, various companies are experimenting with the introduction of hydrogen blends into existing gas pipeline networks, though GHD notes that this comes with its own challenges.

“There are limits to the level of hydrogen that can be accepted into most existing natural gas systems, both due to the suitability of the existing infrastructure for safe transmission of hydrogen and due to the design and operation of end-use appliances and technologies,” say Maunder and Kurban. In addition, the overall GHG benefit of blends is relatively small, they say.

“However, the main benefit of using hydrogen as a blend in existing natural gas systems is that it could enable the potentially rapid emergence of a hydrogen market, with substantial demand that could significantly drive down the cost of green hydrogen production through electrolyser technology improvement and high-volume manufacture,” Maunder and Kurban add.

Indeed, if the other challenges relating to blue hydrogen can be overcome, its potential to spur the broader development of a hydrogen economy has positive implications for green hydrogen too. Growing supply is anticipated to stimulate demand, which in turn will encourage more producers to look at the different ways of developing hydrogen. The more players are involved in testing hydrogen technologies and developing scale, the more costs will go down.

“In some parts of the world, particularly in places where the cost of blue hydrogen is currently significantly lower than that of green hydrogen, large-scale blue hydrogen production is seen by many as being an important element in the stimulation of demand at scale, so creating the ‘pull-through’ for green hydrogen production,” say Maunder and Kurban.

**Forging ahead**

Various countries are now emerging as future buyers and sellers of both blue and green hydrogen.

“At Aurora we’ve tracked multiple potential exporters, but the first movers are looking to be the UAE and Australia shipping clean ammonia to Japan,” says Ganbold, adding that Russia is also targeting hydrogen exports to Europe and Asia.

GHD also sees Australia as having the potential to be a leading exporter of hydrogen. Maunder and Kurban also cite “great potential” for export-led opportunities in the Middle East and North Africa, as well as mentioning Chile and its green hydrogen export ambitions.

“Importers could be anywhere in the world in which the demand-side of the trade picture has emerged and is moving to maturity,” they add. “This includes countries such as Japan and a number of countries in Europe.”

Maunder and Kurban anticipate that the development of the hydrogen economy will initially be driven by regional markets, but that once demand has emerged and has begun to mature, global trade could pick up relatively fast. This is because of the emergence of countries with the potential for low-cost hydrogen production at scale.

In Ganbold’s view, domestic and international markets have the potential to grow at the same time.

“If a country abroad can produce clean hydrogen cheaply, having a low-cost source will encourage hydrogen demand growth domestically,” she says. “Demand for clean hydrogen will be essential to grow a hydrogen economy, and getting the cost of supply down is key for that.”
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Methane pyrolysis: a potential gamechanger?

Many countries have turned to hydrogen as a means of decarbonising areas of their economy that would be difficult to abate otherwise. But while there are several low-carbon ways of producing the fuel, two methods have commanded most of the attention. The first is to use electrolyser, powered with renewable energy, to separate water into so-called green hydrogen and oxygen. The second, currently a significantly cheaper option, is to use steam methane reforming (SMR) and carbon capture to produce blue hydrogen from natural gas, capturing and safely storing the resulting emissions.

JOSEPH MURPHY
However, there are those that advocate for a third option, known as methane pyrolysis. This new process involves splitting natural gas through thermal decomposition in the absence of oxygen, into what is known as turquoise hydrogen and solid carbon. Pyrolysis technologies have been around since the 1950s, although proponents view it as a potential gamechanger.

According to Switzerland-based EH Group Engineering, which is developing a process of microwave pyrolysis based on research at the University of Oxford, a key advantage of pyrolysis is that it can be highly energy efficient. It uses only 10-20% of the energy required for electrolysis and less than a half required for SMR, the company estimates.

Another advantage is that it can leverage existing gas infrastructure already in place, like SMR, but without requiring additional infrastructure for carbon capture utilisation and storage (CCUS). And while both SMR and electrolysis require significant quantities of water, pyrolysis does not involve any water use at all.

“It can also be developed at much smaller scales than blue hydrogen,” Christopher Brandon, co-founder and director at EH, tells Global Voice of Gas (GVG). “Blue hydrogen is inherently for large scale applications only.”

Stefan Petters, the founder of a non-profit organisation from Austria called Carbotopia, notes that turquoise hydrogen can be undertaken at the point of energy use, rather than at larger, central hub, as is the case with blue hydrogen. Carbotopia has developed a thermocatalytic methane dissociation technology to derive hydrogen and solid carbon from natural gas.

Brandon also points to some technical complexities of capture and storage for CO₂ emissions from blue hydrogen production. He notes that pyrolysis can have a zero carbon intensity, provided that it is powered using renewable energy.
whereas SMR still emits some CO₂ due to limits to how much can be captured.

“At the moment it’s just not technologically possible to capture all the CO₂,” he says.

And whereas CO₂ in most cases will have to be stored, pyrolysis results in carbon products that are valuable in industry, such as carbon black, needle coke, graphite and carbon nanotubes. Were pyrolysis to be developed at scale, the output of carbon products would dwarf the market for them, and so the majority would still have to be sequestered, Brandon says, although this would be a more manageable task than dealing with carbon emissions. Solid carbon is easier both to transport and to store.

