Development and Innovation in Focus
All eyes turn to Perth for LNG 18
Flexibility.
The new phenomenon.

5 Key Technologies:

Liquefaction
To liquify sweet dry gas.

Outlet Temperature
Approximately -150 degrees Celsius.

Acid Gas Removal
To remove CO₂ and H₂S from feed gas to prevent freezing in the downstream cryogenic processes and to meet LNG product specifications.

LNG Storage

Capacity
177,000 m³ (2 x 4 storage tank).

Turret
External turret (free hanging type) with Flexible Riser and provision for additional risers and umbilical at future locations. Robustness against various metocean data.

Marine Loading Arms
Enables stable ship to ship, or side by side offloading with targeting system, for accuracy in any condition.

PETROLIAM NASIONAL BERHAD (PETRONAS) (20076-K)
Taking to the seas are two of PETRONAS’ floating LNG facilities. Revolutionising industry standards with superior mobility and flexibility to tap into stranded gas fields to secure energy for the future.

It’s a step forward in the industry’s innovation, setting a benchmark in the world of LNG to meet energy demands.
COMMITTED TO NATURAL GAS

Investing substantially in the cleanest fossil fuel to reduce the carbon footprint
Vision and Mission

The International Gas Union (IGU) is a worldwide, non-profit organization 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 organization 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 organizations.
- 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 organizations 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 emphasizing sound environmental performance, safety, reliability and efficiency across the entire value chain.
- IGU maximizes the value of its services to members and other stakeholders.
Offering innovative LNG liquefaction technology

ConocoPhillips began using its Optimized Cascade® process in 1969 and has since licensed this proven and reliable LNG liquefaction technology for 24 LNG trains around the world. From plant design to startup, our technology and expertise continue to deliver the highest standard of LNG facility performance to our clients and to us.

It’s not just what we do. It’s how we do it.

To learn more, visit lnglicensing.conocophillips.com.
A world leader in energy supply and trading

We produce gas ourselves so we understand the challenges faced by explorers and producers. In a complex and sophisticated market, we can deliver the solutions our customers are looking for.

We are one of the world’s leading international oil and gas companies. We provide fuel for transportation, energy for heat and light, retail services and petrochemicals products. Our activities include oil and natural gas exploration, field development and production, midstream transportation, storage and processing, and the marketing and trading of natural gas, including LNG, together with power and natural gas liquids.

Our size and global reach are important. But we believe that ultimately success comes from the energy of our people and the strength of the relationships we build.

www.bp.com
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### Evaluation of Biological Methanation for Power-to-Gas Applications

*By Frank Graf and Gerald Linke*

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New Sustainable trench for gas distribution network developments

Sustainability has taken on great importance in the civil works field of activities, forcing professionals to combine society's demands and requirements regarding high quality infrastructure with minimizing effects on surrounding areas and environmental friendliness. This has led Gas Natural Fenosa to apply this principle to its gas trench service by proposing a new solution.

This new proposal involves making maximum use of excavated earth for filling in trenches and covering over the tops of trenches, with the use of controlled expansion concrete.

This system is different from the method currently used, as excavated material extracted using trenchers is subsequently reused for filling in the trench instead of being taken to a landfill site. This eliminates or reduces the need to use aggregates, leading to lower consumption of raw materials, lower CO₂ emissions for transporting the extracted earth to the landfill and infill earth to the site, and less solid waste generated on site; at the same time, safety is improved as the number of operations are reduced. Furthermore, the use of expansive concrete, pigmented if necessary, as the top layer for covering over the trench, allows the creation of overly wide trenches and the addition of an asphalt agglomerate layer to be avoided.

New trench infill solution

The main new features of the proposed trench infill solution are the reuse of excavated material, obtained by trencher machines, for filling in the trench, and the use of an expansive concrete to compensate for the drying shrinkage that commonly occurs with this type of solution by adding calcium oxide (CaO), and to guarantee contact with the trench walls.

In addition, pigments should be used to ensure that the appearance of the uppermost layer of this concrete is similar to that of the adjoining asphalt.

Numerical model for validating the new solution

As part of the cross-disciplinary vision of the new trench solution study, a numerical simulation is proposed of the behaviour of the structure when submitted to the action of traffic loads. The fundamental aim is to establish how much the concrete has to expand to ensure contact between the trench and the adjoining earth, and that stresses are transmitted to this earth.

The parametric study conducted using finite element models found that the trench's critical failure mode is shear failure.

Experimental concrete expansiveness study

The experimental expansiveness study was conducted at the Structures Technology Laboratory at Universitat Politècnica de Catalunya, involving a study of the internal stresses generated by confining expansive concrete.

The results obtained from the experimental work indicate that adding calcium oxide to the recommended contents of mortar or concrete mixes can create internal stresses to ensure adequate contact and prevent tensile or shear failures.

Experimenting with concrete pigment

The new trench infill solution offers the possibility, provided that it is permitted by the Administration, of eliminating the top layer of 5-8 cm of asphalt, using the layer of expansive concrete. In this case, the use of pigments is proposed to give the concrete paving surface a similar appearance to the existing asphalt paving surface.

Sustainability must be measured

The sustainability of the proposed new solution was studied using an Integrated Value Method for Sustainable Evaluations as a tool to aid decision making.

As part of this study, an Urban Trench Sustainability Index has been defined. The aim of this index is to serve as a tool for comparing construction alternatives and identifying which is most appropriate for each case from a sustainability point of view, that is, by conducting a joint appraisal of economic, environmental and social requirements.

Conclusions

Pilot tests conducted with the new trench infill solution have been very satisfactory, and excellent behaviour results have been obtained.

Numerical studies conducted to assess the trench's behaviour confirm its technical viability, allowing the trench's concrete layer to be reduced to 15 cm by using expansive concrete.

The elimination of the top layer of asphalt paving surface proposed in the new solution is possible through the use of concrete surface pigmentation. Experimental tests indicate that it is possible to achieve an appearance similar to a bituminous paving surface with this technique.

The Urban Trench Sustainability Index that has been developed is a fundamental tool for evaluating the sustainability of construction solutions for urban trenches. This index has made it possible to appraise the proposed solution as the most sustainable alternative when compared to other solutions.

José María Almacellas of Gas Natural Fenosa is the Chairman IGU Distribution Committee.
At Gas Natural Fenosa, more than 23,000 people work every day to satisfy the energy needs of homes, industry and businesses, with the vision to be a leading energy and services group in constant growth. That’s how we manage to supply energy to over 23 million customers in more than 30 countries around the world. Because we know that the only way to be bigger is to be closer.

Because what’s important isn’t what you say, but what you do.

www.gasnaturalfenosa.com
Message from the President and the Secretary General

Dear Colleagues

Welcome to this edition of the IGU magazine. We hope that your 2016 is off to a great start. Your IGU leadership team remains hard at work advocating for gas as a critical part of the world’s energy portfolio. At the same time, we are working hard to ensure that the value to IGU membership continues to increase.

An example of the advocacy efforts was IGU’s presence at COP 21 in Paris last December. As world leaders gathered in Paris to discuss plans for mitigating the effects of climate change, IGU was there and actively engaged. We clearly see the need to reduce the carbon intensity of energy in the future, and natural gas is well positioned to make a significant contribution towards this. Natural gas stands apart from the other fossil fuels in view of its environmental attributes, the high levels of efficiency when converted to heat and power, to the flexibility it offers in partnership with renewable energies, to the transport sector and its role as an important feedstock fuel in the chemicals and fertilizer industries.

But we also believe strongly that more needs to be done today to improve the health and well-being of our fellow citizens. Poor air quality, laced with toxins and particulates, is a major contributor to millions of premature deaths every year, according to the World Health Organization. The combustion of solid fuels, such as coal and charcoal, in addition to diesel, are major contributors to poor air quality.

During COP 21, we released a report entitled Case Studies in Improving Urban Air Quality that demonstrates the role of gas in improving the air quality in megacities around the world. The report featured real examples from Toronto, Istanbul, New York and Beijing. In each case, increased gas use has led to a measurable improvement in air quality.

We featured this report in an outreach campaign, with a floor presentation by your Secretary General, numerous press interviews, a web posting, and a featured story in the Financial Times web and print editions that stressed the gas industry’s commitment to cleaning the air. A positive message and an excellent example of effective advocacy at work.

We unveiled a revamped Council meeting format last October in Cartagena, Colombia, a format that allowed for more discussion of strategic issues, a greater understanding of local industry trends and market conditions, and ample time for member networking. We owe a big “muchas gracias” to our host.
Eduardo Pizano of the Colombian Gas Association and his team and sponsors for a memorable and productive week in Cartagena.

We’ve also launched two important new initiatives to reach new important stakeholder groups – the Global Ambassador Network, to reach and tell our industry’s story to government officials and policymakers, and the Financial Advisory Board, to closely engage the institutions that finance infrastructure build out and commercial transactions. More to come on these important initiatives in future issues.

As far as this triennium’s work plan, committee work is off and running. Plans are in place to address important global topics, aligned with the IGU’s strategy and advocacy priorities.

We’re fortunate to have a group of outstanding committee leaders, backed up by solid teams of IGU professionals. But we need even more of your experience and energy to build the future of our industry. Help us make a difference – sign up and join your colleagues, now!

So where are we today? Lots of action, lots of change, substantial engagement with members and partners, and one high-impact outreach campaign completed, with more planned. This is what we promised – this is what we’re delivering.

Why the hurry? Because we believe that the time for gas is now – the post COP 21 energy transition is underway in 200 countries. Gas should be a critical part of our future energy mix – and we aim to make that happen.

Looking forward to seeing you at LNG 18.

With best regards,

David and Pål
One-of-a-Kind

- Holding the World’s Largest Gas Reserves
- Exploiting the Giant South Pars Field
- Unique Privilege of Pipeline/LNG Trade
- Huge Investment Opportunities
Members of IGU

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Countries represented in IGU

- 91 Charter Members
- 10 Premium Associate Members
- 47 Associate Members
Fueling the Future

Around the world, natural gas has tremendous potential for growth. The USA triennium is leading the International Gas Union and helping strengthen the global voice of gas to leverage the vast opportunities that exist and support market expansion across the globe.
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Find & Deliver
Natural gas for a safe and stable climate
## Premium Associate Members

- Beijing Gas Group (China)
- China National Petroleum Corporation (China)
- Enagás (Spain)
- ENGIE (France)
- E.ON Global Commodities (Germany)
- IGDAŞ – Istanbul Gas Distribution Co. (Turkey)
- Korea Gas Corporation – KOGAS (Korea)
- PT PERTAMINA – Persero (Indonesia)
- Statoil ASA (Norway)
- TOTAL S.A. (France)

## Associate Members

- Abu Dhabi National Oil Company (ADNOC) Distribution (UAE)
- Anadarko Petroleum Corporation (USA)
- Australian Petroleum Production & Exploration Association – APPEA (Australia)
- BG Group plc (United Kingdom)
- BP Gas Marketing Ltd (United Kingdom)
- Bureau Veritas (France)
- Bursagaz (Turkey)
- Cheniere Energy Inc. (USA)
- Chevron Corp. (USA)
- China LNG Association (China)
- COM-therm (Slovakia)
- ConocoPhillips Company (USA)
- DNV GL (Norway)
- Energo-diagnostika (Russia)
- Energy Economics Institute (Mongolia)
- Eni (Italy)
- Eurogas
- ExxonMobil Gas & Power Marketing (USA)
- Gaslink – Gas System Operator Ltd (Ireland)
- GasTerra B.V. (The Netherlands)
- GAZBIR – Association of Natural Gas Distributors of Turkey
- Indian Oil Corporation Ltd (India)
- Indonesian Gas Society (Indonesia)
- INPEX Corporation (Japan)
- Instituto Brasileiro de Petróleo, Gás e Biocombustíveis – IBP (Brazil)
- Liander N.V. (The Netherlands)
- N.V. Nederlandse Gasunie (The Netherlands)
- OMV Gas & Power GmbH (Austria)
- Origin Energy Limited (Australia)
- Petróleo Brasileiro S.A. – Petrobras (Brazil)
- Petronet LNG Limited (India)
- RasGas Company Limited (Qatar)
- Regas (Italy)
- Repsol S.A. (Spain)
- Russian Gas Society (Russia)
- Santos Ltd (Australia)
- Shell International Exploration & Production B.V. (The Netherlands)
- Société Suisse de l’Industrie du Gaz et des Eaux – SSIGE/SVGW (Switzerland)
- Sonorgás (Portugal)
- Spetsneftegaz NPO ISC (Russia)
- TAQA Arabia (Egypt)
- TIGAS – Transportadora de Gás do Brasil S.A. (Brazil)
- TgP – Transportadora de Gas del Perú (Peru)
- Vopak LNG Holding B.V. (The Netherlands)
- Westnetz GmbH (Germany)
- Wintershall Holding GmbH (Germany)
- Woodside (Australia)

## Organisations Affiliated to IGU

- Energy Delta Institute (EDI)
- Gas Infrastructure Europe (GIE)
- Gas Technology Institute (GTI)
- GERG – Groupe Européen de Recherches Gazières/European Gas Research Group
- GILIGNL – Groupe International des Importateurs de Gaz Naturel Liquefié/International Group of LNG Importers
- NGV Global
- NGVA Europe – European Association for Bio/Natural Gas Vehicles
- International Pipe Line & Offshore Contractors Association (IPLOCA)
- MARCOGAZ – Technical Association of the European Natural Gas Industry
- Pipeline Research Council International, Inc. (PRCI)
- Russian National Gas Vehicle Association (NGVRUS)
- World LPG Association (WLPGA)
The world needs energy. Oil alone isn’t enough. So we’re investing in the responsible development of abundant natural gas. Off the coast of Western Australia, Chevron is developing two of the largest natural gas projects in the world. The world depends on energy. So that’s what we’re delivering.

