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International Gas

April – September 2017

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Vision and Mission

The International Gas Union (IGU) is a worldwide, non-profit organisation promoting the progress of the gas industry. Through its many member countries representing approximately 97% of global gas sales, IGU covers all aspects of the gas industry.

The IGU Vision and Mission were recently redefined to reflect changes in the global gas markets and the growth of the organisation in recent years. The new Vision and Mission – approved at the IGU Council meeting in Paris, France, June 1, 2015 – reflect IGU’s Building for the Future outreach initiative and aim at making IGU a more proactive, focused and effective advocate for the global gas industry. With the changes, focus is moved towards IGU as the Global Voice of Gas and emphasis put on the fact that natural gas is a key contributor to people’s lives and futures.

Vision

As the global voice of gas, IGU seeks to improve the quality of life by advancing gas as a key contributor to a sustainable energy future.

Mission

- ◆ IGU is the key and credible advocate of political, technical and economic progress of the global gas industry, directly and through its members and in collaboration with other multilateral organisations.
- ◆ IGU works to improve the competitiveness of gas in the world energy markets by promoting transparency, public acceptance efforts and the removal of supply and market access barriers.
- ◆ IGU seeks to collaborate with governmental agencies and multilateral organisations to demonstrate the economic, social and environmental benefits of gas in the global energy mix.
- ◆ IGU supports and facilitates the development of new technologies and best practices, while emphasising sound environmental performance, safety, reliability and efficiency across the entire value chain.
- ◆ IGU maximises the value of its services to members and other stakeholders.



IGU

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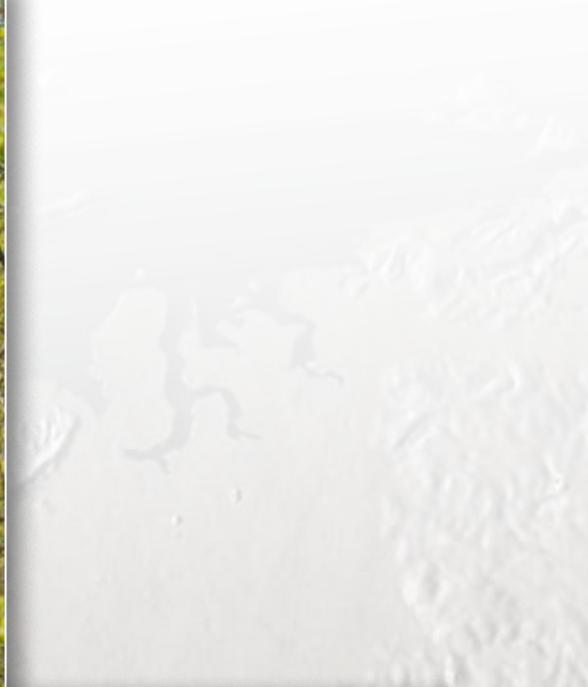
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Message from the President and the Secretary General

Dear IGU readers,

Good day. It is an honour to greet you this first time since the IGU Secretariat moved to Barcelona. Thanks to the collective efforts of many, the transition was smooth, and IGU's interests were protected and advanced during the move from Oslo.

The Spanish Secretariat has started off in high gear, and over the last few months has worked hard to build on the accomplishments of the Norwegian Secretariat. Together the Secretariat and President have maintained their focus on raising the global voice of gas in a series of high profile events.

We're also working to develop and organise upcoming IGU events in a way that strengthens the IGU brand and improves the execution of these events. We want to better attract those outside of the gas sector to the IGU conferences, bringing together a broader group of global stakeholders, including policymakers, to actively engage in debates on the future energy mix and the critical role that gas plays in the mix.

We are now already well into 2017, and a priority for this year is improving the value of IGU's services to our membership. As a worldwide association, distances are challenging and keeping in touch with all corners of our organisation can sometimes be difficult. But hearing from you directly is important to understanding your needs, your suggestions and your expectations for this global organisation. It's our goal to have meaningful contact with our entire membership in 2017.

IGU strives to be an effective global voice, but accomplishing that starts with an understanding of local issues, challenges and opportunities. Our experience is that regional meetings are useful in creating forums to accomplish these objectives. Furthermore, these regional meetings are opportunities to include support and advice from IGU to regular regional events, conferences and symposiums. We're always pleased to hear from you – let us know how we can put IGU to work for you!

We continue to make progress linking the efforts of the excellent work of IGU Committees to the ongoing advocacy efforts. Many of the documents produced by the IGU committees are highly relevant to our strategic partners. IGU aims to strengthen the relations with our strategic partners and better leverage those relationships going forward to reach decision makers and policymakers around the world.

IGU is making a difference in promoting economic, technical and policy progress for our global industry. We are fortunate to have the support of such an impressive list of member organisations. We feel that our dual focus of strengthening our "global voice" and enhancing member value will deliver benefits today, while positioning both IGU and our industry for a bright future.

Yours sincerely,

Luis Bertrán Rafecas
IGU Secretary General
David C Carroll
IGU President

▶ David C Carroll, and
Luis Bertrán Rafecas.





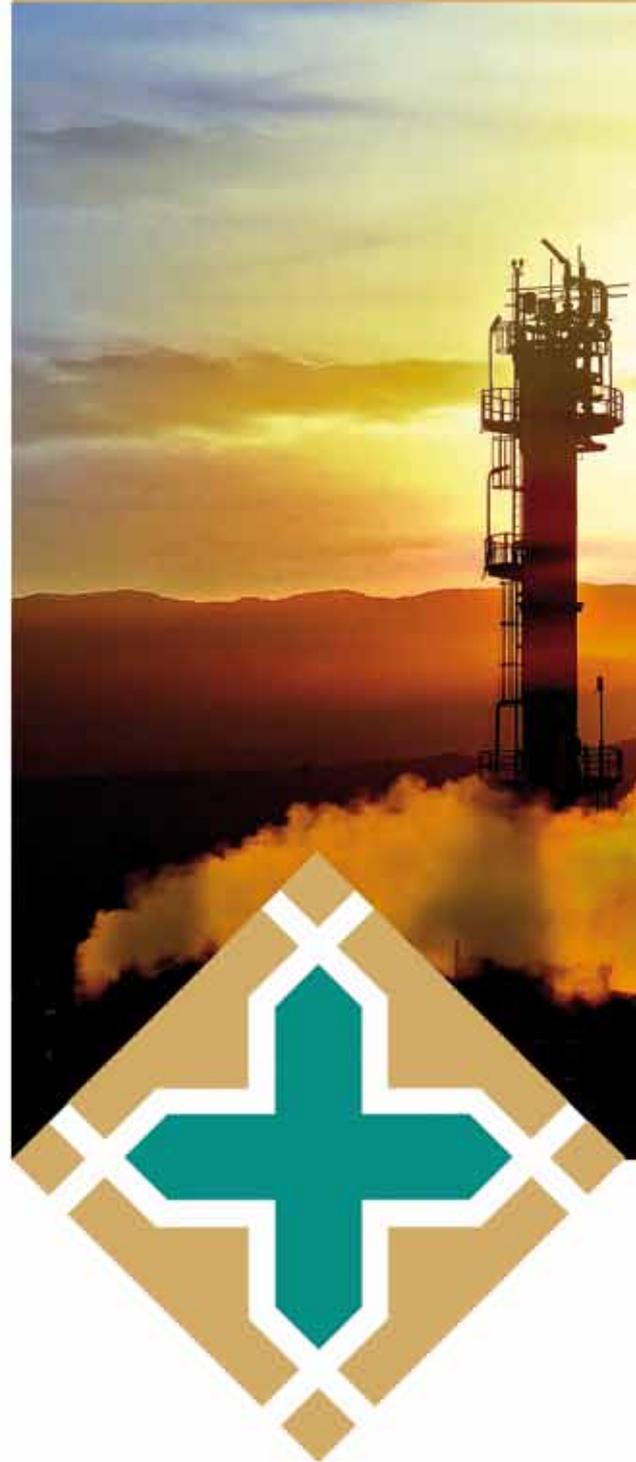
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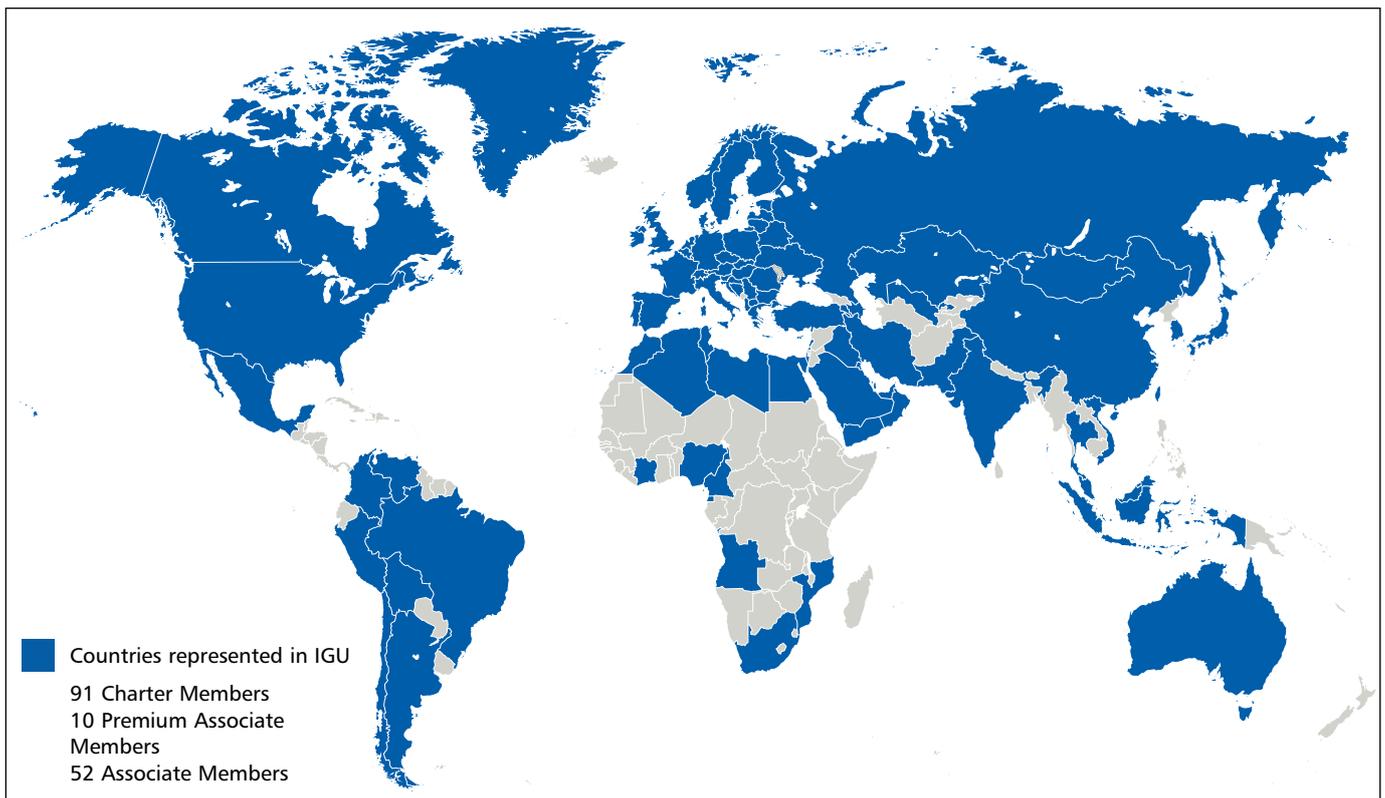
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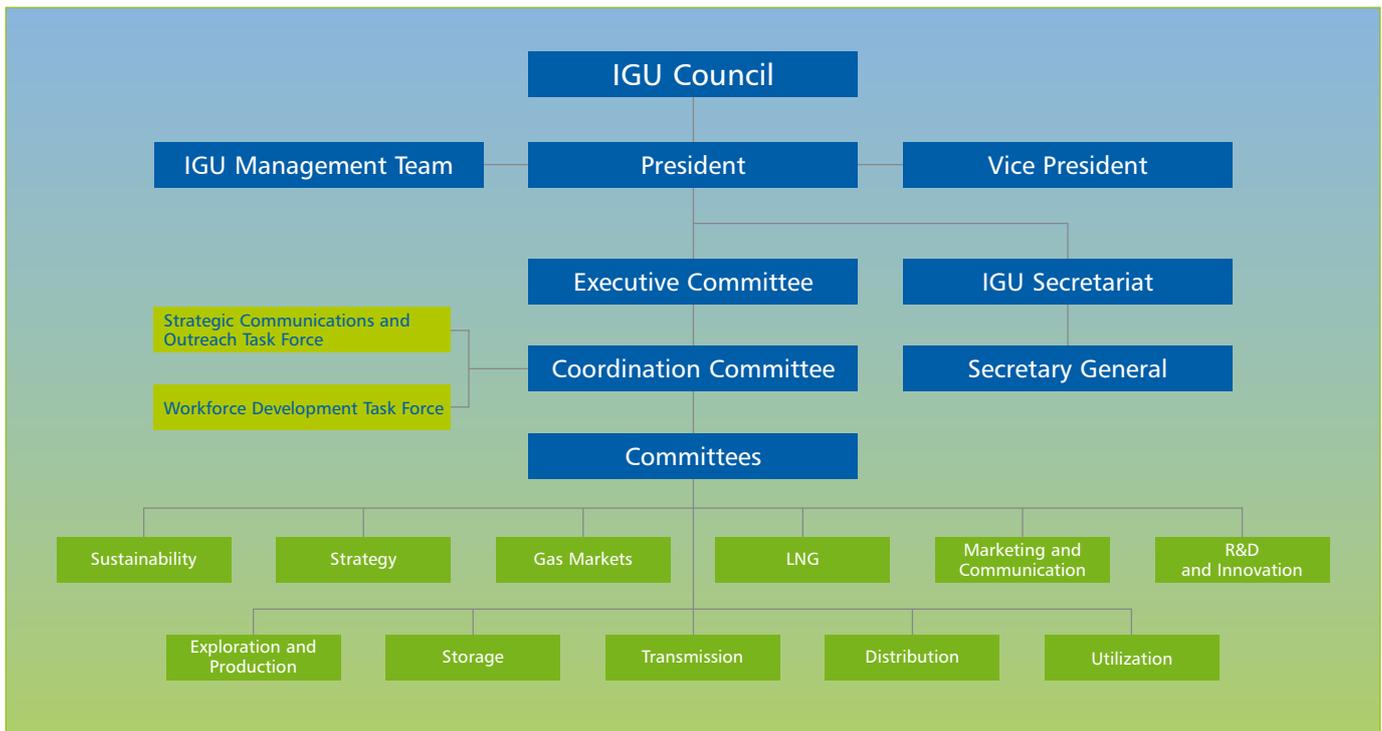
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Features

The importance of natural gas as the fuel of the future has never been more prominent. This issue's features look at the contribution gas can make from global to street level, and at IGU's events portfolio as the organisation advocates for the industry worldwide.

While the historic COP 21 gathering in Paris provided a blueprint to limit global warming, COP 22 in Marrakech last November was a quieter affair, although there were positive overtones for natural gas. The Moroccan meeting requested a fast-track approach to drawing up a Paris Agreement operating manual. What is certain is that a transition to natural gas for many countries is a pressing requirement if they are to meet their Nationally Determined Contributions.

Crucial to curbing harmful emissions is a switch from diesel to LNG or CNG for heavy goods vehicles and it now appears that this is the way forward for Europe's hauliers. Iveco has just launched its New Stralis NP truck – NP: natural power – which, for the first time ever, is able to match its diesel counterpart in terms of power output. *International Gas* was invited for a test drive.

One man with an eye continuously on the future is IGU's new Events Director Rodney Cox, a highly enthusiastic Australian whose existence is spent either hopping from continent to continent on long-haul flights or on the ground helping piece together IGU's upcoming exhibitions and conferences. Rodney reveals his strategies for IGRC 2017 in Brazil, the World Gas Conference 2018 in the US and LNG 2019 in China as well as the next series of IGU events from 2020 and beyond.

We also view the Sultanate of Oman's endeavours to create a secure and stable supply of natural gas. Its open economic policy is attracting international investment that, in turn, is driving its special economic zones.

COP 22: as climate change policy gains momentum, the future gets brighter for gas

By Alex Forbes

The COP 22 United Nations climate change talks in Marrakech last November passed without fanfare on the scale that greeted the previous year's talks in Paris – but the context in which they took place was remarkable and their significance for the future of the natural gas industry profound. The industry has long campaigned for a meaningful international climate agreement that would allow gas to assume its rightful place in the global energy mix. In Paris, it was granted that wish and Marrakech was a big step towards implementation.

When the international community hammered out the Paris Climate Change Agreement in December 2015 – setting a target “to limit global warming to well below 2°C and as close to 1.5°C as possible to prevent dangerous tipping points in the climate system” – even the optimists thought

it would take at least a couple of years for the agreement to come into effect.

For that to happen, it had to be ratified by at least 55 countries accounting for at least 55% of global greenhouse-gas (GHG) emissions. That threshold was passed on October 6, 2016, triggering a 30-day count-down. So, just three days before the COP 22 climate talks in Marrakech began, the Paris Climate Change Agreement took effect – “an unexpectedly rapid result”, commented the secretariat of the UN Framework Convention on Climate Change (UNFCCC).

“The Paris Agreement’s ambitious and essential goals are now a live reality for every government,” said Patricia Espinosa, Executive Secretary of the UNFCCC. “From today, ever-increasing climate action becomes an accepted responsibility and a central part of the sustainable development plans of all countries.”

▼ While attracting less coverage than COP 21 in Paris, COP 22 was well attended by heads of state, governments and ministers from around the world.





This meant that the 22nd Conference of the Parties (COP) to the UNFCCC was the first such conference to take place under the terms of the Paris Agreement and thus played host to the first meeting of the agreement’s governing body, the CMA (which, in the jargon of the UN climate process, stands for the Conference of the Parties to the Convention serving as the meeting of the Parties to the Paris Agreement).

US election

Then, on the second day of the conference, came the result of the presidential election in the United States.

Donald Trump’s victory took many by surprise, casting a shadow over the climate talks because of the negative statements he has made about climate change and the Paris Agreement. He once described climate change as a “hoax” and said on the campaign trail that he would withdraw the US from the Paris Agreement. The IGU delegation that attended the talks later commented: “Spirits were noticeably dampened by the results of the US election.”

At the time of writing, it remains to be seen how US climate change policy will evolve under President Trump, but such was the positive momentum at the Marrakech talks that they ended on an upbeat note despite worries about what the US might do next.

Yet another significant contextual dimension for the Marrakech talks, and for the natural gas industry, was the publication a couple of days before the talks concluded of the latest *World Energy Outlook (WEO)* from the International Energy Agency (IEA).

Arguably, the most influential of the long-term energy outlooks, the 2016 edition of the *WEO* was notable for projections taking account of the almost 200 climate-policy pledges, known as Nationally Determined Contributions (NDCs), that countries had made as part of the Paris Agreement process. The importance of these NDCs cannot be overstated as it is the policies set out in these pledges that are the foundation for meeting the targets in the Paris Agreement.

Time for “concerted, collective endeavour”

In his foreword to the *WEO*, IEA’s Executive Director Fatih Birol writes: “A new sense of direction pervades the international climate and energy community... The commitments made in Paris are national but the determination to realise change is shared. The outlook for global energy changes in consequence.

“Our new projections reflect this. The NDCs... are now at the heart of our New

◀ Patricia Espinosa, Executive Secretary of the UNFCCC, spoke of ever-increasing climate action as central to future development planning.

▼ John Kerry, then US Secretary of State, in his address to participants and press, underlined America’s commitment to climate action. The election of Donald Trump may see a re-evaluation of this commitment.



Policies Scenario [NPS]. The prospective changes to the global energy scene are not yet enough to deliver the necessary containment of CO₂ emissions. But we are making progress. No one believes that COP 21 was the end of the story. But it is, perhaps, the ‘end of the beginning’ – the moment when the world put in place a suitable framework for concerted, collective endeavour.”

Figure 1 shows what the IEA projects for natural gas in its three main scenarios. In the base-case scenario, the NPS, demand continues to climb to 2040 by an average of 1.5% per year. In the 450 Scenario, a case consistent with a 50% chance meeting the Paris target of keeping global warming within 2°C of pre-industrial times, demand rises until the late 2020s and then plateaus, reflecting the flattening off of global primary energy demand growth in that scenario; in contrast, oil demand declines for most of the projection period and demand for coal falls steeply over the whole projection period.

In a statement welcoming the positive outlook for gas in the *WEO*, IGU President David Carroll said: “While an anticipated

growth rate of 1.5% is lower than the 2.5% observed over the past 25 years, natural gas continues to be seen as the fastest growing among the fossil fuels and is expected to increase its share in global primary energy demand from 21% today to 24% in 2040.

“What is more, also in the 450 Scenario, which is even more aspiring in terms of climate change policies, natural gas is acknowledged as a *relatively clean and flexible fuel*.”

Carroll went on to say that the IGU fully supports the transition to a lower-carbon economy consistent with the outcome of COP 21 and recognises the large part that renewable energy will play in that transition: “IGU welcomes IEA’s view that natural gas is ‘especially advantageous to the transition if it can help smooth the integration of renewables into power systems along the way’.”

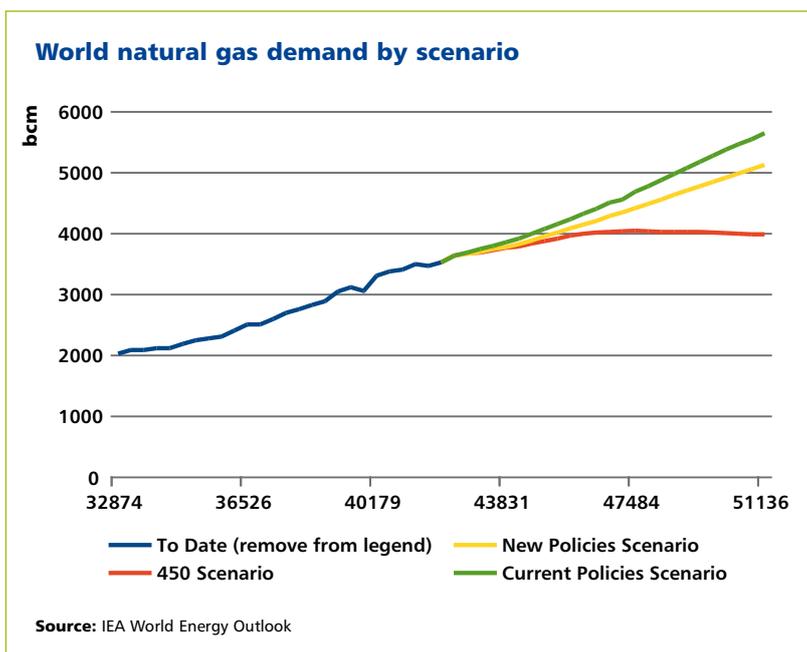
Implementation and action

So what did the COP 22 Marrakech talks achieve? Among the bewildering array of announcements about initiatives, promises and commitments on the part of the UNFCCC, governments, businesses and NGOs, one crucial outcome stands out: agreement to set a “fast-track date” of 2018 to complete the rule book, or operational manual, of the Paris Agreement. In other words, to formulate the rules and processes needed to realise its ambition and measure progress towards it.

“The agreement calls for a significant boost of transparency of action, including for measuring and accounting emissions reductions, the provision of climate finance, and technology development and transfer,” said the UNFCCC. “It also includes work to design the adaptation communications, which is the primary vehicle under the Paris Agreement to share individual adaptation efforts and support needs.”

The prominence of “adaptation” in the climate talks, both in Paris and Marrakech, is an acknowledgement that climate change

▼ Figure 1.





◀ Consultations on the preparations for the entry into force of the Paris Agreement and CMA 1 took place throughout the conference.

is already under way and that mitigation alone is no longer a realistic response. So developing nations, especially the poorer and most vulnerable ones, will need assistance – financial and in capacity-building – not just to contain their GHG emissions but also to strengthen their ability to adapt to the effects of climate change.

The UNFCCC's Espinosa commented that: "COP 22 has been what it needed to be: a COP of action that has accelerated progress under the Paris Agreement across finance, new initiatives, ambition and solidarity between nations and across continents."

Mind the "gap"

The need for all involved in addressing climate change to raise ambition was captured in the Marrakech Action Proclamation that emerged as the culmination of the COP 22 talks: "We, heads of state, government and delegations... call for urgently raising ambition and strengthening cooperation among ourselves to close the gap between current emissions trajectories and the pathway needed to meet the long-term temperature goals of the Paris Agreement."

That "gap" was quantified in the run-up to the COP 22 talks in a report released by the UN Environment Programme (UNEP), warning that even with the climate-action pledges that have already been made in the NDCs, the world is on track for warming of 2.9-3.4°C by the end of this century.

In its annual *Emissions Gap Report*, UNEP said: "Scientists agree that limiting global warming to under 2°C this century (compared to pre-industrial levels) will reduce the likelihood of more-intense storms, longer droughts, sea-level rise and other severe climate impacts. Even hitting the lower target of 1.5°C will only reduce, rather than eliminate, impacts... Waiting to increase ambition would likely lose the chance to meet the 1.5°C target, increase carbon-intensive technology lock-in and raise the cost of a global transition to low emissions."

The pressure is therefore on for all the countries that have submitted NDCs to revisit them periodically and to ratchet up climate action to cut predicted 2030 emissions by "a further 25%", says UNEP – from 54-56 gigatonnes (Gt), as currently projected, to 42Gt.

“If we don’t start taking additional action now, beginning with the upcoming climate meeting in Marrakech, we will grieve over the avoidable human tragedy,” said UNEP head Erik Solheim. “The growing numbers of climate refugees hit by hunger, poverty, illness and conflict will be a constant reminder of our failure to deliver. The science shows that we need to move much faster.”

Under the terms of the Paris Agreement, countries have agreed to submit updated NDCs every five years. The agreement also establishes the principle that “future action plans will be no less ambitious than existing ones”, says the UNFCCC. A global stocktake is to be carried out every five years “to assess the collective progress towards the goals of the agreement”, with the first due in 2023.

Implications for gas

Even as they stand, the pledges in many of the NDCs are ambitious and many countries will struggle to meet them unless natural gas takes a significant share of the energy mix. A paper entitled “The way forward after COP 21: why natural gas is the key to a low-carbon world” – published last October by the IGU Strategy Committee and available on the IGU website – explains why.

To limit global warming to within 2°C, we need to keep cumulative GHG emissions below a level that has become known as the “carbon budget”. There is widespread agreement that for the foreseeable future it will not be possible to meet humankind’s energy needs solely with renewables. So, argues the paper, “it becomes absolutely vital to reduce emissions from fossil fuel use as quickly as possible” to make the most of this carbon budget. It adds: “All major energy scenarios from independent organisations come to the conclusion that this is best achieved by replacing coal – and to some extent oil – by natural gas on as large a scale as possible.”

The rationale behind this is largely to do with the chemistry of fossil fuels and the amount of hydrogen that each molecule contains. When a hydrocarbon molecule is burnt, the carbon it contains reacts with oxygen to form CO₂ while the hydrogen reacts with oxygen to form harmless water. Methane has four hydrogen atoms per atom of carbon, oil roughly two and coal none. So in a power station, gas emits much less CO₂ than coal per unit of electricity generated. (It helps that gas-fired power stations are generally more thermally efficient than coal-fired ones.)

The net result is that unless carbon capture and storage becomes commercially viable for coal-fired electricity generation – and it shows little sign of doing so at the moment – it makes sense to use gas where it is economic to do so.

As governments gear up to implement low-carbon energy agendas, a number of proposed policies will improve the economics of gas, especially versus its main competitor in electricity generation: coal. One such policy is carbon pricing, which is being heavily promoted by the natural gas industry. One of its most vocal supporters among gas industry leaders is Total CEO Patrick Pouyanné: “Around 40 countries and regions have already introduced a carbon-pricing mechanism or are considering doing so,” he says. “Steering investment in the private sector is vital if we want to keep global warming under 2°C. Putting a price on CO₂ is the most efficient financial mechanism to change the rules of the game quickly...”

“The main priority is to reduce the use of coal which generates more emissions than any other type of energy, and to switch to gas and renewables for power generation. A carbon price of \$30-40/tonne would make this possible.”

Alex Forbes is an independent journalist and consultant who has been reporting on energy developments and analysing trends for over three decades.

A European leader in the construction and integrated management of natural gas infrastructure, Snam is the owner, operator and developer of Europe's largest, most accessible pipeline network (approximately 32,500 km long), one of the largest storage infrastructures (with a capacity of 16.5 bcm) and the first LNG terminal built in Italy. With its 3,000 people, Snam is active in natural gas transportation, storage and regasification. It operates, through associated companies, in Austria (TAG, GCA), France (TIGF), the United Kingdom (Interconnector UK) and is one of the leading shareholders of the TAP pipeline.

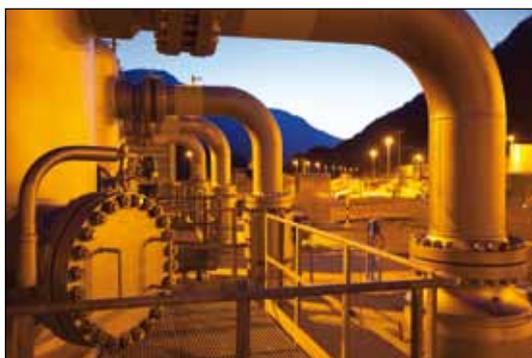
Having demerged its distribution unit in late 2016, the company has taken up the challenge set by a rapidly evolving energy landscape and embraced it to enhance its international footprint. Snam's investments aim at supporting the development of Italian infrastructure and their seamless interconnection with other European infrastructures, strengthening the security, flexibility and liquidity of the overall EU gas system and enhancing supply diversification. On a larger scale, the company leverages its international assets to facilitate the Energy Union network integration, enabling a greater flow of energy between countries thus promoting competition and allowing gas to preserve a fundamental role in the energy mix. As a leading player on Europe's gas infrastructure playing field, Snam has a pivotal role in supporting policymakers in crucial processes such as energy market integration and the achievement of a lower-carbon economy in Europe by affirming natural gas as the fuel of choice for an immediate and efficient sustainable energy mix in today's and tomorrow's environment.

In Italy, the company's investments – approximately €1 billion per year – focus on strengthening the gas transportation network and creating further storage capacity, enabling the completion of reverse flow capacity towards other European countries and including new gas flows coming from

the Caspian region through the TAP, in which Snam holds a 20% interest. Recent international developments include the acquisition of a 49% stake in Gas Connect Austria (GCA) from OMV in partnership with Allianz, which enabled the further enhancement of Snam's position in a strategic market for import transit towards Europe and the core of a regional consolidation, beneficial to the overall south-eastern market development. Snam has had a presence in Austria for more than 40 years, where it has developed – in a long-standing partnership with OMV and lately GCA – the TAG (Trans-Austria-Gasleitung) pipeline, the backbone of the Austrian gas infrastructure, currently holding an 84.47% co-controlling stake jointly with GCA.

Broadening its range of activities, Snam is developing new services and technologies to support emerging uses of natural gas and promote its role in de-carbonising industries and transport. Last year, the company

joined efforts with two industry leaders in Italy, FCA and IVECO, to foster the development of compressed natural gas (CNG) as a fuel for road vehicles, in line with the European Directive on Alternative Fuels for Sustainable Mobility. Methane fuelling for cars, trucks and buses has in fact significant environmental benefits as it ensures a relevant reduction of polluting emissions such as CO₂, NO_x (nitrogen oxides) and particulate matter. Along with CNG for road vehicles, Snam is closely following the development of small-scale LNG services for road and maritime transport, which has a significantly lower environmental footprint compared with traditional oil products, and the development of biomethane, a fully renewable and programmable energy source obtained from agricultural and agro-industrial biomasses, able to give a boost to the energy transition towards an economic model based on a sustainable and circular utilisation of resources.



◀ Gas compressor station, Malborghetto, Italy.



▼ Snam Rete Gas' San Donato Milanese dispatching centre manages and continuously monitors the gas transportation system.

Torque of the town: the gas-powered era of road haulage is under way

By Lee Gale

Just 30 minutes by rail out of London's Fenchurch Street you will reach Basildon in, what is often termed, 'deepest, darkest Essex'. It's a new town that was developed after the Second World War to accommodate the capital's population overspill, an idea which, some say, ought to be revisited today. It is by no means a salubrious district but the inhabitants are fond of their cars, especially high-performance models. Immediately surrounding the rather raggedy Eastgate shopping precinct lies a sprawling housing estate and there, parked along its quiet thoroughfares, you will spy an inordinate amount of privately-owned registrations. A preponderance of beefed-up vehicles have plates starting with MI55 and BO55, suggesting many unmarried women and entrepreneurs.

► The first Iveco New Stralis NP arrived at Iveco's UK headquarters in late January. The engine of this particular vehicle, the 8.7-litre Cursor 9 Natural Power Euro VI, runs on LNG.



Iveco New Stralis NP tractor 4x2 LNG

Cylinders: 6

Total displacement: 8,700cm³

Power: 400hp

Torque: 1,700 Nm

LNG tank capacity: 540 litres left side, 540 litres right side

Autonomy: 1,500km (930 miles)

www.iveco.com

The UK headquarters of CNH Industrial lie beyond the boulevards of spoilers and chrome alloys on the A1235 Crane Farms Road which, for all intents and purposes, is a dragstrip. On foot, it is a life-in-your-hands dash across this dual carriageway to reach the comparative safety of the sizeable CNH compound with its rows of gleaming tractors and trucks. There are 12 brands within the CNH umbrella: the tractors are New Holland; the trucks, Iveco. It is an exciting time for the latter commercial-vehicle manufacturer. The first right-hand drive Iveco New Stralis NP (NP: natural power) truck has just arrived in the UK, still on test plates, and *International Gas* has been invited for a spin.

Gas-propelled trucks are, of course, nothing new. In fact, Iveco has been producing natural-gas commercial vehicles for over 20 years but the Italian firm is particularly perky about its long-haul New Stralis NP, featuring the 8.7-litre Iveco Cursor 9 Natural Power Euro VI engine, which can run on LNG and CNG. It could be said that Iveco is a natural-gas trailblazer, with more than 15,000 of its gas-powered goods vehicles already on Europe's highways. It was the first commercial-vehicle producer to

seriously invest in natural-gas technology and now its forays into research and development are reaping rewards.

“It was the will of our Brand President, Pierre Lahutte,” explains Clément Chandon of Iveco Gas Business Development. “When he arrived in 2014 and had taken control of truck development, he said, ‘What shall we do?’ He understood that gas was one of the key products we should adopt. It’s a strategic product for us. We launched the New Stralis in 2016 and we’re now delivering our first units. It has been a tremendous success. We have 811 orders in our system and have an addition of 250 commitments from clients who are waiting for gas stations to open. It’s a good start.”

What is significant about the New Stralis NP is that it’s the first natural-gas truck to match diesel counterparts for power and torque output (400hp and 1,700 Nm respectively), while delivering 17% more power and 6% more torque than its nearest gas rival. It is also the first natural-gas truck with a 12-speed automatic gearbox and Eurotronic transmission, both conspiring to raise the truck’s driving experience while securing low fuel consumption. New-generation gas injectors, fuel rail and pistons have been created to bolster power and torque, while a three-way catalyst restricts emissions levels and noise. It’s Iveco’s intention to take gas trucks out of the niche market and into the mainstream.

With ambitious emissions-reduction targets following the Paris climate agreement in 2015, attitudes to fuel are changing. Today’s logistics sector is increasingly focused on environmental issues and with the EU reporting that a quarter of Europe’s greenhouse-gas emissions are caused by transport, green credentials are a powerful marketing tool.