Meanwhile green hydrogen can only be produced where there is an abundance of cheap renewable electricity.

“Obviously there’s a massive push towards green hydrogen, but there’s some areas of the world, such as Russia, where pyrolysis likely makes more sense,” Brandon says. “You don’t have the really cheap renewables there, so producing green hydrogen would be very expensive. But there is an abundance of natural gas.”

Brandon and other advocates believe that with development over time, pyrolysis can produce cheaper hydrogen than either SMR or electrolysis (see Figure 1). Exactly how cheap depends on the price of natural gas, as well as how valuable the solid carbon by-products are.

The hurdles

So why has turquoise hydrogen not taken off?

“There are still big technological hurdles with all the approaches of pyrolysis,” Brandon says. “None of the methods have been able to generate enough pure hydrogen and effectively separate the solid carbon.”

In contrast, SMR is already well established in the oil and gas industry, he says, as is the CO₂ injection and storage underground, as producers do this to boost oil recovery at their fields. Operators would rather stick with what they do already, in this case SMR, and add CCS to make the process cleaner, rather than invest in new assets to undertake pyrolysis, Petters adds.

Brandon also concedes that it will be tough to convince some of the climate benefits of turquoise hydrogen, as there is resistance in some quarters of society to deriving any clean fuel from hydrocarbons. There has also been pushback against blue hydrogen for this reason.

“We think that pyrolysis will get tarnished with the same brush,” Brandon says, noting that gas producers should focus on eliminating their methane emissions to strengthen the case for gas-derived hydrogen.

“Scalability is extremely high,” Brandon says. “But it just needs to overcome the technical challenges first. We’re still at too low a technology readiness level on these approaches, and I don’t see that changing for the next couple of years.”

Brandon calls for increased government support for pyrolysis to get past these technological hurdles. There are only around a dozen groups working on pyrolysis methods right now, he says. Besides EH, include Hazer Group in Australia, Gazprom in Russia, BASF and the Karlsruhe Institute of Technology, and Monolith and C-Zero in the US.

“This seems a very small number to be working on a technology that could be a really useful bridge between what is happening now and where we need to get to in terms of emissions,” Brandon says. “Some R&D support would be welcome.”

Still, Brandon is confident of pyrolysis’ scalability, and its important as a potential means of reducing emissions. Meanwhile Petters is bullish on the long-term outlook for turquoise hydrogen, believing it will become the “global standard” for hydrogen and will be produced in greater quantities than blue hydrogen within ten years.
To initiate the process of scaling up renewable gas production and consumption, policy will play a critical role.
We are standing at the threshold of a major global climate milestone set to take place in Glasgow next month, where the 137 countries that signed the Paris Agreement six years ago, will attempt to negotiate a way forward to reaching its goals at COP26.

Taking national commitments under the COP process from pledge to reality will require both exceptionally rapid and massive structural change in the entire global energy system, including the gas industry. Natural gas supply would also need to find ways to progressively decarbonise. This would be achieved by applying low, zero, and negative carbon technologies – such as carbon capture, hydrogen, and biogas/biomethane.

The interest in renewable gas and hydrogen has been growing, and it has increasingly been making entry into a plethora of energy transition strategies. However, to turn this interest into action, concrete measures will be required from the industry, governments, and financial and civil society actors alike. Many articles focus on hydrogen, but we think it important that biogas and biomethane also receive sufficient attention.

Let’s consider the numbers.

Natural gas provided around 25% of total global primary energy in 2020, according to the BP Statistical Review1. That represented total global gas demand of 3.850 trillion m³, equivalent to around 40,000 TWh (in 2020), while the total global production of biogas and biomethane (in 2018) was estimated around 400 TWh (35 Mtoe)2, or just 1% of the size of total natural gas production. A little over half of that production is concentrated in a few countries in Europe, with a further 25% in China. An even smaller portion of this volume is upgraded to biomethane – the process that purifies biogas to make it fully interchangeable with fossil-sourced gas and to use existing infrastructure and equipment to transport and use it. For example, in Europe only around 10% of biogas is upgraded to biomethane, and the rest is consumed in small volumes on site; and outside of Europe, the upgrading capacity is quite small3.

At the same time, the total sustainable biogas production potential is estimated by the IEA to be over 20 times the current level4. If this potential level were to be reached for grid quality biomethane – it could offset around 20% of today’s natural gas demand – and have an enormous decarbonisation benefit. However, that also requires a very rapid build-up of biomethane production capacity. It is important to stress that this production level is considered sustainable, largely from waste streams, including forest residues used for gasification. This level of production would not compete with food for agricultural land.

It may also be helpful to de-mystify the process behind biomethane technology. It generally begins with making biogas through anaerobic digestion of waste using enzymes to convert a wide range of organic material. The output is a combination of methane and CO₂, ranging from 40% to 60% methane content depending on the feedstock and process. The resulting biogas can be used to produce heat and electricity.