Chevron is proud to be a principal sponsor of the LNG 18 Conference & Exhibition in Perth.
IGU Organization 2015–2018

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President

Vice President

Executive Committee

IGU Secretariat

Coordination Committee

Secretary General

Committees

Strategic Communications and Outreach Task Force

Workforce Development Task Force

Sustainability

Strategy

Gas Markets

LNG

Marketing and Communication

R&D and Innovation

Exploration and Production

Storage

Transmission

Distribution

Utilization

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Mr Javier Gremes Cordero, Argentina
Ms Cheryl Cartwright, Australia
Mr Augusto Salomon, Brazil
Ms Lixin Che, China, People’s Republic of
Mr Eduardo Pizano, Colombia
Mr Andreas Rau, Czech Republic
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Mr Gerald Linke, Germany
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Mr Andrea Stegher, Italy
Mr Kyoji Tomita, Japan
Mr Jae Ho Song, Korea, Republic of
Dr Gi Chul Jung, Korea, Republic of
Mr Pramod Kumar Karunakaran, Malaysia
Mr Gertjan Lankhorst, Netherlands, The, Regional Coordinator Europe
Mr Runar Tjersland, Norway
Mr Abdulla A. Al-Hussaini, Qatar
Mr Andrey Sapozhnikov, Russian Federation
Mr Antoni Peris Mingot, Spain
Mr David Carroll, United States of America
Mr Menelaos (Mel) Ydrees, United States of America
Mr Jean-Michel Figoli, Associate Member, ENGIE
Ms Cynthia Silveira, Associate Member, IBP
Mr Youngsik Kwon, Associate Member, KOGAS
Ms Yenni Andayani, Associate Member, Pertamina
Mr Chris Gunner, Associate Member, Shell
Ms Li Yalan, Regional Coordinator Asia and Asia-Pacific
Mr Khaled Abubakr, Regional Coordinator Middle East and Africa
Mr Marcel Kramer, Regional Coordinator Russia, Black Sea and the Caspian area
Mr Pål Rasmussen, Secretary General
Mr Luis Bertrán Rafecas, Deputy Secretary General

Mr Runar Tjersland, Norway
Mr Abdulla A. Al-Hussaini, Qatar
Mr Andrey Sapozhnikov, Russian Federation
Mr Antoni Peris Mingot, Spain
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Mr Pål Rasmussen, Secretary General
Mr Luis Bertrán Rafecas, Deputy Secretary General
IGU Management Team

Mr David Carroll, President (United States of America)
Mr Menelaos (Mel) Ydreos, Chair of the Coordination Committee (United States of America)
Mr Pål Rasmussen, Secretary General

Mr Jae Ho Song, Vice President (Republic of Korea),
Mr Munseok Baek, Vice Chair of the Coordination Committee (Republic of Korea)
Mr Luis Bertrán Rafecas, Deputy Secretary General
Mr Jérôme Ferrier, Immediate Past President (France)

IGU Secretariat

(From left to right in the back row) Torstein Indrebø, Honorary Secretary General; Mats Fredriksson, Director; Kristin Sande, Administration Consultant; Anette Serum Nordal, Information Consultant and Secretary of the Coordination Committee; Sjur Bayum, Senior Advisor; (from left to right in the front row) Antonia Fernández Corrales, Senior Advisor; Pål Rasmussen, Secretary General; and Taeksang Kwon, Advisor.
Snam

Snam is one of Europe’s leading companies in the construction and integrated management of natural gas infrastructures. With over 6,000 employees, Snam is active in natural gas transportation, storage, regasification and urban distribution.

On top of its Italian historical background, Snam has recently developed its international activities in key European infrastructures and projects. These assets include TIGF, which is strategically located along the connection route with the Iberian peninsula and will allow the company to exploit new opportunities for value creation through increased integration with the French market and new possible international interconnections; TAG, which is the most important gas import infrastructure for the Italian domestic market and a strategic asset for the integration of a European common market, in the light of its potential use in reverse flow towards Eastern Europe and Southern Germany; and TAP, the strategic pipeline project that will connect the Caspian region to European markets via the Italian network, opening the so-called Southern Gas Corridor.

Snam favours the right conditions for fair energy costs by managing gas infrastructures efficiently and providing integrated services for the market, and promotes the integration of European networks, including strategic partnerships with the most relevant operators in the sector along the main European energy corridors.

The company follows an ethical and socially responsible business model that is capable of generating value for both the company and the community in which it operates, based on renowned professionalism and transparent dialogue with all stakeholders, whilst respecting the environment and local areas. A clear and sustainable development strategy in the long term, based on one of the biggest industrial investment plans in Italy, allows Snam to attract capital from both Italy and abroad, thus promoting growth and job creation.

At Snam, sustainability and value creation are closely connected concepts. The company promotes an ongoing and constructive dialogue with all stakeholders, having increasingly integrated the shared value approach into its sustainability path, which creates a stronger link between business and corporate social responsibility by aligning the company’s vision concerning value created for itself and its stakeholders. Thus, for Snam, creating shared value means knowing how to play its traditional role in the country’s development in innovative forms by reassessing resources developed over time in terms of infrastructure, technologies, skills and human capital.

With the aim of capturing the opportunities provided by the current environment, which is deeply and rapidly changing, Snam has reviewed its business model and investment strategies, with two well-defined objectives: achieve greater interconnection and flexibility in the European gas system, in line with the principles of the European Third Energy Package, and evolve its own role as market facilitator capable of providing an ever more differentiated and innovative range of services.

The integration of the European gas markets will be supported by the existence of a well-developed infrastructure system, alongside with the development of bi-directional flows along main gas corridors. Moreover, the development of new services meeting the changing needs of shippers and final customers will be able to foster market liquidity and preserve security of supply to all consumers. The new activities will favour optimal access and utilisation of the entire gas infrastructure system by traders and shippers.

The development of the Italian and international infrastructures in the new integrated dimension at the European level is one of the most important strategic targets for Snam. This development is fuelled by an overall investment plan that in the 2015-2018 period for the sole Italian domestic market amounts to €5.1 billion, of which €1.3 billion was spent in 2015, aimed not only at enhancing security of supply and flexibility of the domestic gas system, but also at supporting gas flows towards European markets, in the broader perspective of effective interconnection with continental networks. In this context, Snam will increasingly focus on enhancing existing international assets along the two main European energy corridors (South-North and East-West) with additional selected investments to facilitate the full realisation of a Southern European gas hub.
We transport natural gas from Italy to Europe and from Europe to Italy, crossing countries and borders. We guarantee the country’s energy security through a gas transmission network of more than 32,000 km, 8 storage sites, 1 regasification plant and a domestic distribution network of more than 52,000 km. Employing 6,000 men and women across our territories, we manage a gas network which is highly integrated with our natural surroundings. Because only by creating a network of values can we plan for a bright future.

We have drawn inspiration from nature to make the European gas network great.

PHOTO BY MICHAEL POLIZA/NATIONAL GEOGRAPHIC CREATIVE
Venice, Italy: a perfect combination of natural and anthropic factors has resulted in one of the most important lagoons in Europe. A network that demonstrates the importance of the synergy between man and the environment.
New members

Once again, the IGU’s membership has grown since the last issue of the magazine. The IGU Council meeting in Cartagena, Colombia, approved three new Associate Members: COM-therm, s.r.o, from the Slovak Republic, Energodiagnostika LLC from Russia and Regas SRL from Italy. See pages 156-158 for short profiles of the new members.

The same Council meeting approved 10 new Premium Associate members. The category was introduced at the Council meeting in Paris, France in June and allows a limited number of 10 Associate members owning gas-related assets to upgrade their membership by paying a supplement to the base membership fee. The Premium Associate members will, in addition to the rights of Standard Associate members, have the right to vote in the Council and nominate candidates to chair up to six IGU committees.

The 10 IGU Premium Associate members that were approved are Beijing Gas Group Co., Ltd, China National Petroleum Corporation, Enagas S.A., Engie, İGDAS – Istanbul Gas Distribution Co., KOGAS, PT Pertamina, Statoil ASA, Total S.A. and UNIPER from Germany.

With this, the IGU membership counts 148 members (91 Charter members, 10 Premium Associate Members and 47 Associate members).

Secretariat transition

On November 1, 2016 the IGU Secretariat will move from Oslo, Norway to Barcelona, Spain. The IGU Secretary General, Pål Rasmussen, the IGU Deputy Secretary General, Luis Bertrán Rafecas, and their teams are working closely to ensure a good and smooth transition. Gas Natural Fenosa will be the sponsor of the new Secretariat and has already seconded Antonia Fernández Corrales to Oslo. Luis worked from Barcelona on the transfer until February 2016 when he joined the Oslo team to continue preparing for the transition.
Meeting with the incoming Chinese G20 Presidency and IGU members in China

David Carroll, IGU President, Pål Rasmussen and Mel Ydreos, Coordination Committee Chair, travelled to Beijing, China, from August 9-12. Together with Li Yalan, Chair, Beijing Gas Group Co. Ltd (IGU Associate member), they met with Zhang Yuging, Deputy Administrator of the National Energy Administration, People’s Republic of China and staff from the Chinese G20 presidency.

The aim of the meeting was to discuss and offer recommendations on how gas could be included on the G20 agenda of the Energy Sustainability Working Group when China assumed the presidency of the G20 at the end of 2015. The very productive discussion will lead to a special gas day event to be held in June 2016 on the topic of Natural Gas Powering Air Quality Improvements in the MegaCities of the World.

While in Beijing, the IGU leadership team also took the opportunity to meet and discuss regional issues with China’s Charter member, China Gas Society, and Associate Members, Beijing Gas Group and China National Petroleum Corporation.

3rd Energy Sustainability Working Group meeting, Izmir, Turkey

The 3rd Energy Sustainability Working Group Meeting (ESWG) was held in Izmir on September 1-3. The meeting was attended by the representatives of G20 members, invited countries and representatives of relevant international organizations. Pål
Resources Development Association of Korea. The aim of the event was to share information on the energy market, international energy security issues and the implications of North America’s shale revolution and other matters.

Terence held a keynote where he spoke about climate change negotiations and conventional energy resources.

Gas Competence Seminar in cooperation with the World Bank, Maputo, Mozambique
From September 22-23, IGU, in collaboration with the World Bank Group and supported by SE4ALL, organized a regional Gas Competence Seminar in the city of Maputo, Mozambique. The seminar was also supported by the government of Mozambique. For further information see the article on pages 42-43.