To operate a CNG- or LNG-powered truck in Europe today, there has to be a certain amount of navigational pre-planning before embarking on a long run. C-LNG service stations are few and far between but once fully tanked up, the



◀ The New Stralis NP’s greatest claim is that it is the first gas-powered truck to match the power output of its diesel equivalent. Fully tanked up, it will travel for 1,500km (930 miles).

New Stralis NP can travel 1,500km (930 miles), roughly the distance from Basildon to Vienna. The Europe-wide refuelling network is improving by the month and some of the continent’s foremost hauliers are putting their money where their mouth is. Jacky Perrenot in France has ordered 200 New Stralis NPs, Pe.tra srl in Italy has ordered 95 and Groupe Mauffrey, 42. Major French retailer Casino expects to be running 400 gas-powered Iveco artics by 2020, while supermarket giant Carrefour requires a mix of 270 rigids and artics this year alone. Sainsbury, Waitrose, Tesco and Asda have all requested tests.

“With the New Stralis, we are looking at 40-65% less in terms of emissions compared to diesel,” adds Chandon, “and we are up to 99% less in terms of particulates. It is amazing that we have achieved this. We have been able to drastically reduce fuel consumption because on a gas engine, all the particulates don’t come from fuel, they come from oil that is passing



◀ In the transition to natural-gas power, the UK is lagging behind France, Italy, Spain and the Netherlands but Iveco expects the UK, as well as Germany, to become prominent markets for its NP vehicles.

Joining forces

By Antoni Peris

The international environmental targets set by COP 21, COP 22 and the European Union are highly demanding for everyone. Worldwide, countries must encourage efforts to ensure that global warming does not exceed 1.5°C, while in Europe we need to reduce our domestic GHG emissions by at least 40% by 2030.

To achieve this reduction in emissions and alleviate the effects of global warming, it's vital to change the energy system. A report drawn up by Deloitte entitled "A Sustainable Energy Model for Spain in 2050" states that an intelligent, flexible energy transition is required that ensures international economic and environmental objectives are met.

Natural gas can play a decisive role in the energy transition towards a low carbon-emission system but to achieve this, everyone – government, business, companies and other players in the national and international energy sector – need to work effectively and in coordination.

As the organisation that represents the Spanish gas industry and acts as an intermediary before state, regional and international governments, Sedigas will play a vital role over the coming years in promoting the use of gas as a key factor in the economic development of our country and in the world, as well as a guarantee of the quality of life of future generations.

Our country leads Europe in terms of LNG storage and regasification capacity with 40% and 32% of Europe's total capacity, respectively. It also has a wide range of different natural gas sources and is a world leader in terms of knowledge and use of LNG technology.

According to the report entitled "El papel del gas natural en una economía española baja en emisiones" (The role of



natural gas in a low-emission Spanish economy), drawn up by KPMG in collaboration with Sedigas, Spain's particular features (including its gas infrastructure) could also help our country meet EU targets. Moreover, in a scenario in which natural gas accounts for 33% of the energy mix, our country could achieve savings of up to €223 million per year.

That's why we believe that Spain, given its geographical situation, its knowledge and infrastructures, must become a gateway for natural gas to Europe and the rest of the world. And to achieve this, at Sedigas we will strive, over the coming years, to boost the penetration of natural gas in transport and the presence of natural gas in the domestic and tertiary sectors.

However, energy companies also need to make a greater effort. One case in point is Gas Natural Fenosa which, in accordance with its strategic view presented last year, expects to invest over €5.1 trillion in natural gas distribution networks throughout the world between 2016 and 2020 in order to take advantage of the great potential in Spain and Latin America, especially in the gasifi-

cation projects of Mexico, Colombia and Chile. The company's aim is to increase the number of supply points by 1.4 million in 2018 and by an additional 1.2 million in 2020.

Gas Natural Fenosa is also a benchmark in environmental terms. The company devotes considerable effort to bring its operations in line with values such as sustainable development, combatting climate change and protecting biodiversity with the aim of becoming a key player in Spain in the reduction of carbon emissions.

Initiatives such as its Environment Reports, analysing the company's environmental performance and including, for example, a calculation of its carbon footprint, as well as its involvement in and promotion of projects to develop technologies related to renewable gas sources, are just some examples that have led the company to be recognised by prestigious sustainability indices such as the Dow Jones Sustainability Index, the Carbon Disclosure Project, the FTSE4Good and the EuroNext Vigeo, among others.

We are certainly facing a future in which natural gas will play a key role in the energy mix. According to EU targets, natural gas consumption should account for around 30% of all final energy consumption by 2030, compared with the current level of 19%. But to achieve this, the energy industry and governments must establish a long-term strategy. The gas market needs a road map up to 2030 that contributes towards sustainable energy growth. And this will only be possible if we all join forces.

Antoni Peris is Chairman of Sedigas and Managing Director of Regulated Business at Gas Natural Fenosa.



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And we will do it with all our excitement and enthusiasm.

www.gasnaturalfenosa.com



through the piston rings. So we beat diesel with a particulate filter. In the city, we are more equal to diesel because there is an efficiency gap at low speeds but once the truck is on the open road, the engine efficiency is much better. And with the Euro VI, there is 10-15% less CO₂."

France, Italy, Spain and the Netherlands are Europe's leading markets for natural-gas haulage. Germany is at the beginning of its journey, as is the UK, although Iveco expects both to become prominent natural-gas users in the near future. On the continent, there will be 45 C-LNG fuel stations by the end of 2017. While less-polluting vehicles are obvious attractions for operators and customers alike, Iveco has announced that the total cost of ownership of its new gas-powered truck will be 7% lower than diesel equivalents. As natural gas is less expensive than diesel in many European countries, the savings really start to mount.

Of course, cold, hard figures are one thing but the proof of the pudding is in the eating. It is a raw afternoon in Basildon, with a windchill factor that is more Archangel than Essex. With its long-distance Hi-Way cab, giving 2m of internal height and 10m³ space, the New Stralis NP is a lofty beast and an ideal shelter from the cruel Arctic blasts. Instantly noticeable is the size of the twin, stainless-steel LNG fuel tanks, both of which are, in fact, a tank within a tank, with a vacuum between to provide insulation. Thermos flasks work on the same principle. In no way do the long-distance, elongated tanks detract from the aesthetic of, what is actually, a very good-looking vehicle.

"Jump inside, the door's open," calls Martin Flach, Director, Alternative Fuel at Iveco, who also handily carries a HGV licence. Three steps up and you're inside the cab with a commanding view of the frozen Essex lows. At first glance, everything appears ergonomically precise. Even the steering wheel and high-backed leather seat are welcoming. Flach fires the engine and the first thing you notice is how quiet it is. In fact, at 72dB, it's 3dB quieter than its diesel equivalent.

The accelerator is squeezed and through the passenger-side mirror, white, fluffy wisps can be seen drifting from the exhaust pipe. "People think it's kicking out a tonne of harmful fumes because they're so used to seeing diesel trucks," Flach adds. "It's mostly water vapour."

We swing out onto the Basildon racetrack and it is little surprise to see, 50m along from the entrance to CNH Industrial's compound, three cars on a sliproad at various awkward angles amidst the flashing lights of police and paramedics. The impact must have taken place at high velocity because the bonnet of each vehicle has concertinaed. Following a brief discussion on the falling standards of British driving, we pick up the Southend Arterial Road and navigate roundabouts towards the M25 London Orbital. All the while, cars whose names invariably end with an "i" zip through tight spaces as if we're in an arcade game before hurtling off into the distance. Thankfully, Flach is a patient driver and with the wintry sun briefly bathing us in glorious golden light, Essex, with its profusion of scrapyards, golf courses and trading estates, could almost be described as picturesque.

"Some time back, whenever I was involved with civil servants and politicians, it was all, 'Electric, electric, electric,'" Flach recalls. "I was viewed as an old git from from the commercial-vehicle industry. I'd tell them, 'No, electric works for small vehicles but electrics are not the answer for heavy commercial vehicles. The answer's gas.' And they'd look at me as if I was crazy. The encouraging thing is that in the last couple of years, they're no longer saying, 'Gas isn't the answer.' They're saying, 'Gas is the right answer for commercial vehicles.' Because there isn't anything else which competes with it in the short term. Hydrogen hasn't got the energy density. In the space available, you just can't physically store the stuff. And there's a price saving too. Diesel will cost you \$62,500 a year if you're covering 160,000km [100,000 miles]; gas will save 25% on an operator's fuel bills and the UK government has guaranteed to

maintain the fuel duty differential between gas and diesel until 2024.”

There’s little doubt that a lorry driver’s existence isn’t life’s easy option but if the New Stralis NP were headed for a distant drop in, say, the Algarve, there would be few complaints from this passenger today. We leave the M25 at Thurrock and rumble along Essex A-roads, skirting kart circuits, windswept sites for upcoming car-boot sales and Harvester pubs with their special offers on comprehensive chicken menus. North Stifford, Chafford Hundred and Fobbing slip by, while local M155es and BO55es weave and dart in a furious race for home and hearth. Essex, it seems, is a county that is perpetually set on fast-forward.

Back in the calm of CNH Industrial’s yard, Flach mentions the need to get the right-hand drive New Stralis NP registered and out to potential clients. “If some of the major UK players could have this Stralis tomorrow, they’d take it off me,” he says. “They’re ready, they want to trial it. There’s a whole load of people clamouring to get it first.”

It seems that the transition from diesel to natural gas is already gearing up. By 2025, there will be an extensive network of natural-gas service stations in Europe, with a maximum distance of 150km (93 miles) between CNG fuel points and 400km (249 miles) for LNG. By this time, railways may also be running substantial fleets of natural-gas-powered freight locomotives, meaning the future of goods delivery by land, whether road or rail, will be significantly less polluting – and quieter.

Further environmental benefits will come with biomethane-fuelled trucks. The natural-gas New Stralis NP reduces CO₂ emissions by 15% compared to diesel but running on biomethane, where gas from rotting organic matter is transformed into a usable energy, it’s a 95% reduction. Chandon is enthused by the prospect of power from waste.

“It can be liquid waste, agricultural waste, water waste, it can be from the food industry;



◀ The New Stralis NP will give a 40-65% emissions reduction compared to diesel and 99% less particulates. Major European hauliers like Jacky Perrenot in France and Pe.tra srl in Italy have placed orders.

we have it in great quantity,” he states. “It’s full of energy. So it’s encouraging that biomethane is developing and from problems, we create a very nice solution. Biomethane is the perfect fuel for trucks, with close to zero emissions and it’s neutral in CO₂. A 40-tonne truck will give you the footprint of half a Smart car. You produce energy locally and at the end of the chain you have fertiliser that could be used for agriculture and CO₂ that can be used for raising a crop. You can also use CO₂ for cooling a refrigerated trailer. Liquid biomethane for the truck and liquefied CO₂ for the fridge. It’s a perfectly carbon-free vehicle which will travel 1,500km.”

Analysts at Shell and the Institut Français du Pétrole believe that by 2050, there will be more gas vehicles on Europe’s roads than diesel or petrol. Chandon has shorter targets than this but it’s now apparent that by the time some of us are filling in forms for old-people’s homes, trucks will be a sustainable transport for freight delivery. Whether the incidence of reckless driving in Essex will have declined by then remains unlikely.

Lee Gale is Editor-in-Chief of International Systems and Communications Limited.



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An interview with Rodney Cox, IGU's new Events Director

By Lee Gale

In 1992, Australian radio-friendly soft-rockers Crowded House found chart success in six countries singing “You always take the weather with you” (from the single “Weather With You”). That’s certainly the case for fellow countryman Rodney Cox, IGU’s new Events Director. Looking through the glass doors from the London base of the renowned events and training producer CWC Group, a rare snow flurry is giving the River Thames a Disney-esque touch of winter. “It was the same in Paris yesterday,” Cox announces. “I’m taking the snow wherever I go.”

Since starting his role with IGU in August 2016, Cox has wasted little time in clocking up air miles. He’s been liaising with committee members all over the world ahead of IGU’s busy schedule of conferences, exhibitions and executive get-togethers. Residing in Sydney, Cox doesn’t have a single client in his own time zone but, as he reveals, there is no substitute for the face-to-face approach.

Welcome to London, Rodney. As an Aussie, do you have British ancestry?

I’ve got Scottish in my veins. My mother was a McCulloch. In 1984, I took my mother to Bannockburn to trace the family tree. I went into a gents and there was a man with a kilt on. I thought, “Ah, my first Scotsman!” I started talking to him and discovered he lived three miles from me in Sydney. He’d never put a kilt on before in his life.

Are you constantly travelling?

I spend 100-120 days a year out of Australia and I do the equivalent of seven or eight round-the-world trips every year. But I seldom go to one place. It’s normally a multi-destination trip. Being based in Sydney, everything is long haul. If I’m going to London and I can do business in Doha, Shanghai or Tokyo, you’ll turn a problem into an opportunity. In my previous job with ETF [Exhibitions & Trade Fairs], our clients were everywhere in the world. In fact, in 20-odd years, I’ve never had a client in my time zone. You have to be flexible.

What are you working on?

There’s the 27th World Gas Conference in the US next year. The second biggest event in the IGU portfolio is the International Conference & Exhibition on Liquefied Natural Gas, the LNG series, which was, until Perth in 2016, numbered by chapters. So Perth was LNG 18. But there was confusion in the marketplace that it was different than the date so the name’s been changed. For China, it’ll be LNG 2019 because it happens to be in 2019 and then it’ll be LNG 2022. There’s also the IGRC [International Gas Union Research Conference]

▼ Rodney Cox (right), showing Jérôme Ferrier, then IGU President (centre), Dave McCurdy, AGA President and CEO (left) and Didier Coulomb, IIR Director (rear) around the LNG 17 exhibition floor in Houston in 2013.



2017 in Rio in May, which is a smaller event, on gas research.

IGRC 2020 will be in Tehran. Is that new territory for you?

I haven't been to Tehran before but the Iranians are world leaders in gas reserves, so IGRC 2020 will be an exciting event. We also have WGC 2021 coming up in Korea and LNG 2022 in St Petersburg. And the other side of the cycle are the IGU Council and Executive Committee meetings. The next Council meeting, in October, is in Tokyo. My life is in the future. I can tell you where I'll be in 2022.

What are your responsibilities as Events Director?

We're trying to have consistency of brand values. It's simple things like the logo, the standard features of the event structure and setting objectives so that as the event moves around the world, you get the best of a consistent brand with a local flavour. As I said to one committee, "Wherever the Olympics go, the 100m is 100m long. You can't make it 95m in your country because you happen to think it's OK." That's the kind of thing we're trying to do. Another is to provide consistent support for committees. We can help them by getting ahead of the game. The World Gas Conference used to talk mostly to members. Now, it also talks to the marketplace. It's an outward-looking thing. Advocacy, membership, education, networking and industry standards are all important to the IGU so the events have to support the bigger activity.

Do you have a team that you work with?

IGU is a small team. I sit in Sydney but most of them are in Barcelona. There are people who are Spanish, Korean, Norwegian – it's a multi-cultural team. Having said that, and all credit to the Secretary General Luis Bertrán [Rafecas], the administrative structure of the IGU Secretariat has been modified. At the moment, because of

the transition, it's more effective for me to do some tasks that later on might be done administratively in the support role, but when you're moving through change or uncertainty, it's better to keep your hands on the tiller. This is not just about administration, this is about strategy, objectives and relationships, and trying to manage them.

What can we expect at the World Gas Conference in 2018?

The American organising committee and host gas association are being incredibly entrepreneurial. One of the highlights for the US event will be a focus on policymakers. The US team is engaging with embassies in Washington and through that, engaging with their ministries, so I think there will be an upsurge in policymakers attending the event. They are also speaking to end-user groups and NGOs, as the world is addressing how to deal with the related issues of energy, speaking to the people who use gas, whether it's power generation, large industries or direct use of gas for domestic heating and cooking. Engaging with those end-user groups is critical because demand for gas is more important than supply of gas if you look at the strategy for the future.

▼ Though 3,290 kilometres from home, Rodney's last IGU outing before taking up the role of IGU Events Director, LNG 18 in Perth, was at least in his home country. Rodney is seen here promoting the conference and exhibition at the 21st World Petroleum Congress, Moscow, 2014, with (from left to right) Kevin Skipworth CVO (Agent General for Western Australia, Government of Western Australia), Lucy Ladbroke (Arinex Pty Ltd) and Stuart Russell PSM (Government of Western Australia European Office).



Why did you choose to get involved with the gas industry?

I didn't. Like most of us, we come to these things through other avenues. I was an exhibition and event organiser and when LNG 12 came to Australia in 1998, ETF, the company I was with, won the bid to host the exhibition. We doubled the size of the exhibition from LNG 11. We were proud of what we did. We thought at the time, "That's the end of that, we did a good job, so why don't we ask the Koreans, who are hosting the next one, if we could bid?" We bid and got it. We did LNG 13 in 2001 in Seoul and every event since. In the mid-2000s, we won the bid to do the exhibition and sponsorship for the World Gas Conference. ETF has done every one since. Then IGU created this new role of Events Director. I have a hands-on understanding of IGU events and learnt much about gas over the last 20 years.

Do you place much emphasis on social media?

Generationally, the industry tends to be people who don't prioritise with social media. Again, that's a transitional thing. If you think of the stakeholders for events, exhibitors and sponsors

are making large financial decisions and face-to-face marketing is still the way to go. If you're asking someone for hundreds of thousands of dollars, you're not going to do it using social media. I still argue the case that if you meet someone, you engage with them differently. Meeting people is what creates intimacy in communication. Is social media meeting people? It doesn't engage in that final step of having met someone. Having said that, social media has a role. If you think about events, one of the challenges is that they occur for a limited window of time. But the event portfolio for the IGU has to service the long-term, 365-day objectives. That's advocacy, membership, networking, education, standards, all those things. In a perfect world, you don't want your event to stop and start.

Do you travel light?

No, I gave that up years ago. I leave Sydney with a 32kg suitcase. I travel with a printer, scanner, laptop, tablet and phone. I use airlines that are Wi-Fi connected because with long haul, if there are two legs to the travel, there's a day's work there. You're sometimes spending 24 hours going from Sydney to London. I haven't watched a movie on a plane for 10

▶ Rodney has worked on the exhibitions and sponsorship for the last three, highly successful, World Gas Conferences, most recently in Paris 2015.



years. If you're going from Sydney to London or Washington, one leg is work, the other leg is sleeping, and you hit the ground running.

Do you have a preferred airline?

I'm a big fan of SkyTeam. I went from being a non-member of Air France to being a platinum member in three months. When we were bidding for the World Gas Conference in Paris, I went to France four times in three months, business class. I earned an awful lot of points. Generally speaking, if you're doing long-haul travel and you're changing planes, you want to be with the same group. If there's a problem, it has to be their problem. Is SkyTeam better than any other group? It probably depends what your needs are. But I must say I find them very good.

What about hotels?

If you look at my hotel bills, they alternate between cheap and expensive. The reason behind that is, a man travelling on his own: shower; Wi-Fi; bed - that's a happy traveller without spending much money. But proximity to where you're working is important. It's false economy to save money on a hotel and then spend hours and dollars getting from your hotel to the event. When you go to an event, networking is as important as the programme. If you want to network, you need to be in the same room at breakfast and the same bar in the evening. Don't save \$50 on your hotel room only to spend no time with people because you're in the shuttle or a taxi, trying to get to your hotel which is 20km away. Being with people is what matters. I don't really have a preference, although I stay with Hyatt quite a lot.

Are you multilingual?

Unfortunately, I suffer from the arrogance of the English speaker. The joke is: I can speak American. I remember the first time I ran an event in America, the venue gave me their electricity capacity in horsepower. The US is the only non-metric country I've worked in. I had to

teach my team what a foot was, what a square foot was, that a little dash means a foot and two little dashes means an inch. Language is not just about language; it's about your professional language and the language of your trade. Everywhere you go in the world, hotel staff speak English. Am I proud of it? Not necessarily. But English is the lingua franca of the world.

Are you a sport fan?

When you go to New Zealand, you can buy a T-shirt at the airport that says, "I support New Zealand and whoever is playing Australia". My wife's boss was Dame Marie Bashir, the governor of our state [New South Wales], the Queen's representative. Her husband, Sir Nicholas Shehadie, now in his nineties, was the captain of the Wallabies in the 1940s. My wife once said to him, "Have you met the Queen?" He said, "I played cricket with King George and Philip on the back lawn of Buckingham Palace and met Princess Elizabeth." An amazing story, isn't it? My wife, very kindly through her contacts, got me a ticket to see Australia beat England in the 2015 Rugby World Cup. I was in the English section. There wasn't an Australian for 50m in any direction. The thing about rugby is you want to beat the other team but you have a beer with them afterwards. I like the international-ness of rugby and the culture.

Do you occasionally have time off?

It's stupid to think you can travel a hundred-and-something days a year and then effectively not have a day off. You work hard but you find windows of time to stop and enjoy where you are. We had people at LNG 18 in Perth and literally they flew in and flew back again. We said, "Have you seen a kangaroo?" and they said, "No." I said, "You're crazy! For half a day, go and pat a kangaroo."

Rodney Cox was speaking to Lee Gale, Editor-in-Chief, International Systems and Communications Ltd.

Oman's unique habitat

By Talib Suleiman
Al Zakwani

Oman has been described as “the secret of the Middle East”. The description itself is instructive because it expresses some of the fascinating phenomena that only Oman boasts. Situated in the south-eastern corner of the Arabian Peninsula, the Sultanate of Oman has been popular as an oasis of peace and tolerance. Its 3,165km coastline runs along the Arabian Sea, from the entrance of the Indian Ocean in the far south-west to the Sea of Oman and Musandam, where it overlooks the strategic Strait of Hormuz at the entrance to the Gulf.

From the snowfalls of Al Jebal Akhdar to the mountain peak of the Jebel Shams, the Sultanate of Oman hosts a few of nature's wonders. One is located on the beaches of Ras al-Jinz. Here, endangered green turtles are allowed to maintain their own habitat.

As well as dominating the oldest and most important sea trade route in the world between the Gulf and the Indian Ocean, Oman is also interwoven by the old north-south and east-west overland trans-Arabian caravan routes.

The landscape of Oman is strikingly varied and beautiful: cool, lofty mountains cut by deep gorges, simmering hot gravel planes, golden, high sand dunes and grey slate flats which attract tourists and geologists alike.

Modern state

The Sultanate is a modern state and its administrative divisions are among its best features. Oman's modern Renaissance, now 47 years old, has managed what must have once seemed unimaginable but which has been achieved as a harvest of conscious, insightful leadership: a state of progress, prosperity and opportunity

▼ An endangered green turtle on the beach at Ras al-Jinz.

▶ Oman's rich and varied geography on display at Wadi Suwayh.





that has touched its bounty on every Omani citizen. The citizen and government of the Sultanate have countless reasons, accumulated over two generations, to be proud of the leadership and to be grateful for its embodiment in His Majesty Sultan Qaboos Bin Said, Sultan of Oman.

When he laid the initial groundwork of the great project that has manifested in every part of the country today, HM Sultan Qaboos began a process that has elevated the example of the Sultanate, regionally and globally, to a level that recaptures past eminence and high points in its civilisation. He has never since assuming power paused or hesitated in the clarity or precision of his strategy for the advancement of the Omani society, guided by the realities of the local, regional and international context, and by the certainty of what was needed to move forward.

It took vision and perseverance to see the need for infrastructure development that would be both stable and sustainable over the long term, and to envision how this would be attained. Two fundamental and powerful insights spearheaded the transformation. Firstly, it would be necessary to rally and cement a unifying national spirit as a priority; as a binding force around which to build the development endeavour, which would flourish only in a

climate of security and stability. This was quickly and fully achieved. The second insight expanded on the first, recognising the need to embrace the citizen as full partner in the formulation and direction of the development process, so that the process itself might then be able to rely on the wealth of the engaged and intelligent human potential to carry it forward.

Modern economy

Oman has an economy in which oil provides the basic source of revenue and is used to finance the country's infrastructure projects.

From the start of the Sultanate's modern Renaissance on July 23, 1970, His Majesty Sultan Qaboos Bin Said began to lay the foundation of a diversified economy capable of meeting the needs of the Omani society and funding its programmes. Meanwhile, the five-year planning process, which the Sultanate adopted at an early stage of the modern state, has enabled it to develop the country robustly which guarantees that its oil revenue is distributed fairly throughout its far-flung regions.

Despite the challenges posed on the global economy in general by the fall in crude prices – and particularly to those economies that depend upon oil as a primary source of revenue – Oman's position has remained strong thanks

▲ Enhanced oil recovery techniques like those used here in Haweel will extend the life of Oman's oil reserves.



A better world

With natural gas as the world's cleanest and most efficient fossil fuel, Oman LNG's operations near the Omani city of Sur, is helping to make for a better world. Since starting production in 2000, we have delivered over two thousand cargoes to customers, remaining a reliable supplier of liquefied natural gas that is helping to reduce carbon emissions and preserve the earth's natural environment for future generations to enjoy.

For centuries, this beautiful coast-bound nation of Oman was a trade centre connecting different parts of the world through vibrant and flourishing commerce relations. Trade that supported lives in far lands. At Oman LNG, we continue that tradition of seafarers and commerce through bringing energy to many corners of the world.

Oman Liquefied Natural Gas LLC (Oman LNG) is a joint venture company established by a Royal Decree in 1994 operating under the laws of the Sultanate of Oman. The company engages in the business of producing and selling liquefied natural gas (LNG), and its by-product, natural gas liquids (NGLs) and operates three liquefaction trains at its plant in Qalhat, South Sharqiyah Governorate.

Hand-in-hand with our operations comes a strong health, safety and environment performance. Our recent achievement of 20 Million man-hours without a Lost-Time Injury (LTI) is testament to our HSE excellence, and an exemplary diligence and commitment to the safety of our people, environment, and communities where we operate. Our processes meet the highest of ISO standards, which we are proud to maintain every year and our ceaseless efforts to support the environment through the sponsoring of various initiatives such as the Turtle Research



and Exhibition Centre in Ras al Jinz in the eastern region of the country boasting one of the world's largest breeding beaches for Greenback Turtles. Additionally, Oman LNG is a key sponsor of the Environmental Society of Oman's activities that range from indigenous species protection to the championing of waste reduction, reuse and recycle programmes. As a company our responsibility to our staff, contractors and the community is to provide a safe environment so that they can come to work and return home to their families, every day.

Through our empowerment philosophy, we continue to develop talent and help remove barriers to reach success. Our

aim is to develop all staff to their fullest potential. We support in-country value through focused efforts towards developing local content and stimulating local business ventures by enabling Small Medium Enterprises (SMEs), a major cornerstone of Oman's economy, to flourish and providing equal opportunities to compete for all service contracts.

The company is a corporately and socially responsible organisation by maximising benefits to the employees, stakeholders and community and has a well-designed alignment between Corporate Social Responsibility (CSR) and business strategy, to ensure the strategic balance is maintained between



sustainable social development and the business.

From powering large industries, to keeping homes warm and the lights on, Oman LNG's your reliable energy partner.

Perpetual sustainable investments in the society of Oman

Corporate Social Responsibility (CSR) has been an integral part of Oman LNG with a focused objective: **to deliver tangible value to Oman and its people through social investment by capitalising on the country's natural gas resource.** The company allocates annually 1.5% net income after tax (NIAT) to various social investment and sustainable programmes; a commitment set when the company was founded. In addition, before the first cargoes left the LNG plant, the company invested in sustainable development projects for the community which speaks volumes about the company's business principles; that Oman LNG's initial investment in social development began even before the production line was fully functional.

Today, Oman LNG's CSR programmes span the entire nation and contribute to the socio-economic development of the country. Over the past sixteen years, the company's social investment programmes have spanned the length and breadth of the country with over 4000 projects ranging from healthcare and education to preserving the environment and road safety; reflecting its sincere interest to embed the principles of social responsibility as part of its core existence. Through strengthening the cooperation between the public and private sector, the

projects and programmes aim to supplement the national economy and ambitious development plans implemented in the Sultanate.

Oman LNG Development Foundation supports Oman LNG and the company's ambitious vision and dedication towards CSR. The Foundation champions private sector contribution to the development of Oman and its people, through CSR and citizenship, as an active contributor to social and societal welfare, and through proactively addressing community needs.



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to the stability of its own economy and its solid infrastructure, as well as the legislative framework supporting its economic and investment activities, the steady growth of its non-oil sectors and its trained and qualified national workforce. In addition, its general financial position, banking system, monetary policies and currency have remained solid and stable, so it is well placed to handle unexpected developments in the global financial markets.

The business environment

Oman has an open economic policy in its approach to the world markets and is a member of, and signatory to, several regional and international economic organisations and agreements.

The Sultanate of Oman has been able to captivate domestic and foreign investment thanks to a variety of positive factors including security, political stability, a free economy, a system that allows foreigners to own up to 100 per cent of projects, no restrictions on exporting funds and profits, no personal income tax and a standard tax rate of 12% annually for all Omani and foreign companies and establishments. The government also provides loans for a range of projects at low interest rates with comfortable repayment periods, as well as attractive company tax exemption for up to 10 years.

In a further move designed to improve the quality of its services for investors, the Ministry of Commerce and Industry introduced an E-Commercial Registration facility in June 2015 as part of its endeavour to upgrade its one-stop Invest Easy services. The E-Commercial Registration is one the Ministry's main 'Phase Three' services, introduced as part of its programme aimed at upgrading its one-stop system. It is also a significant new initiative in the country's e-service transformation process under which all the one-stop facilities will become self-service operations. This will enable the investor to complete all commercial admini-

stration electronically, at any time from any location. As a result of its policies, foreign investment in the Sultanate is on the rise and its economic policies have won plaudits from around the world and it receives high ranking in international economic reports.

Strategic centre

Duqm lies safely outside the Gulf region but remains close enough to take full advantage of the continuous flow of energy supply.

Oman is deploying all efforts to transfer the Duqm area to a regional economic centre for trade, industry and investment, buoyed by a strategic location that boosts it as an emerging preferred destination to world economies in the wake of the new global trade shift towards the Indian Ocean.

Such global interest in the Sultanate of Oman, as a regional base and an important strategic centre of economic and trade globally, has expedited energies supervised by the Omani government through the established government entity, The Duqm Special Economic Zone Authority (SEZAD). Many people have described Duqm as a large workshop for projects that may leave a significant impact in the economies of the whole region.

Currently, the region is witnessing establishment of many mega-projects that will enhance its leading role in the industry, trade and investment fields.

SEZAD manages, regulates and develops all economic activities in Duqm. It plans, designs and implements long-term strategies for infrastructural development and attracts investments to promote a wide spectrum of economic activities. It also oversees the urban expansion of the modern Duqm city while protecting the environment, thereby positioning Duqm as the preferred destination to visit, live, work and invest in the Middle East.

SEZAD is the official reference for potential investors. Through its one-stop shop, it registers, licences and provides environmental

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approvals using the best international practices. Imports into the zone will be duty free. Competitive future regulations such as potential company and investment registrations, labour, trade, land, taxation and incentives will be announced in due course. Special economic zone (SEZ) regimes, land-lease rates and utility tariffs will be provided at attractive rates. The Duqm SEZ is a model of an integrated economic development composed of zones: a seaport, industrial area, new town, fishing harbour, tourist zone, a logistics centre and an education and training zone, all of which are supported by a multimodal transport system that connects it with nearby regions (e.g. the Arabian Gulf countries, Middle East, East Africa and South-east Asia). The Special Economic Zone is administered, regulated and developed

by the Duqm Special Economic Zone Authority, a financially and administratively independent government entity.

With land covering an area of 2,000km² and a 70km stretch of coastline along the Arabian Sea, the Duqm SEZ is the largest in the Middle East and North Africa region and ranks among the largest in the world. The Duqm SEZ has long been envisioned as the place that will balance regional development by energising the Al Wusta governorate in addition to diversifying sources of national income and creating job opportunities for Omanis.

Oman LNG

From the first export of oil that left the shores of Oman in 1967, the Sultanate had, over a period of two decades, become indelibly

▼ A tanker docked at Oman LNG's plant at Sur.



associated with oil as the main enabler of its economy. But by the first half of the 1990s, Oman soon reached a new watershed in its illustrious history.

Through a landmark Royal decree issued by His Majesty Sultan Qaboos Bin Said in 1994, the groundwork for developing the country's potential for gas was established to kick-start a vigorous effort geared towards utilising the nation's gas resources. This would earn for the country a new kind of foreign revenue, supplementing income from oil and spurring far-reaching initiatives to grow the nation's economy.

Oman LNG is a tribute to that insightful decree by His Majesty. Since delivering its first cargo to Korea's KOGAS in 2000, the company has remained an enduring evidence of how Oman continues to fashion its progress while staying true to its traditional roots.

While revenue from the export of liquefied natural gas contributes heavily to the country's gross domestic product, Oman LNG through operating a three-train liquefaction project in Sur is the largest single private company investor in social development activities in the Sultanate.

The company's involvement spans many essential areas of the economy including health, education, agriculture, women's development, sports, skills training, environment and culture, and has led to much advancement in these sectors.

Preserving old customs

It is an interesting contrast that the development of Oman's LNG, a forward-looking fuel that many anticipate will eventually replace the wide usage of oil and coal in industries around the world, also contributes to enhance the preservation of Omani cultural heritage.

Oman LNG is a keen advocate and supporter of preserving the Bibi Maryam Tomb in Qalhat. The history of the tomb is said to date back to the 14th century when Qalhat, then a thriving



▲ The Bibi Maryam Tomb in Qalhat.

commercial nerve centre, was frequented by travellers like Marco Polo. After a ravaging earthquake and raiding by the Portuguese, the only enduring artefact of Qalhat's impressive past is the tomb of Bibi Maryam, an outstanding woman who built "one of the most beautiful mosques in the world".

The falaj water system, a source of irrigation in Oman, is another ancient infrastructure championed by Oman LNG. Though many centuries old, this system of water supply is an important source of water used for agricultural and domestic purposes in many parts of the country and is listed as one of UNESCO's World Heritage sites.

The establishment of the Fath al Khair ship-building museum and current efforts by the company to maintain the Sunaysilah fort, both located in Sur, home to Oman LNG's plant, when they become a realisation, will be central in ensuring valuable history lessons are preserved for the future Omani generations and the world.

Talib Suleiman Al Zakwani is Senior Communications Officer at Oman LNG.

Sustainable Future with Natural Gas

Since the first LNG import from Alaska in 1969, Japan has been leading the realization of a sustainable future with natural gas by promoting energy saving and low carbon technologies.

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Focus on the work of IGU's Committees and Task Forces

With research on next-generation fuels that reduce pollution and particulates, the Polish Oil & Gas Company (PNGiG) has put forward dimethyl ether, which can be indirectly produced from natural gas, as a solution for future land and marine transport.

China has huge shale gas resources but production looks set to be affected by a slowdown in the Chinese economy, which could have consequences for overall gas demand. IGU's Gas Markets Committee Study Group considers demand profiles up to 2040.

As natural gas produces less carbon dioxide when burnt than other fossil fuels, as well as lower emissions of nitrous oxides, sulphur oxides and fine particulates, this versatile energy will remain a crucial resource in the coming decades. Research by a joint German and French team have been studying emissions from industrial manufacturing and the move towards more efficient heating processes.

However, the future of gas should not be taken for granted, as highlighted last November at the European Autumn Gas Conference on Public Acceptance and Advocacy in The Hague. A panel, put together by Marcel Hoenderdos, Chair of the IGU Study Group on Public Acceptance of Gas Projects, stated that a stronger relationship with society needs to be built.