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4 IEA Outlook for biogas and biomethane (2020)
To initiate the process of scaling up renewable gas production and consumption, policy will play a critical role. Similar policy measures to those for renewable power have been proposed to drive adoption, including low-carbon fuel standards, renewable portfolio standards, and production incentives. So far, such policies have been most widespread and effective in scaling up markets within Europe. In Denmark for example, the use of feed-in-tariffs has enabled renewable gas production to scale up to 10% of the national gas supply, a share that is projected to grow to 30% by 2030, with a target for the gas grid to be 100% biomethane by 2040. Meanwhile, France recently launched a comprehensive programme to provide purchase price stability for the next decade, thereby incentivising capital investment in renewable gas production. These are just a few examples of supportive policy measures that could unlock major decarbonisation opportunities.

Industry too must do its share and continue to push the envelope on technology innovation and deployment opportunities.

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Industry too must do its share and continue to push the envelope on technology innovation and deployment opportunities.

The scale of the global energy transition challenge is simply too large for any one lever to solve it. This is a multifaceted communal task, requiring collaborative solutions from the industry, governments, the financial community, and civil society.

As a quarter of the world’s energy demand is today met by gaseous fuels, at present predominantly natural gas, it is clear that the gaseous component of the world’s energy system is foundational, and for any realistic rapid energy transition to occur, the gas network will continue to play a critical role. It is also clear that current production of renewable gases (biogas, biomethane and low-carbon hydrogen) is very small in that context. This underlines the scale of the challenge in ramping up production significantly in the coming years. It is also noteworthy that total renewables contribution to primary energy currently is only 6%, so the scale up challenge applies to all forms of renewable energy and not just renewable gases.
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Should we leave for tomorrow what we can do today?

If we look at the available resources, biomethane is today the only renewable gas available at commercial scale and the most cost-effective.

ANGELA SAINZ ARNAU
Communications manager, the European Biogas Association
The European Commission released this summer the long-awaited ‘Fit for 55’ package under the European Green Deal. The package is aimed at putting the EU on track for a 55% reduction in carbon emissions by 2030, and net-zero emissions by 2050. To make Europe the world’s first climate neutral continent, renewable power and gas must become the main sources of energy for the entire economy. Electricity, which is now mostly produced from fossil fuels, will need to decarbonise, and so will our gas grids.

Biomethane is Fit for 55
If we look at the available resources, biomethane is today the only renewable gas available at commercial scale and the most cost-effective. On top of that it can achieve even negative carbon emissions which is unique. On the green hydrogen side there are multiple ongoing projects and this renewable alternative will play an important role in the future energy mix. However, these technologies are not yet fully commercial today for large-scale production.

Existing gas infrastructure needs to be adapted and further developed for the transmission and distribution of hydrogen. This will mean additional investments on the current gas grid during the coming years. Biomethane conversely is indistinguishable from natural gas, but it is derived from biological materials rather than from fossil fuel deposits. This means that it can be used without the need for any changes in transmission and distribution infrastructure or end-user equipment, and is fully compatible for use in natural gas vehicles. Biomethane can deliver the energy system benefits of natural gas while being carbon-neutral or even carbon negative.

The decarbonisation of the gas grid is urgent and we should not wait for the maturity of new technologies or the adaptation of the infrastructure when we already have solutions at hand. 2020 will be the year with the largest amount of new biomethane plants in Europe to date, according to the data collected for the upcoming Statistical Report of the EBA, which will
be released next November. The industry is now producing the energy equivalent larger than the total consumption of Belgium, according to various studies, and in 2050 this may represent up to 30-40% of total gas consumption in Europe.

**Biomethane is already contributing to abate both carbon and methane emissions.** Its production prevents emissions across the whole value chain, with a three-fold emissions mitigation effect. Firstly, avoiding emissions that would otherwise occur naturally: organic residues are taken to the controlled environment of biogas plants, preventing the emissions produced by the decomposition of the organic matter from being released into the atmosphere. Secondly, the biomethane produced displaces fossil fuels as energy source. Thirdly, the use of the digestate obtained in the production process as biofertiliser helps return organic carbon back into the soil and reduces demand for the carbon-intensive production of mineral fertilisers whilst improving the soil.

**Heavy-duty vehicles are going green**

The deployment of renewable gases is essential to accelerate the reduction of GHG emissions in multiple sectors, including buildings, heat-intensive industries and transport. If we look at the transport sector, **biomethane in its liquefied form (bio-LNG) is very well suited to cover demand for heavy-duty and maritime transport.** CNG and LNG vehicles, such as ships or trucks, are more efficient in terms of GHG emissions savings than those fuelled by oil or diesel. Besides, CNG and LNG infrastructure is also suitable for biomethane and will facilitate its deployment in the coming years. Such decarbonisation pathway can be ensured, for instance, through the use of the existing refuelling infrastructure that can accommodate gaseous drop-in biofuels and renewable low carbon synthetic fuels.