KAZENERGY Eurasian Forum
Pål Rasmussen attended the KAZENERGY Eurasian Forum on “New Energy Horizons: Prospects of Cooperation and Investments” in Astana on September 29 – October 1. The forum is an important event for the energy sector in Kazakhstan and unites participants of

Ministry of Energy, Cyprus
On September 4, Mel Ydreos met with Stelios Nicolaides, Acting Director, Hydrocarbons at the Cypriot Ministry of Energy. The Ministry is the IGU Charter member for Cyprus and the objectives of the meeting were to inform of IGU’s recent activities and discuss the current state of the gas industry in Cyprus.

4th Global Energy Security Conference in Seoul, Korea
Terence Thorn, Senior Advisor to the IGU President, attended the 4th Global Energy Security Conference in Seoul, Korea on September 15. The conference was hosted by the Ministry of Foreign Affairs and Ministry of Trade, Industry & Energy of the Republic of Korea and organized by the Energy & Mineral Resources Development Association of Korea.
Focal interest ... Global reach

Over the years, Kuwait Petroleum Corporation has been a leading giant in the petroleum and hydrocarbon industry. Through a clear vision and sharp focus, KPC has become one of the world’s most respected, trusted and reliable suppliers of energy to the world.

Our commitment continues.

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The G20 Energy Ministers meeting also provided an opportunity to discuss IGU’s cooperation with the IEA and IEF.

The IGU Secretary General held a presentation entitled “Fueling the Future – Now”.

Pål Rasmussen attended the G20 Energy Ministers meeting and the Conference on Energy Access in Sub-Saharan Africa in Istanbul, Turkey, October 1-2. In relation to the conference he met with Fatih Birol, who had newly assumed his position as Executive Director of IEA, and with Aldo Flores-Quironga, Secretary General of the International Energy Forum. The aim of these meetings was to discuss cooperation between the two organizations and IGU.

G20 Energy Ministers Meeting and the Conference on Energy Access in Sub-Saharan Africa

Pål Rasmussen attended the G20 Energy Ministers meeting and the Conference on Energy Access in Sub-Saharan Africa in Istanbul, Turkey, October 1-2. In relation to the conference he met with Fatih Birol, who had newly assumed his position as Executive Director of IEA, and with Aldo Flores-Quironga, Secretary General of the International Energy Forum. The aim of these meetings was to discuss cooperation between the two organizations and IGU.

International Gas Forum, St Petersburg, Russia

David Carroll and Mel Ydreos participated in the 5th St Petersburg International Gas Forum in St Petersburg, Russia, October 6-9. The themes of the conference were international trends and governmental policies concerning the natural gas industry, priority industrial projects, and gas industry equipment development.
Natural Gas driving growth and environmental protection forward

DEPA leads the way in Greece

DEPA is the company that introduced Natural Gas to Greece’s Energy Market by developing the necessary infrastructure and networks. It’s a group of companies, consisting of the transmission system operator and three distribution companies. DEPA has the 50% stake in the company, responsible for the construction and operation of the offshore gas pipeline connecting Greece with Italy and participates also in the company that will undertake the development and operation of the pipeline connecting Greece with Bulgaria.

DEPA works for the further expansion of the Natural Gas grid in Greece, so that more consumers can benefit from the environmental-friendly energy solution.

www.depa.gr
The two were invited to the conference by Alexey Miller, Chairman of the Management Committee, OAO Gazprom and met with him and Alexander Medvedev, Deputy Chairman of the Management Committee, OAO Gazprom on October 6. The objective of the meeting was to ensure the union’s continued good relationship with Gazprom and to inform on and discuss IGU’s plans to educate policymakers on the importance of gas, advocate on behalf of the industry and support our members’ advocacy efforts.

**GIIGNL General Assembly, Shanghai**
On October 12, Li Yalan participated in the General Assembly of GIIGNL in Shanghai on behalf of IGU. Ms Li was appointed IGU Regional Coordinator for Asia and Asia Pacific at the IGU Council meeting later in October.

GIIGNL is an IGU affiliated organization and, over the two-day meeting, delegates from Asia, Europe and the Americas shared the current LNG development status.

Li delivered a speech on the development of Beijing’s natural gas market and future outlook. She also shared her observations on future trends of the gas market in China, pointing out that despite the current soft market and weak growth in demand, China’s gas market will continue to grow. The potential for increased demand remains high as China deepens the adjustment of its energy structure and improves air quality. China will continue to be an important driving force for growth in the gas sector in the near future.

Although there has been some frustration on current soft gas demand, delegates agreed that every time that development of natural gas was affected by reasons such as economic difficulty, a low oil price or geopolitics, it was the joint effort from importing countries and exporting countries that tide us through the difficult times.

**Gas Week 2015, Brussels**
Mats Fredriksson, IGU Director, participated in GasNaturally’s Gas Week in Brussels, October 13-16. The Gas Week is an important event that allows industry stakeholders and EU policymakers to come together and discuss the future of Europe’s climate and energy policy.

**Meeting with the President of Colombia**
In relation to the IGU Council meeting in Cartagena, Colombia, David Carroll and Mel Ydreos met with the President of Colombia, Juan Manuel Santos, in the Colombian capital Bogotá. The meeting was held on October 15 and facilitated by Eduardo Pizano, President of the Colombian Gas Association, Naturgas.
Gas contributes to energy transition

With ENGIE, energy is now full of creativity.
As a key international player in gas, ENGIE develops efficient and environmentally-friendly solutions such as Biomethane and Liquefied Natural Gas.
News from the Presidency and Secretariat

American gas in complementing renewables, spurring industrial development and improving air quality.

24th Session of the UNECE Committee on Sustainable Energy, Geneva, Switzerland

The 24th Session of the UNECE Committee on Sustainable Energy was held in Geneva, Switzerland, from November 18-20. Mats Fredriksson and Torstein Indrebø, Honorary Secretary General, attended the meeting on IGU’s behalf. Mats held a presentation and participated in panel discussions on the role of the gas industry in meeting the challenges and opportunities provided by the UN Sustainability Goals and post-COP 21 ambitions.

Asia Pacific Gas Conference, Daegu, Korea

Korea Gas Union, IGU Charter member, hosted the Asia Pacific Gas Conference (APGC) in Daegu, Korea from November 18-20.

The conference, also known as “the Gas Industry Conference”, was first held in 1991 and marked its 19th year in 2015. In 2015 the conference profile was changed from a national to an international one and featured a new name. The conference presented many keynote speeches, one of which was Pål Rasmussen’s at the opening ceremony, in addition to paper and round table sessions and an exhibition. The overall aim of the conference was to discuss and share global gas industry trends and issues and enhance global competitiveness by sharing gas technologies with leading companies in the gas industry.

UNECE Gas Centre, Aktau, Kazakhstan

Torstein Indrebø attended the UNECE Gas Centre’s 11th Task Force Meeting on Supply, Infrastructure and Markets in Aktau, Kazakhstan from November 26-27. UN gas activities were a central theme of the discussions in addition to how UN bodies and the gas industry can cooperate to support the recently agreed 17 UN Sustainable Development Goals (SDGs). Torstein...
gave a presentation on this topic, showing how gas could play an important role in achieving the SDGs, and why an active UN role is important in the implementation phase.

EGATEC, Vienna, Austria
The European Gas Technology Conference (EGATEC) gathered delegates from the European energy industry, research organizations, science and government authorities. It was held in Vienna from November 25-26 and was organised by GERG, Marcogaz and OVGW. GERG and Marcogaz are organisations affiliated to IGU, while OVGW is the IGU Charter member for Austria. Under the theme “Creating the Gas Revolution”, the conference focused on issues of major concern to Europe’s energy future. David Carroll opened the conference together with representatives from the organizing parties and Karl-Franzens University in Graz.

GasNaturally Presidents Meeting, Vienna, Austria
David Carroll and Mats Fredriksson participated in the Conference Call of Presidents of GasNaturally Member Associations in Vienna, Austria on November 26, 2015. The discussions were aimed at shaping the future governance model and objectives of this important European advocacy organization.

6th UNECE Gas Centre Industry Forum, Geneva, Switzerland
Mel Ydreos, Mats Fredriksson and Torstein Indrebø attended the 6th UNECE Gas Centre Industry Forum in Geneva, Switzerland, on December 16. The interactive meeting gave a presentation on this topic, showing how gas could play an important role in achieving the SDGs, and why an active UN role is important in the implementation phase.

EGATEC, Vienna, Austria
The European Gas Technology Conference (EGATEC) gathered delegates from the European energy industry, research organizations, science and government authorities. It was held in Vienna from November 25-26 and was organised by GERG, Marcogaz and OVGW. GERG and Marcogaz are organisations affiliated to IGU, while OVGW is the IGU Charter member for Austria. Under the theme “Creating the Gas Revolution”, the conference focused on issues of major concern to Europe’s energy future. David Carroll opened the conference together with representatives from the organizing parties and Karl-Franzens University in Graz.

GasNaturally Presidents Meeting, Vienna, Austria
David Carroll and Mats Fredriksson participated in the Conference Call of Presidents of GasNaturally Member Associations in Vienna, Austria on November 26, 2015. The discussions were aimed at shaping the future governance model and objectives of this important European advocacy organization.

6th UNECE Gas Centre Industry Forum, Geneva, Switzerland
Mel Ydreos, Mats Fredriksson and Torstein Indrebø attended the 6th UNECE Gas Centre Industry Forum in Geneva, Switzerland, on December 16. The interactive meeting gave a presentation on this topic, showing how gas could play an important role in achieving the SDGs, and why an active UN role is important in the implementation phase.
globalizing gas market while Torstein presented ideas on how cooperation between the UN and the gas industry could be further developed.

The IGU delegation used the opportunity to meet with the UNECE Executive Director Christian Friis Bach and representatives of the Executive Board of UNECE to discuss activities related to the IGU-UNECE Memorandum of Understanding.

1st Energy Sustainability Working Group in Xiamen, China
The 1st Energy Sustainability Working Group under the Chinese presidency was held in Xiamen, China on January 28, 2016. Pål Rasmussen, Mel Ydreos, and Antonia Fernández Corrales attended the meeting on behalf of IGU. Others present at the meeting were representatives of the G20 members, invited countries (for 2016 this is Egypt, Kazakhstan and Sudan) and relevant international organizations.

During the Chinese presidency of the G20, IGU will focus on two areas: providing support on the agenda item “Clean Energy”, and organizing a Gas Day on June 29, 2016 in Beijing.
Building for the Future

The Building for the Future (BFTF) project continues to evolve. Phase I has been implemented with the revised IGU vision and mission, new membership categories and scaled membership fees.

The revised vision and mission made gas advocacy an integral part of the organization and positioned IGU as the “Global Voice of Gas” that seeks to improve the quality of life by advancing gas as a key contributor to a sustainable energy future. The new membership category and new membership fees will give financial strength to IGU to bring out its advocacy activities and develop these further.

According to the changes, the fee of a Charter member now depends on the country’s gas production and consumption, or whether it is a G20 country or not. According to the decision made by the Council at its meeting in Paris in June last year, half of the increase was to be implemented in 2016. The full increase will apply in 2017. The scaled fee structure for 2016 is €6,000, €9,000, or €12,000 according to the criteria. For Associate members the fee in 2016 will be €12,000 for Premium Associate members, while for Standard Associate members it is €6,000.

It is important for IGU that these raised fees will bring something back to its membership. Gas advocacy has top priority and we recognize that it is even more important in the difficult environment that our industry now experiences.

The BFTF project Phase II was given its mandate by the Council in Paris, June 2015. The aim is to strengthen the IGU events portfolio. With the global conference environment getting increasingly competitive, we need to ensure the future success of the IGU-owned events. Greater involvement from IGU in the events will give the union better opportunities to influence and to ensure that the IGU vision and mission is reflected in the conference.

Our experience shows that presently events are handled as individual events with varying models and involvement from the union. The BFTF project sees a need to strengthen the brands by developing formal guidelines and policies to ensure continuity and competence transfer between the conferences.

The project group’s proposal for Phase II will be presented to the Executive Committee in its meeting in Durban, South Africa, on April 5, 2016.

Following Phase II, BFTF Phase III will be initiated which will cover the overall governance of IGU.
The IGU Council meeting was successfully held in Cartagena, Colombia, from October 20-23, spectacularly hosted by the Asociación Colombiana de Gas Natural (Naturgas) who gave the delegates a warm welcome and provided a perfectly convivial ambiance. In addition to the interesting meetings and workshops, delegates were given glimpses of the history, culture and food that make Colombia such a special place to visit.