Mobile system for dimethyl ether production from natural gas

By Marek Kowalczyk,
Jan Hupka and
Andrzej Rogala

This paper discusses dimethyl ether (DME), a potential, next-generation, environmentally benign product for the distribution and storage of energy. It has various applications such as fuel for compression-ignition engines and as a substitute/blend for liquefied petroleum gas (LPG).

The Polish Oil & Gas Company (PGNiG) is evaluating using natural gas to produce DME. The target is to create a mobile system consisting of a DME-producing installation coupled with a methane-reforming installation. This mobile system will facilitate the usage of methane from various conventional and unconventional sources, including multi-well gas production pads, as an alternative to pipeline transport or gas liquefaction and transportation.

DME will be produced with a new proprietary super compact reactor technology and a new innovative reformer for conversion of methane to synthesis gas (syngas). The synergistic effect of DME production and methane reforming simultaneously can improve the economic aspects of the whole DME production process.

Introduction

New transportation fuels are needed to reduce both particulates and gaseous pollution. Environmental protection standards set higher demands for fuels, particularly the content of sulphur. For exhaust gas, standards for the content of aromatic compounds, nitrogen oxides, soot and unreacted hydrocarbons are continuously being reduced.

Currently, the cleanest transportation fuels are liquefied natural gas (LNG) and DME. However, DME has advantages over LNG due to its:

- ◆ Superior performance in various fuel applications, e.g. as a 'standalone' substitute for diesel fuel; and
- ◆ Lower transportation and distribution costs. DME can be indirectly produced from methane or natural gas. A number of technologies for the usage and conversion of methane have been developed and implemented. Besides LNG, it is also used in a compressed form, CNG. However, as a fuel it has some disadvantages and limitations. LPG is commonly used. This fuel, in comparison to gasoline, has numerous advantages but cannot be used in compression-ignition (diesel) engines, mainly due to its low cetane number. On the other hand, a gaseous fuel which may be used in diesel engines without limitation is DME. Although fuels from crude-oil processing dominate the market, DME is the subject of extensive research.

DME can be used as a transportation fuel on land and at sea. In the marine sector, stringent standards for designated emission control areas (ECAs) mean there is a requirement for cleaner transportation fuels. In the Baltic Sea ECA, for example, vessels operate powered by LNG and by DME produced onboard from methanol.

Another need for DME is associated with natural gas production areas where there is low local demand for gas and no access to a gas pipeline. In this case, a mobile system allowing the conversion of methane to DME could be considered. In addition, local voluminous sources of biogas may also serve as a source of methane for DME production. All of this justifies the commencement of work on a mobile system for DME production from natural gas.

Physicochemical properties of DME

DME is the simplest organic compound from the group of ethers having the chemical formula CH_3OCH_3 , as can be seen in *Figure 1*.

At room temperature, DME is a colourless gas. It is a volatile substance which forms a liquid phase at pressure greater than 0.61 MPa (at 25°C), therefore it is used and stored as a liquid. DME burns with a visible blue flame and has similar burning properties to LPG. It has a similar vapour pressure to LPG so it can be used in the present infrastructure used for transport and storage of LPG in the liquid phase. Contrary to other homologous ethers like diethyl ether (DEE), it is chemically stable because it does not form explosive peroxides upon prolonged exposure to air. Hence, its storage and handling is safe. A comparison of DME with other common fuels is presented in *Table 1*.

DME is a versatile fuel with a higher cetane number than petroleum diesel. The calorific value for DME is 28.84 MJ/kg and is 65% of that for petroleum diesel. Taking into account density and calorific value of both fuels at 1 m³, the amount of energy stored in the same volume of petroleum diesel is two times greater than that of DME. The autoignition temperature for DME is lower than in other fuels, thus start of a cold engine is easier. The chemical struc-

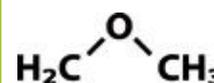
ture and 34.8% [m/m] oxygen contribution in its structure is also advantageous.

Applications and environmental impact

DME is considered an environmentally benign 'fuel of the future' and as a superior alternative to petroleum diesel in compression-ignition engines. The level of engine noise is low and the maximum torque/power is the same as in diesel engines. Used as a fuel, it does not emit sulphur oxides (SO_x) and particulate matter. Combustion generates only small amounts of nitrogen oxides (NO_x), carbon monoxide (CO) and unburned fuel residues, resulting from low autoignition temperature, high oxygen content and presence of C-O and C-H bonds instead of C-C bonds. DME-powered diesel engines achieve parameters that fulfil the majority of emission standards in the US and EU. Due to the combustion properties in diesel engines, DME has been recognised as the most promising substitute for petroleum diesel. Automobile DME installations require adjustment in diesel cars resulting from DME properties, including:

- ◆ Fuel-injection system due to low DME viscosity;
- ◆ Liquid state of DME allowing accurate metering before injection into the cylinder;
- ◆ Necessary addition of lubricant, e.g. fatty acid methyl ester (FAME);

Structural formula of DME



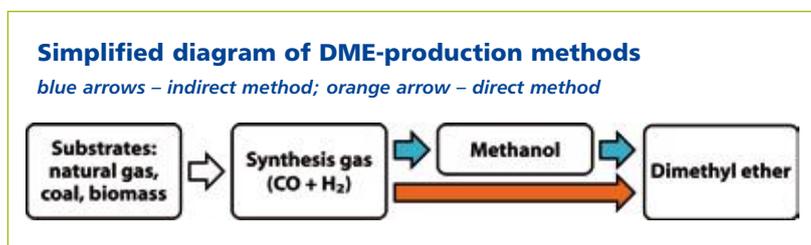
▲ *Figure 1*.

◀ *Table 1*.

Characteristics of DME and other fuels

Properties	DME	LPG	LNG	Petroleum diesel	Methanol
Boiling point, °C	-25.1	a*	-161.5	180 – 370	64.8
Density (liquid), g/cm ³	0.67	0.51 – 0.57	0.72	0.84	0.79
Vapour density relative to air (air = 1)	1.59	1.5 – 2.0	0.55	N/A	N/A
Vapour pressure, MPa	0.61 (25°C)	1.65 (65°C)	N/A	N/A	N/A
Flash point, °C	-41	(-95) – (-60)	-188	38 – 55	13
Autoignition temperature, °C	235	470	632	250	470
Explosive limit, % [V/V]	3.4 – 17	1.9 – 9.8	5 – 15	0.6 – 7.5	5.5 – 36
Calorific value, MJ/kg	28.84	46.3	50.24	42.71	21.1
Cetane number	55 – 60	7	0	40 – 55	5
Octane number	N/A	90 – 110	110 – 120	N/A	115 – 125

a* depending on the composition ratio of propane-butane.



▲ Figure 2.

- ◆ Onboard DME tanks should be correspondingly larger since the calorific value is lower in comparison to petroleum diesel.

Onboard tanks are similar to LPG installations in spark-ignition engines. DME can be also used as an additive to petroleum diesel (30:70) without modifications in present automobile installations. However, a mixture of DME/petroleum diesel has a solubility limit within the -18°C and 2°C temperature range. Below this temperature, the fuel mixture becomes heterogeneous, which significantly affects the functioning of the engine and its lifetime.

DME can be used as a substitute for LPG or as a blend with LPG. In 2014, 65% of world-produced DME was blended with LPG. The optimal mixture of DME with LPG is between 15-20% [V/V], since it requires no modification of equipment or distribution networks. LPG mixed with DME (70:30) can also be used as fuel for spark-ignition engines without modifications in existing installations.

DME is also a key compound used for the production of important chemicals. It is a suitable source of hydrogen in fuel cells. It is used in gas turbines, in aerosols as a propellant and as a refrigerant. DME is not toxic, corrosive or carcinogenic.

Methods of production

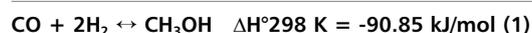
DME can be produced from syngas, which is the mixture of mainly carbon monoxide and hydrogen with several per cent of carbon dioxide, by:

- ◆ Indirect method (from methanol);
- ◆ Direct method (from syngas).

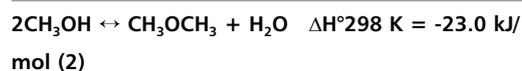
A simplified diagram of DME production methods is presented in Figure 2.

Indirect method

DME has been produced most frequently from syngas in a two-step process in which methanol is produced from syngas, purified and then converted to DME in another reactor. Methanol is obtained according to Equation 1:



In the second step, DME is obtained by catalytic dehydration of methanol according to Equation 2 in a separate reactor:



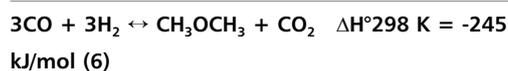
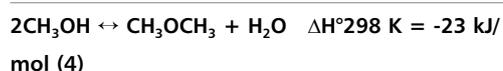
Indirect production of DME is relatively simple and the startup costs are relatively low, therefore, up till now, it has been the more common process. Typically, the DME synthesis module can be easily added to the existing methanol plant. Thus, methanol and DME may be produced together in a ratio adjusted to the market demand. This approach enables a convenient and flexible production strategy.

Disadvantages of the two-step process include conversion of methanol and relatively low natural gas efficiency.

Direct method

Significant improvement of the economic aspects of DME production results from simultaneous methanol synthesis and dehydration in a single reactor. One-step DME synthesis uses a hybrid catalyst serving both methanol synthesis and dehydration. Such an approach is thermodynamically and economically more advantageous than the traditional two-step technology since it involves the conversion of synthesis gas to methanol (Equation 3) with no methanol isolation and purification, followed by dehydration of the latter (Equation 4) to yield DME.

Further improvement of the economic aspects of the process can be accomplished if the water-gas shift (WGS) reaction (*Equation 5*) is combined simultaneously with two previous reactions (*Equation 3* and *Equation 4*):



Equation 4 and *Equation 5* essentially eliminate unfavourable thermodynamic

limitations for methanol synthesis. Methanol from *Equation 3* is consumed in *Equation 4*, forming DME and water. The water, by the WGS reaction, generates CO_2 and H_2 , and the latter enters the methanol synthesis. Thus, one of the products of each step is a reactant for another step in the sequence. This creates a strong driving force for the overall process, allowing very high conversion of synthesis gas in a single-pass operation.

An increasing market for DME will favour its economically viable production in a single step from syngas.

Comparison of methods and syngas production

Direct production allows for higher CO conversion and simple reactor design which

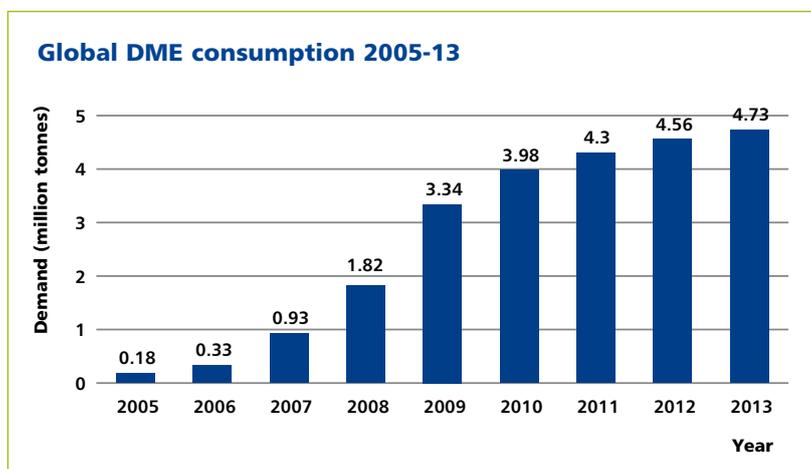


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▲ Figure 3.

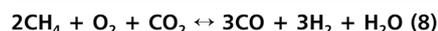
lowers DME production costs. However, to obtain high-purity DME, a more complex separation process is necessary due to the presence of produced CO₂ and unreacted syngas.

Synthesis gas is produced from various carbon-containing substrates which are subjected to temperature in the range of 900-1,000°C in the reforming (natural gas) or gasification (coal, biomass) process. More recent concepts couple the DME production line with reforming installations. Direct production of DME has the highest conversion of syngas when the ratio of H₂/CO is about 1:1. Syngas is produced from natural gas or methane by steam reforming, steam autothermal reforming or partial oxidation. However, in these cases, a stoichiometric ratio of H₂/CO is greater than 1:1 and such gas needs purification and further adjustment to a proper stoichiometric ratio for direct DME production.

Alternatively, carbon-dioxide (dry) reforming or autothermal reforming with carbon dioxide produces syngas with a stoichiometric ratio 1:1 appropriate for direct DME production. Dry reforming of methane occurs according to Equation (7):



However, it is a highly endothermic reaction that needs efficient heat supply. Moreover, carbon deposition that causes catalyst deactivation is the main disadvantage. In order to produce syngas without much additional heat supply, modern installations usually combine exothermic partial oxidation with endothermic reforming. Thereby, heat produced by the exothermic partial oxidation is consumed by the endothermic reforming reaction in a process called autothermal reforming with CO₂ (see Equation 8):



In addition, CO₂ produced in direct DME production according to Equation 6, can be recycled to reforming installation corresponding to Equation 7 or Equation 8. Thus, CO₂ emissions are significantly reduced.

Methane reforming with CO₂ and direct dimethyl ether production is of interest for the PGNiG and its research partner.

Market and perspectives

In several countries, DME is produced on a mass scale. Global demand for DME in 2013 was between 4.6-4.7 million t/y (tonne/year). Ninety-three per cent of worldwide-produced DME is for the Chinese market. Figure 3 shows global DME consumption between 2005-13.

Companies manufacturing, distributing and marketing DME as a new fuel are obliged to comply with all environmental, health and safety laws and regulations, which govern the production, handling, storage, transportation and end use of DME. Commercially available DME has a purity of 99 weight percentage (wt%) with less than 1 wt% of water and less than 1 wt% of hydrocarbons. It may contain trace amounts of methanol, carbon dioxide, carbon monoxide, methyl formate and near-zero sulphur content. It is stable and no hazardous reactions occur when stored in

normal conditions. It is handled with similar safety guidelines and codes as LPG.

In China, there were, in 2012, more than 60 plants with total production capacity reaching over 12 million t/y, more than 90% of the world production capacity. The vast majority of produced DME is blended with LPG. Some 80% of DME produced in China is by the indirect method from coal and 20% from natural gas. The reason for this is the limited access to crude oil and relatively lower coal prices.

DME production plants are being built and function in a dozen other countries. *Table 2* shows selected plants producing DME, e.g. in Iran with Zagros Petrochemical and Japan with Fuel DME Production Co. The DME production plant in Niigata is shown in *Figure 4*. Relatively small production facilities in Europe (Rotterdam and Frankfurt) are oriented to DME production to be used as an environmentally friendly propellant in aerosols. Korean demonstration installations are intended mainly for research purposes.

In Piteå, Sweden, Chemrec's experimental pilot plant started production of bioDME from biomass. The raw material is waste lignocellulose (black liquor). In the United States, Oberon Fuels' skid-mounted, small-scale production units were constructed to convert methane and carbon dioxide to DME from various feedstocks, including biogas and natural gas. In addition, large production plants are planned in Egypt, India, Papua New Guinea, Uzbekistan, Australia and proposed in Saudi Arabia, Vietnam, Oman and Mongolia.

DME production in Poland is mostly considered from shale gas, hard coal, lignite and biomass, which may become a large source in local facilities.

Importance of a mobile system for DME production

PGNiG and its partners, i.e. Gdansk University of Technology (GUT) and Warsaw University of Technology (WUT), are involved in the implementation of a novel method for DME produc-

tion in a single-stage operation using a new proprietary technology. A centrepiece of this technology will be the use of an effective slurry reactor coupled with an advanced reactor (reformer) for syngas production from methane.

The PGNiG project is divided into two steps:

- ◆ Syngas production;
- ◆ Direct DME production from obtained syngas.

Syngas will be produced by methane reforming with CO₂. Methanol-synthesis reaction and methanol-dehydration reaction will be combined simultaneously in a single reactor with the application of a hybrid catalyst. A hybrid catalyst, due to a combination of both methanol synthesis and methanol-dehydration functionalities, exhibits strong synergistic catalytic effects and considerably reduces severe limitations on the mass transfer between phases. Use of such a catalyst is necessary to allow a high conversion in single-pass operations. CO₂ will be recycled from DME production installation to syngas production. After a pilot study, both installations will be coupled and located on a mobile system. A schematic diagram of DME production, coupled with methane reforming, is presented in *Figure 5*.

▼ Figure 4.

DME production plant in Niigata (Fuel DME Production Co)



Selected major plants producing DME

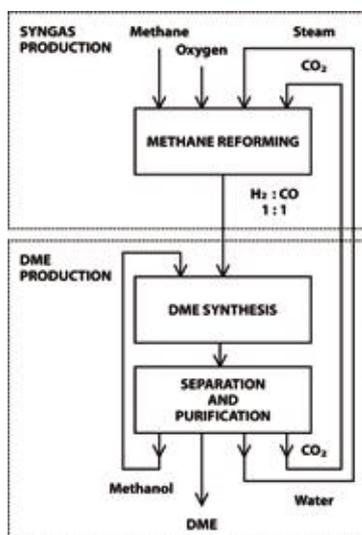
Location (Company)	Production capacity, thousand tonnes/year	Completion date	Starting raw material	Comments
China, Lingzhou (Ningxia Petrochemical)	140	2006	Natural gas	Fuel
China, Shenhua (Ningxia CoalGroup)	210	2006	Black coal	Fuel
China, Zhangjiagang (Xiniao)	200	2007	Methanol	Fuel (blended with LPG)
Iran, Assaluyeh (Zagros Petrochemical)	800	2008	Natural gas	Production for the local market, DME as LPG substitute
Japan, Niigata (Fuel DME Production Co)	80	2008	Methanol	Fuel (blended with LPG)
Sweden, Piteå (Chemrec)	100	2014	Biomass (black liquor)	Fuel for automobiles (standalone)
Trinidad and Tobago, La Brea (Mitsubishi)	1000	2016	Natural gas	Initial stage, production on the regional market as a diesel oil substitute
Egypt, Damietta (Methanex)	200	No data	Methanol (production started in 2011)	Fuel (blended with LPG), being idle in 2015, operations resumed in the fourth quarter

▲ Table 2.

DME production efficiency and the potential of scaling up the process will be evaluated. The scale-up factors that change will include reaction kinetics, fluid dynamics, thermodynamics and equipment selection. A mobile system of both installations enables the use of natural gas from multi-well gas pads as an alternative to pipeline transport or gas liquefaction and transportation in a liquid state. A variety of conventional and alternative sources of methane may be used.

▼ Figure 5.

Schematic diagram of DME production coupled with methane reforming



The simultaneous synchronisation of a DME production installation with a syngas production installation can make possible improvements of the economic aspects of DME production because it is thermodynamically more advantageous than the traditional methods. Moreover, mobile-system design is substantially less costly to build than full-scale plants, reducing the risk which is often associated with the direct construction of large-process plants.

Final comments

DME is considered a potential next-generation, environmentally benign product for the distri-

bution and storage of energy. It has applications as fuel for compression-ignition engines, a substitute/blend for domestic LPG and a superior chemical building block. It can be produced at a competitive price from syngas conveniently synthesised from methane by reforming. In the near future, its abundance at low cost can facilitate the production and selling of cheap DME.

PGNiG and its partners aim at the usage of natural gas to produce 'fuel of the future' DME. The target is to create a mobile system consisting of a DME production system coupled with a methane-reforming system. The mobile system will facilitate the usage of natural gas/methane from various conventional and unconventional sources such as multi-well gas pads. DME will be produced with a new proprietary super-compact reactor technology and a new innovative reformer for conversion of methane to syngas. The synergistic effect of DME production and methane reforming at the same time can improve economic aspects of the entire DME production process.

Marek Kowalczyk, Jan Hupka and Andrzej Rogala are from the Department of Chemical Technology, Chemical Faculty, Gdansk University of Technology, Gdansk, Poland.

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Shale gas in China: some delays for a strong take-off?

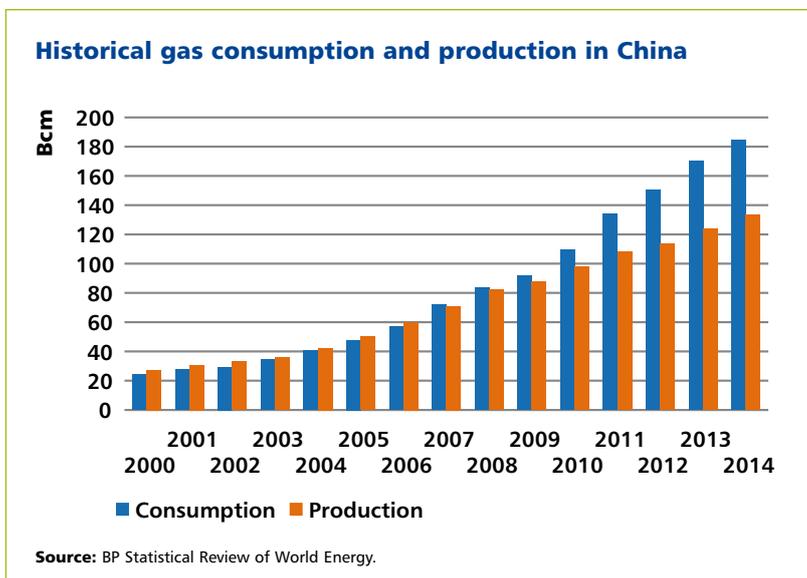
By Nabila Chafai

Introduction

China is a major gas producer, importer and consumer. Since the early 2000s, the country's rapid economic growth has led to a significant increase in energy demand. Although gas remains low in the energy mix (6% in 2015) relative to competing energies, notably coal (66% in 2015), the growth in demand bears witness to the increasing gas needs in China.

Between 2007 and 2013, gas demand in China more than doubled, mainly driven by three sectors: industry, residential and power generation, propelling the country to third place in the world rankings after the USA and Russia in terms of gas consumption. But by 2014, the economic downturn in China led to a reduction in the rate of growth of energy and gas demand, with the country investing more in services and less in industry. Gas demand growth fell from a double-digit rate to 9.6% in 2014 and 4.7% in 2015.

▼ Figure 1.



These elements cast doubt about the achievement of Chinese gas production targets, particularly for shale gas. Shale gas production in China started in 2014 with small quantities (0.6 bcm) and targets up to 2040 are very high aiming to satisfy 11% of total gas demand. The New Policies Scenario (NPS) in IEA's *World Energy Outlook 2015 (WEO)* predicts that China could produce 30 bcm of shale gas in 2020 and 90 bcm in 2040. But lower prospects for gas demand growth in China lead us to ask some questions about the targets for gas production, in particular for shale gas in the medium and long term. In 2014, the Chinese government reduced shale gas production targets for 2020 by 50% to 30 bcm from 60-100 bcm. This revision raises the question, in particular, of the volume of pipeline and LNG imports needed to satisfy gas demand, as well as the production volumes of shale gas for 2020 and beyond.

With this in mind, IGU's Gas Markets Committee Study Group 1 investigated gas demand scenarios and assessed their impact on Chinese gas supply up to 2040 looking at conventional gas, coal-bed methane (CBM), shale gas and gas imports by pipeline and LNG. In order to carry out these calculations, version 3.12 of Nexant's World Gas Model (WGM) created in May 2016 was used. Two scenarios were modelled: a base case where gas demand corresponds to IEA's NPS and a low demand scenario utilising 2016 data from the Oxford Institute of Economic Studies (OIES) where cumulative gas demand in China over the period 2015-2040 is 16% less. The conclusion of the study is that in the low demand scenario total gas production (including shale gas production) over the period 2015-2040 is 10% less

and imports (LNG and pipeline) 22% less in cumulative terms. In particular, the large-scale development of shale gas production is postponed by almost a decade and is 31% less in cumulative terms between 2015 and 2040.

The present study will be included within the Gas Markets Committee report being prepared for the 27th World Gas Conference to be held in Washington DC in June 2018. The results of this study will be included in the report of the subgroup (part of the Gas Markets Committee) in charge of gas-demand analysis and projections of gas supply in the world to 2040. A presentation of the report is expected at the conference.

Uncertainties about Chinese gas demand

With 188 bcm of gas consumed and 132 bcm of gas produced in 2014, China ranks as the third-largest gas consumer and the sixth-largest producer in the world. This appetite for gas began in the early 2000s, when economic growth started to reach double digits, involving a dramatic and substantial growth in average annual gas demand of 16% between 2009 and 2013.

It was only during the second half of the decade that gas demand started to outstrip domestic production (gas demand rose more than sevenfold between 2000 and 2013, while domestic production tripled), requiring pipeline and LNG imports and supply lines to be put in place. Gas imports dependency rose from 0 to 32% during this period. The energy policy had to find a right balance between providing affordable gas supplies and setting a city gate gas price formula which stimulates more domestic production and higher import levels amid ever-growing demand. This should encourage gas penetration in the energy mix (targetting 5% in 2020 and 10% in 2040 according to the last IEA *World Energy Outlook*).

From 2011, China's National Development and Reform Commission (NDRC), the main state agency for economic planning, undertook a reform of Chinese natural gas pricing in the

domestic market. The aim was to realign domestic gas prices to a benchmark of international fuel prices (LPG, fuel oil), replacing the fragmented, cost-plus onshore gas-pricing regime with one that features China's regional prices based on netback market values of competitive fuels at Shanghai city gate, and indexation to oil products. With growing gas import needs, the previous gas-pricing mechanism was constraining the imported volumes bought at a higher price than cheaper domestic gas, which was sufficient to satisfy Chinese demand. Some Chinese midstream and upstream operators lost money in purchasing gas at a high price and selling it at a low price in the domestic market because of the distortion of the gas-pricing mechanism. This step to a more liberalised pricing mechanism was implemented in June 2013 after two trials in Guangdong and Guangxi provinces.

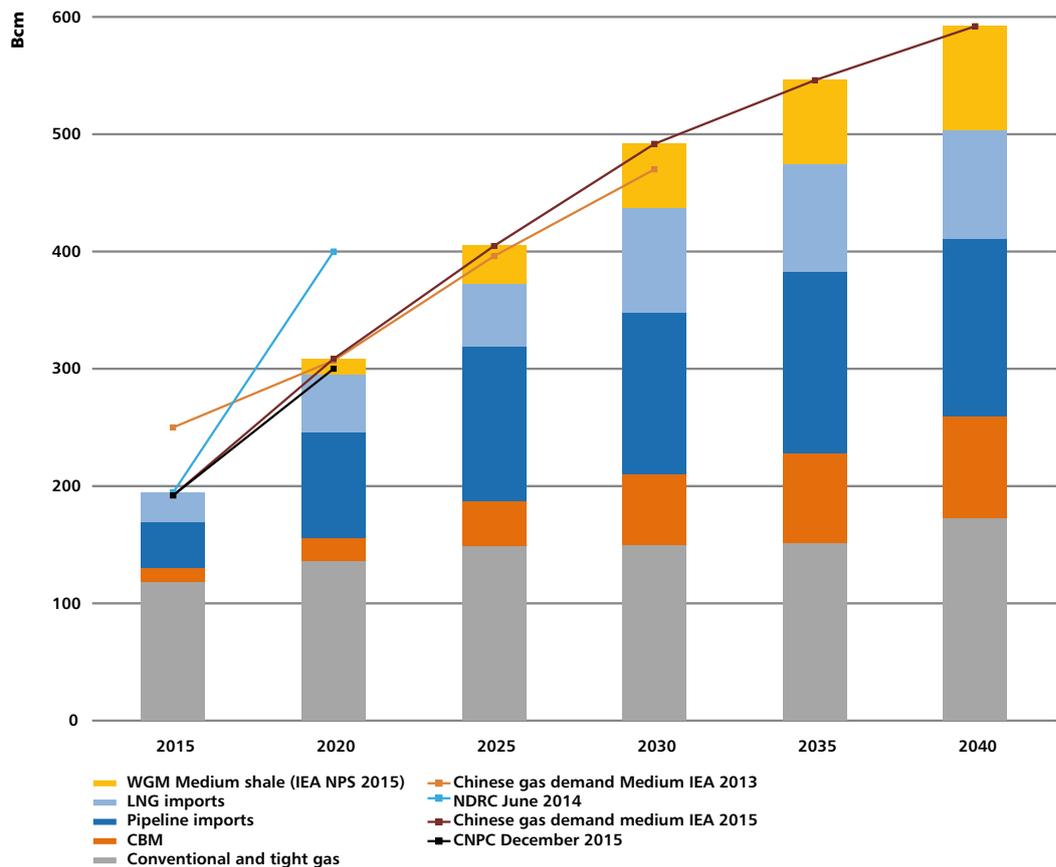
This gas reform resulted in a sharp rise in gas prices in the non-residential sector beyond the level of international LNG spot prices. As a result, gas lost its competitiveness against coal and LPG at the end of 2014, whose prices have fallen since mid-2014. Growth in demand for gas has further slowed to a point where the very optimistic outlook in June 2014 set by the NDRC for a significant increase in demand at more than 400 bcm and a production capacity of 420 bcm/year by 2020 were revised downward to 360 bcm. China National Petroleum Corporation (CNPC), the largest oil and gas producer in China, also revised downward its prospects for 2020 to less than 300 bcm in December 2015. In 2015, China consumed 197 bcm of gas, well below the IEA prospect, given barely two years before, of 250 bcm (see *Figure 2*).

The Chinese gas sector faces many challenges, both internal and external, up to 2020.

On the one hand, the domestic landscape is undergoing an important transformation:

- ◆ *On the supply side*: higher domestic supplies are coming with emerging high volumes of shale gas (even if the targets were revised

Scenarios of Chinese gas demand and gas balance



Source: WGM Nexant May 2016, WEO IEA 2015, EDF R&D.

► Figure 2.

► Table 1.

Sources of Chinese gas imports

	LNG	Pipeline
Qatar	9.2	
Australia	5.2	
Malaysia	4.1	
Indonesia	3.5	
Yemen	1.4	
Equatorial Guinea	1.0	
Nigeria	0.6	
Others	2.1	
Turkmenistan		25.5
Uzbekistan / Kazakhstan		2.7
Myanmar		3.0

Source: OIES, Pang 2015.

down by 50%) and ramping up of conventional outputs as a result of higher domestic prices. In addition, higher LNG and pipeline imports (Eastern and Western Russian routes, reinforcement of Central Asian pipelines) could enhance overcapacity of Chinese gas supplies and thus put more pressure on gas prices.

- ◆ *On the demand side:* the continuous slowing down of growth of gas demand casts doubt about the future aggressive trend encouraged by a government targeting transition from coal and oil to gas because of air pollution.

On the other hand, the external environment is increasingly challenged:



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- ◆ More competition for LNG volumes, despite new volumes which will be coming onstream from the US and Australia before the end of the decade.
- ◆ Oil, LPG and coal-price volatility which will play a role in the competitiveness of gas uses for the power generation, industry and residential sectors.

Given this complex picture, it seems clear that all these factors (gas price reform, huge resources of shale gas, pipeline projects for the Eastern and Western Russian routes, more gas imports from Turkmenistan and Central Asian countries and competition on LNG markets), contribute to contain the uncertainty about the future progression of gas demand in China.

At the same time, a dilemma appears: will it be more economical to develop shale gas and to target more volumes with a different

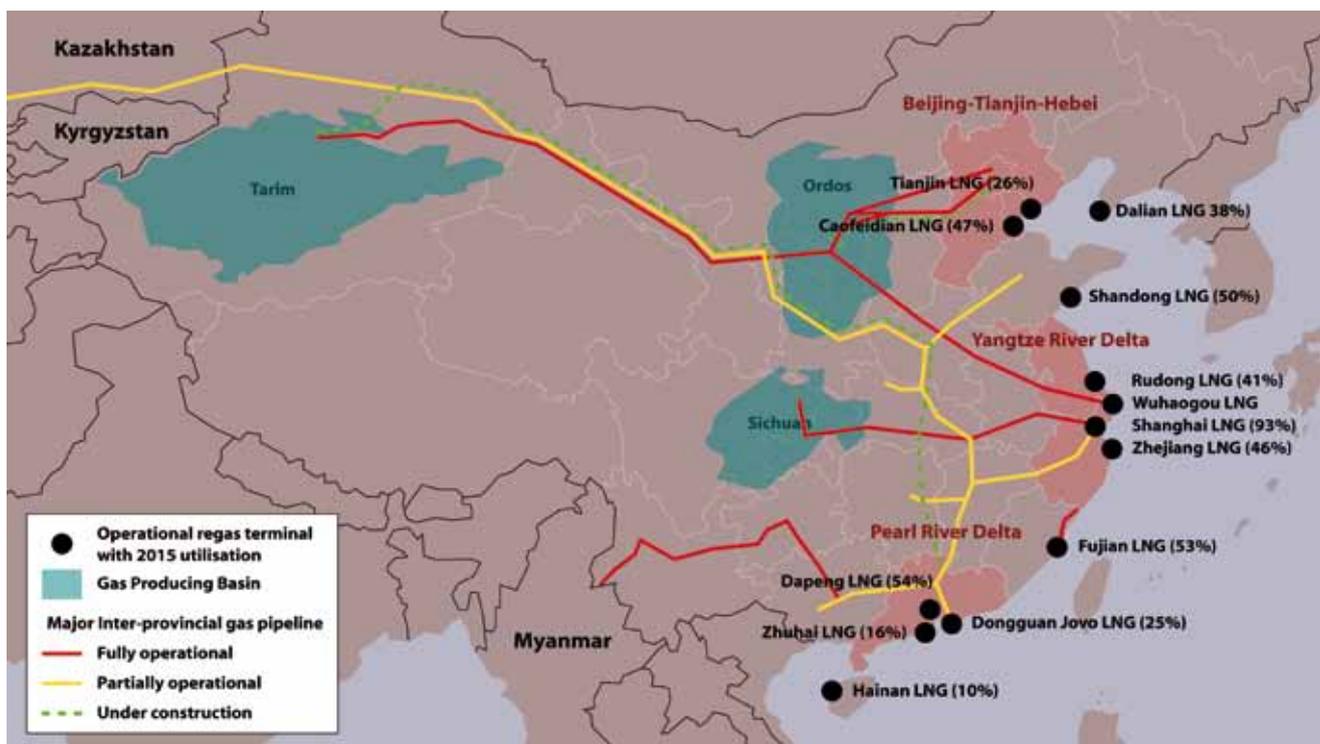
agenda, or to encourage LNG and pipeline imports in order to satisfy a gas demand, which is expected to continue its slowdown and could strengthen the overcapacity on contracted imported volumes? We will try to answer these questions in our scenarios.

Methodology

Model used

Since the 2000s, China has been both a conventional and unconventional gas producer, with shale gas, tight gas and CBM volumes. More than half of conventional production comes from four basins: Ordos, Sichuan, Tarim and the South China Yangtze Platform. Conventional gas production has reached a plateau. Most deposits have been exploited for a long time and are entering their end-of-life cycle. However, China continues to make important discoveries.

Gas production and consumption zones in China



Source: Woodmac, 2016.

Huge resources of shale gas rank China first above the United States, giving the country a potential opportunity to diversify supply and to fight pollution problems mainly linked to coal use. Shale gas resources are distributed across eight basins: Sichuan, Tarim, Junggar, Songliano, Yangtze, Subei, Ordos and Qaidam. In our study, according to data available from the WGM database and external publications, we consider only three for the whole shale gas production: the Sichuan, Tarim and Yangtze basins.

The WGM is a linear programming model (using simplex method) which optimises gas flows by minimising supply costs under constraints of demand, storage and supply capacities (pipeline, LNG). Data is optimised quarterly. At the optimum, the supply satisfies demand based on production profiles and on LNG and pipeline imports. Shadow prices (long run marginal costs or LRMC) are output from the model. In the WGM, demand forecasts for each country and thus for China are exogenous and the model will output the optimum supply (production profiles and trade flows in pipeline and LNG) that meets this demand input. The objective function is a weighted equation of volumes and costs that the model minimises year by year up to 2040. The study horizon is 2015-2040.