**These areas of transport are difficult to electrify.** Batteries need high autonomy to cover long distances, but this increases their volume and weight and therefore that of vehicles, to the detriment of their efficiency and their environmental footprint. To operate a 40-tonne HD truck for over 1,000 km, an electric truck would require a 6.4-metric ton battery with today’s best technology, while the same distance can be covered easily with a compact safe storage of bio-LNG. There are also important factors to consider before putting excessive pressure on the battery manufacturing process. The world reserves of raw materials such as cobalt and lithium concentrate in geographic areas with weak environmental regulations and compliance with human rights.

If we look at maritime transport, this sector carries 80% of the world’s goods, but less than 1% of the world fleet runs on alternative fuels today. **The ‘Fit for 55’ package foresees an increase of bio-LNG in maritime energy of 14.2-16.8 % by 2050, depending on the type of political incentives. LNG is considered as a transitional fuel paving the way to the use of bioLNG.**

**Decarbonising industrial energy demand**

Besides its applications in the transport sector, biomethane will be the only renewable gas available for those industries who cannot be connected to hydrogen grids. Biomethane production allows energy-intensive industries to cut energy costs and replace fossil fuels. Besides, energy production from industrial waste streams that cannot be re-used or recycled and have no other applications is well in line with the resource efficiency efforts promoted by the EU.

**Among the different energy uses, heat makes up two-thirds of global industrial energy demand and comes mostly from fossil-fuel combustion. This demand can be partly covered with biomethane.** If we take the example of beer production, biomethane can cover almost the whole energy demand for heating the distillation process.
A less explored industrial application of biomethane is the replacement of current fossil based raw materials for the chemical industry to produce plastics, solvents, and synthetic fuels. As all other industries, the chemical industry will need to embrace sustainability and increasingly rely on alternative materials in the coming years. This forward-looking solution is fully aligned with the principles of an efficient circular economy.

**Additional biomethane applications**

Biomethane is the cheapest option for society to go green in the buildings sector. The ‘Fit for 55’ package has also promised to improve energy efficiency in the building sector, supporting vulnerable customers in this energy transition and setting obligations of renovation and energy savings in the public sector. This could be an incentive for the deployment of biomethane in households and public buildings with no need for adaptation or development of the existing network.

The production of biomethane also has a positive impact on the development of circular cities. The circular city concept is essential to make sure our municipalities become more sustainable, developing the local economy, creating green jobs, protecting our environment and the wellbeing of our citizens. Biomethane is a true enabler of a circular economy: we can produce biomethane by treating local organic waste and municipal waste water and this renewable gas can be used to fuel both our public transport and private fleets, facilitating the access of all to sustainable mobility. EU cities and regions should be encouraged to develop integrated circular city concepts and make an optimal use of their resources.

In the countryside, residues from animal farming or biomass from agriculture can be optimised and converted into energy, while digestate can be used as an organic fertiliser. This creates additional business models in the farming sector, making it more cost-competitive, and promotes sustainable farming.

Looking at its important role in society and the substantial positive effects on GHG abatements, biomethane should receive the relevant support from policy-makers and investors to ensure their fast scale-up. The energy transition should rely on the smartest combination of sustainable technology solutions, including biogas and biomethane.
Africa disproportionately hit by investors’ reluctance to back oil, gas
Africa has taken the biggest hit from the slump in global oil and gas investment that followed the market collapse last year, the chairman of the African Energy Chamber, NJ Ayuk, tells Global Voice of Gas (GVG). Making matters worse, the continent has also been disproportionately affected by investors’ reluctance to back new oil and gas projects amid growing climate concerns, he says.

Africa has a lot of frontier exploration, making it particularly vulnerable to cuts in investment, according to Ayuk, who is also the founder and CEO of Centurion Law Group. While COVID-19 has been a factor, Ayuk sees a great threat from investors’ perception that further support for oil and gas in Africa undermines the energy transition. And this in turn will put pressure on the continent’s economy.

“We don’t have the economic might to drill a $60mn or $80mn well, or to develop a field for $4bn to build an LNG train,” he said. “We don’t have that kind of funding.”

Many of the largest international oil companies (IOCs) are also scaling back exploration. For example BP, which aims to cut its oil and gas production by 40% over the next decade as part of its transition plan, has said it will not explore in countries where it does not already have a presence. Besides fewer funds, this trend will lead to a shortfall in the expertise and technologies that are needed for some projects in Africa, Ayuk warns.

“The exploration money has dried up,” the chairman said. “It is going to cripple a lot of Africa’s new upstream projects.”

Faced with this slump in investment, many African countries have taken steps to boost their appeal, including introducing new laws. Yet it is still difficult to attract investors, Ayuk says, pointing to disappointing results from recent oil and gas licensing rounds in multiple countries.

Ayuk also hails Nigeria’s recent finalising of a new petroleum law, aimed at providing investors with greater incentives particularly with regards to natural gas development. Both chambers of Nigeria’s parliament passed the bill in July, and it was signed into law by Nigerian president Muhammadu Buhari by the end of the year.