The growing role of IGU in the area of gas advocacy, as well as the interest of the membership in more networking activities and greater knowledge transfer opportunities, has led to a restructuring of IGU’s Council meetings, starting in Cartagena.

The Council meeting began with a networking luncheon on October 21. Following discussions of general IGU business matters on Wednesday afternoon, Naturgas, under the leadership of IGU Executive Committee member and Naturgas President, Eduardo Pizano, had invited Guillermo Perry, Colombia’s former Minister of Mines and Energy, and former Minister of Finance and former Chief Economist for Latin America and the Caribbean at the World Bank, to address the “Key issues in the Colombian and South American Gas Industries.”

Earlier the same day the first in what will be a series of regional IGU member luncheons was held. This first luncheon brought together members from Colombia, Brazil, Argentina and Bolivia, for the purpose of focusing on key gas industry issues in the region and possible opportunities for greater IGU support and involvement. The IGU leadership looks forward...
to connecting similarly with many Charter and Associate members at future regional meetings.

The Council meeting continued on October 22 with a Council Workshop offering a full day of networking activities and knowledge transfer opportunities. The day began with an excellent overview of the Colombian natural gas industry presented by Tomás González, Colombian Minister of Mines.

**Council Workshop – Outlook for the Natural Gas Industry**

Following the remarks from the Minister, a panel discussion was facilitated by Timothy Egan, President and CEO of the Canadian Gas Association and IGU Regional Coordinator for North America on the outlook for the natural gas industry. Luis Oscar Herrera from BTG Pactual Andean Region and Argentina provided remarks with respect to the global economy through his presentation “Global Economic Outlook and Latin America”. According to him, Latin America is stuck in the middle of the transition from the post-financial crisis; between the US recovery and Fed interest rate liftoff and China’s slowdown, deleverage and demand rebalancing. He highlighted the following points from the 2015 Lima World Bank meetings held earlier in October:

- Global growth rotation and the “new mediocrity” commodities glut to drag on;
- Risk rotation and capital retrenchment from emerging market economies; Latin America’s “golden years” are over; and

**Quick Colombian Gas Industry facts**

- Produced 11.8 billion cubic metres (Bcm) of dry natural gas and consumed 10.9 Bcm in 2014. Natural gas consumption has grown, rising by more than 54% in the past decade. 7,683 kilometres of natural gas pipelines.
- Generated 62,196.6 gigawatt hours (GWh) of electricity in 2013. Of the electricity generated, hydroelectric plants provided 68%, natural gas accounted for 18%, coal accounted for 8%, oil accounted for less than 1%, and the remaining electricity was from other sources.
- Over 500,000 CNG vehicles in operation.
<ul><li>2016 is at a crossroads – smooth normalization or going from mediocre to miserable.</li></ul>

Bassam Fattouh from the Oxford Institute of Energy Studies presented an excellent and thought-provoking presentation entitled “The Fall in the Oil Prices and Its Implications on Gas and LNG Markets”. Major conclusions included:

- Supply and demand imbalances will continue to put downward pressure on oil prices. Until stocks are drawn-down, price recovery will be capped;
- The supply response is yet to come, but with the advent of US Shale the timing and magnitude of response are more uncertain;
- The $100+ oil price environment is unlikely to return in the foreseeable future (unless there is a big supply disruption);
- Low oil prices are already having implications for the LNG market:
  - Accelerated convergence of prices across basins;
  - Henry Hub is less competitive in Asia reducing incentive to move away from JCC to HH based contracts;
- Until 2020, waves of LNG will keep prices low accelerating convergence across markets;
- Unwanted LNG from the US and Qatar will likely be diverted to Europe competing with Russian gas; and
- Russia’s strategic response will be key to price outcomes and price formations.

Ed Kelly from IHS Energy followed with an equally insightful presentation entitled “Natural Gas Markets – Growth and Challenges”. Major conclusions included:

- Supply and demand drivers are moving in opposite directions;
- If WTI stays below the $45/bbl level as we expect, then US production will slow sharply in the next few months;
- Market opportunity gap – can new projects compete with existing contract extensions?
- IHS LNG supply and demand outlook to 2025 suggests that there is only room for 1-in-15 projects;
- 2016 is at a crossroads – smooth normalization or going from mediocre to miserable.
Future supply additions likely to come from the US and floating projects; and
Demand growth supports higher natural gas prices, but still under $4/MMBtu until late 2021.

Global and Regional Spotlight Workshops
Following the first panel discussion, two excellent and informative panels discussed the role of gas in terms of COP 21 and any potential outcome from the Paris conference as well as the key regional issues and opportunities.

The COP 21 panel was moderated by Dave McCurdy, President and CEO of the American Gas Association and panellists presented the Intended Nationally Determined Contributions (INDCs) of a number of countries including the USA, Japan, South Korea, China and Australia. An excellent presentation on Statoil’s 2°C Pathway was also presented. The final discussion centred around the contribution gas can make in cleaning up the polluted and dirty air of the megacities of the world, the major focus of IGU’s contribution to COP 21.

The regional panel discussion was moderated by Eduardo Pizano and very insightful presentations were made highlighting the extremely important role that gas plays in improving the quality of life in South America. Great opportunities exist for expanded use of gas as presented by panellists from Mexico, Venezuela and Colombia.

The IGU expresses its full appreciation to the many local sponsors that made this event such a success and particularly thanks Eduardo Pizano for his relentless drive and effort to organize such a world-class event.

International Gas Union Council Meeting
October 20 - 23, 2015, Cartagena, Colombia

www.naturgas.com.co  @naturgas
As part of IGU’s work to raise the voice of gas, two IGU Diplomatic Gas Forums were organized in November and December 2015. The US Presidency has decided to establish a Washington DC-based Diplomatic Gas Forum, utilizing the diplomatic corps for annual discussions about gas industry issues in their respective countries. The Global Ambassadors Network of the US presidency is designed to engage the extensive Washington DC diplomatic corps in the activities of the US presidency over the next three years, and ultimately to be active participants in WGC 2018.

The first meeting of the forum was held in the American capital on November 12, at the headquarters of the American Gas Association and was chaired by Dr Neil Parsan, former Ambassador from the Embassy of Trinidad and Tobago to the United States, and current Secretary for Integral Development at the Organization of American States.

The luncheon event, held just prior to the COP 21 meetings in Paris, featured presentations by IGU President, David Carroll and IGU Secretary General, Pål Rasmussen, while the keynote presentation on the Outlook for the Global Gas Industry was provided by Mary Barcella, Director, North American Natural Gas, IHS Energy. Barcella’s comments focused on the significant growth potential for gas in most regions, and the possible impact of the COP 21 meetings. According to Barcella, energy transitions consistent with a 2°C scenario are compatible with a substantial increase in global gas consumption over the next 15 years, and abundant global gas supplies can play an important role in reducing greenhouse gas emissions.

In commenting on the success of the event, which attracted representatives from over 40 countries, Ambassador Dr Parsan noted, “We look forward to engaging all members of the
diplomatic corps with the IGU team as we prepare to welcome the global gas industry to Washington in June 2018.”

The IGU Secretariat also organised a diplomatic gas forum in Oslo, Norway. On December 15, IGU and DNV GL, IGU Associate member, invited high-level representatives from the diplomatic missions to DNV GL’s headquarters to discuss how to take full advantage of gas’ potential in the future sustainable energy mix.

This was the third Diplomatic Gas Forum in Norway and under the theme “Natural Gas as a Solution to the World’s Energy and Environmental Challenges”, the event program focused on the opportunities that gas gives for meeting future global energy demand while at the same time reducing global emissions. Presentations were given on this theme, on the link between gas and clean, healthy urban air; and on how challenges of flaring and venting can be addressed. The IEA’s newly released World Energy Outlook 2015 was also presented.

The following outcomes were taken from the forum: Gas definitively has a role to play in the future energy mix. Natural gas is part of the solution both in the transition to, and as part of, a sustainable future energy mix. It is the cleanest fossil fuel and a relatively low-carbon fuel that can help meet CO₂ reductions. It is also a solution to urban air quality problems and can help improve the health and quality of life of millions of people. At the same time, there are also challenges that must be met. More gas infrastructure is needed and this is often a chicken-and-egg problem. Without infrastructure, there is less demand and without demand, there are fewer investments. Flaring and venting are also important challenges.

The Oslo event gathered almost 50 delegates, including 26 ambassadors, from 44 embassies accredited to Norway.
Gas Seminar in Maputo, Mozambique

The International Gas Union, in collaboration with the World Bank Group, and supported by SE4ALL and the Government of Mozambique, organized a regional Gas Competence Seminar in the city of Maputo, Mozambique from September 22-23, 2015. The seminar attracted governmental bodies, the gas industry and representatives from international organizations not only from Mozambique but from the whole southern African region.

The event provided an opportunity for the delegates to share knowledge, raise awareness and discuss strategic options that natural gas offers for sustainable access to energy and social and economic development. The by-invitation-only event attracted more than 100 delegates, and speakers included experts from the energy industry; both local and global companies; governmental officers; international organizations including SE4ALL, UNESCO and the African Development Bank; as well as other invited participants.

Many of the participants and speakers had long experience from other nations and regions that have gone through similar gas industry developments. The presentations and discussions pointed to the tremendous opportunities, but also challenges that exist in this geographical area.

The discussions also raised the concern that the speed at which frameworks, regulations, and business models are developing can have consequences for the region’s development outcome. While some think the implementation is going far too slow, others are warning that implementation is too rapid. It is therefore important to ensure that great care is taken and respect shown to the regional particularities.

Another concern raised was the global economic climate, since development of the gas...
industry will require massive investment and the current environment makes them challenging to finance. Recommendations were given to look for new unconventional funding models and possibilities of funding in smaller increments.

The topics discussed at the seminar were the following:
- Regulatory and institutional frameworks;
- Large scale industrial development;
- Gas and power development;
- Project financing and structuring;
- Gas market development;
- Sustainable energy and social development; and
- Long-term competence building – Next steps.

The discussions pointed to the tremendous opportunities but also challenges that exist, and can be summarized as follows:

Opportunities
- Gas for the production of electricity;
- Industrial development with gas as a feedstock to local industries such as fertilizers; and
- Improvement in the environment of cities in the region.

Challenges
- Growing concern over lack of competence as it relates to developing the gas industry;
- Lack of training and educational institutions that focus on gas industry aspects; and
- The need to establish long-term business models for both competence and infrastructure development.

The IGU and the World Bank worked closely on the seminar and the event can be seen as a very successful initiative resulting from the partnership that IGU and the World Bank has agreed to through the Memorandum of Understanding signed in 2014.
Promigas

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

As a holding, Promigas develops energy markets in Colombia and Latin America focusing on the following transmission and distribution businesses: natural gas transmission; integrated solutions for the hydrocarbon industry and power generation; natural gas and electrical power distribution. Recently, it 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.

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.

We also 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 18 001 in Occupational Health Safety and ISO 14 001 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.

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<th>Transmission business unit</th>
<th>Natural gas transmission</th>
<th>Promigas</th>
<th>Promioriente</th>
<th>Transmetano</th>
<th>Transoccidente</th>
<th>Pipeline network: 2900 km</th>
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<td>Capacity: 836 MCFD</td>
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<td>Integrated solutions for the hydrocarbon industry and electrical power generation</td>
<td>Promisol</td>
<td>Enercolsa</td>
<td>Zonagen</td>
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<td>Dehydration capacity: over 520 MCFD</td>
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<td>Installed compression capacity: 13 000 hp</td>
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<td>Cogeneration plants: capacity in excess of 60 MW</td>
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<th>Distribution businesses</th>
<th>Natural gas distribution</th>
<th>Surtigas</th>
<th>Gases de Occidente</th>
<th>Gases del Caribe</th>
<th>Efigas</th>
<th>Gases de La Guajira</th>
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<th>Electrical power distribution</th>
<th>Compañía Energética de Occidente</th>
<th>Clients: 321,327</th>
<th>Energy demand: 517 GWh</th>
<th>Employees: 273</th>
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<th>Non-banking finance</th>
<th>Brilla</th>
<th>Loans awarded: $494,233,550</th>
<th>Number of users benefited: 1,300,265</th>
<th>Loan portfolio: $305,642</th>
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Reports from the Regional Coordinators

In this issue we return to IGU’s Regional Coordinators for Asia and Asia-Pacific and for Europe, following on from the last issue’s reports from the Regional Coordinators for Africa and the Middle East, Latin America and the Caribbean, and North America.