As China is a large country in terms of population, geographic extent and demographics, any analysis of natural gas market developments needs to capture its regional variations. In the model, China is represented through nine regional nodes: North, North West, South, South West, East, North East, Central, Hong Kong and Taiwan. In the WGM, all the Chinese nodes are supplied either by LNG and/or by pipeline and/or by other Chinese nodes.

Description of scenarios

In order to quantify the impact of growing or slowing gas demand in China on shale gas production to 2040, two gas demand scenarios

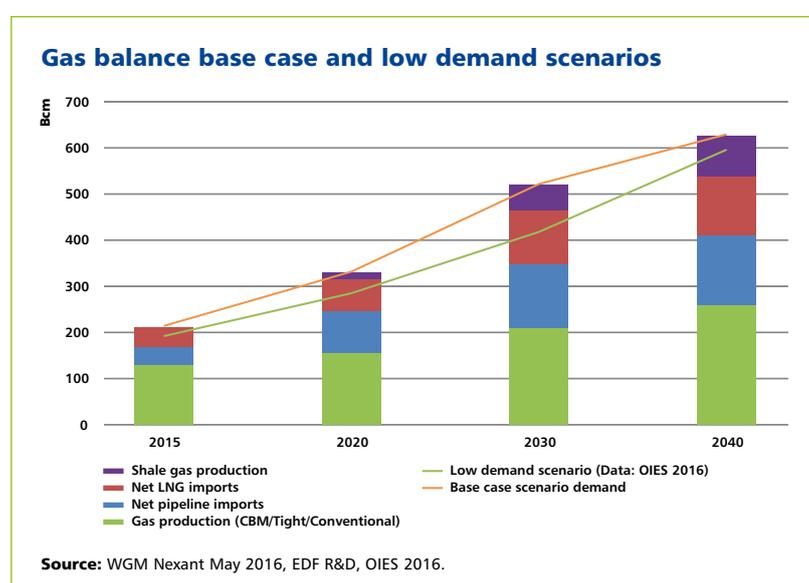
were modelled: a base case and a low-demand scenario. The goal is to see if shale gas production targets fixed by the NDRC can be achieved by 2020 (30 bcm) and 2040 (90 bcm). The assumptions for the demand scenarios are:

- ◆ *Base case*: In this scenario, gas demand is considered as medium and is based on IEA's NPS reaching 629 bcm in 2040.
- ◆ *Low demand scenario*: In this scenario, based on a CNPC business-as-usual scenario from 2015 published in an OIES analysis of Asian LNG demand, gas demand is 9% lower than IEA's NPS in 2015 and an average of 16% lower over the whole period reaching 566 bcm in 2040.

Concerning shale gas production, a medium level of shale production is considered, based on IEA *WEO* data, which targets 30 bcm in 2020 and 90 bcm in 2040. If we consider the recent publications about shale gas production in China, and according to the IEA *WEO*, Chinese shale gas well drilling costs remain significantly higher than those in North America.

The range for China is \$8-11m/well in comparison with \$5-7m for North America leading to a production cost of around \$10/MMBtu. Therefore, we decided to consider an LRMC for Chinese shale gas at almost

▼ Figure 3.



Message from the Chairperson of Beijing Gas Group

Since the middle of the 20th century, coal and oil as major fuel sources have provided a strong impetus for global industrial progress, but also exerted an increasingly severe impact on air quality. In 2016, the Paris Agreement entered into force thanks to the leadership of China and the United States, signifying a transformation towards green, low carbon and sustainable development.

In the past year, global primary energy consumption reached nearly 12.8 billion tons of oil equivalent, a mere 0.8% increase year-on-year, registering the lowest growth rate since the 1990s except during the time of the Asia financial crisis. However, transformation of the global energy consumption structure has been accelerating. Natural gas is playing a more prominent role in this transformation, accounting for 24.9% of primary energy consumption, a 0.3% increase.

The US shale gas revolution significantly raised the evaluation of natural gas reserves and changed the previous pessimistic expectation. Natural gas is recognised as a main source of energy with great potential for further development. Such



recognition will provide strong support to the development of the natural gas industry. As a low carbon, clean energy, natural gas is the primary option for countries as an alternative energy, therefore enjoying huge scope for further growth. Despite decreases from Korea and Japan, consumption growth in China and India will sustain the dynamism of the Asia Pacific market and become the main engine driving global consumption growth.

The 5.6 trillion cubic metres of recoverable natural gas reserves provide strong support for China's supply security. To address air pollution, wider usage of natural gas in China has

become the focus of the Chinese energy sector. Natural gas consumption will continue to increase, reaching up to 10% in the primary energy consumption.

The Chinese government's dedication to push forward 'energy transformation' and address environmental issues provides a great opportunity for the development of the country's natural gas industry. As the largest city gas company in China, Beijing Gas Group will closely follow the development strategy of "Establishing a foothold in Beijing; developing business in both Chinese and overseas markets; focusing on natural gas and expanding business to cover the whole value chain." We will accelerate our development of natural gas transmission in the upstream and midstream gas markets and in downstream gas applications. We will continue to promote the usage of natural gas and reduce carbon dioxide emissions. China will also strengthen cooperation with the International Gas Union to make its due share of contribution to the global gas industry.

Li Yalan is Chairperson of Beijing Gas Group Company Limited.



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\$7/MMBtu level for three basins: Sichuan, Tarim and Yangtze.

Once each scenario is implemented on the WGM, the model optimises, one year at a time, with quarterly profiles. We will compare each scenario with the base case following outputs:

- ◆ The gas balance including domestic production, LNG and pipeline imports to China.
- ◆ The gas production in all the countries supplying China by pipeline or LNG.
- ◆ The marginal costs of supply.

Scenarios results and analysis

Global gas supply shifts

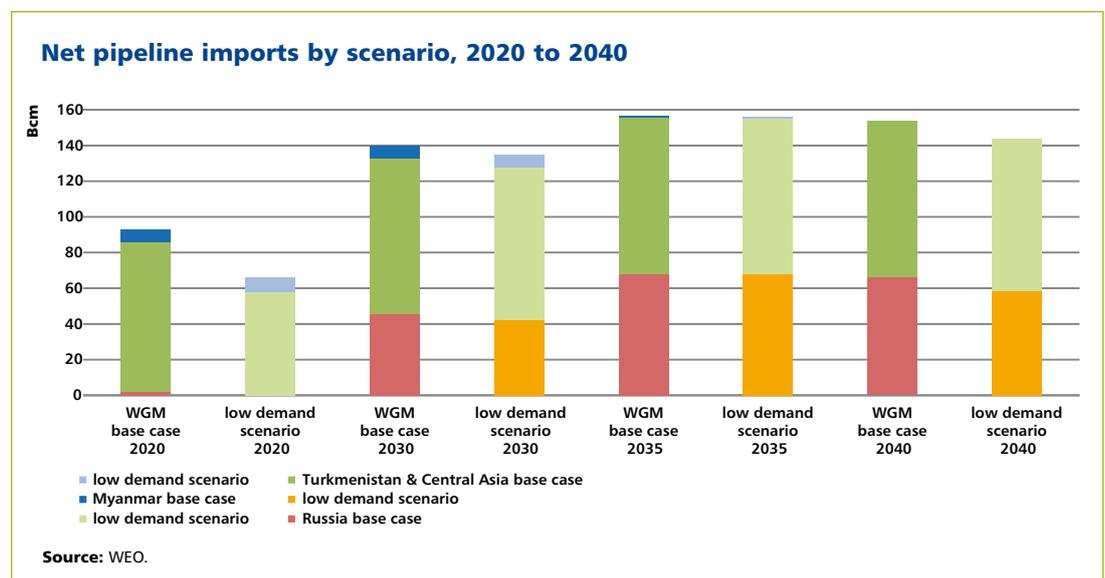
As gas demand is reduced, the model automatically reduces gas supplies. Shale gas production is reduced and postponed by almost a decade (see Figures 5 to 8). As we see in these figures, all types of supplies are impacted by a reduction of 15-20% of gas demand year-on-year between 2015 and 2040. Conventional production is lower by 5-8% while shale gas production drops drastically by 98% in 2020 then by 62% in 2030, and its take-off is postponed by almost a decade to 2033 in the low demand scenario rather than in 2025 in the base case. Pipeline

imports (Figure 4) are also strongly impacted and reduced by 29% in 2020 but less after this date as there will be a bigger reduction of LNG imports (41-43%) in 2030 and 2040 (Figure 9). However, the NDRC shale gas production target of 90 bcm in 2040 seems to be achievable (88 bcm in each scenario). If shale gas production is increased in the future, this is influenced by the conventional and shale gas LRMC and the arbitrage that the model makes versus LNG and pipeline contract prices. However, even if volumes produced and imported are reduced from one scenario to another, we can see that within each scenario these volumes are growing during the period under study.

Pipe and LNG imports shifts

As Chinese demand is reduced between the two scenarios, in the low-demand scenario Russian deliveries are postponed from 2020 to 2022 from Power of Siberia 2 (Altai) and reduced by 11 bcm between 2030 and 2040 including Far East deliveries. In order to satisfy demand, the lack of pipeline and LNG imports is replaced by the growth of shale gas production as in the base case. The shift in gas deliveries (net pipeline and LNG imports) to

► Figure 4.



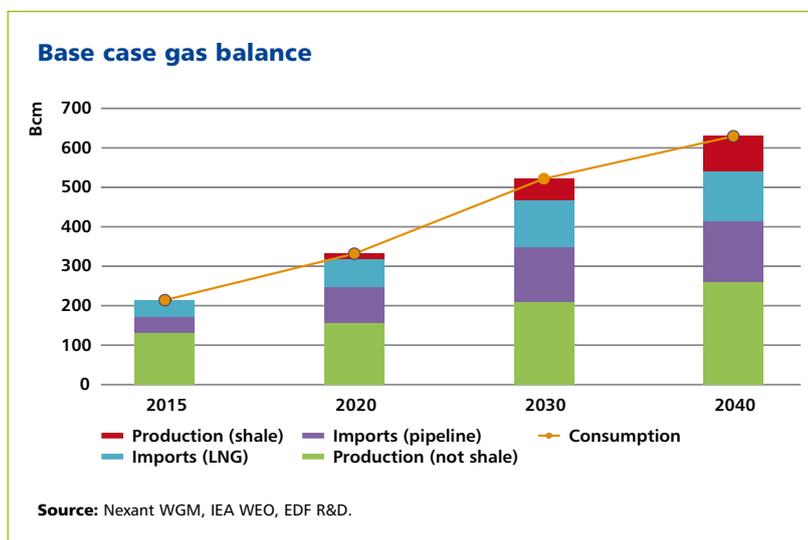


Figure 5.

China at each horizon explains the shift in production, gas withdrawals and consumption in the countries delivering to China. Net deliveries mean imports less exports and stock change.

In 2020, Turkmenistan, Kazakhstan and Uzbekistan deliver 25 bcm less gas to China in the low-demand scenario than in the base case. Hence, less gas is produced in these countries (15 bcm) but more gas is delivered to other Asian countries (Thailand, Bangladesh, etc) in order to satisfy their gas balance. Also when Russia produces almost 30 bcm less gas then 31 bcm less are sent to Europe by pipeline in the low-demand scenario in 2020 but 2 bcm more are sent to China.

Regarding LNG deliveries, the same mechanism is observed between the two scenarios through the two horizons. In 2030, Australia will deliver 17 bcm less to China, will produce 3 bcm less, but will deliver 14 bcm more LNG to other Asian and Asia-Pacific countries (Japan, Korea, India, Malaysia and Indonesia).

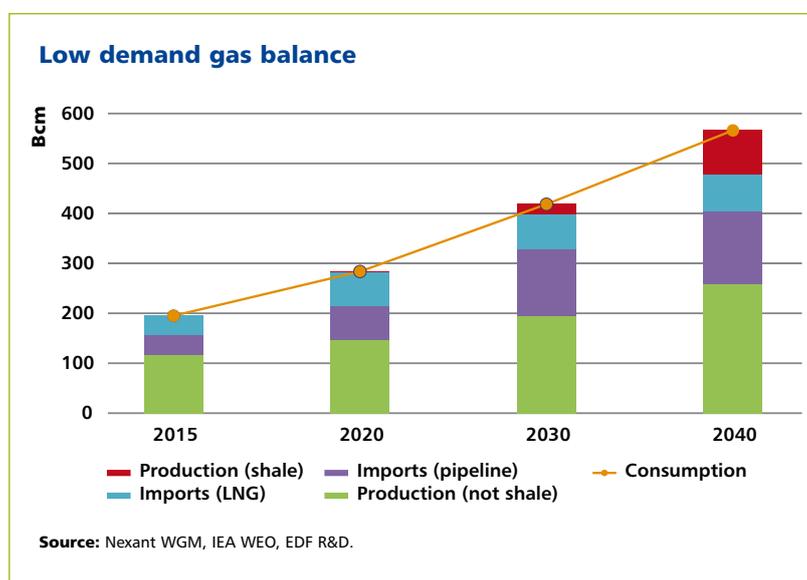
Also for Qatar, whose LNG prices are among the highest, even if its production and consumption is not changing in 2020 and 2030, 5 bcm more LNG is sent to China and less gas is then delivered to Japan and Korea (6 bcm) and less to the Middle East (2 bcm).

All these offset mechanisms between suppliers and customers through the different regions are motivated firstly by gas demand reduction in China, also by LNG and pipeline contract prices, take-or-pay constraints and local needs.

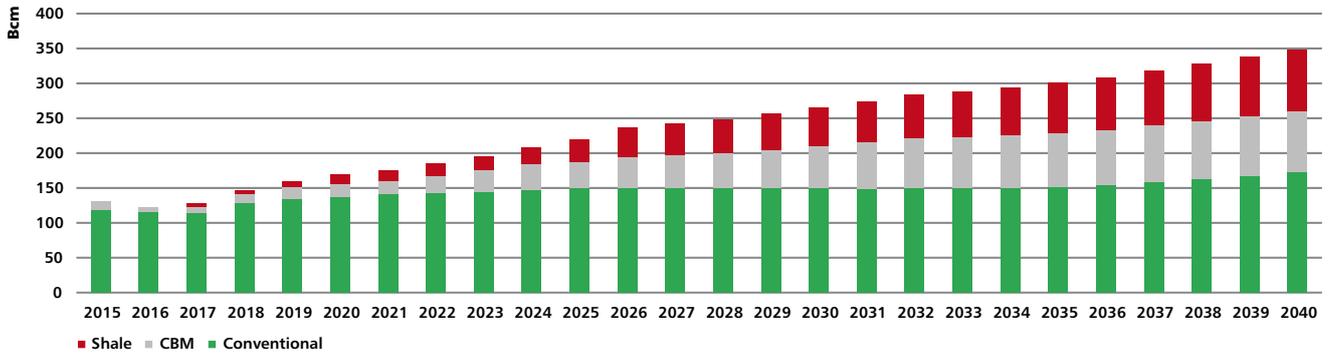
Key factors to explain the shift in deliveries

Between the two scenarios, pipeline imports decline more in 2020 and more slowly after this horizon up to 2040. LNG deliveries are

Figure 6.

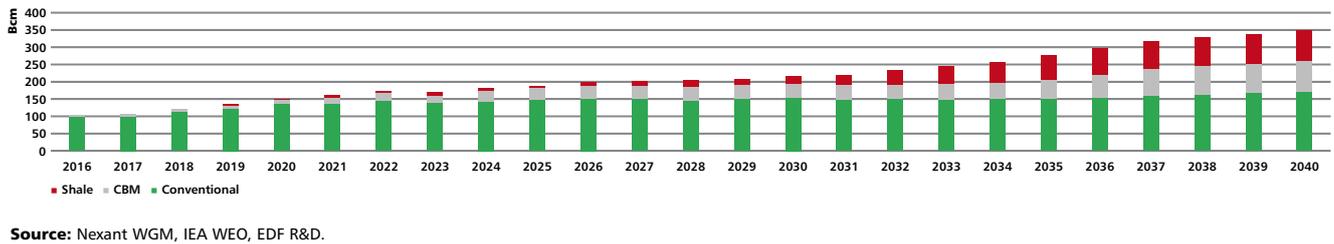


Base case production profile



▲ Figure 7.

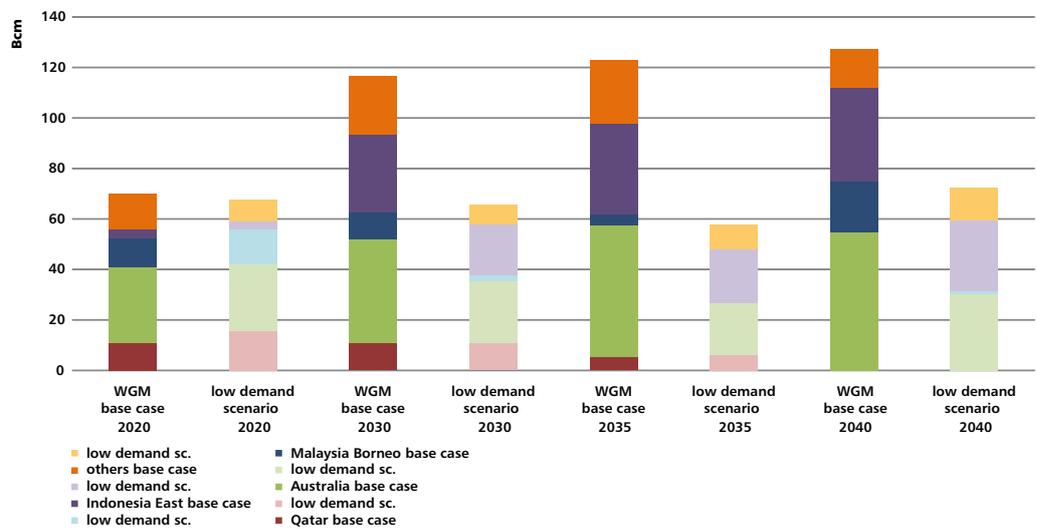
Low demand production profile



▲ Figure 8.

▶ Figure 9.

Net LNG imports by scenario, 2020 to 2040





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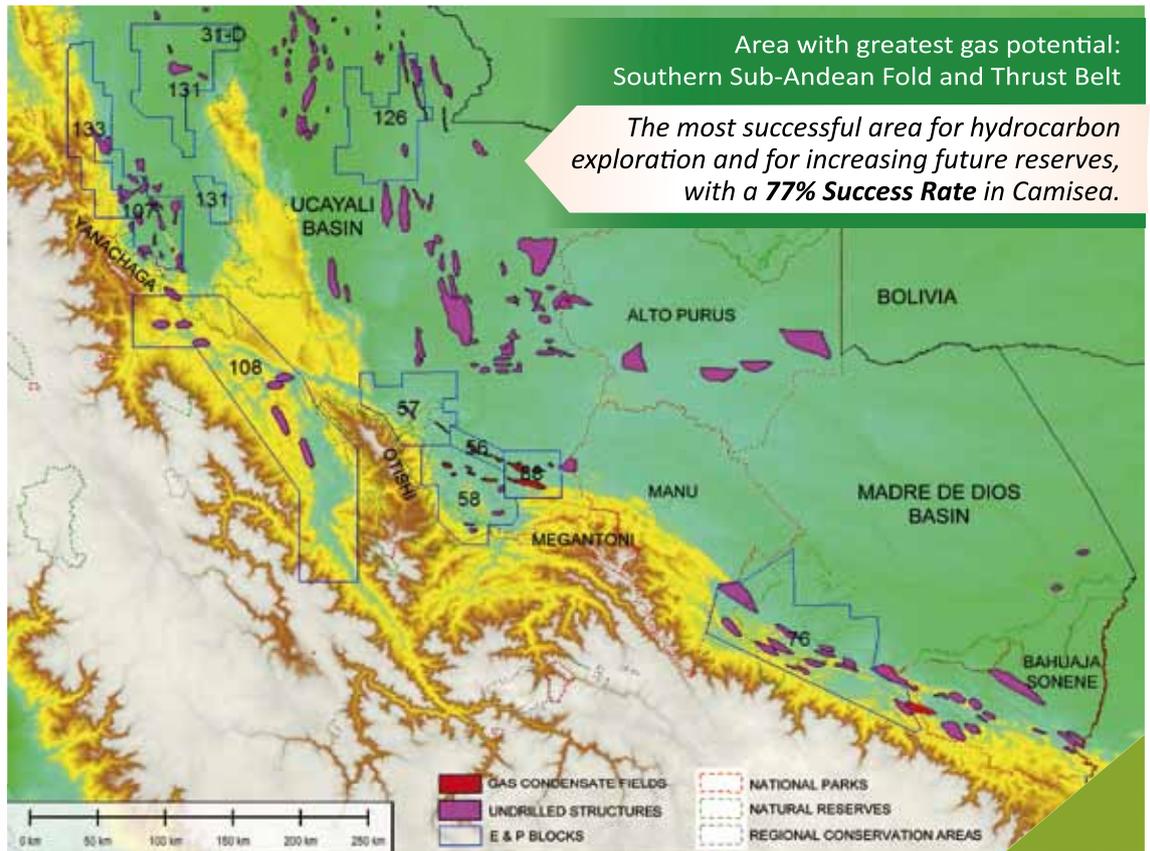
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PERU'S UNDEREXPLORED GAS POTENTIAL

As of 31st December 2015, there is an estimated total of 3,535 million BOE of proven hydrocarbon reserves, of which Natural Gas and associated NGLs make up the largest volume.

Various oil and gas reserves discovered last decade are still yet to begin production.

It is estimated that the Gas and NGL reserves discovered to date are approximately half of the total potential.

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A RENEWED STRATEGIC FRAMEWORK
FOR PERUVIAN HYDROCARBONS IS CLOSE**

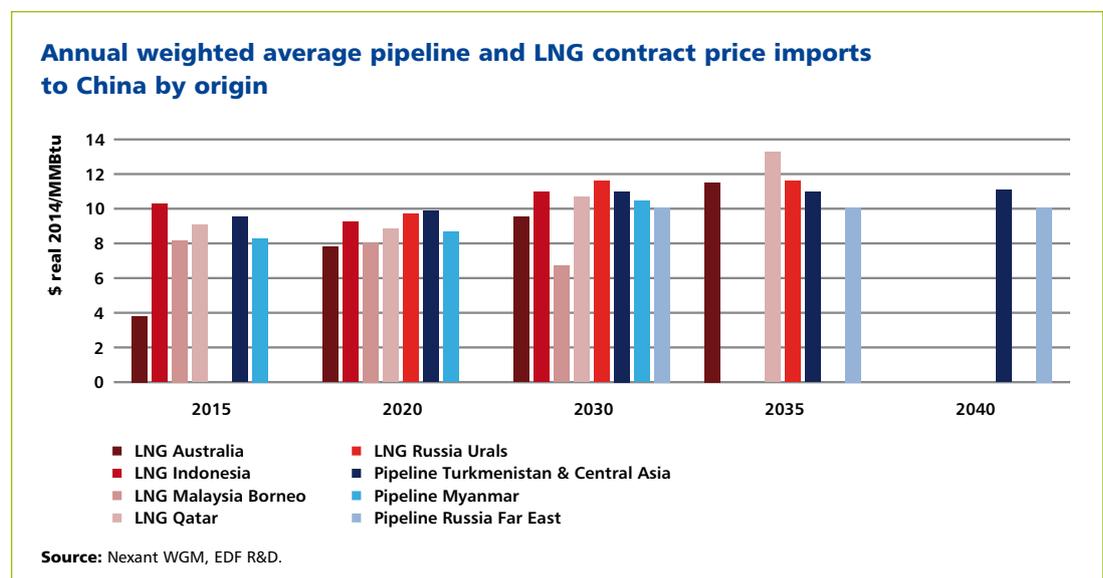


more impacted after 2030 as shale gas production starts its strong growth. But the reasons for these shifts are also related to contract prices and production costs of shale gas. Conventional gas and CBM production costs (LRMC) are cheaper than shale gas production costs of \$7/MMBtu which decrease to around \$5/MMBtu from 2015-2040, with hypothetical technical improvements. The weighted average level of pipeline and LNG imports costs are in a range of \$4-13/MMBtu. This is much higher than shale gas production costs. Shale gas production starts later in the low-demand scenario (2019 rather than 2017 in the base case) because of the reduced demand needs. But what constrains the model to maintain gas imports can be summed up in two factors: the first one is the take-or-pay volumes, and the second is the gas demand satisfaction even if it is reduced. Gas imports will increase from 32% today to 40% in 2040 even if they are more costly than shale gas production, hence the shadow price is increasing during the studied period.

With a lower gas demand, in 2020 China will be mainly delivered with take-or-pay contracts from Central Asian countries at a weighted contract price of \$9.9/MMBtu.

This is a price much higher than the contract price with Myanmar weighted at \$8.7/MMBtu in 2020. At the same time, LNG contract prices are weighted at \$8.6/MMBtu through the 21 suppliers, less than pipeline import costs; this implies maintaining LNG volumes between 2015-2025. As gas demand is reduced, pipeline deliveries are reduced to the take-or-pay level. From Myanmar for example, the pipeline capacity is 12 bcm, but only 7 bcm are delivered which corresponds to the take-or-pay level (70% of 10 bcm annual contract quantity – this gives 7 bcm of contracted volumes). The arbitrage is made between types of deliveries (pipeline or LNG), shale gas production and which suppliers to choose. At the end of the second decade, shale gas production starts its growth and strengthens from 2031. As the LNG import prices weighted at \$10.7/MMBtu are higher than pipeline prices (weighted for \$10.04//MMBtu) and production costs (averaging \$7/MMBtu) during this period, it is naturally more economical to reduce LNG imports than pipeline imports to satisfy the new gas balance compared to the base case. The price contracts are obviously different from one supplier to another.

► Figure 10.



On average, the weighted shadow price is reduced from \$7.7/MMBtu to \$5.5/MMBtu for China or by 30% between the two scenarios between 2015 and 2040.

So if we compare the contribution of all gas deliveries to China between 2015 and 2040 in the base case scenario, we can see that even if produced and imported volumes grow during this period, shale gas production will see its contribution in total supply growing total supply growing to 14% in 2040. This also means that despite China's huge estimated shale gas resources (36 tcm, IEA 2013), it will be the arbitrage between costs of deliveries by contracted or uncontracted volumes from foreign suppliers and the LPMC of domestic production (including shale gas) that will shape the future supply of gas to China and production targets of shale gas.

Change in objective function

The overall change in the objective function is exactly equal to the marginal cost of supply in consequence of gas demand reduction in China. This confirms the fact that a decrease in gas demand from China, which in 2040 represents 10% of global supply, 70% of Asian supply and 12% of global gas consumption, reflects the change in the objective function between the base case and the low demand scenario.

Conclusion

Over the last 13 years, China has been the source of growing world gas demand, but the situation has changed since 2014 and China appears to have entered a phase of lower growth.

Between the base case and the low-demand scenario, large-scale shale gas production is delayed by a decade as cumulative gas demand is 16% in China between 2015 and 2040. Pipeline imports are also impacted by the lower demand and contribute to postponing the development of shale gas. The target of 30

bcm fixed by the NDRC in 2014 for 2020 is not reached before 2026 in the base case and after 2031 in the low-demand scenario.

It is clear from this study that a slowdown in the Chinese economy and thus of gas demand growth in China would not only slow down shale gas production but also gas imports, mainly LNG. Indeed, in spite of the huge recoverable shale gas resources that China holds (first in the world ahead of the USA, Argentina and Algeria), a massive production of this new resource to satisfy its gas demand seems to be unlikely in the medium or long term. However, the weakening of economic growth in China would not necessarily imply a reduction in gas volumes to be consumed, but rather a slowdown in gas demand growth or a decrease in the rate of growth of gas demand. In fact, Chinese gas demand is large enough to require increased volumes to be both locally produced and imported via pipeline (from Turkmenistan and Russia) and by LNG (from Australia, Qatar, Malaysia and Indonesia).

Competition over LNG could also occur with Southeast Asian countries before the end of the decade because of the very large liquefaction capacities in Australia and the USA, most likely pushing prices down. This would involve more trade-offs between LNG imports and shale gas production targets. Increasing the volumes of gas for demand will still require significant domestic production and significant volumes of gas to be imported. This is reinforced by China's clear desire to reduce the share of coal in its energy mix and raise the share of natural gas and renewables, particularly in the electricity sector in the largest consumer areas (east and south).

Nabila Chafai is a researcher at EDF R&D and member of IGU's Gas Markets Committee Study Group 1. The original, fully referenced version of this paper can be downloaded from the IGU website.



PETRONAS Floating Liquefied Natural Gas:

Redefining Technology to Deliver Excellence

PETRONAS' strategic undertaking which was first put forward in 2010 to develop the first Floating Liquefied Natural Gas facility has culminated into the successful development and completion of PFLNG Satu, PETRONAS' first floating LNG facility, scheduled for operational start-up this year at the Kanowit gas field, 180km offshore Bintulu, Sarawak.

Limiting the need for extensive pipelines or heavy infrastructure, PFLNG Satu redefines LNG processing and production, creating an unconventional solution to monetize natural gas trapped in unviable locations where conventional rigs and pipelines simply won't work.

Undoubtedly innovative, requiring state-of-the-art technology to address a multitude of technical and operational challenges, the entire facility, upon start-up,

will encapsulate all the required LNG processing and production facilities, personnel accommodation and more importantly, an efficiently operable and HSE-compliant storage and offloading facility that allows for direct shipping to markets.

This game-changer epitomizes Malaysia's excellence in inventive engineering solutions to meet increasing global energy demands. Once on-stream, PFLNG Satu will produce 1.2 million tonnes per year (mtpa) of LNG over a period of 20 years of its design life - boosting Malaysia's total LNG production capacity to about 32 mtpa.

Consisting of 22 modular components, the facility includes gas treating, liquefaction, storage and offloading systems. The heart of the FLNG is essentially the liquefaction system which liquefies natural gas to minus 162 degrees Celsius, a process that shrinks its volume by 600 times. Once liquefied, the LNG will be stored in a dual row membrane type Cargo Containment System (CCS) before being offloaded to the LNG carrier.

"PFLNG Satu is the result of our tireless efforts in applying our best and brightest minds to innovate and deliver this groundbreaking energy solution in these challenging times. By unlearning conventional processes and reshaping the rules to design and build this technological marvel of unprecedented scale and ambition, we continue to press forward as a leading global LNG player," said PETRONAS President & Group Chief Executive Officer Datuk Wan Zulkiflee Wan Ariffin.

PFLNG Satu further fortifies PETRONAS' competitive edge in the value chain of the business from gas production right up to marketing of the LNG, offering end-to-end value to LNG buyers. With PFLNG Satu in its LNG portfolio, PETRONAS is well-positioned to drive and influence similar scale FLNG developments worldwide in terms of niche expertise and capability development.

PFLNG Satu is a first-of-its-kind development, hence unlike building onshore facilities where a Work Breakdown Structure (WBS) already exists for reference. The WBS for the project had to be developed from scratch and is based on active integration between upstream and downstream experiences, whereby strict project governance has been put in place to monitor each significant stage of the project.

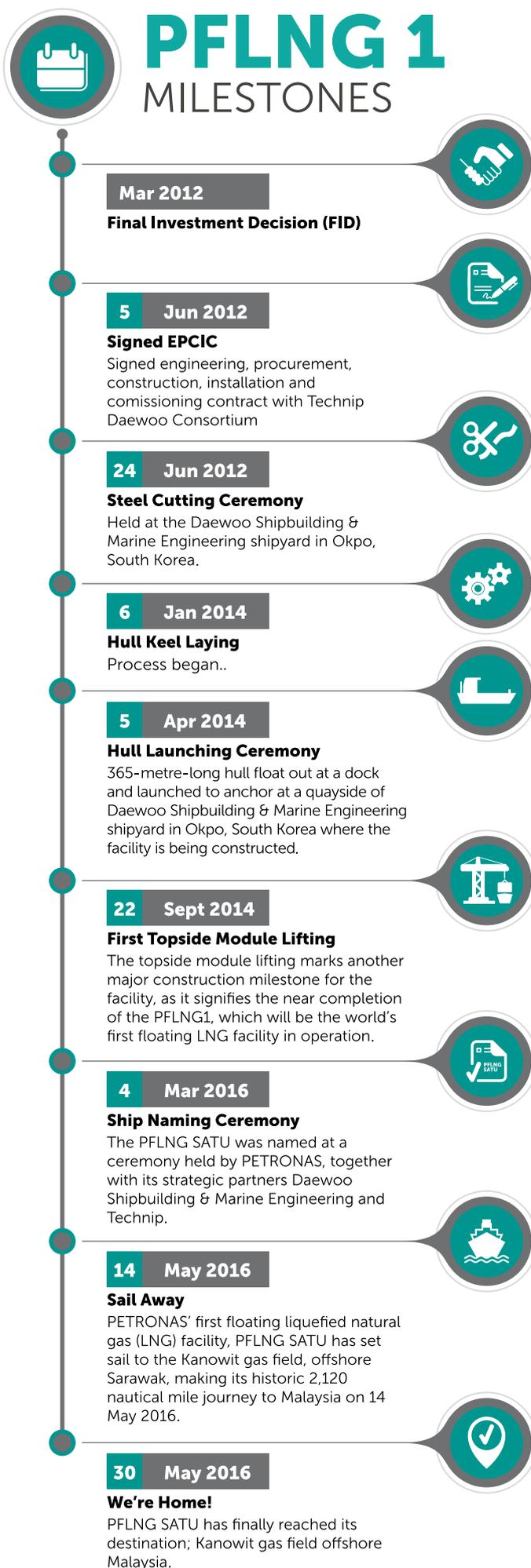
The innovative and challenging part of the project is essentially building a plant on a floating barge, where the topside engineering work for offshore installation is far different from onshore design. Numerous technologies and solutions developed by PETRONAS' very own Project Delivery & Technology division were applied. These included the PETRONAS Instrumented Protective Function (P-IPF™), a methodology to determine the adequacy of safety related instrumentation in a plant. The application of this process safety solution helps to identify and minimize process safety-related issues. Besides this, the FnGMap™, a 3D Fire and Gas Mapping software, accurately determines placements of fire and gas detectors for a hydrocarbon environment.

The PETRONAS Risk Based Inspection (P-RBI™) for plant and maintenance inspection software is also implemented. In addition, the PETRONAS Electrical and Safety Operability Review tool (P-ELSOR™) was developed and deployed to verify electrical system and equipment for preliminary and design stages to prevent potential electrical failures.

With the PFLNG Satu up and running in due course, the future remains optimistic for FLNG with the potential monetization of more than 600 marginal gas fields which would otherwise remain stranded and undeveloped without such a technology.

PFLNG Satu is testament to the Company's continued fervor in driving innovation and technology excellence to meet global energy demand.