“The bill is not everything the industry needs. The industry would have preferred a more robust bill with more incentives and more guarantees...
“Were the advice in the net-zero report followed, it would lead to austerity in Africa, in turn creating instability and crisis”

— NJ Ayuk, Chairman
African Energy Chamber

“The analysis is inaccurate. They’re relying on technologies that do not even exist yet,” he says. Ayuk views natural gas as a bridge fuel in the energy transition, and this is a position that the IEA itself held only a few years ago. “Were the advice in the net-zero report followed, it would lead to austerity in Africa, in turn creating instability and crisis,” he warns.

Africa only accounts for 2% of the world’s anthropogenic CO2 emissions, he notes, and should therefore be able to pursue a different path towards sustainable development to other regions like Europe. “We cannot have an unjust transition,” he says.

Developed countries promised in 2009 to provide at least $100bn annually to developing nations for financing climate initiatives by 2020, under the UN Framework Convention on Climate Change. But the financing that has arrived has fallen far short of this goal. And in any case, many times more is needed to support for Africa’s energy transition, according to Ayuk.

It is largely Western investors that are shying away from new oil and gas projects, although there have been setbacks with other financing options as well. Russia held its first African summit in the Black Sea resort of Sochi in October 2019, and the event was hailed as a success at the time. A raft of memoranda were signed between African and Russian companies, but almost two years on, few of those deals have led to firm commitments.

Ayuk reasoned that Russia had abundant undeveloped oil and gas resources of its own, and was therefore in no rush to pursue opportunities overseas. There are also limits to how much Africa can rely on Chinese financiers, he added.

Reuters reported on mid-July that Nigeria was seeking $1bn in financing to support further work on the $2.8bn Ajaokuta-Kaduna-Kano (AKK) gas pipeline amid delays with the disbursement of funds promised by Chinese lenders. Negotiations with Bank of China and Sinosure to secure $1.8bn of funds continue, Reuters said. Chinese lenders were originally expected to cover the bulk of the project’s cost.

Africa’s path

The International Energy Agency (IEA) made a stir in May when it published its net-zero scenario, in which it concluded that no further investment in oil and gas is needed if the world continues on the path towards net-zero emissions by 2050. Ayuk describes the report as a “fairy tale” and a “publicity stunt.”

on fast-tracking petroleum developments and approvals,” Ayuk says. “But still the bill gives us a chance to kickstart exploration in Nigeria once again. It gives a lot for host communities. It focuses on incentivising frontier exploration and gives incentives for developing Nigeria’s 205 trillion ft³ of proven gas.”
Nigeria kickstarts decade of gas with new petroleum bill

The government is embarking on a sweeping natural gas development drive, in order to make its energy cleaner, more affordable and more accessible.

JOSEPH MURPHY

While better known as a major oil producer, Nigeria has vast but largely untapped natural gas resources. In its latest statistical energy review, BP estimates the country’s proven gas reserves alone at 5.5 trillion m³. Nigeria’s government believes roughly a further 17 trillion m³ could be discovered.

Authorities in Abuja are eager to capitalise on this wealth. They want to see Nigeria expand its LNG exports, already set to reach 30mn metric tons/year in 2024 when the NLNG consortium commissions a seventh train at their liquefaction complex on Bonny Island. But they are also eager to see gas play a greater role in the domestic economy, both to drive economic growth and improve standards of living, and to reduce emissions by displacing more polluting fuels. The government envisages increased gas use in a range of sectors, from vehicle transport and household cooking to power generation and petrochemicals.
For many years, though, Nigeria’s natural gas drive has produced lacklustre results, which many observers have blamed on inadequate conditions for investment across the value chain. But this is set to change, after Nigerian president Muhammadu Buhari signed into law a new petroleum industry bill (PIB) that overhauls nearly every aspect of the country’s oil and gas legislation, in a bid to attract more investors. The bill has been in the works for almost two decades, with delays attributed to political disagreements. But in a major breakthrough, it was finally approved by both houses of Nigeria’s National Assembly on July 16, and then was sent to the president’s office for approval.

The key changes in the bill include reduced and streamlined royalty payments, support for frontier exploration, reforms to national oil company NNPC, and improvements in regulation governing the sector. While some industry voices have said that the legislation does not go far enough in improving investment conditions in Nigeria, it has generally been well-received.

“With a primary focus on investor certainty and transparency, as well as the enhancement of the sector’s attractiveness for international investment, the newly passed PIB is expected to position Nigeria as one of Africa’s top energy markets,” the African Energy Chamber said in a response to the bill’s signing into law. “By integrating 16 petroleum laws into one comprehensive and coherent document, that provides a framework to boost oil and gas output, the PIB will accelerate investment and development in a post-COVID-19 landscape.”

The chamber’s chairman, NJ Ayuk, added that through the bill’s passing, “Nigeria has managed to elevate itself onto the global energy stage.”

“The rising global demand for cleaner energy sources has offered Nigeria an opportunity to exploit gas resources for the good of the country.”