Update on natural gas developments in the Asia and Asia Pacific Region
By Li Yalan

In the endeavour to tackle climate change, countries in the Asia and Asia Pacific region have submitted Intended Nationally Determined Contributions (INDCs) and supported the adoption of the Paris Agreement on climate change. Developing countries such as China, India and Indonesia are facing greater challenges than developed countries including Japan, Korea and Australia. Natural gas plays a major role in their effort to fulfil their commitment to emissions reduction.

China has made a commitment to the international society that its carbon dioxide emissions will peak by around 2030 and that it will work hard to achieve the target at an earlier date. To this end, the share of natural gas in primary energy consumption will be increased to 10% in the next five years. “Expanding natural gas consumption and accelerating pipeline construction” is identified as a key task in the 13th Five Year Plan for the energy sector.

The decreasing natural gas price and the return of Iran have brought more opportunities to the South Asia region, where natural gas resources are relatively insufficient. As the world’s fourth largest emitter of CO₂ and third largest consumer of coal, India is striving to develop renewable energy while actively expanding and enhancing its natural gas supply. Negotiations are being held between India and Iran to build an undersea gas pipeline; the two countries are also discussing the joint development of the Farzad B field in the Persian Gulf. At the end of December 2015 the Turkmenistan-Afghanistan-Pakistan-India (TAPI) pipeline project was formally inaugurated. The proposed approximately 1,800-kilometre pipeline is expected to be operational by 2019, enhancing supply security for all countries involved. Pakistan and Qatar have finalized a 15-year LNG supply deal. Following the contract, Qatar will supply 1.5 million tonnes of LNG to Pakistan per year.

South-East Asian countries seek development while cutting emissions by increasing natural gas in power generation. Currently
more policies to impact supply and demand
by gertjan lankhorst
this year, the european energy union will issue new legislation. amid the tendency in europe towards political market interference and an increasing focus on national interests, completing the internal market should remain the leading priority of policymakers in brussels. the internal market is the prerequisite for security of supply, which in turn is intertwined with security of demand. the latter is greatly strengthened if policymakers acknowledge the contribution of gas to emissions reduction.

last year, the energy news in europe was dominated by views on the future. starting with the creation of the energy union, and ending with a global climate agreement in paris.

li yalan is chairperson of the board of directors of beijing gas group and the igu regional coordinator for asia and asia pacific.

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at COP 21. 2016 will be the year in which the policy fallout of both will be addressed.

At the time of publication of this article, the European Commission is expected to have presented a package of policies which aim to reduce Europe’s gas imports. From my experience, I seriously question whether import dependency in itself should be a matter of concern. The way we deal with it is the real issue. The view of the European gas industry is quite simple: rather than political meddling, more competition and cooperation within Europe is needed.

LNG is an interesting example. Despite large amounts of unused capacity in existing terminals, new terminals are planned, because politicians think this serves national interests. However, construction of new terminals merely on political grounds would negatively influence, among other matters, market flexibility. In order for gas to flow freely through Europe, markets should be well connected. This, I believe, is a prerequisite and hence should be the main policy objective. Furthermore, policy efforts should focus on maintaining and increasing the global attractiveness of the European gas market. Stronger political involvement in commercial contracts or creating strategic gas storages is in this respect counterproductive. The success of the NBP and TTF trade hubs clearly shows that the creation of one large integrated market with transparent prices and liquid hubs proves my point.

While the ink of the signatures to the Paris Agreement is still wet, Brussels is currently developing new directives for renewable energy and energy efficiency, as a first step in converting the climate agreement into regional legislation. Of course, mankind needs to be prudent with the resources the earth is endowed with. However, selecting winning technologies to reduce our dependence on these resources would hamper innovation. Moreover, there are many pathways to the ultimate objective: reducing CO₂ emissions. Natural gas, in that respect, is not to be disregarded as an obsolete fossil fuel. It is a modern energy source, supporting emissions reduction through solutions ranging from innovative power-to-gas technologies to highly efficient heating appliances that balance prosumer’s energy demand profiles. The potential to increase resource efficiency is still huge. In that respect I was very surprised to hear that the European Commission aims for a massive turn to district heating as the ‘fuel’ of choice. This doesn’t make much sense since an almost European-wide dense network for gas is available. So, building on the benefits of the existing natural gas market to reduce emissions will result in higher levels of trust by Europe’s natural gas suppliers, which is key to attracting the required supplies.

Acknowledging the value of natural gas for Europe’s climate ambitions contributes to the security of supply pillar of the Energy Union, by creating certainty in the European market for suppliers around the world.

Gertjan Lankhorst is CEO of GasTerra, Member of the IGU Executive Committee and IGU Regional Coordinator for Europe.
Achievements and commitments

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Planning has begun for the 27th World Gas Conference (WGC), to be held from June 25-29, 2018 at the Walter E. Washington Convention Center in Washington, DC. Under the direction of a very broad and diverse 40 person National Organizing 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 compelling program for the event, recognizing the dramatically changing nature of the global gas industry. The extensive, world-class IGU committee network is actively engaged in working with the WGC team to develop an outstanding program that will focus on three key areas – Access, Markets and Social Licence. The team is especially pleased that ExxonMobil and Chevron will be serving as Host Partners for WGC 2018.

Much has changed in the gas industry in the 28 years since the USA last played host to the World Gas Conference. WGC 2018 will be designed to showcase the role that natural gas can play in a low carbon energy future. With IGU’s growing role as the global voice of gas, the event is uniquely positioned as the only global gas industry event able to address the most timely and topical, strategic, commercial and technical issues and opportunities facing the global gas industry. The Washington, DC location provides a special opportunity to bring together policymakers with technical, commercial and strategic experts from across the globe to discuss these key issues. And, discussion and debate will be of key importance to WGC 2018.
Feedback from delegates at previous WGC events, as well as ongoing feedback from IGU members has the WGC team focused on providing a forum for all voices to be heard regarding the role of natural gas.

Just a few of the many things that will be new and different at WGC 2018:

- **Engagement of key global policymakers** has already begun. The Global Ambassadors Network is a group representing the extensive Washington, DC diplomatic corps; they are working closely with the WGC team to bring key policy leaders to the event from across the globe.
- With the very large New York financial community just a short train ride away, the first ever WGC Financial Forum will provide a structured opportunity for significant numbers of financial community representatives to meet with the numerous publicly-traded global energy and energy related companies that participate in the WGC.
- An invitation only VVIP function the day before WGC, as well as other VVIP functions during the early days of WGC, will provide the most senior level delegates the opportunity to spend quality time with key thought and policy leaders from across the globe.
- The exhibition will feature a "Showcase America" Pavilion, as well as a Technical and Innovation Center.
- 3,500 sleeping rooms are within an 18 minute walk of the Convention Center. Virtually all of the major museums and key government buildings (like the US Capitol and the White House) are walkable from the Convention Center and nearby hotels. All of the Smithsonian museums are free of charge.
- WGC 2018 is being held in conjunction with the 100th anniversary of the American Gas Association.

The WGC team welcomes any and all suggestions regarding WGC 2018. Feel free to contact me personally at jcopan@wgc2018.com. 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.*
Embracing Our Responsibilities for a Sustainable Future

RasGas understands the environmental challenges and risks that are associated with its activities as an energy supplier aiming to produce reliable and clean energy. Therefore, RasGas perceives its responsibility for the preservation of the environment as a core commitment.

The oil and gas industry is energy-intensive, and with climate change being increasingly a major global concern, RasGas, as a consumer of energy, implements a greenhouse gas strategy to tackle the global challenge of greenhouse gas emissions.

Increasing energy efficiency
Underpinned by the goal of continuous improvement, RasGas follows an environmental management system that clearly outlines protection of the environment as a key pillar of sustainable development. This system incorporates measures to promote energy efficiency; as such RasGas has taken steps to increase the energy efficiency of its operations through different initiatives, most significantly the implementation of two five-year flare minimization programs, the first of their kind in Qatar. These initiatives are aligned with Qatar’s goal to reduce flaring and support the country’s participation in the World Bank-led Global Gas Flaring Reduction (GGFR) program, a partnership that seeks to overcome the challenges by sharing global best practices and implementing country-specific programs. RasGas’ approach is to use industry best practices and innovative planning including improved facility designs, new operating procedures, and the use of waste gas for power generation.

In association with Qatargas, RasGas also implemented the Jetty Boil-Off Gas Recovery (JBOG) Project, which is a significant milestone in the oil and gas sector. JBOG recovers gas flared during loading of LNG at Ras Laffan Port, resulting in a massive saving of 800,000 tonnes per year of natural gas, and reducing CO₂ emissions by an estimated 1.6 million tonnes per year.

Increasing the efficiency of RasGas’ shipping operations is another significant approach that demonstrates the company’s efforts in this regard. This approach included unique initiatives carried out by the company such as:

- Supporting the use of larger shipping vessels fitted with re-liquefaction facilities to reduce the number of voyages and cut emissions per nautical mile.
- Retrofit older vessels to use clean LNG, thus reducing harmful direct emissions from the vessels themselves and the indirect emissions from the refinery production of residual fuels.
- Modify three conventional and four Q-Flex vessels to meet the stricter emissions controls regulated by European Union Laws, which state that all vessels trading in European emissions control areas must burn less than 0.1% Sulphur content in fuel or emit equivalent emissions.

RasGas will continue to take actions to deliver reliable, affordable and cleaner energy to meet the world’s needs in an efficient manner, where the company’s greenhouse gas strategy sets the context for its actions and the comprehensive system defines the company’s responsibilities for environmental issues.
Energy powers our world, it enriches our lives. Korean artist Mina Cheon uses energy as an inspiration for her art. It fuels her imagination. RasGas provides clean, reliable energy for Qatar and the world. Energy for Life.

“The light and energy of Seoul ignites great ideas.”
Mina Cheon - Artist
News from Organizations Affiliated to IGU

This issue we lead with an update on the World LPG Association’s WINLPG initiative and follow with further news from WLPGA, the Gas Technology Institute (GTI), Energy Delta Institute (EDI) and International Pipe Line and Offshore Contractors Association (IPLOCA) who also share their history in the features section on pages 148-153. We conclude with an article from NGV Global on their achievements in 2015 and plans for the coming year.

Changing the Face of the LPG Industry: Women in LPG Global Network

By Alison Abbott

Women have never been in a stronger position to lead, change and shape the economic, social and political landscape. The 21st century has seen a dramatic shift in traditional ‘family’ dynamics and greater recognition of gender in legislation. As a result, women are more economically independent and socially autonomous. As growing numbers of women enter the economic mainstream, they will have a profound effect on global business and social change. Some people may ask why women need a special network and support program, but when you start to evaluate it, there are many overwhelmingly compelling personal, professional and business reasons that support the significant benefits of advancing women in leadership in the corporate and entrepreneurial world.

Having more women in management positions improves a company’s financial performance and can boost company returns. Evidence shows that companies with women on their board can out-perform their rivals by a 42% higher return on sales by enhancing company decision making through use of all available perspectives, ideas and skills¹, reflecting the gender diversity of customers and employees is beneficial to the industry. The industry also suffers from the negative perception of being old fashioned and uninteresting, indeed, a recent graduate survey showed that the oil and gas industry as a whole is one of the most unpopular career paths².

Many companies support mentoring and development of senior women as a pipeline to talent at board level, firstly because board members can gain insight and learn from the relationship but most importantly because it makes good business sense. It is estimated that over the next 5-10 years, women will make up 80% of the growth in the world labour market and organizations need a clear strategy to attract and retain women at all levels. If you really take the time to digest all the arguments for gender equality, the economic facts alone are overwhelming and the long-term gains for businesses who support and inspire women to participate in the LPG Industry are already proven to be significant.