For more information please visit www.petronasofficial.com/flng

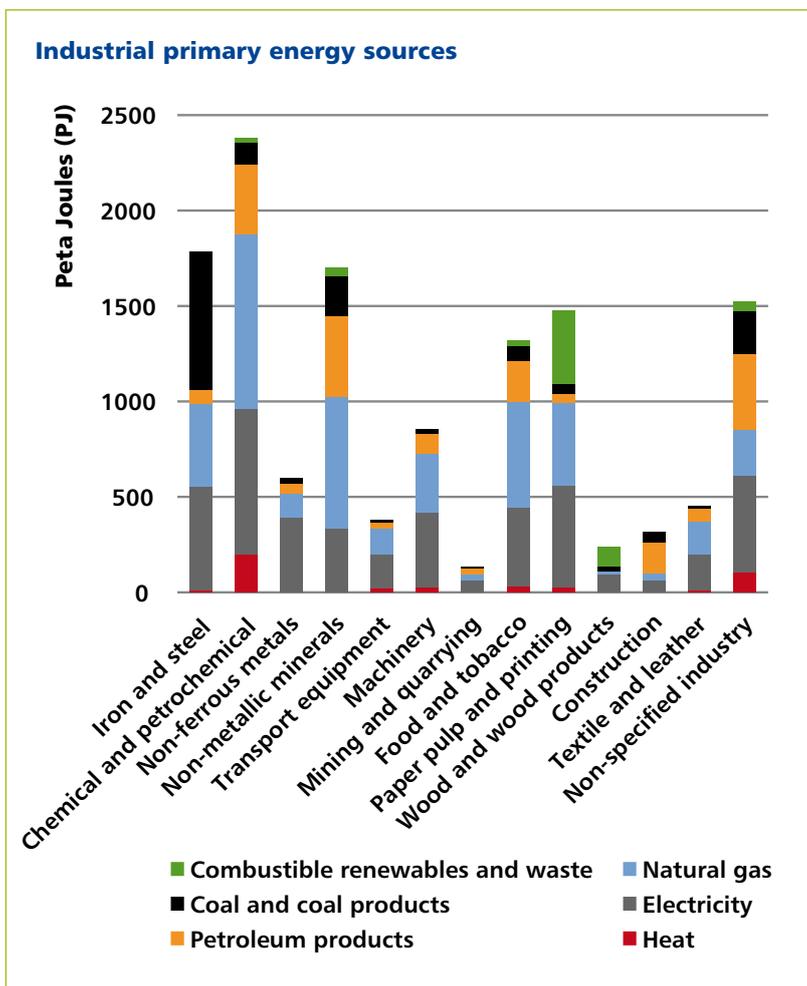


Pollutant emissions reduction in industrial gas-fired applications

By Bernard Blez, Philippe Buchet, Anne Giese, Klaus Görner, Jörg Leicher and Mathieu Ourliac

For many industrial production processes, natural gas is the premier choice to provide process heat in an efficient and environmentally friendly manner. A globally abundant supply, the lowest carbon dioxide (CO₂) emissions of all fossil fuels and good controllability, resulting in high efficiencies and excellent product quality, are just some reasons why natural gas is used for many production processes across many different industries.

▼ Figure 1.



From an environmental perspective, natural gas does not only produce less CO₂ when burned but also significantly lower emissions of other major pollutants such as nitrogen oxides (NO_x), sulphur oxides (SO_x) or fine particulate matter than with other fossil fuels.

Industrial gas utilisation is characterised by a high degree of specialisation. Combustion processes in various industries are often radically different from one another with regards to temperature levels, burner technologies and many other factors. Basically, each thermal processing plant is unique. This article reviews some technological developments in the fields of burner and process technologies to show how different thermal processing industries have successfully reduced their ecological footprint using natural gas and to highlight current developments to achieve even further emissions reductions.

Introduction

In 2014, industrial utilisation accounted for 31% of the total consumption of natural gas in the European Union, an increase of 0.7% when compared to 2013. Power generation accounted for a further 22.6%. After residential and commercial utilisation, the industrial sector is the second-largest gas consumer in the EU. It is safe to assume that the situation is similar in many other highly industrialised regions around the world. *Figure 1* shows the main primary energy sources for various industries in the EU and some other regions in 2003.

While there are an estimated 167 million domestic gas-fired appliances in the EU, the number of installed industrial gas applications is much lower. The firing rate of a given piece

of gas-fired equipment, however, is usually drastically higher than that of a residential or even commercial heating or cooking appliance, so that the total natural gas consumption of the residential and industrial sectors is on roughly the same level. While there are some discussions of increasing the share of electrical-process heat generation using wind or solar power in the wake of the energy transition movement, especially in Europe, this appears unlikely for many industries due to technological or economic constraints. Natural gas will remain a crucial energy source for many industries for the foreseeable future.

Compared to the residential sector, the use of natural gas in manufacturing industries is highly diversified and specialised. Even within a given industry, there can be a distinct lack of standardisation, with many different competing technologies for the same application. Process temperatures range from less than 300°C in the food, paper or textile industries (e.g. for drying purposes) to about 1,600°C in high-temperature melting processes, for example in metallurgical industries, or glass and ceramics manufacturing. Maximum temperatures in the combustion zones can be much higher. Air excess ratios tend to be low for efficiency reasons ($\lambda \approx 1.02$ -1.2), though some methods such as galvanising processes in the metals industries are intention-

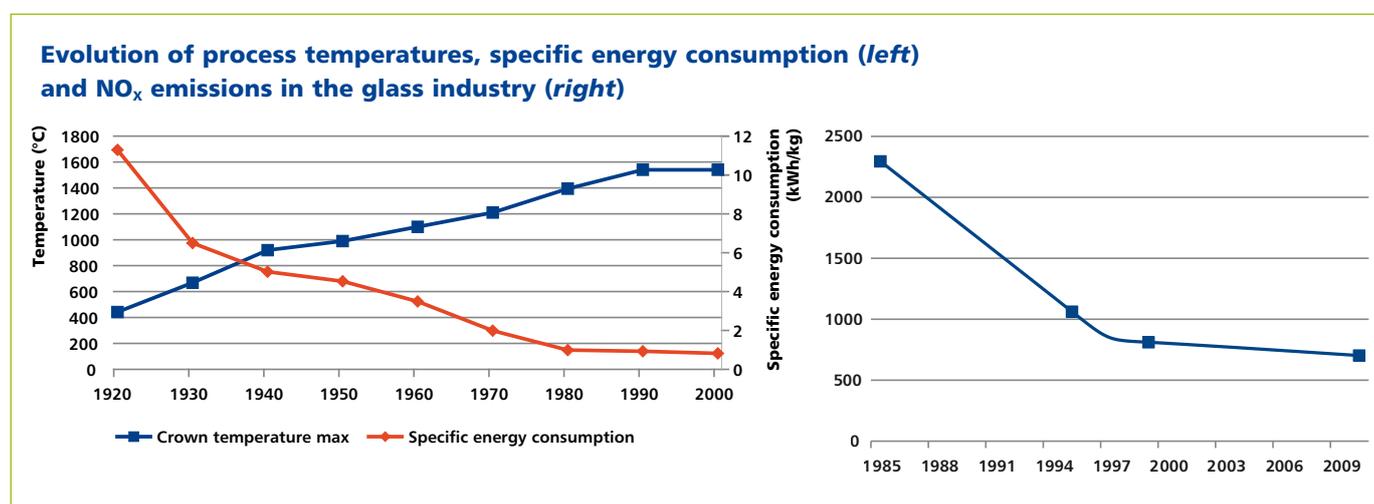
ally operated in a sub-stoichiometric regime to protect the product from interaction with oxygen. Other production processes require very specific and tightly controlled temperature-time profiles, for example annealing or glazing processes. The chemical industry uses natural gas not only as a fuel but also as a feedstock for chemical-conversion processes such as hydrogen or ammonia production.

It is worth mentioning that the largest amounts of process heat are required at very high process temperature levels ($> 1,400^\circ\text{C}$), with the corresponding technological challenges in energy efficiency and emissions control.

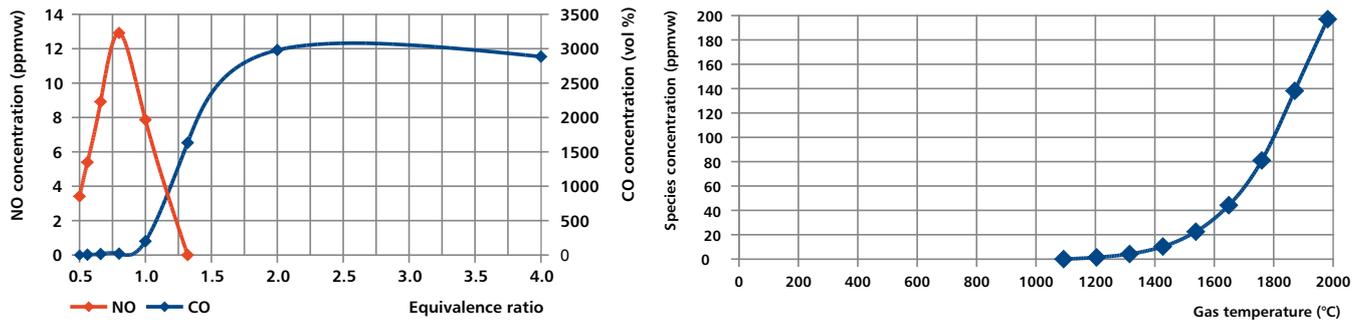
The common denominator for most industrial gas-fired processes is that they have to satisfy increasing demands with regards to product quality, energy efficiency and pollutant emissions. Operational safety, obviously, is paramount. Over the decades, processes, plants and components have been continuously improved, sometimes at the expense of operational flexibility, for example, in the context of fluctuating gas qualities. *Figure 2* shows technological trends from the glass industry as an example.

These diagrams demonstrate that despite being an energy-intensive industry with high-process temperatures, the glass industry has steadily decreased its energy consumption per product unit by a variety of measures, such as

▼ Figure 2.



Left-hand side: effect of equivalence ratio ($= 1/\lambda$) on CO and NO formation; right-hand side: dependency of thermal NO formation from combustion temperature.



▲ Figure 3.

switching from producer gas to oil firing and later natural gas, the introduction of better refractories and the extensive use of recycling. At the same time, NO_x emissions have also been reduced despite increasing process temperatures. Part of this NO_x reduction is due to the switch from oil (which tends to produce large amounts of NO_x via fuel-bound nitrogen compounds) to natural gas, but improvements in burner technologies and furnace design have also played their part. Today, despite furnace temperatures of about 1,600°C and air pre-heating often exceeding 1,350°C, many glass manufacturing plants manage to comply with current European NO_x emission limits without resorting to secondary measures such as selective catalytic reduction or selective non-catalytic reduction plants to remove NO_x from the flue gas. Similar developments can also be shown for other industries.

However, these diagrams also show that the slopes of the curves become less pronounced. Further reductions of energy consumption and pollutant emissions will require increasing technological efforts or even require a trade-off between efficiency and emissions.

Compared to the rather homogeneous residential gas utilisation, the industrial sector is much more diverse. The technological solutions to achieve high-product quality, low fuel consumption (which, of course, directly translates

into low CO_2 emissions) and low pollutant emissions vary drastically from industry to industry, from application to application.

In thermal processing, there often is no standard solution.

Pollutant formation

From the point of view of combustion, the most relevant pollutant species when burning natural gas are carbon monoxide (CO), CO_2 and NO_x . Since natural gas, at least in Europe, is basically sulphur-free, SO_x emissions from combustion are generally negligible unless there are other sulphur sources in the process.

CO emissions usually occur either due to a global lack of oxidiser in the combustion space, leading to incomplete combustion (see also *Figure 3, left-hand side*). Other causes for high CO emissions can be excessive heat loss (basically quenching the flame), combustion instabilities or poor local mixing between fuel and oxidiser. In general, high CO emissions should not be an issue in a properly designed and adjusted furnace system.

CO_2 emissions, on the other hand, are directly related to the fuel consumption itself. Given the high firing rates and competitive pressure in manufacturing industries (large industrial furnaces can easily have firing rates of 100 MW), reducing fuel consumption and hence operational expenditures has always

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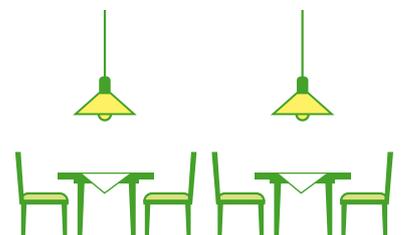
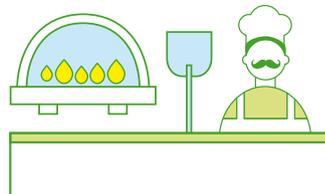
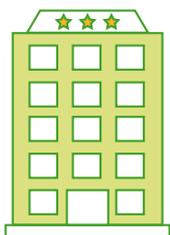
- ✓ energy efficient
- ✓ environmentally friendly
- ✓ easy to use



in vehicles



in industry



in businesses



in homes

DEPA introduced natural gas into the Greek market, knowing its many advantages for all customers - and our precious environment. Our priority is to expand the natural gas network in Greece and to develop and implement CNG/LNG technology. This way, we can supply natural gas to more individual customers, remote areas, and the country's many islands.



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been a priority for industrial combustion systems, especially in countries where natural gas is comparatively expensive.

One of the most effective ways to reduce fuel consumption is to use the hot flue gas to preheat the combustion air by means of recuperators or regenerators that are either part of the burners themselves or as separate plant components, like hot blast stoves in steelworks or regenerators in glass-melting furnaces. In the case of central regenerators, these units can be larger than the actual furnace itself, depending on the firing rates.

Recuperative systems can be operated continuously, whereas regenerative systems have to be cycled, with cycles ranging from several seconds to 30 minutes, depending on whether regenerative burners (where the regenerators are an integral part of the burner unit) or central regenerators are used.

While air preheating has a positive effect on the fuel efficiency, it also leads to significantly higher combustion temperatures. For example, the adiabatic flame temperature (a theoretical value which gives the maximum temperature that a flame can obtain absent any losses) of a stoichiometric methane air flame at ambient conditions is about 1,970°C. An air preheat temperature of 500°C (which can be achieved with a standard metallic recuperator) already leads to a flame temperature of 2,150°C. If the combustion air is preheated to 1,400°C (a realistic value for modern regenerative glass-melting furnaces), the adiabatic-flame temperature reaches more than 2,400°C.

High combustion temperatures, however, can lead to unacceptably high NO_x emissions (see *Figure 3, right-hand side*). NO_x emissions are regulated since nitrogen oxides act as a greenhouse gas and also attack the ozone layer. During the combustion process itself, NO is produced which then continues to oxidise to nitrogen dioxide (NO₂) in the atmosphere.

When burning natural gas, the dominant way to form NO_x is the so-called thermal nitro-

gen monoxide (NO) formation mechanism. NO is formed from nitrogen and oxygen contained in the combustion air as long as temperatures are sufficiently high (> 1,200°C) and there is sufficient oxygen present. An easy way to minimise NO emissions would be to use sub-stoichiometric combustion but this would lead to unacceptably high CO emissions and low fuel efficiency due to incomplete combustion (see *Figure 3, left-hand side*). One technological challenge in burner design is thus to achieve high fuel efficiency and, at the same time, low CO and NO emissions.

While thermal NO formation rates are slow compared to other chemical reactions in the combustion process, they are an exponential function of the local temperature which means that even a small temperature increase can lead to a significant rise in NO emissions.

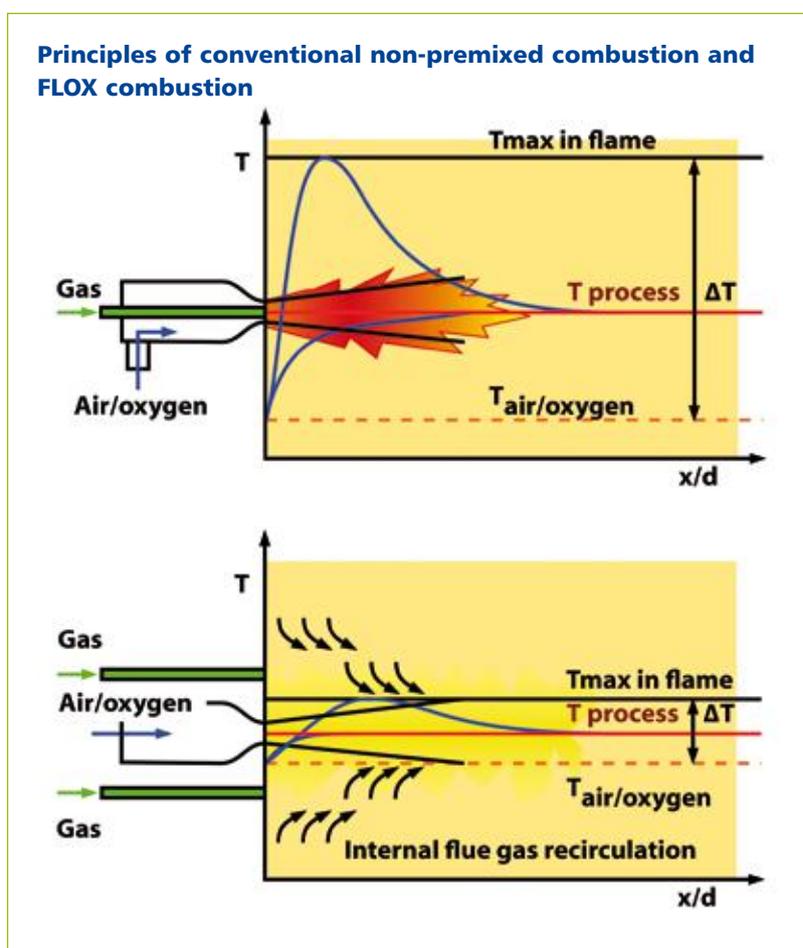
There are other routes to NO formation but their impact on emissions from a natural gas combustion process is negligible unless the fuel gas is contaminated by nitrogen-carrying compounds like ammonia (NH₃) or hydrogen cyanide (HCN).

In principle, thermal NO formation can be controlled by four factors:

- ◆ Local temperature;
- ◆ Local oxygen concentration (or local nitrogen concentration in the case of oxy-fuel combustion, i.e. the combustion of natural gas with pure oxygen instead of air);
- ◆ Residence time in the hot zone;
- ◆ Pressure (usually not an issue for industrial furnaces operated at ambient pressure but significant for high-pressure combustion systems like gas turbines).

The way to combine high combustion temperatures with low NO formation is thus to avoid regions within the combustion space where high local temperatures coincide with a sufficient oxygen supply and long residence times. This is the basis of most primary measures for NO_x reduction in gas combustion.

► Figure 4.



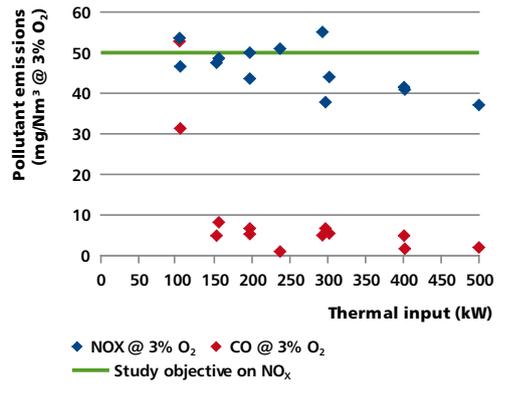
Flameless oxidation

Flameless oxidation (often abbreviated as FLOX) has been credited as one of the most successful primary measures for NO_x formation reduction in many industries. This form of combustion is also known as moderate or intense low-oxygen dilution combustion (MILD combustion). Compared to a conventional burner system, fuel and combustion air are injected into the combustion space with higher velocities in a FLOX burner (see Figure 4). As a result, the fuel and air jets entrain large amounts of hot but chemically inert reaction products which results in a dilution of the reaction zone. For combustion to occur, temperatures in the reaction zone have to be above the self-ignition limit ($> 850^\circ\text{C}$ for safety). Usually, FLOX burners can therefore be operated in both conventional

flame and flameless modes. The flame mode is used to heat up a furnace to a temperature level above the self-ignition limit. The burner is then switched over to flameless mode for normal operation with a minimum of emissions.

In principle, flameless oxidation can be considered to be an extreme form of internal exhaust gas recirculation. The name derives from the fact that in FLOX mode, there is no visible flame in the combustion zone in the optical spectrum. Only using UV flame-imaging technology can the reaction zone be visualised. The effect of the extreme dilution of the reaction zone is profound: temperature peaks are drastically lessened and the local oxygen concentration is severely reduced. The shape of the reaction zone also changes into a form of volumetric combustion. As a result, temper-

NO_x and CO emissions over the entire modulation range of a patented Crigen burner in a 500kWth fire-tube boiler



► Figure 5.

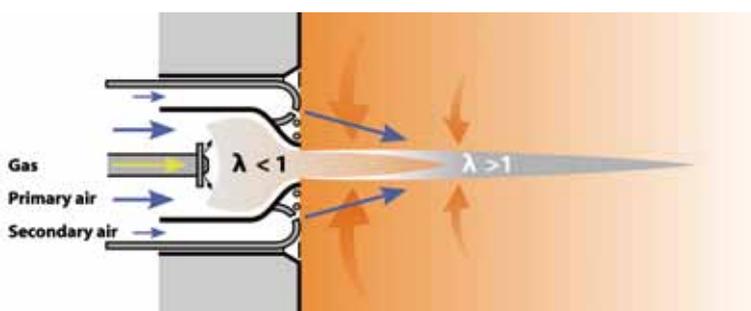
ature distributions in the combustion space are very homogeneous and very low NO_x emissions can be achieved.

This technology has been successfully introduced to many high-temperature processing industries, in particular in the steel industry, with significant reductions of NO_x emissions. Also, the characteristic homogeneous temperature distributions are advantageous for many applications, often leading to increased productivity and reduced fuel consumption.

In Germany, flameless oxidation was even used for firing a recuperative glass-melting furnace, a so-called “unit melter”. Compared to the previously installed conventional burner

► Figure 6.

Principle of air staging in an industrial burner



system, operational experience over a period of more than seven years shows that NO_x emissions from the furnace were reduced by about 50% while maintaining fuel consumption and, most importantly, product quality.

In addition to furnaces for the direct or indirect heating of materials, industrial boilers (both in water-tube and fire-tube configurations) are another form of large-scale, gas-fired applications found in many industries. Thus, the Large Combustion Plant Directive of the European Commission aims at reducing NO_x from large combustion plants. Best available burners technologies for industrial boilers comply to NO_x emissions limits (100mg/Nm³@3% O₂) only with great difficulty. Moreover, many NO_x reduction methods incur additional costs on turn-down range and/or energy efficiency in these applications.

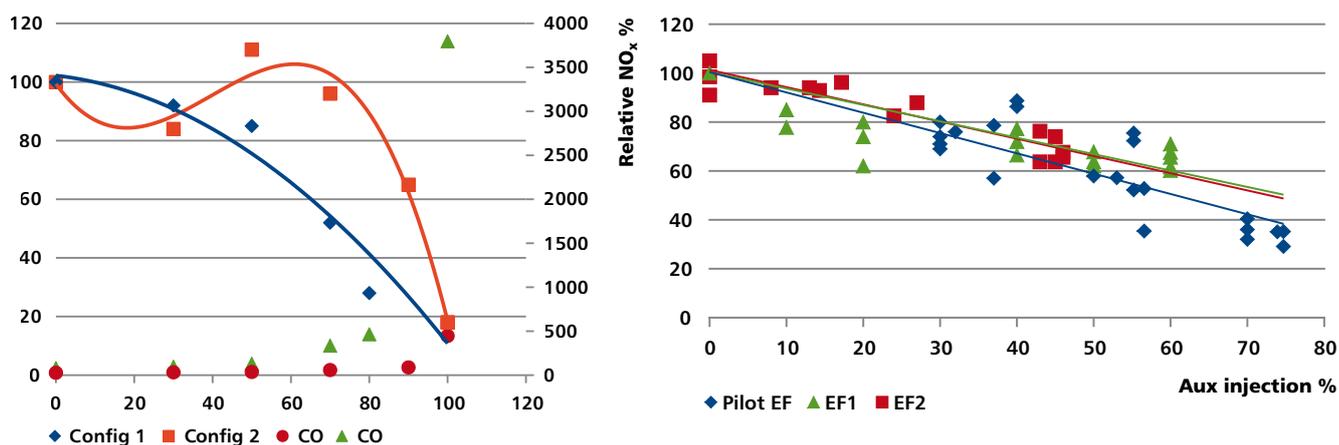
Engie’s technology lab, Crigen, worked with the laboratory of École Centrale Paris and Coria Laboratory in France to obtain more insight on flameless combustion and, in particular, its interaction with low wall temperatures. The aim was to develop the 2020s gas-burners technology, with NO_x emissions lower than 50mg/Nm³@3% O₂ and modulation range larger than 1:8 for all kinds of boilers (fire tube and water tube).

The project concluded with a patented design of a flameless combustion stabilisation technology for low-temperature furnaces and boilers. The concept was validated at semi-industrial scale (500 kWth fire-tube boiler). With a small air excess (high-energy efficiency) of 5%, NO_x emissions are lower than 50mg/Nm³@3% O₂ on a 1-5 modulation range (see Figure 5). Further R&D work is in progress to increase the modulation range and to test performances at industrial scales (10 MWth at nominal thermal input).

Staging of fuel and/or combustion air

The left-hand side of Figure 3 shows that NO formation is highly dependent on local air

Left-hand side: NO_x reduction by means of auxiliary firing (fuel staging) in a test rig for various configurations; right-hand side: measurements at industrial furnaces and a test rig.



ratios. Thermal NO formation has its maximum in the near-stoichiometric regime due to locally high temperatures. In the very fuel-rich or very fuel-lean regimes, on the other hand, NO formation is drastically reduced. This can be exploited by staging the combustion process, i.e. dividing the reaction zone into separate reaction zones, each with a local air ratio way below or way above stoichiometry. There are many different ways to implement staging, either as part of burner design or in an entire combustion space (similar to power-plant boilers).

Figure 6 shows an air-staging concept in an industrial burner. The combustion air is divided into primary and secondary air flows. Fuel and primary air mix in the primary reaction zone at locally substoichiometric conditions, with consequently low local NO formation but also incomplete fuel conversion and strong formation of both CO and soot. Soot formation in a natural gas flame is actually often an advantage in these applications because it leads to a strongly luminous flame with excellent radiative heat-transfer properties. The remaining combustion air is then injected into a secondary reaction zone further downstream at very fuel-lean conditions in order to achieve complete burnout and deconstruct the soot. Ideally, the

secondary reaction zone is placed in a region where the flame has already lost a lot of energy but local temperatures are still sufficiently high to ensure complete fuel conversion.

Staged combustion can also be realised in the furnace space itself. This was demonstrated for regenerative glass-melting furnaces in the EU-funded Craftem project and in the German research project Spektral-II. In both, the amount of natural gas injected through the primary lances into the furnace was reduced while the air volume flow remained constant. In this manner, a locally lean reaction zone is established where NO formation is reduced. The missing fuel is then injected into the furnace by means of a secondary fuel lance in a region in which it is mixed with excess oxygen and hot flue gas products.

The measurements shown in Figure 7 underline the effect that this so-called auxiliary firing can have on NO_x emissions. However, the diagram on the left-hand side also demonstrates that careful planning and analysis have to be used when implementing such a secondary gas injection in a furnace. It can be seen that with some configurations, NO_x emissions actually increase in the test rig due to an unfortunate configuration. Computational fluid dynamics

▲ Figure 7.

simulations of the turbulent reacting flows within the furnace can be a valuable tool in this context to evaluate various configurations in order to find an optimum. If designed properly, significant NO_x emission reductions are possible, as the results of Craftem demonstrate. These results are corroborated by the German research project, which also reports that a reduction of fuel consumption of 2% was measured when implemented in an already well-adjusted glass-melting furnace. The operator of the furnace has since started converting other regenerative furnaces to use fuel-staging concepts.

Oxy-fuel combustion

While all primary measures presented so far reduce thermal NO emissions by interfering with the NO formation process in one way or the other, oxy-fuel combustion “simply” removes the main source of nitrogen in the chemical system: air. Instead of air, pure oxygen is used as an oxidiser, which, in theory, allows for an almost complete elimination of nitrogen oxides. In real life, things are not as easy but nevertheless, oxy-fuel combustion offers potential for drastic NO reduction and often also reduced CO_2 emissions, especially for high-temperature processes. The latter is due to an increased thermal efficiency and also increased heat transfer because of a flue gas which consists basically of CO_2 , H_2O and some O_2 . This can help severely reducing heating times and hence improve plant throughput.

Oxy-fuel combustion in thermal processing must not be confused with oxy-fuel combustion in power generation where the combustion air is replaced by a mixture of oxygen and recirculated CO_2 . In power plants, oxy-fuel combustion is considered a precursor for carbon capture and storage (CCS) since the dried exhaust gas consists almost exclusively of CO_2 . The ratio of oxygen to CO_2 in the oxidiser is adjusted in such a way that combustion temperatures are on a similar level to what can be found in conventional boilers or gas turbines. Most often, this

type of oxy-fuel combustion is discussed in the context of combustion for power generation but there are discussions to extend CCS technology also to large industrial plants with significant CO_2 emissions.

In many thermal processing industries, oxy-fuel combustion (using pure oxygen as an oxidiser to achieve very high process temperatures) has found widespread utilisation: about 25% of new glass-melting furnaces in the US and 18% in the Netherlands are oxy-fuel systems.

The steel industry in particular uses oxy-fuel burners for many different applications and also for many different fuels (e.g. process gases with low calorific values, fuel oil or natural gas). In modern electric arc furnaces, for example, high-momentum oxy-fuel burners are often used to support the heat influx into the melt, reduce electricity consumption and help avoid ‘cold spots’, thus increasing the productivity of the plant. In many cases, CO_2 and NO_x emissions could be reduced quite drastically, while significantly increasing throughput. Even despite the additional electricity required to produce oxygen in large quantities on-site, oxy-fuel combustion has great potential, both from an economic and ecological perspective.

The aluminium industry, on the other hand, has been more cautious to adopt oxy-fuel technology because of the high flame temperatures which can damage the aluminium surface. Developments like low temperature oxy-fuel burners, based on the flameless oxidation principle, promise a more efficient recycling and remelting of aluminium, with higher melt rates, less dross, lower fuel consumption and very low NO_x emissions.

While the CO_2 -emission reduction is inherent in oxy-fuel combustion due to higher thermal efficiencies and improved heat transfer, which allow higher plant throughput and hence reduced energy consumption per product unit, reduced NO_x emissions are not necessarily guaranteed. In fact, possible nitrogen sources have to be closely monitored because, due to



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the very high local temperatures, any nitrogen present can actually result in extremely high NO emissions if the burner system is not designed accordingly.

Infiltration air and N₂ contents in fuel or oxidiser in particular can be problematic. In some industries, nitrogen or nitrogen compounds are also added as part of the production process, for example nitrates in the glass industry to remove bubbles from the melt describes a case in which an oxy-fuel converter for precious metals was supplied with impure oxygen (5 vol-% N₂ content). NO_x emissions were extremely high until the burner lance was redesigned to operate with very high momenta to reduce NO_x formation, basically achieving a flameless oxidation mode.

Nevertheless, oxy-fuel combustion can offer a massive reduction of NO_x emissions if properly designed and implemented. Oxy-fuel combustion can also be combined with other primary measures to suppress NO formation even further, like flameless oxidation, external exhaust gas recirculation, flat flame burners or staging.

Technologies to recover some of the energy in the flue gas of oxy-fuel furnaces are currently being investigated, for example fuel and oxygen preheating, thermochemical recuperation or even thermochemical regeneration. Theoretical analyses, simulations and first field tests promise even better energetic efficiencies but also point to challenges regarding refractories and furnace control.

Conclusion

Natural gas is a very versatile energy source essential to many different industries. Compared to other sectors of the international gas markets, industrial gas utilisation is highly diverse and very specialised. Often, the combustion process is only one sensitive link in a complex production chain. Standard solutions are rare; almost every process is unique. Given the high firing rates in industrial applications, the focus of operators and manufacturers of

industrial gas-fired equipment as well as national authorities has always been on high efficiencies and very low pollutant emissions. The consequent pressure to improve, both economic and regulatory, has pushed many industries to reduce fuel gas consumption (and thus CO₂ emissions) and pollutant emissions for the last decades, often by implementing high efficiency natural gas solutions. At the same time, productivity has generally been increased quite significantly.

This article highlights just a few technologies to reduce nitrogen oxides and carbon dioxide emissions, the most relevant for industrial gas-fired equipment. The examples were taken mostly from the field of high-temperature thermal processing industries like metals or glass manufacturing which, due to the high process temperatures required, are especially sensitive to NO_x emissions and are very energy intensive.

The cases presented here demonstrate the ongoing potential of natural gas as a clean and efficient energy source for many industrial manufacturing processes. However, they also underline the necessity of continuous research and development activities of academia, gas suppliers, equipment manufacturers and plant operators to provide tailor-made solutions for clean and efficient industrial gas utilisation.

Anne Giese is Head of Department for Industrial Combustion Technology, Klaus Görner is Scientific Director (and Head of the Chair of Environmental Process Engineering and Plant Design at the University of Duisburg-Essen) and Jörg Leicher is Research Engineer, all at Gas- und Wärme-Institut eV, Essen, Germany; Bernard Blez is Senior Vice President, Research & Technology Department, Philippe Buchet is Director of R&D Programmes and Senior Key Expert in Energy & Environmental Efficiency in Industry and Mathieu Ourliac is Industrial Combustion Expert, all at Engie Lab - Crigen, Saint-Denis, France.

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Solutions in natural gas transmission systems



The role of gas in a carbon-neutral energy mix

By Marcel Hoenderdos and Dimitri Schildmeijer

Marcel Hoenderdos (EBN) and Dimitri Schildmeijer (WPNT) are members of the Marketing and Communications Committee. This committee looks at the role of communications in engaging stakeholders on new building projects, sustainability, clean air and innovation. Marcel and Dimitri chair the Committee's Study Group on Public Acceptance of Gas Projects.

At the European Autumn Gas Conference on Public Acceptance and Advocacy (The Hague, November 2016) Marcel Hoenderdos organised a panel. Marcel is the Communications Director of EBN, the Dutch state-owned participation company and a partner in every oil and gas project in the Netherlands. The panel was moderated by Dimitri.

The premise of the panel was that the certitude of gas as part of a sustainable energy future is not a given and needs to be earned. Marcel and Dimitri invited four speakers in a round table discussion to further explore how the sector can reinvent its relationship with society.

Panel member Scott Seatter, Managing Director of Vermilion Energy Netherlands BV, believes there is a future for onshore gas production in the Netherlands. The starting point is the licence to operate. "Companies have only the

rights given to them by society," Scott stated. It wants to engage with all stakeholders as early as possible and do so in an open, transparent and respectful manner. The Canadian-owned company operates 100 wells in the Netherlands alone. And today, the company is asking the Dutch government for fiscal reform. Vermilion believes the local jurisdictions should receive a share of the revenue generated from gas developments in exchange for hosting the activity.

UK Onshore Oil and Gas (UKOOG) Director Corin Taylor talked about lessons learned from his hard-fought battles over shale gas in the UK. For him, a future role for onshore gas starts with a changing narrative on the role of gas: "Gas is vital for our lives. But local gas production also means less imports. Gas can mean green gas and low-carbon solutions like hydrogen and carbon capture and storage. By reframing the narrative on gas, you can start to reinvent your relationship with society." Corin also provided advice on engaging communities to get buy-in for gas projects:

- ◆ Focus on creating (economic) value for local communities. For example, make sure you hire a lot of local people as employees or contractors. They carry a lot of credibility.
- ◆ Make transparency the good practice – for example, be honest and open about the chemicals you use and the environmental impact you have. Be ready to change the project based on feedback.
- ◆ Work very hard to minimise risk and the worry about risk. For example, UKOOG invested in designing a brand new insurance scheme to reassure citizens that any damage as a result of the wells – now or in the future – is covered.

▼ From left to right: Scott Seatter (Vermilion), Corin Taylor (UK Onshore Oil and Gas), Paul Stamsnijder (The Reputation Group), Thijs Starink (EBN) and moderator Dimitri Schildmeijer (WPNT) at the European Autumn Gas Conference in November 2016 in The Hague.



- ◆ Build a coalition of supporters of the project. This is ultimately a local political campaign. Identify supporters and encourage them to speak up.