— Nigerian president Muhammadu Buhari
The recently signed PIB not only increases the competitiveness of the Nigerian energy sector, but through fiscal incentives, market-driven policies, and unified regulations, the bill has positioned the country as the premier investment destination for both regional and international investors,” he said.

The bill’s signing was also praised by OPEC, whose secretary general Mohammed Barkindo described it as an historic achievement.

“With the stroke of a pen, you have inaugurated a new era for the industry following years of legislative efforts to strengthen the legal, regulatory, fiscal and governance framework of the petroleum sector,” Barkindo said. “Indeed, the new law will enhance the Nigerian petroleum industry’s reputation, open the door to new investment and ultimately strengthen its position to meet the world’s growing demand for energy.”

By helping to expand Nigerian oil and gas production, he said, the new legislation supports efforts to alleviate energy poverty, in line with the UN’s seventh Sustainable Development Goal, which calls for “affordable, reliable, sustainable and modern energy for all” by 2030.

After the bill cleared parliament, Wood Mackenzie commented that its approval would mean “the fiscal uncertainty deterring investment across the upstream, gas, midstream and downstream will be alleviated.”

The bill “offers incentives and concessions made to assuage stakeholder concerns, the Edinburgh-based consultancy said. “Lower royalty and tax rates are proposed. Marginal fields and indigenous producers are expected to benefit more from favourable terms.”

A decade of gas

PIB’s signing is the most important development in Nigeria’s oil and gas industry this year, and arguably in the past decade. But 2021 is also a noteworthy year as it has seen the country unveil a major initiative to establish Nigeria as a major producer and consumer of natural gas.

The government hopes that the improvements set out in PIB will help turn this vision into a reality. Indeed, the new law supports gas development in several ways. It introduces terms for developing gas under production-sharing contracts for the first time, as well as special tax breaks for companies investing in gas projects.

Critical for the government’s domestic gas plans, the law also prioritises gas supply to the domestic market, providing incentives such as a reduced royalty rate of 2.5% for gas that is consumed in-country, versus 5% for gas that is exported.

Buhari announced the Decade of Gas initiative in March, which essentially aims to gasify Nigeria’s economy by 2030. The country already relies on gas for 80% of power generation, but it is also the largest user of oil-fired back-up generators in Africa, and a significant user of coal. Expanding gas use will be key for reducing power-sector emissions and increasing electricity access in the years to come.

“The rising global demand for cleaner energy sources has offered Nigeria an opportunity to exploit gas resources for the good of the country,” Buhari said when announcing the plan. “We intend to seize this opportunity. We are a gas nation with a little oil, and we must focus on this gas.”

The Decade of Gas initiative builds on the Year of Gas plan that was announced for 2020.

A cornerstone of the initiative is the Ajaokuta-Kaduna-Kano (AKK) pipeline. The 614-km pipeline is set to provide some 56mn m³/day of gas from new fields to support up to 3.6 GW of power generation, as well as gas-based industries along its route. Construction began in July last year.

The government meanwhile introduced the National Gas Expansion Programme last year, which aims to make compressed natural gas (CNG) the fuel of choice for transportation, and liquefied petroleum gas (LPG) a key fuel for domestic cooking, captive power facilities and small industrial complexes. The programme is backed by a 250bn naira ($650mn) intervention facility created by the Central Bank of Nigeria.

The government is also promoting small-scale LNG supply and is seeking to eliminate gas flaring, to reduce emissions and unlock extra energy for use.
Pakistan’s upstream declines will drive LNG demand

Between declining domestic gas production and a lack of piped gas import options, the country’s LNG demand is set to continue growing

ANDREW KEMP
The Pakistani government announced plans for a new upstream bid round last month that it said would reduce the country’s growing dependence on imports of currently expensive LNG.

The country has been caught up in a political skirmish over expensive imports of the fuel and the government is eager to mitigate some of the backlash. Unfortunately, between the country’s limited domestic upstream potential and a distinct lack of overland gas import options, Islamabad is unlikely to succeed on this front.

The Pakistani Energy Ministry announced on July 30 that it intended to auction several attractive blocks before the end of the year. However, the majority of the licences up for grabs were previously awarded and have either been cancelled or are still under litigation.

“The government is ... doubling down on its efforts to enhance gas production by launching the next exploration and production bidding round, targeting high-potential ‘surrendered’ and ‘under litigation’ blocks, by the year end,” the ministry.

While the government is anxious to bolster flagging production and reserves, industry observers remain unconvinced about the country’s upstream potential and expect its LNG import dependency to continue growing. Indeed, as things stand, the country might be better served through an increase its portfolio of long-term LNG supplies in order to reduce its exposure to the spot market.

Swimming upstream

Pakistani LNG consumption has grown steadily over the last seven years – barring last year when the pandemic slammed the brakes on economic activity.

Natural gas production slid from 35.3bn m³ in 2011 to 32.7bn m³ in 2019 and 30.6bn m³ in 2020, according to BP’s Statistical Review of World Energy 2021. Consumption expanded from 35.3bn m³ in 2011 to 44.5bn m³ in 2019, before easing to 41.2bn m³ in 2020.