According to Energia, an NGO focusing on women’s issues in the energy industry, most LPG consumers are women. Many women make and manage the purchasing decision and it is largely women who are using the product. However, within the industry itself there are few women, not only at executive level, but at all levels. This phenomenon is shared in many


² PwC 2011 survey of 4,364 graduates from over 75 countries.
industry. WINLPG aims to create a network of members on a global basis who can support women to make a difference to themselves, their teams and ultimately their organizations. It will provide a platform and opportunity for like-minded people at all levels to meet, formulate strategies, cultivate relationships and develop a ‘making a difference’ plan. It will give a global opportunity for women and young people to communicate directly with successful female leaders, coaches and mentors who can help them with purpose-driven solutions to career, business and organizational challenges.

**What will WINLPG do?**

WINLPG has three pillars of objective. First of all to support and retain women already in the industry through a network that will enable women to further their professional development and access colleagues and mentors. Secondly, to promote role models and case studies via the media and at industry events and, thirdly in the more long term, to work with universities to educate and attract women to the industry.

WINLPG has a provisional goal of increasing the number of women in middle management to 40% and at board level by 30% by 2030.

The network set-up will mirror three existing WLPGA networks and in the immediate term will meet three times a year with a flagship meeting to be held at the time of the World LPG Forum. Regional workshops are scheduled to tie in with other industry events. At press time the first regional workshop was planned to take place in Bogotá in March 2016 at the time of the Latin American LPG Association’s annual conference.

WINLPG is chaired by Nikki Brown, Managing Director of Cavagna UK, and is coordinated from WLPGA by Alison Abbott.

“The issue is that gender balance is not optimized in the LPG industry and WLPGA is in a unique position to start to make a change,” says Alison Abbott. “This change to sectors of the energy industry and indeed in other areas of business.

There is an opportunity for the global LPG industry to take medium- and long-term actions that can address the issue of attracting, retaining and developing women in the LPG industry. As the authoritative voice for the global LPG industry, the World LPG Association (WLPGA) is uniquely positioned to develop and implement these actions.

So, to address this issue and develop a strategic response to the issue of attracting, retaining and developing women, and in fact young people in general, to work in LPG, the WLPGA has set up a new global network, the Women in LPG Global Network (WINLPG) which was launched in September 2015. The network’s mission is to support and help empower women in the worldwide LPG industry by leadership, coaching, mentoring and promoting role models to enable a change in organizational attitude to become more inclusive and authentic for all genders at all operational levels. WINLPG aims to bring women, and men, together across all business sectors, ages and levels to discuss and support the development of diversity within the LPG industry. WINLPG aims to create a network of members on a global basis who can support women to make a difference to themselves, their teams and ultimately their organizations. It will provide a platform and opportunity for like-minded people at all levels to meet, formulate strategies, cultivate relationships and develop a ‘making a difference’ plan. It will give a global opportunity for women and young people to communicate directly with successful female leaders, coaches and mentors who can help them with purpose-driven solutions to career, business and organizational challenges.

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“The issue is that gender balance is not optimized in the LPG industry and WLPGA is in a unique position to start to make a change,” says Alison Abbott. “This change to
be driven by a network that will recommend actions and activities as part of the WLPGA strategic planning process."

It is important to emphasize that WINLPG is not a club, and its focus is not about the promotion of women just because they are women. It is about the promotion of women despite being women but maybe, even more importantly, WINLPG wants to encourage and give support to an industry-driven philosophy where individuals are chosen for a position because they are the best person for the job despite gender, sexuality, race or age.

If you are interested in joining WINLPG please contact Alison Abbott.

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Email: aabott@wlpga.org
Website: www.worldlpg.org
Twitter hashtag: #WINLPG

A Bridge to the Future – The 29th World LPG Forum & 2016 AEGPL Congress
By Esther Assous
If you only attend one LPG industry event each year then the World LPG Forum should be the one. Travelling the globe each year, the World Forum unites the full LPG global industry in one packed week giving unparalleled networking and business opportunities.

The 29th World LPG Forum & 2016 European Congress is the third time that WLPGA will combine its Forum with the European industry, following Madrid in 2010 and London in 2013. The event will take place in Istanbul, Turkey from September 27-29 in the International Convention and Exhibition Centre under the theme “A Bridge to the Future”.

The event has developed over the years into a highly influential week combining not only a high-level conference and major exhibition but also a choice of dedicated smaller summits and dynamic side events which cover the entire industry.

This year’s Global Technology Conference will showcase the most innovative and original technological ideas in the industry and entry is free for exhibitors.

The exhibition is the centre of the event and offers exceptional networking opportunities. It’s the unique showcase for key LPG companies to present their cutting-edge technology, first-class equipment and services to the international and regional LPG community. Coffee and lunch break stations situated within the exhibition area guarantee further interaction. In addition to the conference attendees, external visitors will also be strongly encouraged to meet you face-to-face in the exhibition.

Registration for delegates and visitors will open in April. For full details about the Forum visit the dedicated event website www.worldlpgforum-aegpl2016.com.

For more details contact:
Esther Assous,
WLPGA Events Director.
Email : eassous@wlpga.org
Website: www.worldlpgforum-aegpl2016.com
Twitter hashtag : #LPGistanbul2016
Developing a New Quantification Protocol for Methane Emissions Reduction

By Diane Miller

In the US, aggressive efforts are underway to reduce methane emissions from the natural gas sector and the industry is working on technologies and approaches to facilitate this. But the way emissions are quantified must also be improved. By establishing reasonable baselines, utilities will be able to provide more accurate reports about their emissions profiles and implement mitigation and reduction programs. Gas Technology Institute (GTI) and its industry partners are working to update those baselines now.

“It’s important for us to help the industry better quantify its methane emissions profile and incorporate this data into an overall mitigation strategy that puts safety and the environment at the top of the priority list,” says Paul Armstrong, GTI Director of Business Development. “GTI understands that this is a critical issue for the natural gas industry as a whole and that each industry sector has its own unique challenges that must be addressed.”

Since 2009, GTI has taken the lead in addressing the gaps in determining a more accurate emissions baseline for the natural gas distribution sector, leading a multi-phase project designed to develop a methodology that can provide a greater level of accuracy.

The first phase of the project, completed in 2010, focused on developing a new technique to measure emissions. Researchers field-tested and validated an approach to measuring methane emissions at the surface using the Hi-Flow Sampler, a portable device that provides efficient, real-time measurements of gas flow rates and concentrations.

The GTI team then set out to update the national emission factors (EFs) for plastic pipe. Expanding the dataset beyond that of the original 1996 Gas Research Institute study,
the testing program provided a new national EF estimate that was much more representative of plastic distribution systems. Subsequent phases of the project continued the field test program for cast iron and unprotected steel pipe.

A methodology for implementing revised EFs has also been developed, launching a new approach that will enable operators to create utility-specific emissions estimates based on their own leak data instead of national estimates to more precisely define their individual company profiles.

In the final phase of the project, the GTI team is focusing on implementation of the new EFs and improving estimates for activity data. In the proposed methodology, activity data may be based on miles of pipeline (as used by the US Environmental Protection Agency [EPA]) or on annual leaks records for each utility. The team will address implementation of activity data on a per-leak basis, using existing leak, repair, and duration records.

The results will deliver a case based on high-quality data and improved processes for the acceptance of the new quantification methods for compliance with EPA reporting requirements and other emissions regulations. This will include communicating with various stakeholders, such as trade organizations and environmental groups.

In addition to developing these more accurate methods for quantification, GTI is also developing technologies and processes for detection, prevention, and mitigation of methane emissions. A tool that can accurately quantify emissions in the field and provide emissions data that can help prioritize repairs, as well as be used for emissions reporting, is under development. Researchers are evaluating the use of alternative technologies, such as optical gas imaging cameras, to detect and quantify leaks throughout the natural gas system. Although much of GTI’s work has been focused on emissions up to the meter, a new project being sponsored by the California Energy Commission will measure emissions beyond the meter, with a focus on the commercial sector. Researchers are investigating the amount of methane being released from homes and commercial buildings, using an approach that focuses on specific points within the structure and nearby exterior locations. GTI’s knowledge and experience with gas piping, distribution mains, gas connections, and appliances is providing knowledgeable insight to identify the best testing locations.

GTI is also promoting close collaboration among partners in industry, government, research, and academia as the environmental concerns around methane emissions are being discussed and debated. For the past two years, GTI has organized a conference, CH₄ Connections, that features insights from industry thought leaders and experts on quantifying methane emissions, new technologies, and best practices for leak detection and mitigation in natural gas production, transmission, and distribution. The event focuses on the solutions to mitigate the impact of methane emissions while providing the public with needed energy and services.

Another round of the CH₄ Connections conference will be held later in 2016 in Washington DC; details are still being finalized. Check GTI’s website at www.gastechnology.org for updated information on dates and location.

Diane Miller is Senior Marketing Communications Manager at GTI (www.gastechnology.org).

Future Leaders of the Energy Industry
By Nadja Luchtmeijer
The European energy industry, and the global energy industry in general, is undergoing significant transformation. The traditional business models of fossil energy producers and utilities are increasingly challenged by the emergence of new market players, rapid integration of
The Force of Our Energy Empowers Our People
renewables in the energy system, technological development, low oil price, changing policies and the implications of climate change, particularly after the successful COP 21 summit in Paris. How can a traditional energy company survive this change and be successful in the new energy reality? This is the question that Energy Delta Institute (EDI) keeps asking itself and the industry.

As the readers of this magazine might know, EDI has its roots in the natural gas sector, and we see that this ongoing change in the energy landscape also has an impact on EDI’s activities. According to EDI’s Vice President for Innovations, Bert Stuij, the industry needs to find a business model which is robust in the changing environment and also needs to have a clear vision for the future and strong leadership to withstand the change. The concern, however, is not mainly about the leadership within the company, but the positioning of the company in the current and future market.

Alongside EDI’s existing programs, such as Mini MBA New Energy Realities, Mini MBA Energy Transition and Innovation and European business management courses, which are focused on new business models, finance, innovation and leadership, EDI was keen to continue its work on developing new programs that are oriented on assisting (young) energy professionals in challenges they face in the current energy environment.

In this framework, EDI was very enthusiastic and proud to begin its collaboration with the FLAME conference, the largest annual European meeting of global gas community and LNG leaders. Together, we have designed a new program – the FLAME Future Leaders Master Class, which provides a carefully selected set of topics and tools for early/mid-career professionals, who are ambitious to make the transition to senior management roles in the future. Highly recognizable speakers from the energy industry, who are speaking at the FLAME conference this year, are also involved in this master class, taking place from May 9-11 in Amsterdam (parallel to the main FLAME conference).

EDI has asked the organizers of the FLAME conference to share their views on this master class with the readers of the IGU magazine. Below we include a short interview, which gives more insights into this distinguished program.

EDI: Why was FLAME interested in organising the FLAME Future Leaders Master Class next to the main conference?
FLAME: We are constantly striving to ensure that FLAME evolves along with the gas industry it serves. Energy companies are increasingly needing to innovate to stay competitive and this means investing in the next generation of leaders. It is no secret that the industry is facing a possible shortage in the numbers of qualified candidates. We want to offer aspiring industry professionals an in-depth, up-to-date master class that will enable them to meet the needs of their companies and the changing world around them.

EDI: What are the benefits for [young] professionals participating in this master class?
FLAME: This master class is designed for those who want to expand their knowledge, skill set and network. Participants will benefit from a CPD-accredited course on energy industry fundamentals, business and finance models, corporate strategy and leadership skills. They will learn from outstanding industry experts
through hands-on case studies and a new business model game, created especially for this master class. Finally they can benefit from three days networking with over 650 FLAME 2016 attendees, representing more than 170 energy companies from over 40 countries, taking back to the office an increased depth of knowledge and contacts.

**EDI: Which developments in the industry have stimulated FLAME to focus this master class on the new business models and leadership?**

**FLAME:** By raising the profile of the energy industry as one of the most exciting to work in, future energy leaders will be professionally and personally equipped to remain competitive. With this in mind, having a clear understanding of energy market fundamentals, business and finance models, strategic positioning, technology, global trends in business and the changing nature of the workplace is essential.

**EDI: It is essential that energy professionals have a grasp of the main industry drivers. What are these drivers, from your perspective?**

**FLAME:** We believe that these drivers are as follows: knowing how to respond to the outcome of COP 21; the relatively negative press surrounding the gas industry; the significant reduction of gas demand in recent years; the drop in oil price; the slowdown in emerging markets; the consequences of Russia’s geopolitical activity in Ukraine; and the changing market structure and challenges facing utilities.