Stakeholder management expert Paul Stamsnijder complimented the gas sector on being very much “tuned in” with decision makers in the sector. The challenge, he put to the room, was to get out of the industry’s comfort zone and start engaging with non-traditional stakeholders in society. His approach is to know, measure and ‘date’ stakeholders. Paul makes the point that this starts by changing the culture in your own organisation. “You have to go from an ivory tower to an open house,” is at the heart of his vision on transforming companies and getting more in tune with society.

Finally, EBN’s Asset Director Thijs Starink stated that his organisation fully supports a carbon-neutral energy mix by 2050. He said that for EBN this was both the end goal and the starting point of a discussion on what gas can be. EBN is one of the leading companies that is working on “Gas by Design”, a new Dutch approach to redefine the role of gas. It means that using gas is not a given, but a choice. It is a renewed promise that in the forcefield of climate change, public acceptance, seismicity and geopolitics, gas can carry the good cause.

Thanks to the panel for its insights!

Marcel Hoenderdos and Dimitri Schildmeijer chair the IGU Study Group on Public Acceptance of Gas Projects. Contact: dschildmeijer@wpnt.com



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News

We start the section with an update on the work undertaken by IGU since the last edition of *International Gas* in October 2016.

The project that is transforming IGU, *Building for the Future*, now enters Phase III. Two issues require detailed study and suggestions for reform: the role of the IGU Presidency; and role of organising the World Gas Conference. Luis Bertrán Rafecas, IGU Secretary General, presents the plans.

Now running since 2008, the IGU Global Gas Award will be a feature of the World Gas Conference in Washington DC. We provide an overview of the Award criteria and process, look back at its most recent winner and provide details of the entry requirements for 2018.

IGU's Regional Coordinators for Asia and Asia-Pacific and for North America discuss important topics affecting their spheres of influence.

IGU's work with government and policymakers is highlighted in two articles, the first reporting on the 5th IEA/IGU Ministerial Gas Forum and the second on engagement with the diplomatic corps through the expanding Diplomatic Gas Forum event series.

We have details from IGU's 2016 Council meeting that was held in Amsterdam last October, which marked the handover from Norway to Spain as host of the Secretariat. Highlights included Pål Rasmussen addressing his final IGU meeting as Secretary General and details of a draft report on fugitive methane emissions by Mel Ydreos, IGU Executive Director Public Affairs.

There is also an update on the 27th World Gas Conference, which is now just over a year away. WGC 2018 Executive Director Jay Copan reveals the state of play with keynote speakers and what you can expect in the exhibition's special pavilions. We also bring you the final preview ahead of IGRC 2017 in Rio de Janeiro in May.

News from organisations affiliated to IGU this issue provides the latest updates from GTI, GIIGNL and WLPGA.

And finally we introduce you to IGU's newest Associate Members, the Natural Gas Society and PwC.

News from the Presidency and Secretariat

Amsterdam Council Meeting – A celebration of IGU’s 85th anniversary and the final meeting under the Norwegian Secretariat

The last annual IGU Council meeting under the Norwegian Secretariat took place in Amsterdam in October 2016. Running over four days the event was hosted by KVGN – the Royal Dutch Gas Association – with IGU Honorary Member Robert Doets presiding over an outstanding programme for attendees.

The Council week provided the opportunity for discussion, debate, and engagement on important issues facing the industry.

The Dutch Gas Industry Workshop

The IGU Council week in Amsterdam featured three workshops. The first was the traditional host country gas industry workshop, discussing the latest industry developments in the Netherlands.

On the panel was Gertjan Lankhorst, CEO of GasTerra, and until recently, President of the Dutch Gas Association and IGU Regional Coordinator for Europe; Thijs Starink, Director Asset Management at the Dutch company EBN; and Coby van der Linde, Head of Clingendael International Energy Programme and IGU Wise Person.

The Methane Challenge

The second workshop focused on a deeper discussion relating to the issue of methane emissions. With the issue becoming increasingly debated over the last year, methane emissions are a critical challenge for the growth of the industry and IGU is stepping up its work on the topic.

The workshop entitled “Measure, Document, and Reduce – the Gas Industry’s Commitment

to Managing the Methane Challenge” was divided into two parts.

Speakers on the technical and economic issues were Prof. Pieter Levelt, Head of KNMI R&D Satellite Observations Department & Professor at Delft Technology University; Roy Harstein, Vice President, Strategic Solutions, Southwestern Energy; Paul Balcombe, Faculty of Engineering, Department of Chemical Engineering Research Associate, Imperial College of London; and Dr Konstantin Romanov, Head of Division, Gazprom.

The second part of the workshop focused on policy and regulatory issues and included panelists were Muhunthan Sathiamoorthy, GHG and energy efficiency expert, safety and operational risk, BP (CCAC Initiative); Joel Bluestein, Senior Vice President, ICF International; Tim Gould, Head of Division, World Energy Outlook at IEA; and Dave McCurdy, President and CEO of the American Gas Association.

Further information on the workshop and copies of the presentations can be found in the News section of the IGU website.

Building for the Future

IGU’s Building for the Future initiative is now entering Phase III which will review and explore potential governance related changes including the possible establishment of a permanent secretariat at the conclusion of the Spanish term. IGU Secretary General Luis Bertrán Rafecas provides the latest updates on pages 102-103 and a full assessment and recommendation will be tabled at the Tokyo Council meeting this autumn.

IGU Diplomatic Gas Forum – Amsterdam

The final event of the meetings was a Diplomatic Forum under the theme of “Energy Transition in the EU: the role of natural gas in the energy future”. Many members from European embassies based in the Netherlands joined the Council members at the forum. The event provided a platform for industry and the diplomatic corps to come together and discuss how the gas sector can provide solutions to energy and environmental challenges on both a regional and global scale. IGU’s engagement with the diplomatic corps around the world is expanded upon further on pages 118-120.



Iran to host IGRC 2020

While we look forward to IGRC 2017 in Rio de Janeiro in May, at the Council meeting it was announced that Iran has been selected to host the 16th International Gas Research Conference, to be held in Tehran in 2020, hosted by IGU Charter Member the National Iranian Gas Company (NIGC).

Time to say goodbye

At the last Council meeting of their term, the Norwegian IGU Secretariat team said goodbye after nine excellent years in Oslo! Many have contributed to the Secretariat over the years and almost all secondees were gathered in Amsterdam.

"I wish Luis and his team all the best in their efforts to mature IGU to be even more relevant in the future," says Honorary Secretary General Pål Rasmussen.

IGU Webcast Live from Amsterdam

The aim of the webcast series, an initiative by the IGU Marketing and Communications committee, is to bring the voices of gas that matter to you. This edition of the webcast was broadcast as part of the Council meeting programme in Amsterdam, the Netherlands, a place, that according to the two hosts Dimitri Schildmeijer and Hansch van der Velden, has

had a happy marriage with natural gas for more than 60 years. However, the marriage is recently showing some real signs of fatigue. The problems, earthquakes in the gas producing region Groningen, have become so big that they cannot be ignored any longer.

The expert panel consisted of:

- ◆ Tjerk Wagenaar, Director of Nature & Environment, a leading Dutch NGO
- ◆ Mel Ydreos, Executive Director, Public Affairs, IGU
- ◆ Coby van der Linde, Director, Clingendael International Energy Programme (CIEP)

In the course of the panel’s wide-ranging discussions Tjerk Wagenaar said, “Everyone is needed to solve [global warming] and we need innovation, we need technology, we need probably other pricing systems like a carbon tax or regulation but above all we need leadership, leadership from new business, leadership also from what I would also call the old business, where bold decisions have to be taken, but also from governments and financial institutions [...] I think that gas will be part of the solution.”

Mel Ydreos addressed the subject of air quality in his opening remarks, saying, “Clean air is a real environmental crisis that the world currently faces. It’s not 20 years from now, it’s not 30 years from now, it’s right now. There are millions of people who are dying prematurely

▲ From left to right: Pål Rasmussen (Secretary General), Torstein Indrebø (Honorary Secretary General), Hans Riddervold, Kristin Sande, Jeanet van Dellen, Erik Gonder, Barbara Schmidt, Florijana Dedović, Carolin Oebel, Ksenia Gladkova and Mats Fredriksson. Khadija Al Siyabi and Sjur Bøyum were not able to attend, while Taeksang Kwon and Anette Nordal will continue to work with the Secretariat in Spain.



▲ Luis Bertrán Rafecas, the new IGU Secretary General.

because of respiratory diseases associated to dirty and polluted air in many of the cities around the world. Certainly Asia has some acute cases of bad air but this is not an Asia only issue. I can point to many European cities that do not meet the World Health Organization standards so this is not a unique issue for just Asia. But we always hear about Asia because the situation there has gotten so extreme it makes the news.”

Coby van der Linde, speaking about her young staff at the CIEP said, “Most of the staff are young graduates and their learning curve is much faster than what we’ve been doing with energy technologies, because we need to breed new generations of kids who really love solving this stuff and who enjoy figuring things out [...] I see a lot of young kids who are moving on in the world and are writing great stuff if they are given half a chance.”

And she continued, saying, “What we should do is give [the young] time to ripen because there’s really great thought and stuff going on with these kids and I think some of our papers are evidence of that. That if you give them a little bit of time and a desk and really good discussions there’s some really talented young people out there who can help us, who can help this societal debate actually move along.”

Luis Bertrán Rafecas assumes position of IGU Secretary General

On November 1 Luis Bertrán Rafecas assumed the position of Secretary General, taking over from Pål Rasmussen.

With the change in leadership, the IGU Secretariat relocated from Oslo, Norway to Barcelona, Spain, with Gas Natural Fenosa and Sedigas becoming the new Secretariat host organisations.

Luis Bertrán commented, “I am delighted to take up the position as Secretary General and work closely with IGU President David Carroll to further advance the role of natural gas in the global energy mix.”

IGU President David Carroll said, “We congratulate Luis on his new position, and also thank outgoing Secretary General Pål Rasmussen for his leadership and contributions to the IGU over the past two years. We would also like to thank Statoil for their significant and generous contribution to the IGU in hosting the Secretariat for the past nine years, and recognise Gas Natural Fenosa and Sedigas for their willingness to host the new Secretariat.”

Meeting at the Italian Embassy, Washington DC

On November 1, over 135 participants representing dozens of embassies, US Capitol Hill and Administration policymakers, regulators, energy experts, think tanks and consultancies gathered at the Italian Embassy in Washington DC to discuss “The Globalization of the Natural Gas Industry” and learn about plans for WGC 2018.

The event fostered topical discussions about the present and future state of the global gas industry and the geopolitical challenges and opportunities for natural gas. In the Welcome Remarks, Deputy Chief of Mission, Luca Franchetti Prado said, “Natural Gas will play an important role at the G7” while Ambassador Dr Neil Parson, Acting Executive Secretary for Integral Development, Organization of



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▼ Luis Bertrán David Carroll at COP 22.

American States, said, “Natural gas is not a bridge fuel, but a fuel for today and tomorrow.”

COP 22

A delegation from the IGU, including President David Carroll and Secretary General, Luis Bertrán, attended COP 22 in Marrakech, Morocco (see pages 24-28 for our report on COP 22). The President spoke at an event on November 10 organised by the OPEC Fund for International Development (OFID) on the theme of “Energy Access and Climate Change through the Food-Water-Energy Nexus”.

“While gas is slightly disadvantaged to coal in terms of cost, both the water requirements and the greenhouse gas emissions from gas-based power generation are much lower,” he argued, in reference to the role natural gas can play in granting access to electricity for those

who need it, particularly in Sub-Saharan Africa.

In addition to attending the conference, the Secretary General and other members of the delegation took the opportunity to meet with the IGU Charter Members for Morocco and Algeria, in addition to international organisations including UNEP and IFC.

Urban Air Quality Report (Second Edition)

IGU released the second edition of its Case Studies in Urban Air Quality report highlighting how the enhanced use of natural gas in power generation, heating and transport can drastically reduce emissions, mercury and particulate matter levels – resulting in improved urban air quality and reduced greenhouse gas (GHG) emissions. The second edition focuses on the cities of Berlin, Dublin, Krakow and Rotterdam.

The report was presented at an IGU MEP hosted breakfast session held in collaboration with GasNaturally's Gas Week in Strasbourg, France, on 23 November. It can be downloaded from the IGU website at www.igu.org/publications.

5th IEF-IGU Ministerial Gas Forum

The 5th IEF-IGU Ministerial Forum took place in New Delhi, India, on December 6. Hosted by the Government of India and supported by IGU Associate Members GAIL (India) Limited and the Natural Gas Society of India. The theme of the 5th forum was “Gas for Growth; improving economic prosperity and living standards”.

▼ The second edition of IGU's Urban Air Quality Report was presented at a breakfast session during GasNaturally's Gas Week on 23 November.



Held biannually, the IEF-IGU Ministerial Gas Forum has become an important opportunity for ministers, policymakers and industry to come together to discuss the actions that need to be taken in support of gas as a key contributor to the long-term sustainable energy mix.

A full report on the event can be found on pages 122-125.

4th Oslo IGU Diplomatic Gas Forum

The IGU Diplomatic Gas Forum has become a yearly event in Oslo, Norway. On December 12 the fourth forum was held at the headquarters of DNV GL in Norway. This was the third year DNV GL has hosted the event.

The focus of the programme was “The Energy Transition and Natural Gas’s Role in the Sustainable Energy Future” and presentations were provided by IEA, IGU, DNV GL and Gassco.

IGU and the World Bank Gas Competence Seminar

A Gas Competence Seminar with the theme “Towards Ending Gas Flaring and Unlocking Gas Potential in Nigeria” was jointly organised by the World Bank Group and IGU in Abuja, Nigeria from December 13-14. This was an excellent platform to bring together key stakeholders to deliberate the government’s twin objective of ending the practice of routine gas flaring within the petroleum industry and unlocking gas potential in Nigeria.

The objectives of the seminar were:

- ◆ Consultation for the new Nigerian Gas Flare Commercialisation Programme
- ◆ Build awareness for new small scale technologies to utilise gas
- ◆ Explore financing options for flare reduction and gas utilisation
- ◆ Share best practices for sustainable and inclusive access to energy

The event was well attended, with 250 participants from across the spectrum of interested parties in finance, technology, community leaders, oil companies and government. The



◀ IGU President David Carroll speaking at the 5th IEF-IGU Ministerial Forum.

Ministry of Petroleum Resources has the objective of ending routine gas flaring by 2020.

G20 Energy Sustainability Working Group

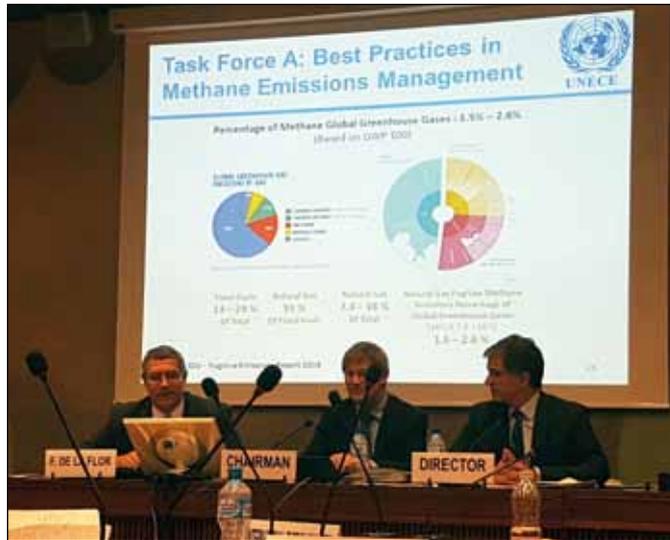
The first meeting of the G20 Energy and Sustainability Working Group under the German G20 Presidency was held on December 14-15 in Munich. The Presidency laid out an energy and climate agenda that will address the implementation of the Paris Agreement together with the questions of the long-term transition towards the decarbonisation of energy systems.

Key elements of the G20 Energy Sustainability Working Group agenda were:

- ◆ Energy and Climate Policy after Paris
- ◆ Transition towards a Greenhouse Gas Neutral and Climate Resilient Economy
- ◆ Transformation of the Energy Sector

▼ IGU’s engagement with the G20 Energy Sustainability Working Group continued in Munich.





▶ IGU Director Rafael Huarte representing IGU at a meeting of the UNECE.

▶▶ Marcel Kramer speaking at the IRENA event in Abu Dhabi.



- ◆ Rising Demand, Energy Security, Economic Growth, and the Transition to a GHG-Neutral Energy System
- ◆ Energy Efficiency
- ◆ Renewable Energy and Other Sustainable Energy Sources
- ◆ Making Paris a Reality: Long-term Pathways to Greenhouse Gas Neutrality

The role of gas as a clean energy source was discussed during a number of presentations and the IGU offered to advance this work during the second ESWG meeting that will be held in March. Specifically, IGU offered to table a report and presentation on the role of gas in enabling clean marine transport. A number of discussions around the issue of methane emissions were also held as the issue continues to receive attention and priority.

Reinforcing strategic partnerships

Strategic partnerships continue to be important for IGU in its work to raise the global voice of gas. Ensuring a good transfer of relationships and activities related to this area has been important in the recent IGU Secretariat transition. During December and January, the new IGU Director, Rafael Huarte, met with UNEP, UNESCO, UNECE, SE4ALL and OFID with the aim to foster greater cooperation towards

common goals. The topics of discussion were energy access, methane emissions, energy efficiency, gas and renewables, biomethane and synthetic gas, and gas for transportation.

With SE4ALL and UNEP especially, IGU is looking to increase cooperation on issues such as energy access, sustainability and renewables, air quality and biomethane. This will help raise the voice of gas amongst governments and policymakers.

IRENA Conference and The Role of Natural Gas in the Energy Transition

On January 16, the first day of the World Future Energy Summit held in Abu Dhabi, UAE, IGU Regional Coordinator and President of the Energy Delta Institute, Marcel Kramer, participated in an expert discussion organised by IRENA, the International Renewable Energy Agency. The theme was “Decarbonisation of the Energy System by 2050 – the Need for Innovation”. Marcel’s presentation was entitled “The Role of Natural Gas in the Energy Transition”. He highlighted how in almost all energy scenarios, gas demand grows, fuelled by the thirst for energy in Latin America, India, China and the Middle East.

“The global gas industry fully supports efforts towards a sustainable energy future,”

said Marcel, and pointed out how and why gas is an effective partner to renewable energies. Policies through either emissions regulation or carbon price mechanisms need to reflect the full economic cost of air pollution and CO₂. The opportunity to allow the integration of decentralised smart energy grids must also be made possible through necessary regulatory changes. Greater financial support towards investments in innovation and technology that will maximise the benefit of natural gas and renewable energy systems are also needed.

The event also presented the initial findings from a forthcoming decarbonisation study, requested by the German government, that will inform the G20 in cooperation with other parties to explore scenarios for meeting objectives set forth in the Paris Agreement.

Global Energy Forum

David Carroll, IGU President, took part in a panel discussion at the Global Energy Forum in Beaver Creek, USA on January 26.

The event, now in its sixth year, is presented by the Global Energy Forum Foundation in partnership with the Stanford University Precourt Institute for Energy and the Stanford University Precourt Energy Efficiency Center and brings together leaders from around the world to discuss and examine the future of energy. The subject for the panel was "Integration of Natural Gas and Renewables: The Perfect Match".

Global Overview of the Outlook for the Gas Industry

On January 26, the WGC 2018 Financial Advisory Board hosted a breakfast session in New York for sell-side analysts from the financial community to provide them with an outlook of the global gas industry. David Goldwyn, former Special Envoy for International Energy Affairs at the US State Department was the featured speaker.

The meeting provided the opportunity to hear and discuss the globalisation of natural

◀ From left to right:
Panel Moderator Mark Zoback, Professor of Geophysics, Director of Natural Gas Initiative, Stanford University; David Madero Suarez, Director General, Cenagas; David Carroll, President, IGU and GTI; Jacob Irving, President, Canadian Hydropower Association; and Frank Wolak, Professor of Economics, Stanford University.





◀ Jay Copan addressing the session in New York.



▶ From left to right: Mehrad Feizi, Gas Transportation Analyst, GECF and IGU Secretary General, Luis Bertrán.

gas and the outlook for natural gas under the new US Administration.

For more information on WGC 2018 or the WGC Financial Forum, please contact Jay Copan (JCopan@wgc2018.com) or Liliana Fonnoll (LFonnoll@aga.org).

Initial planning underway for the 2018-2021 triennium

The incoming Korean presidency team held its first preparatory meeting with the incoming chairs of the IGU committees for the 2018-2021 triennium at the IGU Secretariat in Barcelona, on February 7.

Discussions began with an overview of the preliminary themes and areas of focus for the triennium and looked at potential key topics for IGU committee work for 2018-2021.

Iran LNG & Gas Partnerships Summit

The Secretary General spoke at the Iran LNG & Gas Partnerships Summit on February 14. His presentation covered a broad range of topics from the work of IGU to climate policy effects on fossil fuel markets and the importance of switching from coal to gas to reduce carbon dioxide emissions and increase air quality.

Expanding the Secretariat team

Barbara Jinks has joined the Secretariat on a part-time basis in the role of Marketing Manager. Barbara brings over 34 years of experience in the gas industry to bear along with 11 years experience of IGU on various committees and as Executive Director of LNG 18. Barbara is currently Chair of the Marketing and Communications committee and will be an invaluable member of the Secretariat's staff.

▶ Korean presidency team at their first meeting at the Secretariat in Barcelona.





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"Energy and form are a major inspiration for my work"
Yousef Ahmad - Artist

the power of the drop
THE ENERGY TO TRANSFORM

Building for the Future

By Luis Bertrán
Rafecas

The Building for the Future (BFTF) project is transforming IGU. Phases I and II strengthening the Union's financial position to support advocacy efforts and developing the event portfolio have been successfully implemented. Accordingly, IGU is becoming more influential and relevant to the media, other worldwide organisations, policymakers and the general public. Meanwhile, the IGU flagship events are playing a stronger role in promoting gas as a key contributor to a sustainable future energy mix.

Right now, IGU is working on Phase III of the BFTF project looking at the Union's governance. In Phase III, we have on the table two major issues to study and to suggest reforms. One is a split between the role of the IGU Presidency and the role of organising the World Gas Conference (WGC). The other is the establishment of a permanent office for the IGU Secretariat.

Let me give you a short overview of these potential changes. Today, the country holding the Presidency is also responsible for the organisation of the WGC and the provision of the conference venue. Up to now the venue has been in the same country as that holding the Presidency, although the Articles of Association do allow the WGC to be held in a different country. The Presidency is also responsible for nominating the Chair of the Coordination Committee. He or she leads the IGU Committees for three years, working to deliver a great programme for the WGC which ends each Presidency.

The IGU Secretariat is home to the headquarters of IGU and manages the administrative and legal tasks of the Union. It is responsible for the budget, the accounts and

the audit, while, at the same time, supporting the Management Team, Executive Committee, Council and Coordination Committee. The Secretariat is hosted by a Charter member who nominates the Secretary General and other staff to serve for six years, with a potential extension for a further three years. This ensures continuity and stability alongside the three-year cycle of the Presidency.

In recent years, the gas industry has seen continuous changes in the face of the overall energy environment challenges. IGU has realigned resources and developed new initiatives to ensure the Union is able to continue to raise the global voice of gas, advancing gas as a key contributor to a sustainable future energy mix. Under Phase III, IGU has started to study how the WGC, independent of the Presidency, could serve to promote the Union's global goals in terms of conveying the best advocacy messages to policymakers and the general public, while being held in a venue where the local industry and market are developing strongly. In this way, the WGC's contribution to IGU's mission could be enhanced.

To do that IGU needs a bigger and a permanent Secretariat. This will give continuity, certainty and credibility and improve its competency. It will also remove the need to seek sponsorship from individual members for the Secretariat. There are increasing constraints on the ability of members to commit to a six-year sponsorship term.

Given these two big potential changes, and in order to ensure that they are managed in the best possible way, the BFTF working group proposed to the Executive Committee and Council meetings in Amsterdam in October 2016 that

the establishment of a permanent office be prioritised while the next Presidency election (for the period 2021-2024) should still be combined with WGC (in 2024). The working group proposed a subsequent evaluation of how to split the Presidency and WGC once the required resources and permanent offices were in place.

In accordance with this, the Secretariat has invited members to present their candidatures for the 2021-2024 Presidency through a formal letter to the IGU Secretariat. Candidates will present their proposals during the Tokyo Council meeting in October 2017, when the election for the Presidency will be held.

The working group is being supported by the Executive Committee in the preparation of an implementation plan to establish a permanent IGU office by 2022 when the term of the current Secretariat hosted by Spain finishes.

This plan will be presented to the next Council meeting in Tokyo.

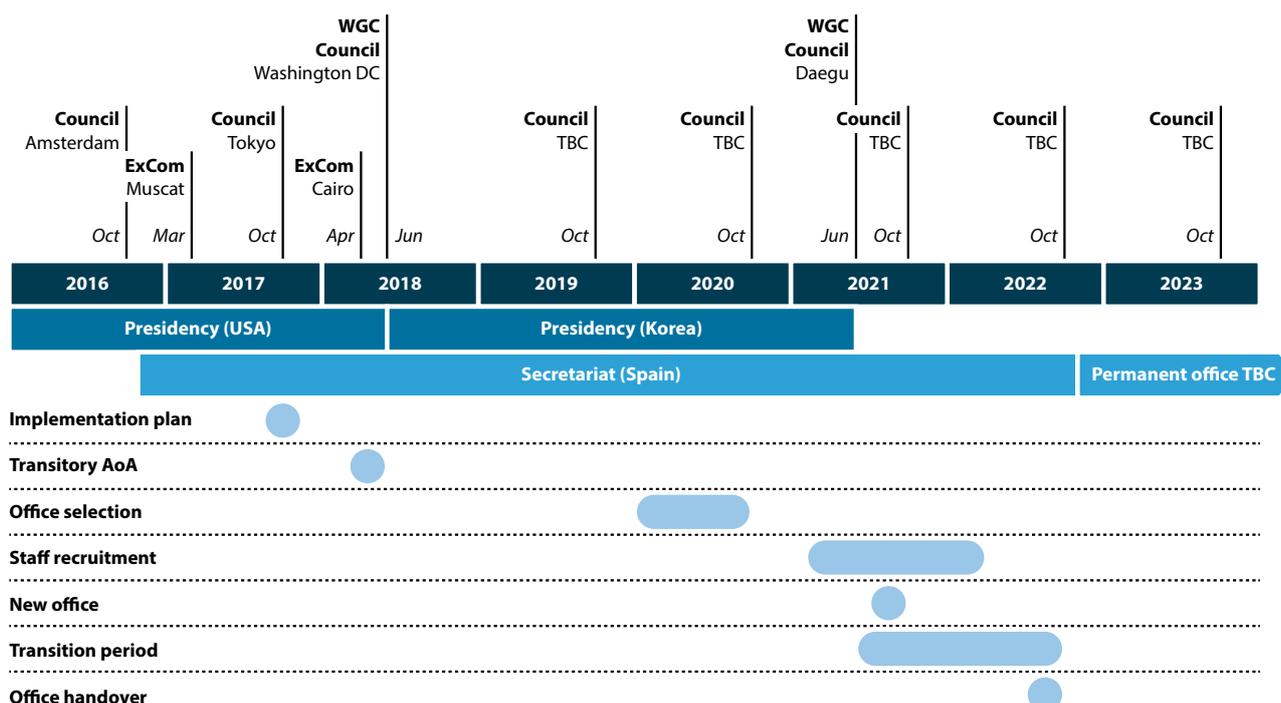
Following this mandate, a 2017 work programme has been established up until the Tokyo meeting. A key aspect of this programme is the creation of a reference group with representatives from all geographical regions, Regional Coordinators and members of the Executive Committee who have expressed their willingness to contribute to the work. This group will review and give feedback on the working group's activities.

A first draft of the work programme will be presented to the Executive Committee during their meeting in Muscat in March for discussion and feedback.

The draft of the implementation plan is currently being prepared but will contain the timeline of the key elements. Some of these are shown below.

Luis Bertrán Rafecas is the Secretary General of IGU.

Timeline of implementation plan



Promigas

Energy that boosts wellbeing

Promigas is one of the oldest private companies in the natural gas sector in Latin America with 40 years of experience providing mass access to natural gas in Colombia. Since its beginnings it has played an active and important role in this process.

Promigas develops energy markets in Colombia and Latin America focusing in the following transmission and distribution businesses: natural gas transmission; integrated solutions for the hydrocarbon industry and power generation; natural gas and electricity distribution. Recently, Promigas has started in the liquefied natural gas business with the construction of the first LNG regasification unit in Cartagena, Colombia. The number of subsidiaries that compose our strategic business units is 20.

We transport 50% of the natural gas in Colombia through a 2,900 km pipeline system and we provide services for hydrocarbon producers and large industries which include the compression and dehydration of natural gas, the construction of gas pipelines, interconnection lines, and energy solutions such as generation, cogeneration and self-generation.

We are the main shareholder of Sociedad Portuaria El Cayao (SPEC), which owns the first LNG terminal in Colombia. The priority of this facility will be to receive LNG imports for the principal thermoelectric power generators on the Caribbean coast, in order to guarantee that this fuel is available at times of peak demand.

In Colombia, we supply natural gas to more than 2.8 million users, 40% of

the national market, which represents approximately 10 million people. In Peru we service more than 163,000 users.

Also, we operate and maintain approximately 24,000 km of electrical power distribution networks, reaching more than 321,000 users in 38 communities in the department of Cauca, south of Colombia.

We have AAA ratings for debt issues in Colombia and BBB- internationally for IDR issues in foreign and local currency and are certified ISO 9001 for quality, OHSAS 18001 in Occupational Health Safety and ISO 14001 in environmental systems.

For over 24 years we have participated in the natural gas for vehicles (NGV) business, which we pioneered and continue, searching for new growth opportunities.

Transmission business unit	Natural gas transmission	Promigas Promioriente Transmetano Transoccidente	Pipeline network: 2,900 km Capacity: 836 MMpcd Employees: 435
	Integrated solutions for the hydrocarbon industry and electrical power generation	Promisol Enercolsa Zonagen SPEC-	Dehydration capacity: over to 520 MMCFD Installed compression capacity: 13,000 hp Cogeneration plants: capacity in excess of 60 MW
Distribution businesses	Natural gas distribution	Surtigas Gases de Occidente Gases del Caribe Efigas Gases de La Guajira Cálidda (Perú) Gases del Pacífico (Perú) Orión	Users connected: 3.2 million Gas sales: 8459 Mmm ³ Employees: 2,149
	Electrical power distribution	Compañía Energética de Occidente	Clients: 321,327 Energy demand: 517 GWh Employees: 273
	Non-banking finance	Brilla	Loans awarded: \$494,233,550 Number of users benefited: 1,300,265 Loan portfolio: \$305,642

20 companies, 2 countries

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PROMIGAS

IGU Global Gas Award 2015-2018

By Lee Gale

Established in 2008, the IGU Global Gas Award is a hotly contested competition that takes place over a three-year period. The winner is announced at the World Gas Conference (WGC). It recognises a groundbreaking project that best demonstrates an understanding of the many in-depth challenges facing the natural gas sector. IGU considers that research must work towards a more sustainable energy future, reducing greenhouse gas emissions and increasing security of supply.

In the run up to a WGC, an IGU Judging Panel studies entrants' projects and after much deliberation, finds a submission that best displays innovation while contributing to the gas industry on both a regional and global basis. The Judging Panel includes: the IGU President, IGU Secretary General, IGU Coordination Committee Chair, IGU Wise Persons and Regional Coordinators. The Global Gas Award has a number of

objectives that a winning project must demonstrate. These include a contribution to the progress of the gas industry that promotes innovation and sustainability, a furthering of technical know-how that can be transferred to other regions, and the raising of IGU's profile on the global stage through media coverage. How natural gas benefits society while overcoming challenges are key ingredients of a successful submission.

The winner for the 2012-2015 triennium was SGN, a UK operator of 74,000km of gas mains in Scotland and the south of England. Its *Opening up the Gas Market* paper was written by Angus McIntosh, Jamie McAinsh, Richard Mason and Caroline Geddes. SGN's *Opening up the Gas Market* project demonstrated that gas which meets the European Association for the Streamlining of Energy Exchange-gas (EASEE Gas) specification, but sits outside the characteristics specified within GB Gas Safety (Management) Regulations (GS(M)R) 1996, can be distributed and utilised safely and efficiently in Britain. As part of its work, SGN used one of its isolated networks that it operates in remote parts of Scotland, known as the Scottish Independent Undertakings.

The main aims of *Opening up the Gas Market* were to secure a reliable gas source while supporting energy diversity, to be low carbon so as to be consistent with stringent legally binding carbon targets and, crucially, provide customers with an affordable service. Oban on the west coast of Scotland, with its own independent gas distribution network, was an ideal setting for SGN's trials. Oban is also, statistically, a microcosm of Britain: it was discovered that 1,104 gas-supplied

► Angus McIntosh receiving the IGU Global Gas Award 2015 from Maria van der Hoeven, then Executive Director of IEA and member of the Judging Panel.



homes roughly contained the full range of appliances that can be found in a wider context in Britain. The project was a pioneering one for the UK and paved the way for new sources of gas which support energy diversity and supply security. See feature article, pages 162-166, *International Gas*, October 2015-April 2016.

For the 2015-2018 triennium, the theme of the Global Gas Award is "Call for the Role of Natural Gas in Enhancing the Quality of Life, Today and in the Future". A call for papers is to be launched on April 5, 2017. An initial screening of entrants will be carried out by the IGU Coordination Committee, Presidency and Secretariat. Next January, an Evaluation Committee will choose a shortlist of finalists. This Committee is formed of: the IGU Director; Acting Chair, Coordination Committee; Chair, Strategy Committee; Chair, Markets Committee; Chair, Sustainability Committee; Chair, Marketing and Communications; and Senior Advisor, USA Presidency. Further assessment will then be made by the IGU Judging Panel and their thoughts passed to IGU's Management Committee and the World Gas Conference 2018 Steering Committee.

For such an esteemed competition, the judging criteria has to study a number of

factors. The project must be relevant to the development of the gas industry and contribute to the advocacy of natural gas. It also has to improve quality of life and tackle issues of climate change and air pollution. Increasing the competitiveness of the industry is also viewed favourably, as is a world-class demonstration of gas industry knowledge. The winning entrant must also have a long-term element, with natural gas placed prominently in the future energy mix.

The winner will be announced at WGC 2018 in Washington DC at a special Global Gas Award session, and details will also be made available via IGU's newsletter, magazine and website. For the finalists, an IGU token of appreciation will be made, which includes an IGU diploma and an invitation to the Award ceremony. The winning entrant may be invited to showcase their findings during a specially arranged WGC session. Winners also receive free entry to WGC 2018, with free travel and accommodation to Washington DC and a prize of \$5,000. The deadline for entries is September 1, 2017.

Lee Gale is Editor-in-Chief at International Systems and Communications Ltd.



◀ Oban in Scotland proved a perfect testing ground for SGN's project.

TAP: CONSTRUCTION IS UNDERWAY

The Trans Adriatic Pipeline (TAP) is a strategic energy project. Once completed, it will bring an initial 10bcm/a of Caspian gas to Europe. 878km long, the pipeline crosses northern Greece, Albania and the Adriatic Sea, before reaching southern Italy.

In line with the *Energy Union's* energy security pillar, TAP's realisation paves the way for real energy diversification providing a new source of supply and a new route for gas flows to Europe.

Moreover, TAP will facilitate gas supply to regions where it is most needed, meeting the energy security and energy demand needs of South East Europe, a region identified by the European Commission as the most vulnerable to supply disruptions and external shocks.