The growing divide between supply and demand forced the country to import its first cargo of LNG in 2015, with volumes growing from 1.5bn m³ that first year to 11.8bn m³ in 2019, before they too eased to 10.6bn m³ in 2020.

Pakistani Energy Minister Hammad Azhar warned on August 16 that the country’s natural gas reserves were declining by around 10% each year. His comments came during a signing ceremony with Oil and Gas Development Company Ltd (OGDCL) for five exploration licences.

He said the contract awards were an important step towards increasing upstream investment and eventually bridging the supply and demand gap.

Pakistani LNG consumption has grown steadily over the last seven years – barring last year when the pandemic slammed the brakes on economic activity.
Pakistan has struggled for years with power shortages, caused in part by its overdependence on costly and polluting fuel oil. Lacking sufficient upstream prospects at home, the government has turned to LNG as a more affordable and cleaner solution. It launched its first LNG import terminal in 2015 and brought online a second in 2017. By 2019, its LNG intake had reached 11.8bn m³.

Pakistan is eyeing a further expansion in the regasification capacity, although this will need to be accompanied by improvements to its internal gas and power infrastructure, as well as energy system management, to help it make chronic electricity shortages a thing of the past.

Given the lacklustre performance of the country’s oil and gas developers in recent years, coupled with an investment focus on expanding already producing fields rather than finding major new discoveries, the challenges on this front are many.

“Exploration is focused in the onshore Indus basin but average commercial success rates have been low. In addition, the majority of spend is on producing assets with no major greenfield development on the horizon. We expect gas production to decline resulting in import dependence growth,” Wood Mackenzie senior analyst Vidur Singhal told NGW. The consultancy projects that Pakistan’s demand will grow from 6.93mn metric tons/year in 2020 to 12.9mn mt/yr in 2025.

Rystad Energy shares a similar outlook, with analyst Kaushal Ramesh telling NGW that there was only a “limited possibility” of substantial new gas reserves being discovered in the near to medium term.

Ramesh said: “We expect Pakistan’s LNG imports to increase from around 7.5mn mt in 2021 to 12mn mt by 2025 and potentially to 20mn mt by 2030. However, this would depend on the available regasification capacity and the price sensitivity of Pakistani importers could mean imports during”
The lack of piped gas options has therefore driven the country to begin building out a domestic gas grid that is underpinned by future LNG supplies.

**LNG in the pipeline**

Pakistan signed a deal with Russia in May for the construction of a 1,100-km pipeline that will pump gas from LNG import terminals in Karachi and Gwadar to Lahore. The $2.5bn project should be completed by 2023 and will deliver up to 12.3bn m³/yr to the country’s industrialised northern region.

Singhal said: “Given Pakistan’s heavy dependency on natural gas across sectors, the government appears to have few viable alternatives [to LNG] for keeping the lights on, literally.”

Given soaring spot market costs, however, Pakistan may find it more politically expedient to secure long-term supply contracts in the vein of its 10-year, 3mn mt/yr deal with Qatar that was signed in February. The Middle Eastern state is set to start exporting the fuel in 2022.

Singhal said: “We anticipate more such long-term deals as a means of lowering Pakistan’s import bill versus the alternative of LNG spot market purchases in long run.”

He added that current long-term LNG contracts were being signed at around 10.2% Brent plus a small constant, which represented a significant discount to current spot prices. Singhal said: “Many sellers are currently offering bridging contracts which combine lower short-term prices in exchange for longer term demand security.”

Pakistan’s gas import dependency appears to be here to stay, despite the government’s hopes for its next exploration bid round. Islamabad’s decision to build a 1,100-km pipeline to feed LNG from the southern coast to industrial centres in the north indicates the government is already preparing for this likely future.
EU Fit for 55: From an existential threat to an opportunity?

The European Commission unveiled on July 15 its Fit for 55 package, aimed at aligning current EU laws with 2030 and 2050 emissions targets. The publication was focused on the EU Emission Trading System revisions and the Carbon Border Adjustment Mechanism. By the end of the year the decarbonised gas package and the methane emissions strategy should be published to finalise the EU Green Deal vision.

DR THIERRY BROS
Professor, Sciences Po Paris
The European Commission published its Fit for 55 package of legislative proposals on July 14, striving to align EU law with the bloc’s new climate ambitions. Having read the more than 800 pages focused on the EU Emissions Trading System (ETS) and the carbon border adjustment mechanism (CBAM), the first impression is the low quality of analysis and a written style that makes it (purposely?) difficult to read. Nevertheless, the publication is an existential threat to the actual oil and gas business model. Perhaps the most striking conclusion is that, assuming the same new linear factor for ETS Phase 4 pre and post 2030, the cap goes to 0 metric tons in 2040. In other words, there should therefore be no more CO₂ emissions from the power and manufacturing sectors from 2040.

There is another challenge for the long-term vision of the Commission: if CO₂ emissions need to go to zero by 2040, EU allowance (EUA) prices will skyrocket to abate the last CO₂ molecule (with inflationary risk not measured) before going to €0/metric ton.