**EDI: How was EDI chosen for the development of this master class?**

**FLAME:** EDI is a world class, respected, international energy business school. We wanted to offer a tailored program that prepares the next generation of energy leaders in the coming years and with EDI’s rich knowledge of the market and outstanding training courses it was the obvious choice.

For this last question, EDI’s Vice President for Innovations, gives his comment: “In its activities, EDI is bridging the current energy realities and the new realities, providing a platform for an open dialogue. We increasingly focus on leadership, innovation and energy transition in our activities, following the industry trend. We believe in building networks between the “old” industry players and the “new” ones, and in sharing the knowledge between them. The FLAME Future Leaders Master Class provides the context, where this can be achieved in an efficient and effective manner. Future energy leaders should master openness, awareness and agility to thrive in this new world.”

EDI would like to thank the FLAME organizing committee and Bert Stuij for their contribution to this article. For more information about the FLAME Future Leaders Master Class please visit EDI’s home page (www.energydeltainstitute.org). We would be happy to welcome participants from the IGU.

*Nadja Luchtmeijer is a Senior Energy Analyst at Energy Delta Institute* (www.energydelta.org).

**News from IPLOCA**

*By Juan Arzuaga*

Around 510 members, media partners and guests attended the 49th International Pipe Line and Offshore Contractors Association (IPLOCA) Convention in Singapore from October 5-9, 2015. The IPLOCA Convention, taking place over five days, is a unique annual gathering of the leading global players in the pipeline construction industry. This was the second IPLOCA Convention to be held in Singapore; the last one taking place in 1989.

During the convention, the association elected its Board of Directors for 2015 to 2016. The following were named to positions on the board:
New from Organizations Affiliated to IGU

Bruno Guy de Chamisso (Spiecapag), Director, Europe Mediterranean;
Adam Wynne Hughes (Pipeline Induction Heat), Director, Europe North-West;
Larry Bolander (Fluor), Director, America North;
Scot Fluharty (Mears Group), Director, America North;
Ebbo Laenge (Conduto), Director, Latin America;
Georges Hage (The C.A.T. Group), Director, Middle East & Africa;
Najib Khoury (CCC), Director, Middle East & Africa;
Ma Chunqing (China Petroleum Pipeline), Director, East & Far East;
Jaya Sinnathurai (Caterpillar), Director, Associate Members;
Steve Sumner (Lincoln Electric), Director, Associate Members; and
Doug Fabick (PipeLine Machinery), Director, Associate Members.

Officers
Atul Punj (Punj Lloyd), President; Director, East & Far East;
Rubén Kuri (ARENDAL), 1st Vice President; Director, Latin America;
Andrew Ball (J. Murphy & Sons Limited), 2nd Vice President; Director, Europe North-West;
Jan Koop (Bohlen & Doyen), Treasurer; Director, Europe Central; and
Jean Claude Van de Wiele (Spiecapag), Immediate Past President.

Directors
Haldun Iyidil (Limak Construction Industry and Trade), Director, Europe Eastern;
Iosif Panchak (Stroygazmontazh), Director, Europe Eastern;
Mesut Sahin (Technip), Director, Europe Central;
Oliviero Corvi (Bonatti), Director, Europe Mediterranean;

Front row:
Jan Koop, Rubén Kuri,
Atul Punj, Andrew Ball,
Jean Claude Van de Wiele,
Juan Arzuaga.

Second row:
Jim Frith, Mesut Sahin,
Haldun Iyidil, Georges
Hage, Bruno Maerten,
Marco Jannuzzi (since retired), Ma Chunqing.

Third row:
John Tikkanen, Iosif
Panchak, Doug Evans,
Adam Wynne Hughes,
Wilhelm Maats, Oliviero
Corvi.

Fourth row:
Ebbo Laenge, Steve
Sumner, Larry Bolander,
Scot Fluharty, Doug
Fabick, Najib Khoury,
Bruno Guy de Chamisso.
Not present: Jaya
Sinnathurai.
The growing demand for clean energy resources

LNG has emerged as a strong competitor in the global energy arena. The United Arab Emirates and its capital Abu Dhabi, is recently witnessing a rarely matched boom and comprehensive development in all walks of life. As a key contributor to the development march of the Emirate of Abu Dhabi, Abu Dhabi Gas Liquefaction Company Ltd (ADGAS) had and continues to play a strategic role, spanning for more than four decades of operations in the LNG industry, and has built a long experience and excellent reputation in the global energy market.

Building on its long experience and excellent reputation in the global LNG market, ADGAS has managed to lay a solid foundation in the natural gas industry, being the first LNG production company in the whole Middle East region. Since its foundation in the early 1970s, ADGAS signed a long term agreement with Tokyo Electric Power Company (TEPCO), to power the Japanese capital of Tokyo with electricity for 20 years. This unique and successful partnership was further strengthened with the signing of a new agreement, before the first even expired. Under this new agreement, ADGAS would double its LNG production, and this would be purchased by TEPCO for an additional 25 years.

In addition to Japan, ADGAS’ unrivalled global reach of LNG, LPG (Propane and Butane), Paraffinic Naphtha and Sulphur has grown, enabling ADGAS to get closer to consumers in America, Europe, Korea and the Far East.

Additionally, ADGAS plays a central role in the UAE’s economic development, ensuring that a sustainable source of energy is available to meet Abu Dhabi’s growing demand for energy. After the completion of two strategic projects; namely the Offshore Associated Gas (OAG) project and the Integrated Gas Development (IGD) project, ADGAS has recently started to feed gas to the national grid by exporting around 1 billion cubic feet of gas on a daily basis to onshore processing facilities. Furthermore, to meet the increasing energy demand of Abu Dhabi, expansion of IGD facilities is currently being undertaken to provide an addition of 400 MMSCFD of gas, which will increase daily gas exports by 2018 to 1.4 billion standard cubic feet.
At the presentation of IPLOCA’s Health & Safety Award for 2015 are (from left to right): Bruno Maerten, Chairman of the IPLOCA HSE Committee; Harald Dresp and Giovanni Muriana from Max Streicher; Bruno Guy de Chamisso of Spiecapag, Mike Prior from Michels Corporation and Jean Claude Van de Wiele, Spiecapag.

**Directors-at-Large**

Doug Evans (GIE);
Jim Frith (McConnell Dowell);
Wilhelm Maats (Maats Pipeline Equipment);
Bruno Maerten (Entrepose), Chairman of the HSE Committee; and
John Tikkanen (ShawCor).

The Open General Meetings held on Thursday and Friday included presentations on a wide variety of subjects including the history of Singapore, the feasibility of new pipeline projects in the new macroeconomic environment, trends in international upstream mergers and acquisitions in a depressed oil price market, efficient deep water seabed intervention, pipeline projects in Saudi Arabia, and high pressure water transmission pipelines.

The full list of guest speakers was as follows:

- Ho Chi Tim, Instructor, Department of History, National University of Singapore (NUS): Beyond the Singapore Story – Historical Connections to Region, Empire and the World;
- Ricardo Markous, Gas & Power General Diector, Tecpetrol, Techint Group: Feasibility of New Pipeline Projects in the New Macroeconomic Environment and with Increasing Capital Expenditure Costs;
- Jonathan Green, Business and Competitive Intelligence Manager, Addax Petroleum Ltd: Trends in International Upstream M&A in a Depressed Oil Price Environment;
- Andreas Kohler, Managing Director, ILF Business Consult and Alexander Heinz, Head of Water Pipeline Engineering, ILF Consulting Engineers: The Market for High Pressure Water Transmission Pipelines; and
- Mansour S. Al-Shehri, Manager, East West Pipeline Projects Department, Saudi Aramco: Pipeline Opportunities with Saudi Aramco.

Members also attended the Annual General Meeting and the presentations of three industry Awards: the IPLOCA Health & Safety Award sponsored by Chevron, the IPLOCA Corporate Social Responsibility Award sponsored by Total, and the IPLOCA New Technologies Award sponsored by BP.
**IPLOCA Health & Safety Award**
The award is in recognition of members’ initiatives, all of which are aimed at improving the health and safety of the pipeline industry.

This year, the award was presented by Bruno Maerten, Chairman of the IPLOCA HSE Committee to Max Streicher S.p.A., in recognition of their Belt System. The Adjudication Committee made their decision for the following reasons: this initiative shows employee engagement; it is derived from the analysis of accidents; it is a simple, efficient and innovative solution.

Also recognized as runners-up were Michels Corporation for their “Promise Me” video campaign that brings safety back to its real goals, and Spiecapag for their “Finish Strong” initiative that emphasizes safety in the last phases of a project.

**IPLOCA Corporate Social Responsibility Award**
The award is presented in recognition of an initiative aimed at improving the living conditions of the people in communities local to, and impacted by, pipeline industry work.

Marc Geniteau of Total and Bruno Maerten presented the award to Technip for their policy “Encouraging a Fair Return for All”. This project was selected for its involvement in long-term planning, its applicability to projects worldwide and the fact that it is a self-funded initiative. In addition, it shows top-level management commitment and promotes environmental awareness.

Two runners-up were also named: Saipem S.p.A. for the “Promotion of Entrepreneurship Opportunities”, a long term and self-funded program; and Spiecapag for their Community Capacitation program applicable to multiple projects.

**IPLOCA New Technologies Award**
This award is given every second year in recognition of a significant achievement in the development of new pipeline technologies.

It was presented by Michael Hiam of BP and Jean Claude Van de Wiele, Chairman of the New Technologies Committee, to Denys and Selmers, in recognition of their work on their onshore automatic vacuum field joint blasting. This entry was chosen because the new tool improves HSE conditions for workers in the field; it is an initiative that involves both a contractor and a manufacturer working together, and it is an example of technology transfer from the offshore to the onshore industry.

Two runners-up were also named: Herrenknecht AG, for their new drilling tools that increase performance of horizontal directional drilling; and PipeSak, for their PipePillo Structural Pipeline Pillow, a simple and very creative method.

The IPLOCA 50th anniversary convention will take place in Paris, September 12-16, 2016. To read more about the history of IPLOCA and its half century of service to the industry see pages 148-153.

Juan Arzuaga is Executive Secretary of IPLOCA (www.iploca.com).

**NGV Global Marks 2015 Achievements; Plans Major Event for 2016**

*By David Perry*

NGV Global, as the international trade association for the natural gas for transportation sector, is committed to advocating the many benefits of natural gas as a fuel and maximizing opportunity for the industry. It is affiliated with IGU and supports their work to increase opportunities and remove barriers for the adoption of LNG, CNG and renewable natural gas.

It does this through leading and participating in working groups and committees for international standards and regulations, the building of relationships, and sharing information via high-level consultation and events, and through various communications.

Much was achieved in 2015 on behalf of all industry stakeholders, as described below,
NGV Global continued to take the voice of our members to every standardization committee dealing with NGVs. NGV Global leads the efforts at the ISO and the UN, and collaborates with NGVA Europe for the European Committee for Standardization (CEN) and NGV America and the Canadian Natural Gas Vehicle Alliance (CNGVA) for the Canadian Standards Association (CSA). The goal is to provide harmonized standards which will allow manufacturers and installers to have global compatibility. As examples of the work carried out, NGV Global has conferred with and represented members on the following items:

- ISO 17519 Gas cylinders — Refillable permanently mounted composite tubes for transportation (ISO TC58 SC3).
- ISO/CD 13769 Gas cylinders — Stamp marking (ISO TC58 SC4 WG6).
- ISO PC252 Natural gas fuelling stations for vehicles.
- ISO TC22 SC41 Specific aspects for gaseous fuels (WG3).
- ISO TC 220 Cryogenic vessels.

and 2016 promises to be rich with opportunity and challenge. In October this year, the world’s attention will turn to St Petersburg for NGV Global 2016, being held for the first time in Russia and in conjunction with the St Petersburg International Gas Forum.