Besides its valuable contribution to energy diversification, TAP will play an important role in the decarbonisation of economies, particularly in South East Europe and the Western Balkans where the energy sector is overly reliant on the use of heavy fossil fuels for power generation. In the face of declining domestic production and Europe's steady import dependency, natural gas supplied by TAP will provide a sound alternative to use of coal (and sometimes wood) for home heating in countries where up to 60% of the population suffer energy poverty.

Much more than just an energy project, TAP is contributing to local economies across the value chain, through direct and indirect jobs and projects stemming from TAP's social and environmental investment framework.

As of early December 2016, TAP's construction was well underway: 205km along our route have already been cleared, 125km line pipes welded and 95km lowered in.

TAP is a key project on Europe's energy landscape, helping to ensure the security and diversification of energy supply for decades to come.



TAP construction activities near Alexandroupoli, Greece, September 2016



TAP construction is underway



TAP successfully began construction in 2016. One of the most important energy infrastructure projects in Europe, TAP will bring many benefits to its host countries:

- Promote economic development and job creation
- Improve local infrastructure: e.g. access roads and bridges in Albania
- Boost the countries' roles as energy hubs: support physical interconnections and market integration
- Social and environmental investments: community investment programmes
- Direct contribution to GDP through taxes

TAP is a project for the future, helping to ensure the security and diversification of Europe's energy supply for decades to come



Trans Adriatic
Pipeline

For more information, please visit our website:
www.tap-ag.com

Reports from the Regional Coordinators



Li Yalan

In this issue we bring you updates from IGU's Regional Coordinators for Asia and Asia-Pacific and for North America.

Overview of China's natural gas industry

By Li Yalan

Today, China is the world's third largest gas market after the US and Russia and sixth largest gas producer after the US, Russia, Iran, Qatar and Canada. Last year, China surpassed the US to become the world's third largest gas importer after Japan and Germany.

Market

Over the last decade, China's natural gas market has experienced the fastest growth in the world.

From 2000 to 2016, China's demand for natural gas has grown over seven times from 24.5 billion cubic metres per year (bcm/y) to 204 bcm/y, or 15% growth per year. Demand growth is expected to continue with gas seen

as an important fuel to combat air pollution, reaching 300-360 bcm/y by 2020.

In 2016, gas accounted for 6.2% of China's total energy mix, up from 3% in 2000. The share of natural gas in the total energy mix is expected to rise to 10% by 2020 and 12% by 2030.

City gas accounts for 41% of total gas demand in 2016, followed by industry (28.9%), gas power (17.4%) and petrochemicals (12.8%). With an accelerated urbanisation pattern, city gas (including gas use for transport) will continue to be the main driver for gas demand. In 2016, city gas demand grew by 15% year-on-year. Gas power is another key driver, with demand in 2016 rising by 8%.

Supply

China has vast gas reserves with 50 trillion cubic metres (tcm) of recoverable conventional gas, 22 tcm of recoverable shale gas, and 12.5 tcm of recoverable coal-bed methane.

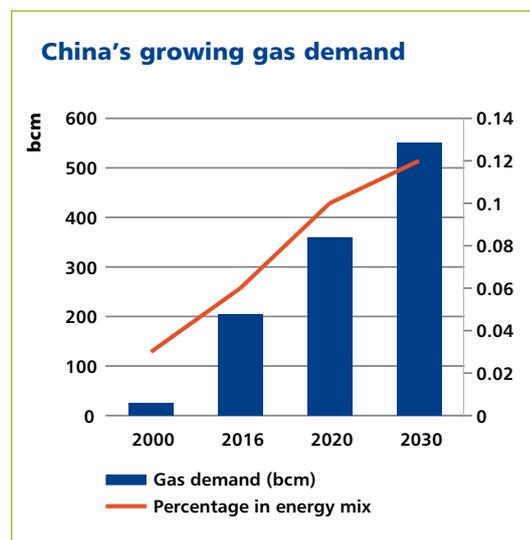
In 2016, China's domestic gas production was 146 bcm, including 132.4 bcm of conventional gas, 1.6 bcm coal-to-gas, 5 bcm coalbed methane and 7 bcm shale gas.

In the same year, China imported 38.6 bcm of gas via pipeline from Kazakhstan, Turkmenistan, Uzbekistan and Myanmar, and 34.7 bcm of LNG from 13 countries including Qatar, Australia, Indonesia, Malaysia, Russia, and Nigeria. Imports accounted for 35.3% of total Chinese gas supply.

Infrastructure

China has developed an important domestic high-pressure gas pipeline network, with a total length of 70,000km in 2016. China is also

► Figure 1.





◀ An LNG delivery at Dapeng LNG in Guangdong province, one of China's 12 regasification terminals.

connected by pipelines with Central Asia (Kazakhstan, Uzbekistan and Turkmenistan) through three operating long-distance pipelines and a fourth line under construction. Together these pipelines have a total capacity of 85 bcm/y.

The Myanmar-China gas pipeline was completed in 2013, with a total capacity of 12 bcm/y.

Additionally, China has set up 12 LNG receiving terminals with a total capacity of 46.8 Mtpa, and 18 underground gas storages of 6 bcm total capacity, as well as 6,500 CNG/LNG filling stations. A map of China's major gas infrastructure is reproduced on page 64.

Policy

China is committed to making natural gas a major fuel in the energy mix, to both combat air pollution and reduce CO₂ emissions as part of the Paris Agreement.

'The 13th Five-Year Plan for Energy Development' has set the target of increasing the share of natural gas in the energy mix from 6.2% today to 10% by 2020, largely through replacing coal in various energy applications.

A large number of policies and measures have been put forward to both encourage upstream

gas production (including unconventional gas) and downstream gas development, through 'the 13th Five-Year Plan for Natural Gas Development', the "Air Pollution Prevention and Control Action Plan", the "Energy Development Strategy Action Plan (2014-2020)" and 'Policies for the Promotion of Natural Gas Utilisation'.

Third-party access to gas infrastructure has also been promoted by the government as a way to encourage gas supply and imports.

Challenges

Further gas market development in China is facing significant challenges.

First, gas needs to be more cost competitive to promote its utilisation, particularly as the country has cheap and abundant coal resources. The broad policies in favour of gas development need to be translated into concrete fiscal and financial incentives for using natural gas instead of coal.

Second, third-party access to gas infrastructure is crucial for gas market development. This is to be balanced against the need to encourage gas infrastructure investment.

Third, there needs to be detailed supportive policies for non-state entities to

participate in domestic gas exploration and production.

Last but not least, further development of the natural gas industry in China requires support not only from policymakers in the energy field, but also policymakers from all other sectors of the economy. This is why further advocacy beyond the energy industry is so critical for the future of natural gas development.

Li Yalan is IGU Regional Coordinator for Asia and Asia-Pacific and Chairperson of the Board of Directors, Beijing Gas Group Co Ltd.



Timothy M Egan.

North America

By Timothy M Egan

President Trump's victory in November 2016 and active agenda since his inauguration in January have been, and continue to be, the dominant topic of conversation in almost every field of policy in North America. Energy policy is no exception.

The expedited development of American energy resources, including all hydrocarbons, as a key means to deliver a growth strategy has

been front and centre for Donald Trump since the earliest days of his candidacy. The appointment of Rex Tillerson to Secretary of State, Rick Perry to Secretary of Energy, Elaine Chao to Secretary of Transport and Scott Pruitt to EPA Administrator, all give powerful signals of how firm the President is on this agenda. What are the implications for the North American gas industry?

For the US, the President's commitment to reduce regulatory burdens and corporate taxes, and to build out infrastructure, promise opportunity for gas resource development, transportation and distribution infrastructure expansion, and end use growth. Any federal discussion of the phasing out of hydrocarbons is off the table, and natural gas will benefit even more because of its affordability. After almost a decade of very difficult economic times, building on the strength of affordable gas to attract investment to the US creates a very positive picture. Whether state governments (and California stands out in particular) share that enthusiasm is questionable, and the strong protest movement against any infrastructure,

► The Durango combined cycle power plant in northwest Mexico. The importance of gas imports from the US and investment opportunities in the country should help to smooth current tensions.



compounded by the post-election surge of anti-Trump protests, may pose local and state challenges to infrastructure construction. Trump's impact on gas in the US? On balance things look good.

For Mexico, the US President's strong language about the trading relationship and his commitment to "build the wall" have chilled almost two decades of warming relationships between the two countries. Some commentators think things will get much colder still, but, pun intended, gas warms things up: gas trade remains a good news story on both sides of the border. The US is a significant (and growing) exporter of gas to Mexico, delivering clean and affordable energy that helps the Mexican economy, improves the country's environment, reduces balance of trade concerns and ultimately contributes to a rising standard of living. If there is a problem between the US and Mexico, gas should help to shrink the size of it. Moreover, US (and several Canadian) companies are very significant investors in gas infrastructure in Mexico, reinforcing an existing good integration story. Trump's impact on gas in Mexico? If the bilateral political tension doesn't undo things, the prospects remain very positive.

For Canada, the integration story on energy has long been a source of great strength for Canada and the US. The President's rhetoric about Canada has been largely positive. He indicated in his first days in office his support for major pipeline interconnects, and his administration has made it very clear that the trading relationship with Canada (a bilateral free trade agreement existed before NAFTA) is the kind of relationship the US wants to have. All is not rosy on the Canadian side however. The development of unconventional gas resources across the US has meant Canada's role as a key supplier is ending – potentially leaving (growing) Canadian gas supply stranded and looking for markets. In addition, the prospect of a significantly improved investment regime (see regulatory and tax changes noted



above) in the US, where supplies already have strong and growing access to international markets, will mean competition for Canada. And the great looming question is how markets will respond to the Canadian government's promised "price on carbon". As some commentators have noted, a Canadian "carbon tax" is the more likely border tax than any protectionist measure by the US Administration or Congress, as it will affect the competitiveness of Canadian energy exports and manufacturing. Trump's impact on gas in Canada? Markets and Canada's domestic policy framework will decide.

The long-term impact of Donald Trump's presidency is one we will have to wait years to read about: in more than 140 character summaries. But it has certainly changed the status quo of North American energy policy. It could be very good for gas, depending in no small part on how policymakers respond to the new dynamic.

Timothy M Egan is IGU Regional Coordinator for North America and President and CEO of the Canadian Gas Association.

▲ While Canadian gas production is growing, unconventional gas developments south of the border may force Canadian producers to find new markets.

The Netherlands hosts the 2016 Council meeting

By Mark Blacklock

Held in the Mövenpick Hotel, Amsterdam on October 19 and 20, following sessions of the Coordination Committee and Executive Committee, IGU's 2016 Council meeting marked the handover from Norway to Spain as host of the Secretariat. Other highlights of the meeting included the accession of two new members, the presentation of IGU's draft report on fugitive methane emissions and an address by Bjørn Håmsø, Programme Manager of the World Bank-led Global Gas Flaring Reduction (GGFR) Partnership. The Council meeting was followed by workshops on methane emissions and the gas industry in The Netherlands. The event was rounded off with a Diplomatic Gas Forum.

IGU President, David Carroll opened proceedings by welcoming delegates and thanking the Royal Dutch Gas Association (KVGN) for hosting the meeting. He then asked Pål Rasmussen to address his last IGU meeting as Secretary General.

Pål paid tribute to Statoil's support of the Norwegian Secretariat and to the staff who worked there during the nine-year term between November 2007 and October 2016. "Statoil has been the largest single contributor to IGU in the history of the Union," he declared.

Diplomas were given to staff and Pål was awarded the title Honorary Secretary General. Delegates were also given a special brochure commemorating Norway's term as host of the Secretariat.

Incoming Secretary General, Luis Bertrán Rafecas, who formally took over shortly after the Council meeting on November 1, thanked the Norwegian team for working to ensure a smooth handover and introduced his team. Luis also briefed delegates on the latest phase of the Building for the Future project, which is looking at the governance and structure of IGU including the possibility of a permanent Secretariat. The working group led by Luis will report back to the Council in 2017.

▼ IGU's Executive Committee pose for a group photograph before commencing their meeting on October 19.



“The Building for the Future project,” said David, “is about making sure that this organisation is an effective advocate for natural gas and a provider of highly valued services to its membership which also runs great conferences and events that bolster the profile of IGU and contribute to its financial stability.”

The Council approved four changes in the membership of the Executive Committee with Shinichi Tada taking over from Kyoji Tomita for Japan, Hazli Sham Kassim from Pramod Kumar Karunakaran for Malaysia, Han Fennema from Gertjan Lankhorst for The Netherlands and Scott Ickes from Abdulla Al-Hussaini for Qatar. It also approved the accession of two new Associate Members: the National Gas Society, India and PwC, The Netherlands.

Senior Advisor, Taeksang Kwon gave an update on the marketing strategy to attract new members, saying that the Secretariat was working to enhance membership value and would create the position of Relationship Manager.

Delegates were briefed by Pål on the success of the G20 Natural Gas Day (held on June 29, 2016 and reported on in the last issue of *International Gas*). “I think this is a very good example of how things progress and mature in this organisation from IGU’s first G20



◀ Pål Rasmussen and Luis Bertrán Rafecas marked the handover of the IGU Secretary Generalship at the Council meeting.

involvement during the Russian Presidency in 2013,” he said. “We intend to have a major presence during the German G20 Presidency in 2017 and following that during the Argentine Presidency,” added David.

Outgoing Director, Mats Fredriksson gave an update on IGU’s strategic partnerships with other international organisations. He said that five issues have been prioritised: climate change, emissions, energy access, economic development and energy security, while cooperation will be focused on seven organisations: the G20 forum of major economies, International Energy Agency (IEA), International Renewable Energy Agency (IRENA), Sustainable Energy for All (SE4ALL), UN Environment



◀ During the Council meeting Pål was awarded the title of Honorary Secretary General by IGU President David Carroll.



▲ The Iranian delegation with IGU's incoming and outgoing Secretaries General, President and Event's Coordinator, Rodney Cox. Tehran will host IGRC 2020.

Programme (UNEP), World Health Organisation (WHO) and World Bank. Relationship managers have been appointed with the new Director Rafael Huarte responsible for SE4ALL, UNEP, WHO and the World Bank, Pål for the G20 and Marcel Kramer, IGU's Regional Coordinator for Russia, the Black Sea and Caspian area for IEA and IRENA.

IGU's Executive Director Public Affairs, Mel Ydreos presented IGU's draft report on fugitive methane emissions, which are quickly becoming a significant global climate issue. He said that IGU and the industry need to work to improve the accuracy of measuring methane emissions and share best practices to reduce them.

Mel's presentation was followed by one from Bjørn Håmsø, Programme Manager of the GGFR Partnership. "Gas flaring is an oil industry issue which also tarnishes the reputation of the gas industry," he declared, explaining that according to the latest satellite data, some 145 bcm of gas is being flared annually and that the World Bank's aim is to eliminate routine flaring by 2030.

There were previews of IGU's participation in COP 22 in Marrakech and the Gas Week in Strasbourg in November 2016, and of four major forthcoming events: the 6th IEF-IGU Ministerial Gas Forum in New Delhi on December 6, 2016, IGRC 2017 in Rio de Janeiro

in May 2017, WGC 2018 in Washington DC in June 2018 and LNG 2019 in Shanghai in April 2019. It was also announced that Iran had been elected to host IGRC 2020 in Tehran, the decision having been made by the Executive Committee immediately prior to the Council meeting.

Looking further ahead, Pål and Luis gave details of the procedure for the elections of the country to hold the IGU Presidency for the 2021-2024 Triennium and for the vice chairs of the technical committees for the 2018-2021 Triennium. (Those vice chairs will become the chairs for 2021-2024.) Applications will be assessed by the Executive Committee during its meeting in Muscat in March 2017 and the Council will vote during its next meeting in Tokyo in October 2017.

Matsuhiko Hataba, Vice Chairman and Senior Managing Director of the Japan Gas Association (JGA) invited delegates to the Tokyo meeting, and Satoshi Yoshida, JGA Deputy General Manager, gave details of the programme and venue.

As the most senior Honorary President present, Hans Jørgen Rasmusen (1994-1997) closed the meeting and asked for a vote of thanks for the host, KVGN.

Mark Blacklock is the Consulting Editor of International Systems and Communications.



The Bridge to the Future of Natural Gas

INGAS

2017 7. ULUSLARARASI DOĞALGAZ KONGRE & FUARI | 1-2 November 2017
7th INTERNATIONAL NATURAL GAS CONGRESS & FAIR | Istanbul



Photographed by Talan Karikal

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**GAS CONNECT
AUSTRIA**

Engaging with the diplomatic corps

By Anette S Nordal and Victoria J Jolly

The IGU Diplomatic Gas Forum has become a yearly event in Oslo. It is a prime opportunity to interact with the diplomatic corps and let it know the benefits and potential of natural gas.

Last year, a Diplomatic Gas Forum was also held in Amsterdam, meaning that in 2016, there were two IGU Diplomatic Gas Forums. For 2017, IGU is looking at possibilities for events in the US and Spain.

In addition to the work that the IGU is conducting with the Diplomatic Gas Forums, the World Gas Conference (WGC) 2018 team is also engaged with diplomatic corps through the WGC 2018 Global Ambassadors Network and Government Relations teams.

Amsterdam: energy transition in the EU: the role of natural gas in the energy future

In Amsterdam, the IGU Diplomatic Gas Forum discussed the role of gas today and how the improvements and contributions of the gas

sector can bring about solutions to the EU's and the world's energy and environmental challenges. The event was held in Amsterdam in conjunction with the IGU Council meeting. The Royal Dutch Gas Association and IGU had invited mainly European embassies accredited to the Netherlands.

Eighteen embassies attended with 21 delegates, seven of whom were ambassadors.

The panel featured eight eminent speakers:

- ◆ Gertjan Lankhorst, Chairman, VEMW
- ◆ Bernard Bot, former Dutch Minister of Foreign Affairs
- ◆ Dr Sun Xiansheng, Secretary General, International Energy Forum
- ◆ Tim Gould, Head of Division, World Energy Outlook at the International Energy Agency
- ◆ Dr Coby van der Linde, Director, Clingendael International Energy Programme and IGU Wise Person
- ◆ Timothy M Egan, President and CEO, Canadian Gas Association and IGU Regional Coordinator for North America
- ◆ Khaled Abu Bakr, Executive Chairman, TAQA Arabia and IGU Regional Coordinator for the Middle East and Africa
- ◆ Marcel Kramer, President, Energy Delta Institute and Regional Coordinator for Russia, the Black Sea and Caspian area.

▼ Members of the panel for the IGU Diplomatic Gas Forum in Amsterdam.

From left to right:

Marcel Kramer, Timothy M Egan, Dr Coby van der Linde, Tim Gould, Dr Sun Xiansheng, Bernard Bot.

Not pictured but also on the panel were Khaled Abu Bakr and Gertjan Lankhorst.



Oslo: the role of natural gas in the sustainable energy future

The second of last year's diplomatic forums was in Oslo. Held on December 12 at the headquarters of DNV GL, this was the third event

hosted by DNV GL and the fourth held in Oslo. IGU Honorary Secretary General Pål Rasmussen welcomed the diplomats and set the scene of the current, post-COP 21 environment of the natural gas industry. The theme aimed at giving an update on industry trends and specific areas, providing fresh and updated information.

DNV GL Group President & CEO Remi Eriksen opened the Forum. He pointed to the “golden age of gas”, announced in 2011 but already evaporating, and how the COP 21 agreement has put even more pressure on hydrocarbons. Despite this, natural gas still has a role to play in the future, Eriksen said, especially in power generation.

The panel featured:

- ◆ Markus Klingbeil, Senior Energy Analyst, International Energy Agency
- ◆ Mats Fredriksson, former IGU Director
- ◆ Bernard Bot, former Dutch Minister of Foreign Affairs
- ◆ Liv Hovem, Senior Vice President, Oil & Gas, DNV GL
- ◆ Martin Layfield, Global Gas Segment Director, DNV GL
- ◆ Frode Leversund, CEO, Gassco



- ◆ Torstein Indrebø, IGU Honorary Secretary General

▲ DNV GL Group President & CEO Remi Eriksen opened the fourth Oslo Diplomatic Gas Forum.

WGC 2018 Global Ambassadors Network

Washington DC, the host city for WGC 2018, is home to the embassies of 177 countries. The WGC 2018 Global Ambassadors Network is responsible for engaging the members of the diplomatic corps from many of



◀ IGU Honorary Secretary General Pål Rasmussen introducing Markus Klingbeil, IEA Senior Energy Analyst, in Oslo.

► The WGC 2018 Global Ambassadors Network meeting held at the Italian Embassy in Washington DC was attended by diplomats, industry leaders, policymakers and energy experts.



the leading gas-producing and consuming countries in the development of the programme.

The gathering on November 1, 2016 of the WGC 2018 Global Ambassadors Network was the second of many activities through which the WGC team is working with policymakers from across the globe to build the voice of gas and ultimately develop the WGC 2018 Conference programme.

Over 135 participants attended the meeting, organised by the American Gas Association and the Embassy of Italy.

The event featured discussions about the present and future state of the global gas industry and the geopolitical challenges and opportunities for natural gas.

The tone was set during the welcome from the Deputy Chief of Mission, Luca Franchetti Pardo, who said, "Natural gas will play an important role at G7." Ambassador Dr Neil Parsan, Acting Executive Secretary for Integral Development, Organisation of American States, added, "Natural gas is not a bridge fuel but a fuel for today and tomorrow."

It was a positive meeting attended by many ambassadors, captains of industry, Washington-based policymakers and energy experts, and there is every reason to believe that the WGC 2018 Global Ambassadors Network will draw record numbers of policymakers from across the globe.

Speakers included:

- ◆ Luca Franchetti Pardo, Deputy Chief of Mission, Embassy of Italy to the United States
- ◆ Ambassador Dr Neil Parsan, Executive Secretary for Integral Development, Organization of American States
- ◆ David C Carroll, President, International Gas Union
- ◆ David Goldwyn, President, Goldwyn Global Strategies
- ◆ Frederico Arisi Rota, Executive Vice President for the Americas, Eni
- ◆ Andrea Stegher, Corporate Strategy Senior Vice President, Snam
- ◆ Amos J Hochstein, Special Envoy and Coordinator for International Energy Affairs, US Department of State
- ◆ Dave McCurdy, President and CEO, American Gas Association

The 2017 Global Ambassadors Event for WGC 2018 will be held at the Embassy of Canada in Washington DC on September 26, 2017. It will be an afternoon presentation, followed by a reception. For further information, please contact Jay Copan at jcopan@wgc2018.com.

Anette S Nordal is Coordination Committee Secretary/Information Consultant at IGU; Victoria J Jolly is Head of Marketing, WGC 2018.



IndianOil

The Energy Of India

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Natural Gas is emerging as the fuel of the 21st century, steadily replacing liquid fuels and coal due to its low ecological footprint and inherent advantages for all user segments: Industries-Transport-Households.

Indian Oil Corporation Ltd. (IndianOil), India's downstream petroleum major, proactively took up marketing of natural gas over a decade ago through its joint venture, Petronet LNG Ltd., that has set up two LNG (Liquefied Natural Gas) import terminals at Dahej and Kochi on the west coast of India.

Over the years, the Corporation has rapidly expanded its customer base of gas-users by leveraging its proven marketing expertise in liquid fuels and its countrywide reach.

Its innovative 'LNG at the doorstep' initiative is highly popular with bulk consumers located away from pipelines.

IndianOil is now importing more quantities of LNG directly to meet the increasing domestic demand. It is also setting up its own 5 million tonnes per annum LNG import terminal at Ennore, near Chennai on the east coast, to be operational by 2018.

The Corporation has formed two joint ventures to enter the burgeoning city gas distribution segment through Piped Natural Gas (PNG) networks that are coming up in many urban centres.

IndianOil is also adding compressed natural gas (CNG) as a green auto-fuel at its 25,000+ fuel stations across India. Yet another joint venture of the Corporation is investing in cross-country natural gas pipelines.

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5th IEF-IGU Ministerial Gas Forum, New Delhi

By Anette Sørum Nordal

The biannual IEF-IGU Ministerial Gas Forum is an important cooperation between IEF and IGU. It was first held eight years ago, and in December 2016, the 5th IEF-IGU Ministerial Gas Forum took place in New Delhi, India.

This by-invitation-only event brings government officials and the gas industry together to discuss the current issues facing the gas industry. It is one of a few events where gas industry players do not only talk among themselves but invite and go into dialogue with policymakers and regulators, in addition to other international organisations. As the IGU Secretary General, Luis Bertrán Rafecas, expressed during the event, "It is a great opportunity to promote gas as a source for the sustainable future energy mix."

▼ The IEF-IGU Ministerial Gas Forum provides a platform for industry and government figures to discuss the most pressing concerns that affect both industry and society in relation to natural gas.

This 5th IEF-IGU Ministerial Gas Forum was organised in cooperation with the government of India with support from GAIL (India) Limited, IGU Charter member, and the Natural Gas Society of India, IGU Associate member, on December 6, 2016 in New Delhi. It was not by coincidence that New Delhi was chosen as a backdrop. The Indian government is taking several measures that can increase the share of natural gas in the country's energy mix and move its economy to a gas-based one. The government is planning to expand India's natural gas import infrastructure in the years to come and is also taking measures to increase the demand side. As a consequence, gas's share in the Indian energy mix is expected to increase in the medium and longer term.



Gas for growth

The topic of the 5th IEF-IGU Ministerial Gas Forum was 'Gas for growth: improving economic prosperity and living standards', aiming to better understand the "current state of play in the gas industry and how the gas industry sector can contribute to a sustainable growth and secure the energy future". These are hot topics for both the industry and governments. Climate change is high on the agenda and carbon reduction targets must be met but at the same time growth in world population and rising living standards will result in increased energy demand. Urban air quality is also a great concern and countries and cities are taking on local air quality initiatives.

Current state of the industry

Abundant supply is a key characteristic of the gas industry right now. This brings both opportunities and challenges for the gas industry. LNG production has increased and at the same time demand growth has been weaker than

expected. Gas prices are currently low across all markets due to increased supply, but also the decline of the oil price. A key question at the Ministerial Gas Forum was the role that gas occupies in this oversupplied market and in a world that faces multiple challenges with regards to sustainability.

IEF's YouTube channel interviewed some of the most central Forum delegates at the event. In the Q&As, the delegates agreed on the IEF-IGU Ministerial Gas Forum's success and importance. The conclusion seemed to be clear: the future of natural gas is still looking bright, although there are also challenges to overcome.

A bright future

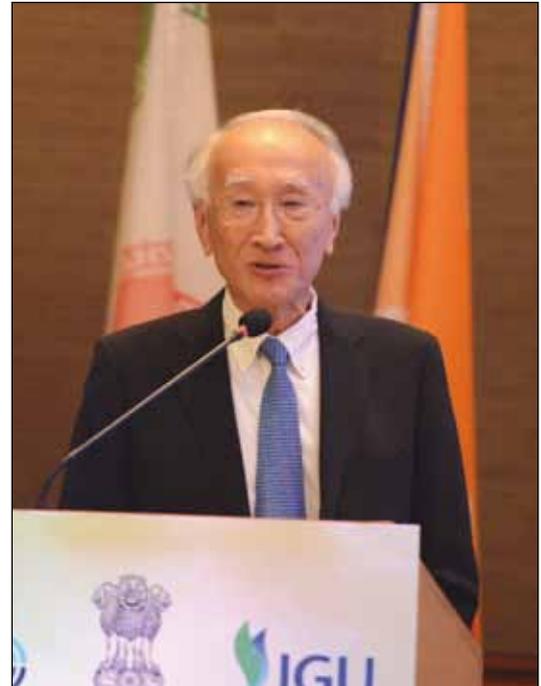
A bright future for natural gas is supported by projections on the future energy mix, something that was referenced in the presentations of the Forum and in the IEF interviews.

According to the IEA, gas is the only fossil fuel set to increase its share in the primary energy mix by 2040. Even in its 2°C scenario,



▶ HE Shri Dharmendra Pradhan, India's Minister of State for Petroleum and Natural Gas gave opening remarks to the Forum.

▶▶ IGU Wise Person Nobuo Tanaka highlighted the importance of discussion with both consumers and producers.



the IEA expects the gas market will grow, as does the Gas Exporting Countries Forum (GECF). According to GECF's Global Gas Outlook, global demand for gas is likely to increase by 50% between 2015 and 2040 with the share of gas in the energy mix increasing from just over 21% in 2015 to 25% in 2040.

The reasons for this increase in natural gas use are its environmental advantages in comparison to other fossil fuels and its possibility to partner with and support renewable energy sources. "When used in place of higher-emitting coal and oil, natural gas cannot only help reduce global greenhouse gas emissions but also improve air quality and provide access to affordable and clean energy in rich and poor countries alike," as the IGU background paper for the event stated.

Furthermore, natural gas is available and gas markets are becoming increasingly interconnected. The so-called 'second gas revolution' – to quote the IEA – is ongoing and involves a wave of LNG capacity that has come on stream. As stated in the IGU background paper: "...low-cost floating regasification technology allows

a growing number of countries to quickly tap into the global LNG trade. Thanks to an unprecedented wave of investment in new LNG export capacity, the rapid expansion of global gas trade is set to continue to 2020 and beyond. The gas market has entered a period of abundance with lower gas prices across the main importing regions. To benefit from a buyer's market, prospective natural gas importers will have to invest in new infrastructure, including regasification terminals, pipelines, electricity networks and gas-fired power plants."

Challenges facing natural gas

At the same time, the new gas revolution brings with it challenges, and the bright projections for the fuel can only become a reality if these are dealt with. The abundant supply, together with weaker than expected demand growth, has also led to oversupply.

IGU Wise Person Nobuo Tanaka, the former IEA Executive Director and currently President of the Sasakawa Peace Foundation, highlighted in his interview with IEF that it is important

that the discussion on how to deal with this is undertaken with both consumers and producers. He characterised this bilateral discussion as the key to bringing an agreement to oversupply. “Certainly, having better information for both consumers and producers is definitively necessary,” said Nobuo. “It is not easy to share the whole information but general discussions [are needed] about the direction of the market and how we contribute to better pricing, better security and better sustainability for the future.”

The oversupply and decline in gas prices naturally affects investment. The Minister of Energy & Industry of Qatar, HE Dr Mohammed Bin Saleh Al-Sada, said in his keynote speech that with the expectations of strong demand growth for natural gas, there are many challenges in terms of capital investment for the gas supply industry.

“LNG prices have fallen dramatically during the last couple of years following the path of the oil market. Under this uncertain environment, the industry has no other alternative but to curtail investment and take measures to reduce costs. This in turn negatively impacts the development of future projects. As a result, as markets recover, the energy requirements will not be available to meet the forecasted growth.”

The need to secure investments and how to ensure a predictable investment environment was a major concern at the Forum. As stated in the IGU background paper: “To continue to play a prominent role in the future energy mix – and contribute to a more sustainable energy future – natural gas requires a balanced playing field from policy.”

The same background paper highlights four policies that could accelerate the growth of natural gas in the coming decades:

- ◆ A strong and predictable carbon price signal would support gas (and zero carbon energy sources) against higher carbon-emitting fuels in most major economies around the world. At the minimum, a strong carbon price must



◆ HE Dr Mohammed Bin Saleh Al-Sada, Qatari Minister for Energy & Industry, spoke of the capital investment challenges facing the gas supply industry.

be taken into account in government policy decisions.

- ◆ Continuing market reforms could ensure that gas supply and demand responds to clear and transparent market price signals, and that natural gas is traded in an increasingly deep and liquid global market (much like crude oil). Japan’s recent deregulation efforts illustrate the type of changes needed to create more competitive domestic gas and power markets.
- ◆ Continued support for free trade in LNG remains critically important to enable gas to flow freely around the world, especially in the face of growing calls for protectionism on both sides of the Atlantic.
- ◆ The industry would benefit from a more stable and predictable regulatory approach, especially for unconventional gas production, which is increasingly controversial and the target of environmental opposition from the United States and United Kingdom to Colombia and China.

Anette S Nordal is IGU Information Consultant and Secretary of the Coordination Committee.

Update on the 27th World Gas Conference

By Jay Copan

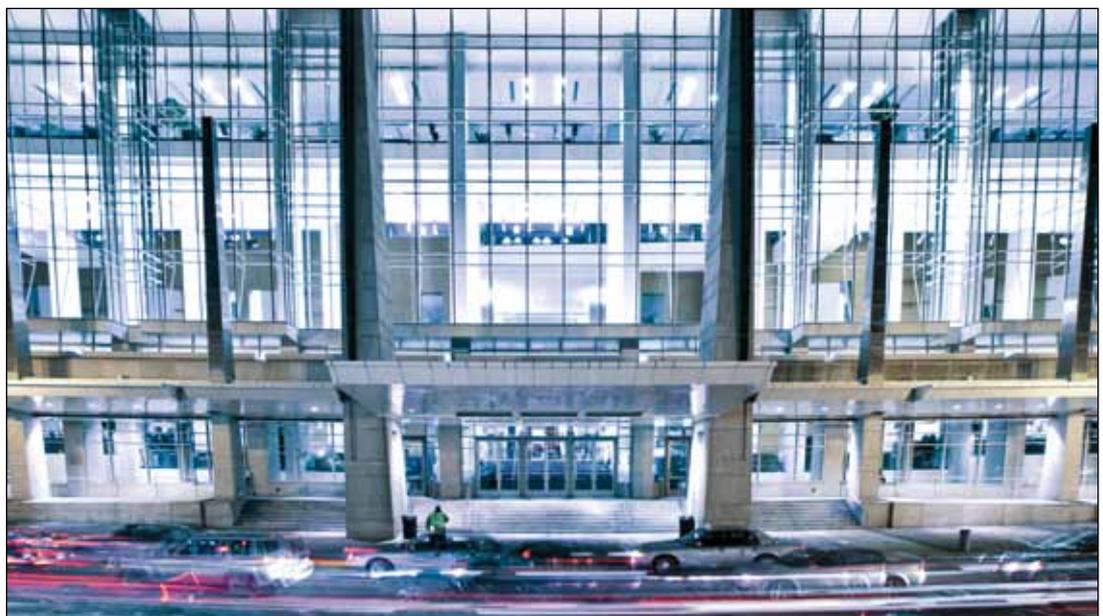
The 27th World Gas Conference (WGC) is now just over one year away and the level of planning, activity and accomplishment is proceeding at a rapid pace. The event will be held June 25-29, 2018 at the Walter E Washington Convention Center (WEW) in Washington DC. The WEW is a stunning, state-of-the-art venue in the heart of Washington DC – just minutes walk to all the major museums, monuments and important sights. Most importantly, virtually all hotel rooms are within an 18-minute walk of the WEW and all conference activities will take place within this beautiful self-contained venue. The exhibition space, 40,000m², is likewise contained within the venue itself.

Under the direction of the National Organising Committee (NOC), chaired by Dave McCurdy, President and CEO of the American Gas Association (AGA), and working closely

with the IGU Secretariat, the WGC team, led by IGU President David Carroll, is developing a market-based programme for the event, recognising all of the key issues and opportunities facing the global gas industry over the coming years. With the support of the 1,000-member IGU committee network, the team is preparing the most timely and topical programme ever conducted for WGC, a programme that will focus on three key areas: access, markets and social licence.

We are pleased that already over two dozen keynote speakers have confirmed their attendance and participation. These speakers represent not only the leaders of the global energy industry, but policymakers, NGOs, global customers, the financial community and other various constituencies. The most up-to-date listing of confirmed speakers can be found on the WGC website, www.wgc2018.com. The

► All WGC 2018 conference activities will take place within the state-of-the-art Walter E Washington Convention Centre.



WGC team met recently in Washington DC to develop plans for the Current Debates sessions at WGC. These discussions, formerly known as Strategic Panels, will focus on the absolute, most timely and topical, strategic, commercial and technical issues and opportunities facing the global gas industry.