There are ways to improve the way the system works however. For example, under the current rules, the EU ETS does not recognise negative emissions: indeed, the maximum amount of CO₂ that can be credited is today limited to the amount of CO₂ that is emitted from installations covered by the EU ETS. The establishment of a market for

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1 The analytical work completed for the ETS revision is low quality: important data are either missing (XX mt maritime sector is emitting today under this new regulation) or incorrect (117mn mt rebasing of ETS in 2024); the 2023-2030 hedging analysis doesn’t take into account: 1. maritime, 2. massive increase in industrial when free allowances will be reduced & 3. funds entering this new asset class (a carbon ETF is already available) to land magically at a 2030 hedging needs between 400 and 700mn mt, ie in the actual TNAC range (400-833mn mt).

2 On top of data & ref missing, same scenario being named differently in the report; outdate scenarios, extensive use of magic maths to allow massive private subsidy farming hoping that it can change the laws of physics.
carbon removal certificates\(^3\) which recognises negative emissions through both nature-based and technological solutions, and is compatible with the EU ETS, can therefore help balance the remaining effective emissions taking into account the merit order between competing abating technologies. The outcome will be a net zero Europe where CO\(_2\) emitters will pay the EUA price for someone else to take care of it by capture and sequestration. Let us hope that this will be the outcome of a later EU ETS revision.

**International arm twisting**

The CBAM is not a new idea. It was invented as an “EU carbon tax” by French President Jacques Chirac in 2007\(^4\). It took 15 years to transform this idea into a “mechanism” as the European Commission would need an improbable unanimity inside the European Council to implement a tax. This “mechanism” must now be WTO compatible to avoid international issues and we already know that the US, Australia, Russia and China are opposing it.

Oil and gas have not been included in the pilot 2023-2025 CBAM phase and the industry should avoid interfering on this highly political issue, leaving it to Presidents Biden, Putin, von der Leyen and Xi.

The industry is facing a much more serious threat about methane emissions (with the December publication) and should do whatever it takes to reduce those emissions to the bare minimum without spending hours in sterile discussions on the measurement methodology.

**European political bargaining**

The Commission is insisting that all those legislative proposals are to be adopted if we want to achieve the new targets of reducing greenhouse gas emissions by at least 55% by 2030. But, it also needs the approval of both European Parliament and Member States. It is therefore highly uncertain that all proposals will go ahead. For example, the European Commission has two reasons for creating a new separate ETS for buildings and road transport:

- Phasing only maritime emissions to the actual ETS from 2023 to 2026 would only add 5% allowances and should be done without disrupting the actual system.
- However, building and road transport account for an additional 45% of emissions, and for that reason using a unified system for all emissions could be greatly unpopular among the public – due to the high energy cost implications of such a system.

Including building and road transport in an ETS system is going to be a barter between the Commission and the Parliament, and even the separate option might not be approved at the end.

**What options for the oil and gas industry?**

In front of an existential threat, the only viable option is to concentrate work, time and money on what is likely the best option(s). Analysts can provide in-depth views of the challenges ahead when the verified emissions might start to be above the cap, leading to extreme prices and political backlash. But as the investment time is at least a decade in energy, this is posing a threat to today’s oil and gas industry.

The oil and gas industry is spending far too much time in trying to engage with the European Commission in a “damage control” approach. This has not been successful so far and is highly unlikely to ever be successful. The oil and gas industry should leave some fights to others stakeholders that are better positioned (MEPs for ETS building and road transport, foreign states for CBAM) and fast adapt its business model to fit the EU 2030 targets.

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3 European Commission Executive Vice President F. Timmermans in the 14/7/21 “Fit for 55” presentation

4 elysee-module-11141-fr.pdf
On top of reducing emissions (CO₂ and CH₄) to the bare minimum, one of the paths forward is to invest massively in carbon capture & sequestration (CCS) to develop a circular economy where on one side oil and gas will still be produced and used as cheap and reliable fuels to power our economy while on the other side, the CO₂ emissions will be captured and stored in a permanent way. Technologies are either readily available (transportation, upstream knowledge) or need to be scaled up massively (capture & sequestration). What is making the problem more costly in Europe is the NIMBY factor that entails that CO₂ storage needs to be far offshore to avoid upsetting voters. This looks difficult at first sight, but this business model is exactly the one of water companies all over the world; they sell both clean water and the associated services of cleaning dirty water.

This is an expensive solution and needs now massive capital expenditure and human resources to scale it up fast as we are running out of time. If it works it would provide a win-win-win solution:

1. the oil and gas industry will keep its social licence to provide fuels with no arm to the environment as the CO₂ emissions will be taken care of in parallel;
2. the policymakers will have fostered a cleaner world with the least costly path;
3. the banking industry will be able to use the revised very liquid EU ETS to foster investment in greener technologies and to provide real green portfolios.

Unfortunately, I do not see any real other alternatives. Even if the EU ETS is badly designed, the oil and gas industry needs to act now on CCUS to ensure that this existential crisis is averted.