WGC 2018 continues to engage a wide variety of constituencies as part of the programme and exhibition. For example, just some of these groups include:

- ◆ WGC 2018 is actively engaged with the new administration in Washington DC in terms of getting both domestic and international policymakers involved in the upcoming event. Planning is well under way for a number of briefings for policymakers.
- ◆ Our Financial Advisory Board recently hosted meetings in New York to continue developing the support of the financial community for all things related to the World Gas Conference.
- ◆ We are continuing our engagement with the 177 resident embassies in the Washington DC area through our Global Ambassadors Network. Planning is well underway for an event later this year to discuss the geopolitics

of natural gas, and where the WGC fits in with that topic.

Within the 40,000m² exhibition, there will be a number of special pavilions focusing on robotics and automation; LPG; gas as a transportation fuel; Showcase America and others. Over 80% of the exhibition space is already allocated.

The WGC 2018 Call for Papers will be issued on April 5, with submissions due by September 7. We encourage everyone to submit abstracts addressing the key issues facing the global gas industry and we encourage you to check out our website at www.wgc2018.com, and follow us on Twitter and LinkedIn. Conference registration will open on May 24.

The WGC team welcomes any and all suggestions regarding WGC 2018. Feel free to contact me personally at jcopan@wgc2018.com. We are under 500 days away from WGC 2018 and it is full speed ahead. All of us on the WGC team look forward to welcoming you to Washington DC in June 2018!

Jay Copan is Executive Director, WGC 2018, and serves as the Special Advisor to the President of the International Gas Union.



◆ WGC 2018 is actively engaged with the new administration in Washington DC with planning well under way for a number of briefings for policymakers.

Registration open for IGRC, one of the greatest technical events of the gas sector



By Cynthia Silveira
and Jorge Delmonte

The International Gas Union Research Conference (IGRC), regarded as one of the most important technical events in the natural gas sector worldwide, is being held for the first time in Brazil from May 24-26. The city of Rio de Janeiro was chosen to host the 2017 edition of the Congress, which is promoted every three years by the International Gas Union. Here, it is being organised by the Brazilian Petroleum, Gas and Biofuels Institute (IBP). Registrations are open.

Speaking about the conference Cynthia Silveira, Chair of the National Organising Committee, said, "Brazil has an amazing opportunity to bring the debates to the country, especially in a time when new investment opportunities are increasing. We want to integrate debates on Brazilian industry with the global one, sharing experiences and best practices".

The theme of the IGRC's 2017 edition is "Natural Gas: Catalyzing the Future". For three days, the event will address the strategic role of technology in the development of the natural gas market.

The programme includes plenary sessions, presentation of technical papers in poster sessions and technical visits. There will be eight oral and four plenary sessions altogether, which will discuss technology and innovation concerning E&P, gas transportation, distribution, use of industrial gas, climate and the environment, among other topics. The lectures will be given by specialists from all over the world and also from the local market. Panel discussions will cover "Natural Gas: Renewable Energy Partnership Enabling an Environment of Lower Fossil Fuel Use (Impacts of COP 21 on the Gas Sector)" and "Technology Radar – Innovations in the Gas Value Chain (E&P, Storage, Midstream, Distribution, Utilisation)".

Representatives from the countries where natural gas is important and has an active industry such as France, Iran, Germany and the United States are already confirmed.

For the presentations of technical papers, 570 abstracts have been written by authors from 25 countries. Of these 429 have been approved to be presented at the event. The highest number of approved papers is from Iran (197), followed by Brazil (44), Russia (31), and France (30). Gas transmission and distribution is the topic with the largest number of papers submitted (136). Exploration and production, climate and the environment will also be extensively discussed.

About IBP

IBP is a private, non-profit organisation focused on promoting the development of the Brazilian oil, gas and biofuels industry in a competitive, sustainable, ethical and socially responsible environment.

Founded in 1957 IBP today has 166 associated companies and professionals and is recognised as a leading industry representative both for its technical knowledge and for encouraging discussion and debate of the most important issues facing the industry.

Organiser of the main oil and gas shows in Brazil, such as the biennial Rio Oil & Gas conference and exhibition, IBP also develops technical courses and is responsible for standardisation, certification of inspection services and technical publications.



The broad scope of subjects that will be covered at the conference are grouped in the following thematic areas:

- ◆ Climate and environment
- ◆ Cross-cutting topics
- ◆ Domestic and commercial gas utilisation
- ◆ Energy convergence and marketing
- ◆ E&P and storage
- ◆ Gas-driven mobility
- ◆ Gas transmission and distribution
- ◆ Industrial gas utilisation

IGRC 2017 will be the event of the year for the natural gas business, in a country where the natural gas industry has a promising future, where local government is discussing a large programme to bring diversification of agents,

competition and liquidity to the local market. The conference will be a place to meet those who are active and matter in the gas business. It will be an advanced forum for technological discussions where each contribution, presence and remark will have an impact on the future.

Jorge Delmonte, IBP's Natural Gas Manager and IGRC Conference Director spoke of the opportunities hosting the event will offer. "We have many issues that are being discussed in the Brazilian gas industry, regarding challenges such as the gas production in pre-salt fields. Once they were overcome, they have potential to turn into new opportunities."

For further information visit www.igrc2017.com.br.



Cynthia Silveira is Chair of the IGRC2017 National Organising Committee; Jorge Delmonte is the IGRC2017 Conference Director.

▼ The venue for the IGRC2017 is RioCentro Exhibition and Convention Center, Pavilion 5.



News from organisations affiliated to IGU

This issue we have news on developments from the Gas Technology Institute (GTI) which recently celebrated 75 years of operation. They highlight some of their latest projects and initiatives from all points along the gas value chain. The International Group of Liquefied Natural Gas Importers (GIIGNL) reports on its General Assembly which was held in New Orleans in October last year. And finally we have an overview of the World LPG Association's new Exceptional Energy in Action website, a highly comprehensive database of information about LPG and its applications across all sectors of society.

GTI continues to build on 75-year legacy of technical innovations and market impact

By Diane Miller

For more than seven decades, Gas Technology Institute scientists and engineers have developed high-impact technologies and provided technical insights to unlock the potential of natural gas and other energy resources, helping make them economically and environmentally sustainable, while reducing costs for consumers.

Looking back over 75 years of accomplishments, Illinois-based GTI has achieved an impressive record of success in improving the ways energy is produced, transported and used around the world. These contributions are the foundation of GTI's reputation as a trusted partner to industry and government.

Looking to the future, society needs innovative solutions to deliver the affordable and reliable energy that is critical for developing nations currently dealing with population growth, urbanisation and poor air quality. Natural gas, coupled with the many technologies under development at GTI and elsewhere, will help ensure that expanding global energy needs will be met responsibly and safely for decades to come.

Efficient and sustainable production of shale gas

Shale gas is one of America's premier examples of joint government and industry R&D yielding tremendous cost/benefit ratios and long-term, transformational societal value. After 30 years of research and field experiments conducted by the Department of Energy (DOE), GTI and the private sector, the 'shale revolution' emerged during the recent recession, providing a securely accessible, low-cost energy resource for the 21st century while supporting the country's economic resurgence with millions of industry jobs and billions in annual economic value. Innovations in reservoir mapping, hydraulic fracturing and horizontal drilling coupled with favourable tax policies unlocked a national treasury of unconventional oil and natural gas.

With recovery of shale hydrocarbons in place under 20%, the US industry has just scratched





the surface of its tremendous potential. GTI continues its leadership in unconventional oil and gas solutions through the Hydraulic Fracturing Test Site (HFTS) programme, a public-private partnership that addresses challenges to sustainable long-term development. The initial test site in Texas included more than \$22m of funding from the US Department of Energy National Energy Technology Laboratory (DOE/NETL) and numerous operators and service companies. The programme, targeting horizontal shale wells, has already delivered a one-of-a-kind through-fracture core sample that shows the physical properties of the fractures for observation. Along with comprehensive data, it illustrates how induced underground fractures spread and will fundamentally alter the understanding of hydraulic fracture propagation, modelling and effectiveness.

The goal of these efforts is to optimise required well spacing and reduce the environmental impacts of responsible development. Future experiments are being planned and developed in other basins. In October 2016, GTI and BHP Billiton Petroleum (BHP) signed a letter of intent for HFTS No. 2 in the Delaware Basin. Such programmes have the potential to

reduce by thousands the number of wells required to sustain environmentally prudent resource production.

Midstream methane-emissions measurement and mitigation

The US natural gas infrastructure is a robust, flexible and reliable delivery system. While natural gas has lower carbon emissions than some other energy resources, methane detection and leakage must be addressed to fully realise its environmental benefits and expand its usage.

GTI is developing technologies to provide remote monitoring of natural gas pipeline conditions and early detection of factors leading to a potential for unintended methane release. To reduce methane emissions, GTI is developing an integrated thermoelectric generator/burner system for oil and gas field operations to eliminate natural gas use as the operating fluid for pneumatic controllers (a significant upstream source of methane emissions). Other mitigation measures are needed, including alternatives to casing repair materials, techniques for capturing methane at natural gas transmission compressor stations and gas processing facilities, and demonstration of mitigation technologies under development.

Clean and efficient power applications

GTI, with partners Southwest Research Institute (SwRI) and GE Global Research, will conduct a \$110m DOE/NETL project to design, build and operate a 10 MWe (megawatts electrical) pilot plant to develop power systems using supercritical carbon dioxide (sCO₂) fluid. This project will integrate and prove compact, modular technologies that can be applied to generate power from natural gas, coal, next-generation nuclear, solar and industrial waste heat recovery and offer a step-change increase in efficiency and corresponding reduction in emissions.

◀ The Hydraulic Fracturing Test Site No. 1, hosted by Laredo Petroleum in a Permian basin field in west Texas.

► In proof-of-concept testing GTI's new gas-fired heat pump water heater has shown a significant improvement over standard models.



reducing energy consumption and environmental footprint.

Partnering with Stone Mountain Technologies and AO Smith, GTI designed and demonstrated a novel ultra-high-efficiency gas-fired heat pump water heater through laboratory proof-of-concept testing. The system meets NO_x requirements and has an energy factor that is more than twice that of standard gas water heaters.

Utilization Technology Development

Established in early 2004, Utilization Technology Development (UTD) helps utilities build technology portfolios and expand efficiency programmes. UTD secured its first European member in 2015. Gas Natural Fenosa is headquartered in Spain and has utility operations in multiple countries, including Mexico. Led by 17 member companies, UTD represents over 37 million natural gas customers in the Americas and Europe.

Diane Miller is Senior Marketing Communications Manager at the Gas Technology Institute (www.gastechnology.org).

GIIGNL's General Assembly, New Orleans

By Vincent Demoury

Last year saw the export of the first LNG cargo from continental USA in over 50 years. This was a momentous occasion for the industry and for



Residential and commercial gas equipment efficiency

GTI has a long legacy of promoting the clean and efficient use of energy resources in residential and commercial end-use markets. Our experts have made significant contributions to codes and standards issues and we have developed factual scientific data regarding the benefits of source energy to support energy efficiency standards. Assessments to verify equipment durability and performance have increased product adoption by providing potential customers with the knowledge and confidence to buy. Residential and commercial appliance innovations have led the way in

▼ GIIGNL Members gathered in New Orleans, Louisiana.



**BRIDGING
THE GAS
MARKETS
IN EUROPE**



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IN 3 ACTIVITIES**

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OF NATURAL GAS 

TERMINALLING
OF LIQUEFIED
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OR ELECTRICITY**

Fluxys as a gas infrastructure company seeks to foster the integration of the European gas market through the development of a cross-border infrastructure backbone linking gas sources to markets, bridging the markets and gas trading places, and providing security of supply.

Fluxys is convinced that gas and gas infrastructure will continue to feature as core components of an affordable energy mix for tomorrow's low-carbon economy.

- Gas is the cleanest fossil fuel with the lowest carbon footprint and the lowest emissions impacting health.
- Gas infrastructure and gas-fired power plants provide the flexibility required to complement variable power generation from renewable sources.
- Gas infrastructure is a highly versatile asset for transmission and storage of large quantities of energy at low cost. New technologies such as power-to-gas will make the gas system even more flexible in the future energy landscape.



▲ From left to right: Domenico Dispenza, Jean-Marie Dauger and Tsuyoshi Okamoto, Executive Vice President, Tokyo Gas Co Ltd.

LNG importers who gathered in October in Louisiana, the state where the Sabine Pass liquefaction facility is located.

The annual General Assembly meeting of GIIGNL was held on October 17 and 18, 2016 in New Orleans, at the kind invitation of Cheniere Energy.

Around 150 senior representatives from 78 GIIGNL member companies and 25 countries met to exchange views and to receive updates on the latest commercial and technical developments of the LNG industry.

Three new member firms from three different regions joined the association and attended the meeting for the first time: ENN LNG Trading, Gazprom Marketing & Trading and Exceleerate Energy.

On October 17, Jack Fusco, CEO of Cheniere Energy welcomed participants and expressed his strong belief in the future growth of LNG, predicting a spectacular shift to cleaner-burning natural gas for power generation worldwide, for economic as well as environmental reasons.

The opening presentation from Giorgio Bresciani, Senior Partner and Director of the Global Gas practice at McKinsey, examined the promising role of natural gas and LNG in the context of the energy transition. He highlighted the current market features and pointed out the necessity of cooperating along the value

▶ Jason Bordoff of Columbia University addressed the impact of US LNG exports on the global LNG market.





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At TgP we know that, so in fulfilment of our commitments to Peru, we inaugurated the new Kámani Compression Plant in the jungle, which will allow the country to continue to grow.

chain in order to address the upcoming challenges to be faced by buyers and sellers.

As a complement to a series of regional market overviews, Gordon Exel, Chairman of NGVAmerica (Natural Gas Vehicles for America), presented the opportunities and challenges for LNG as a fuel for trucks.

On the afternoon of October 17, GIIIGNL members elected Jean-Marie Dauger as President, succeeding Domenico Dispenza. A new Executive Committee was formed, composed of three regional Vice Presidents and of 12 Executive Committee members also representing the three regions: Asia, Americas and Europe.

The first day of the meeting ended up with an outstanding gala evening during which delegates had a chance to listen to a highly talented New Orleans jazz music band.

On the second day of the gathering, Jason Bordoff, Professor at Columbia School of International and Public Affairs, discussed the economic and geopolitical impact of US exports

on the global LNG market. He gave the audience his views on the price competitiveness of US LNG in the medium to long term, considering the uncertainties weighing on global LNG supply and demand. A former advisor to the White House, Bordoff also provided some rare insight on US energy policy and on American public opinion with regard to climate change issues.

Later on the second day, Alan Townsend, Senior Director Energy, World Bank, reviewed the implications for LNG in a post-Paris world. According to him, one of the main challenges is the fact that new gas infrastructure will be required in the future while volumes that are needed will be difficult to predict, in part due to the fact that COP 21 targets will be met on a non-mandatory basis. Townsend explained that the World Bank supports the growth of natural gas and the slowdown of coal plants, specifically targeting South and Southeast Asian countries (mainly Indonesia, India, Pakistan, Philippines and Vietnam) in order to promote a

▶ Alan Townsend from the World Bank on "Implications for LNG in a Post-Paris World".



combination of energy efficiency, renewables and natural gas.

Finally, Nikos Tsafos, CEO of Washington DC-based energy consulting firm Analytica addressed the role of gas in the energy transition by questioning traditional assumptions related to energy and gas: will energy demand really keep growing? Will transition to new energies be slow? Will gas gain in a carbon-constrained world?

His conclusions - quite similar to Townsend's findings, but slightly more pessimistic - showed that although there is a general consensus that gas should gain market share because it is cleaner and can complement intermittent renewable energy, the truth is somewhat more complex. In many parts of the world, the market share of natural gas has peaked and it

appears that gas can be a good complement to renewables only in the context of good policy. In this uncertain environment, Tsafos invited energy companies to rethink their ways of responding to energy demand, emphasising the fact that customers do not value the commodity itself but rather the potential benefits associated with it.

In the afternoon of October 18, the participants enjoyed a fascinating tour of New Orleans in a traditional streetcar from the 1920s, concluded by an exquisite private dinner at Brennan's, one of the city's most renowned Creole fine-dining landmarks.

Vincent Demoury is General Delegate, International Group of Liquefied Natural Gas Importers (www.giignl.org).

Enagás supports the diversity of supply in Europe



Enagás' large experience as independent Transmission System Operator, TSO accredited by the EU, and leader in liquefied natural gas infrastructures at the service of diversity of supply in Europe.

International leader in LNG infrastructures

WLPGA's LPG applications database: exceptional energy in action

By Nikos Xydos

The World LPG Association (WLPGA) is the authoritative voice of the global LPG industry, representing the full LPG value chain. The primary goal of the association is to add value to the sector by driving premium demand for LPG while also promoting compliance to good business and safety practices. WLPGA has a four-point mission and one of these four core goals is to identify innovation. WLPGA actively promotes technology and innovation and constantly seeks new technologies that will guide future opportunities.

LPG is used by hundreds of millions of people and for thousands of applications around the world. LPG is an exceptional energy source due to its origin, benefits, availability and the variety of applications that use it. As arguably the world's most multi-purpose energy, LPG plays a pivotal role in the transition

towards a more secure, sustainable and competitive energy model.

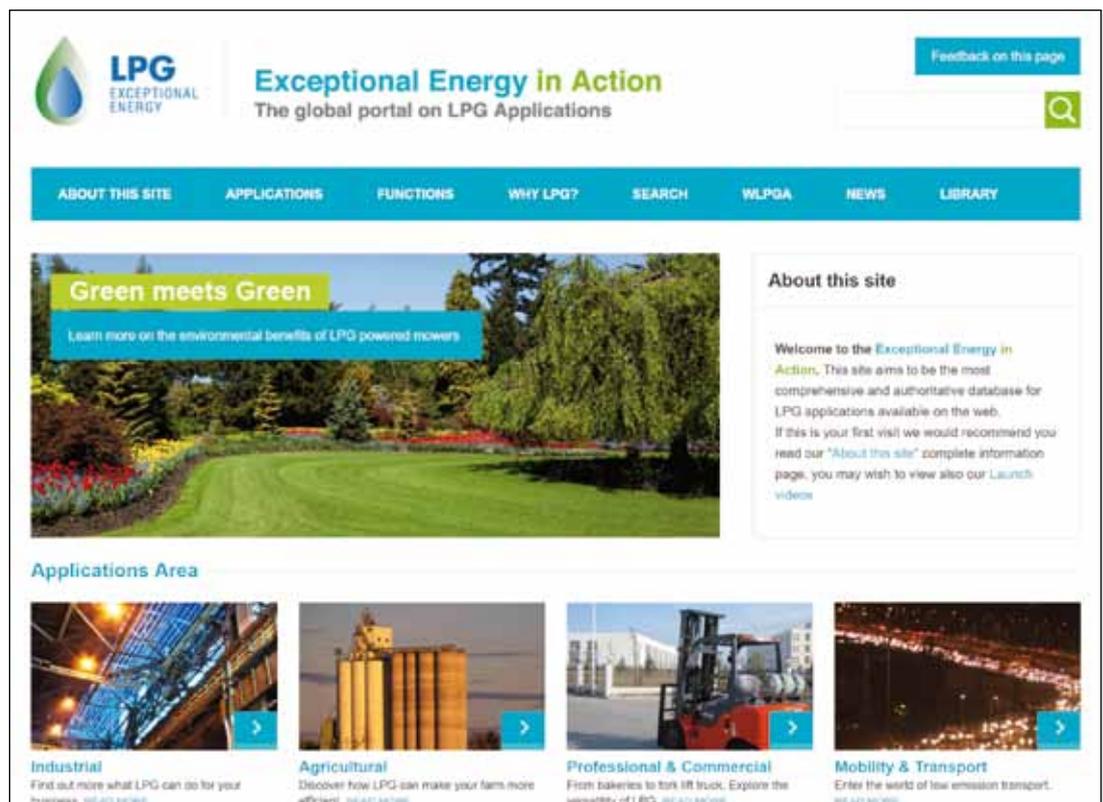
However, while the vast variety of applications that can use LPG as a fuel is one of the key advantages of LPG, some of the applications are little known to the wider public and sometimes even among parts of the LPG industry itself.

Recognising this, in 2014, WLPGA launched a dedicated online LPG applications directory. Called Exceptional Energy in Action (EEIA), the goal of the database is to list and promote, as far as possible, all known and existing applications and appliances of LPG.

The goal of EEIA is to raise awareness of the exceptional variety of applications and support the spread of new LPG applications and technologies. In addition, EEIA will promote the use and knowledge of LPG and its applications within the industry and beyond.

Now fully live, the EEIA website is continually developed and enhanced and is a valuable knowledge base on everything there is to know

► The Exceptional Energy in Action website, www.lpg-apps.org, is a centralised database featuring news, case studies, and information on the whole range of LPG's applications worldwide.





◀ With such a wealth of information available, the comprehensive search functionality of the site allows visitors to drill down to the content relevant to their needs.

about LPG applications. It includes a variety of supporting materials such as industry reports, case studies, videos, photos, etc, to complement the actual database. With EEIA, the industry now has, in one place, a comprehensive listing of how LPG can be used around the world.

With a comprehensive search tool, any information contained can be easily explored by market sector such as industrial, agricultural, commercial, etc, even down to a very specific sub-sector such as hotels, bakeries; or by function, as in heating, cooking, cleaning, power generation or simply by a direct search. In addition to the information contained on the various uses and

applications, EEIA features current news related to new LPG applications, appliances and products that are new to the market.

Topping the list of any Google LPG applications search, EEIA has become today the most comprehensive and authoritative database for LPG applications available. Produced and maintained by WLPGA, visit EEIA at www.lpg-apps.org and follow EEIA on Twitter at [@LPGapps](https://twitter.com/LPGapps).

Nikos Xydas is WLPGA's Technical Director. For more information, please contact him on nxydas@wlpga.org and discover the WLPGA at www.wlpga.org.



◀ More than a thousand LPG applications are broken down on the site via sector and usage.

Presenting IGU's new Members

In the following pages we provide a brief overview of the activities of IGU's two new Associate Members who were welcomed at the Council meeting in Amsterdam last October: PwC (Global) Energy Group, based in the Netherlands, and the Natural Gas Society of India.

PwC (Global) Energy Group

PwC (Global) Energy Group is a strategic consultant, tax advisor and/or auditor for many companies in the gas sector. Their dedicated industry network plays an active role in the ecosystem around gas players, with prime knowledge of stakeholders

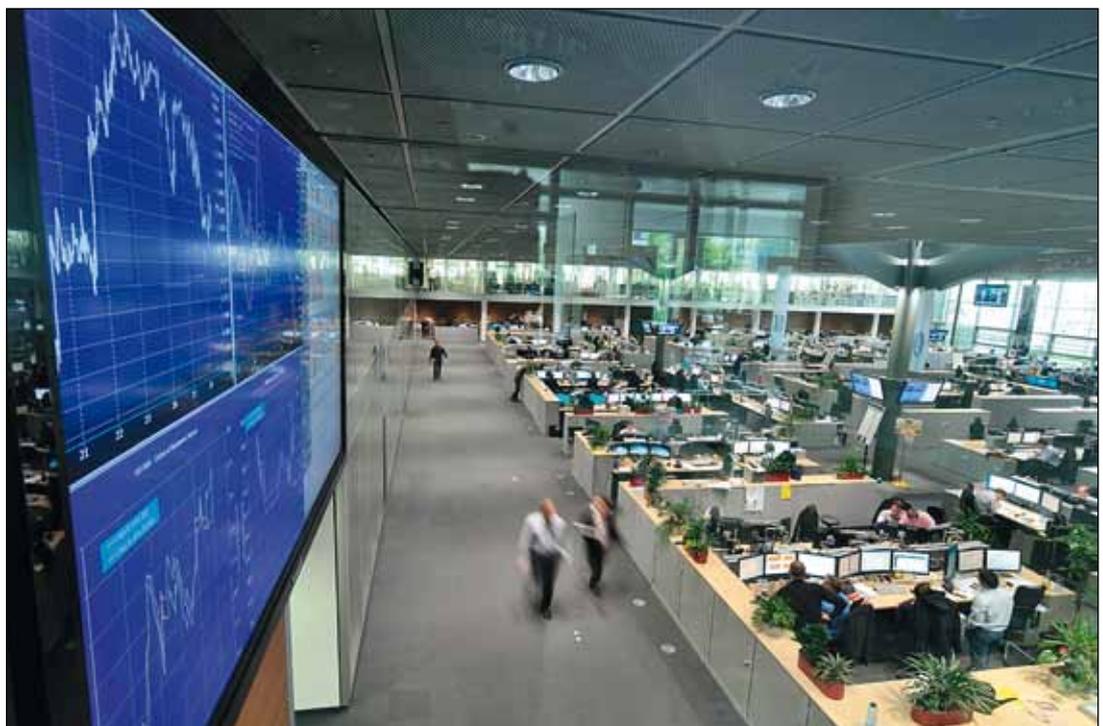


and c-suite staff. The Group's purpose is to contribute to solving the important problems the industry is facing.

The energy sector is in constant motion and will continue to be for some time. It is an exciting but highly demanding sector, where everything is happening all at once in almost every segment; in energy transition and sustainability, ageing infrastructure, increasing dependence on oil and gas imports and security of supply. In addition, we also have the advent of smart meters, the lack of qualified young people and European and global policy – or lack of – in areas of incentives and regulation, which cuts across all of these issues.

Investment needs are daunting and – in a financial crisis and a volatile climate –

► PwC offers post-degree programmes on energy finance.



also difficult to meet. Internationalisation requires international solutions but these are not always forthcoming. Meanwhile, increasingly articulate consumers are demanding cheap and reliable energy. All of this amounts to a great deal of uncertainty regarding the future and demands the utmost from the players in and around the energy sector. Succeeding in a capital-intensive sector with a long-term horizon is not easy.

PwC believes that these challenges call for a collective, international approach, with clear regulatory frameworks and oversight, including for subsidies. This is why they work in an international team, to provide the best possible service, locally and internationally.

PwC's team of specialists are happy to share their extensive knowledge and expertise in all energy segments. But it doesn't stop at sharing. The Group also harnesses its position and knowledge in order to advance the sector by acting in the areas of its strengths: people; networking and relations; and knowledge.

Via their network initiatives, thought leadership and round tables on topics such as energy transformation, PwC shares its independent views with the industry. PwC offers post-degree education programmes on energy finance in order to share knowledge and build relevant industry networks, working with the University of Groningen and the Energy Delta Institute to create an international postdoctoral programme entitled Finance and Control in Energy, which is offered in Groningen, Houston, Moscow and Qatar.

Due to their advising role, they have a good insight into the sector and its developments, and have contacts with market players in the gas sector at a global level. PwC also puts the sector in touch with politicians through the EnergyPoort conference in The Hague and build on the international network through participation in the World Energy Council. PwC is the impetus behind the Dutch Women in Energy

network, a successful and diverse knowledge platform that organises popular events every year, for and by the sector. PwC also supports institutes and initiatives such as Energy Valley and its objectives in the Hanseatic Energy Corridor.

PwC will participate in IGU's activities and provide their knowledge of the industry, as well as access to their network, where appropriate. PwC's relationship with international governments and regulators can serve IGU to make its case. The group's independent view on the important role of gas as part of the world's energy transformation, as reflected in their thought leadership, can support the industry in its positioning and their L&D programmes will contribute to knowledge sharing.

PwC want to be relevant to society and help solve important problems in the gas industry. As such, it seeks to be more than a consulting organisation. The Group contributes to shaping the industry's future by using their core knowledge, industry network and competency for that purpose.

For further information visit www.pwc.nl/en/energie-utilities/olie-en-gas.html

Natural Gas Society

The mission of the Natural Gas Society (NGS) is to promote and facilitate sustain-

able growth of the natural gas industry in India. It fosters the safe and healthy growth of the sector through information exchange, sharing of good practices and collaborating with similar organisations around the world.

NGS looks forward to knowledge sharing in the development of the gas industry in India while participating in the research programmes of IGU. This will enable NGS and IGU to exchange and share the experience of skilled professionals on a regular basis. NGS is the only





▶ Natural Gas Society member Petronet LNG's Kochi regasification terminal.

body in India which seeks to represent the natural gas sector with the primary mission of facilitating further sustainable growth.

NGS has been associated with various national and international gas events, including the Asian Gas Partnership Summit, which is held in India and supported by IGU, and the Asian Gas Market Forum in China. We can play a vital role in the gas sector in partnership with IGU.

The following are the ways that NGS would like to contribute to the development of the gas industry through active participation with IGU.

- ◆ Sharing information and research in the natural gas sector in India.
- ◆ Participating in research programmes initiated by IGU in the field of natural gas, LNG and city gas distribution, enhancing the development of gas infrastructure and industry in India and also worldwide.

- ◆ The regular exchange of experience among skilled professionals of IGU and NGS.

NGS provides, free of charge, news and information on the natural gas sector through a fortnightly SNAPSHOT on its website. The Society also carries out research for the Asian Gas Market Forum in China, producing a quarterly publication of gas statistics and reports highlighting periodical gas data, including production and consumption, imports, CNG, PNG, LNG and international and domestic price data.

NGS has three task forces covering: gas cylinder safety; regulation and bidding criteria for city gas distribution projects; and operation and maintenance.

The current members of NGS are GAIL (India) Ltd, Indraprastha Gas Ltd, Mahanagar Gas Ltd, Petronet LNG Ltd, Adani Gas Ltd and Cairn India Ltd.

For further information visit ngsindia.org

Publications available from IGU

As a non-commercial organisation promoting technical and economic progress in the gas industry worldwide, IGU offers its publications free of charge.

You are invited to download the publications currently available from the IGU website www.igu.org or order hard copies (if in stock) from the Secretariat (see Title page for contact information).

Reports launched in 2016

Global Gas Markets Supporting Growth and Sustainability

Case Studies in Improving Air Quality, Second edition (European cities)

Wholesale Gas Price Survey – 2016 edition

Case Studies Enabling Clean Energies

World LNG Report – 2016 edition

Report launched at the IGU

COP 21 Gas Day

Case Studies in Improving Urban Air Quality

Reports launched at

WGC 2015

Biogas – from refuse to energy

Prospects for Natural Gas: Identifying the key developments that will shape the gas market in 2050

Other publications

IGU Articles of Association

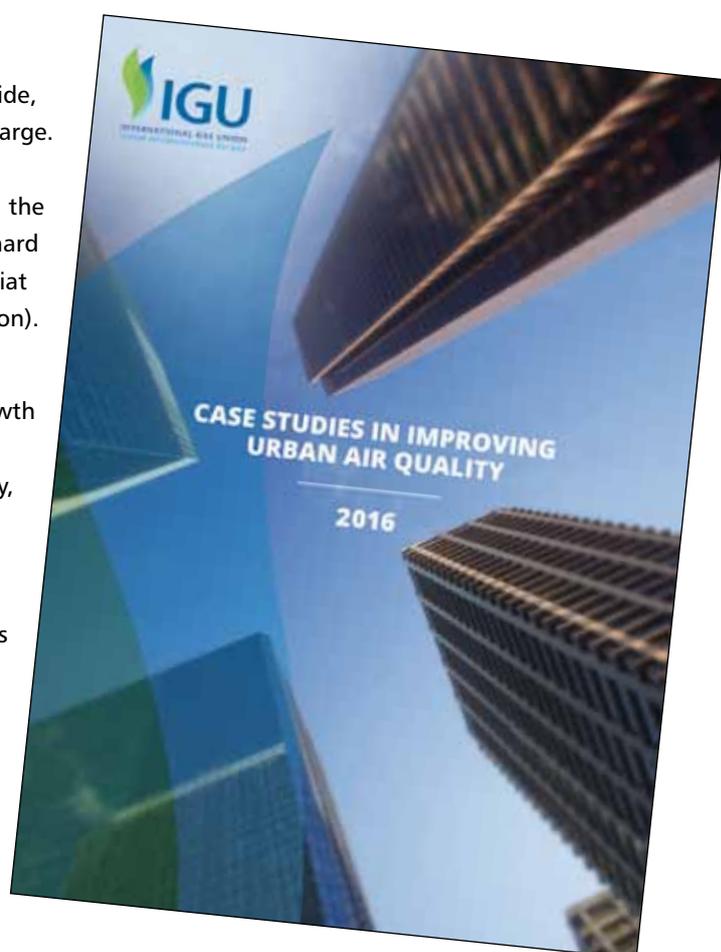
IGU Annual Report

IGU General Brochure

Triennial Work Program 2015-2018

Shale Gas – The Facts about the Environmental Concerns

Natural Gas as a Transportation Fuel



Global Vision for Gas – The Pathway towards a Sustainable Energy Future

IGU Natural Gas Conversion Guide

IGU Natural Gas Conversion Pocketbook

International Gas Union 1931-2012

International Gas, back issues of the bi-annual IGU Magazine

Please check the IGU website for other (older) publications which are still available from the IGU Secretariat.

IGU Events and Other Major Gas-related Events 2017-18

2017

March 28-30
IGU Executive Committee and Coordination Committee meetings
Muscat, Oman

April 4-7
 Gastech 2017 Conference & Exhibition
 Chiba, Japan

May 24-26
IGU Research Conference, IGRC 2017
Rio de Janeiro, Brazil

June 22-23
 GIE Annual Conference
 Prague, Czech Republic

July 9-13
 22nd World Petroleum Congress
 Istanbul, Turkey

September 25-29
 IPLOCA Annual Convention
 Mexico City, Mexico

October 3-5
 30th World LPG Forum
 Marrakech, Morocco

October 8-11
 GIIGNL General Assembly
 Brussels, Belgium

October 24-26
IGU Council, Executive Committee and Coordination Committee meetings
Tokyo, Japan

November 6-17
 23rd Session of the Conference of the Parties to the UNFCCC (COP 23)
 Bonn, Germany

2018

April 17-19
IGU Executive Committee and Coordination Committee meetings
Cairo, Egypt

June 25
IGU Council meeting
Washington DC, USA

June 25-29
27th World Gas Conference
Washington DC, USA

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Cover: Gazprom (left: GTL facility), BASF (upper right: Nanocubes for hydrogen storage), BASF (centre right: Researcher), Gazprom (lower left: Metallised protective pipe coatings).

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COP 22: as climate change policy gains momentum, the future gets brighter for gas: IISD/Kiara Worth [enb.iisd.org/climate/cop22/enb/15nov.html] (24), IISD/Kiara Worth [enb.iisd.org/climate/cop22/enb/7nov.html] (25 upper), IISD/Kiara Worth [enb.iisd.org/climate/cop22/enb/16nov.html] (25 lower), IISD/Kiara Worth [enb.iisd.org/climate/cop22/enb/18nov.html] (27).

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Oman's unique habitat: Roderick Eime [CC-BY-2.0] (42 left), Arian Zwegers [CC-BY-2.0] (42 right), Petroleum Development Oman (43), Oman LNG (48, 49).

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Engaging with the diplomatic corps: IGU.

5th IEF-IGU Ministerial Gas Forum, New Delhi: IEF [www.ief.org].

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Registration open for IGRC 2017, one of the greatest technical events of the gas sector: Riocentro Exhibition and Conference Centre.

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www.SempraLNGM.com.



QUICK FACTS

- » Sempra LNG & Midstream developed one of the first liquefaction export facilities in the U.S., Cameron LNG in Louisiana; and the first LNG receipt terminal on the west coast of North America, Energía Costa Azul in Baja California, Mexico
- » Liquefaction projects in development: Cameron LNG expansion, Port Arthur LNG in Texas and a liquefaction project Energía Costa Azul
- » Our Pipeline & Storage projects in development provide the required infrastructure to LNG export terminals and other industrial customers
- » Our projects in development will help meet the global demand for energy

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