Standards and Regulations – 2015 Achievements

- NGV Global provided Secretariat support to the Task Force that amended UN regulation R-110 to include LNG fuel system components. This inclusion will allow LNG vehicle approval, which requires the fuel system components to be certified.
- NGV Global partnered with the European LPG Association (AEGPL) and succeeded in securing the approval of CNG and LPG as accepted fuels for trucks transporting dangerous goods (previously only LNG had been accepted, after another effort by NGV Global).
- NGV Global participated in the work of the IGU study group WOC 5.3 “Natural Gas Vehicles”.
- NGV Global continued to lead the standardization efforts for an ISO international standard on CNG and LNG fuelling stations.
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NGV Global met with authorities of Daegu, Korea, during discussions on NGVs in the region and the country’s participation in the industry.
Success isn’t only in numbers...

It is in warming up life with a touch of care. Providing joy of life with the never-ending energy of happiness. Enlightening the future with knowledge and experience. Success is leaving a more livable world by caring for nature and making life more convenient. For 28 years, İGDAS has been working for these values that add meaning to life. Therefore, for İGDAS, success is more than numbers. However, if numbers are important for you, with its steel lines of 1,800 km, polyethylene lines of 15,000 km, 5.6 million subscribers and natural gas consumption of over 5 billion m³/year, İGDAS is one of the leading natural gas distribution companies.
ISO TC 67 SC9 Liquefied natural gas installations and equipment.
ISO TC 58 Gas cylinders.

These activities continue in 2016. Included in goals for this year is conclusion and publication of ISO standards on LNG and CNG fuelling stations to be published during 2016 and follow-up on new proposals for amendments and modifications of UN R-110. NGV Global is working with IGU’s WOC 5.3, contributing to a report on Gas for the Transportation Industry for the US IGU presidency.

Relationships and Events – 2015 Highlights

The Korean association KANGV joined NGV Global as an affiliated organization. Associations representing Argentina, Asia-Pacific, Brazil, Canada, Europe, Italy, Russia, and the USA are also members.

NGV Global conducted an NGV Technical Forum in the US during ACT Expo 2015, to address specific technical issues presented by North American firms – including a discussion on gas quality. Similar forums will be conducted in Europe and in North America during 2016.

A joint technical Global Experts Committee was formed with representatives from NGV America, NGVA Europe, NGV Italy, CNGVA and the Asia Pacific Natural Gas Vehicles Association (ANGVA).

NGV Global worked with IGU to organize and deliver the first ever dedicated NGV pavilion at a World Gas Conference (Paris, June 2015), and participated at the IGU Council meeting. IGU has determined to include the use of natural gas in transportation as one of the 10 key issues of the triennium.

A cooperation process was initiated with CSA toward international participation of the North American NGV industry.

In recognition of the expanding applications for natural gas fuel, NGV Global broadened its activities to cover the use of natural gas in ships, both marine and inland waterways, through ISO and cooperation with the Society for Gas as a Marine Fuel (SGMF).

In collaboration with NGV Global, GasTech 2015 presented an NGV Centre of Technical Excellence (CoTE) in Singapore.
Information and Guidance – 2015
NGV Global participated in a high-level meeting with Korean government agencies and government (KEITI, Ministry of Environment), companies (KOGAS) and the Korea Gas Union. The purpose of the meeting was to discuss the future of NGVs in the region and Korea’s participation in the NGV industry in particular and the gas industry in general. Korea will hold the IGU presidency in the next triennium.

The association also assisted in the cooperation between the US Department of Energy and the government of Israel to prepare Israeli government officials for the introduction and supervision of NGVs.

NGV Global participated in several other events throughout 2015, enhancing capacity for its members and industry stakeholders, and will build on this growing and effective presence throughout 2016 and beyond.

These activities are funded in large part by sponsor and member contributions. To continue this work, NGV Global invites industry stakeholders to join by inquiry to the Executive Director, Diego Goldin (dgoldin@ngvglobal.org).

NGV GLOBAL 2016

The Association’s 15th consecutive biennial conference and exhibition – NGV GLOBAL 2016 – will be held in St Petersburg from October 4-7.

Since 2013, when the government decreed massive targets for natural gas refuelling infrastructure and natural gas fuelled fleets, Russia has taken a fresh look at the many benefits of utilizing natural gas as a clean, sustainable mobility fuel. Vehicle and component manufac-

Davit Perry is the Business Manager of NGV Global (www.ngvglobal.org).
It was said that bringing gas from Camisea was almost impossible.

It’s been 10 years that we’ve been transporting gas from the jungle to the coast, traveling across all the varieties of climates and geographies Peru has.

A challenge is judged by its results.
Focus on Research & Development and Innovation

The new triennium is already strongly underway, guided by the presidency of the United States, and with it has come an expansion of the work of IGU’s committees and task forces. We introduce this new section of the publication highlighting the ongoing work of IGU’s expert membership with an article discussing just some of the ways that they are sharing their knowledge both within the industry and with the wider world.

Following are three papers from the Research & Development and Innovation committee. First we gain insight into a new methane-hydrogen fuel technology that could aid in the transition to a hydrogen-based economy; thereafter two papers look at different aspects of power-to-gas applications, the relationship of the process to renewable energy and its technical and economic aspects.
The IGU committees and task forces are now well into their work for the triennium and are holding their second round of committee meetings. The total team of global experts is just shy of 1,000, with representatives from more than 50 countries. This level of participation and the work undertaken by the committees truly differentiates IGU from all other organizations in our industry.

A key objective of the current 2015-2018 triennium is to ensure that the committees and task forces become more timely and dynamic with deliverables leading up to the World Gas Conference (WGC). Traditionally the committees have presented their results at the WGC at the end of every triennium. However, as the Triennial Work Programme 2015-2018 states, today’s energy market requires more dynamic, active and engaging committees and task forces that support the leadership team throughout the triennium.

The intermediate deliverables may take many forms. Reports, case studies, best practices and presentations specific to the committee’s study areas, but also, for specific issues, and in support of raising the “Global Voice of Gas”, through symposia, seminars, workshops and publications.

These are just a few examples of their contributions:

**IGU newsletter**

Over recent months, the committees have started to contribute to the IGU newsletter. A new Committee Corner has been established to highlight and share their work. So far the LNG, Marketing and Communications, Strategy and R&D and Innovation committees have...
already contributed and more committees are lined up to do so.

**IGU publications**
The first committee report is also soon to be released. The IGU LNG committee has worked hard to make an updated version of the *IGU World LNG Report* which will be released at the LNG 18 conference in Perth. This flagship publication is widely recognized in many circles, both inside and outside the industry, and this year’s report addresses some of the critical questions facing the international LNG industry’s development since early 2015. The months since the last report was published at WGC 2015 in Paris have been a transitional period in which precipitous declines in world oil prices and a resurgence of coal in the power generation sector have created new challenges for expansion of LNG. With many new supplies of LNG expected to enter the market soon, the foreseeable future has become a buyer’s market with further global price convergence emerging.

**IGU webcasts**
The IGU Marketing and Communications committee took on a completely new initiative, launching the IGU webcast series with the *IGU Webcast Live from Berlin* on Thursday 25 February. The webcasts, hosted by Hansch van der Velden and Dimitri Schildmeijer, will give a voice to the players and issues that really matter to the natural gas industry. The first webcast featured three guests: IGU Secretary General, Pål Rasmussen; Marcel Hoenderdos, Manager Communications at Dutch State participation company EBN; and Alex Burnett, Chair of the IGU Strategic Communications and Outreach taskforce. The three spoke of global gas advocacy efforts; Pål and Alex gave IGU’s perspective on the union’s work to reinforce IGU as the credible global voice of gas and on the very successful urban clean air campaign that was launched at the sidelines of the UN Climate Conference (COP 21) in December 2015.

Marcel presented GILDE, a Dutch initiative to rethink the role of natural gas in a sustainable energy future, particularly at a time when The Netherlands has experienced a dramatic drop in the perception of natural gas due to concerns over shale exploration.

**Research papers and IGRC 2017 preparations**
A key role of the R&D and Innovation committee is to support the organization of the IGU Research Conference 2017 (IGRC 2017) by encouraging input from R&D institutes and researchers and creating and executing the program. The committee is currently working on the preparations for the conference which will take place in Rio de Janeiro in May next year.

The R&D and Innovation committee has also encouraged its members to submit research papers for distribution both in the IGU newsletter and the IGU magazine. Three of these are featured in the following pages.

If you want to learn more about IGU committee work, please consult the *Triennial Work Programme 2015-2018* at [www.igu.org](http://www.igu.org) or send an e-mail to Anette Sørum Nordal, Coordination Committee Secretary at aneno@statoil.com.
New Methane-Hydrogen Fuel Technology and its Potential Application in the Gas Industry

By Oleg Aksyutin, Alexander Ishkov, Konstantin Romanov, Valery Khloptsov, Varazdat Kazaryan and Anatoly Stolyarevsky

This article deals with highly efficient hydrogen energy carriers based on natural gas, their production technology and potential application in the gas industry. It formulates the innovative methods of natural gas conservation and environmental protection in the gas sector, providing for the creation of efficient methane-hydrogen mixture (MHM) production technology, with hydrogen content of 40-48%, based on proven industrial processes and used catalyst agents.

The unique properties of hydrogen make it possible to increase the heat engine efficiency 1.5 to 1.7 times, with the actual cycle of a hydrogen-fired engine being much closer to the ideal cycle than with any hydrocarbon fuel. In addition, the emission toxicity falls dramatically (2 to 4 times), hydrocarbon fuel consumption decreases by 35-40%, while cost efficiency grows by 20-25%.

Methane-hydrocarbon mixture (MHM) technology
There are several industrial technologies for hydrocarbon production. Steam methane reforming (SMR) is considered to be the most affordable and cheapest technology. However, a new technology, adiabatic methane conversion (AMC), developed in Russia, considerably facilitates the industrial process of MHM production. The benefits of the technique are that it does not require oxygen generation, it is carried out at lower temperatures (up to 680°C), does not need energy- and cost-consuming water electrolysis and is based on technological solutions, flow patterns and catalyst agents tried and tested in high-tonnage chemistry.

Figure 1 illustrates the process flow diagram of AMC. A steam-gas mixture is fed into a high-temperature heat exchanger and then, having
On-site MHM production through adiabatic methane conversion will not only provide for involving hydrogen in the conventional energy sector, but will considerably save the necessity of preliminary stripping and fractionating natural gas at sophisticated and costly facilities. It will also help establish small scale production of methanol.

The transition to methane-hydrogen fuel will allow improving the performances of many gas turbine drivers, which are currently less efficient than modern gas compressor facilities. The testing of combustion chamber burners in different modes with different MHM compositions have shown that the use of MHM will significantly improve the emission indices of gas turbine units making it possible to reach low NOx values (down to 10-12 mg/m³) with a simultaneous sharp decrease in CO emissions (down to 4-8 mg/m³) with the excessive air emission by a burner at high values of $\alpha$.

The presence of hydrogen in the main burner circuit significantly extends the stable operating range in terms of the air speed in the burner (approximately doubles), as well as in terms of

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**General overview of Gazprom’s pilot MHM production unit.**

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been heated to 640-680°C, is delivered into a two-piece adiabatic reactor filled with a catalyst. After the reactor, the methane-hydrogen mixture together with water steam flows into a waste-heat exchanger for dehydration. At the waste-heat exchanger output we obtain a purified MHM. In some technical applications, for example, in the Tandem model described below, MHM together with water steam is supplied to the gas turbine unit burner.

Gazprom has designed and is now testing a pilot MHM production unit with the performance of 1,000 m³/hour for joint testing with a gas turbine drive (Figure 2). In the aforementioned unit the heating temperature of a steam-gas mixture does not exceed 700°C, which allows for obtaining a high-hydrogen MHM.

The designed MHM production unit surpasses its global counterparts in all basic properties (performance, hydrogen content in the mixture, energy resource consumption, emissions rate). The new solution provides for increasing the degree of methane conversion, reducing heat consumption and prolonging the lifetime of the adiabatic reactor catalyst agent.

The fuel and energy complex is the most promising market for MHM. The use of MHM for gas industry-specific needs, with a view to increase the efficiency of both natural gas production and transportation, may boost the development of this business line.

At present, the application of MHM production technologies at fields may be considered, first of all, for treating raw gas and increasing the efficiency of on-site use of rich gases (stabilization gas, associated gas from marginal, remote or low-pressure fields), transportation of which is unprofitable.
utilization of gas with a relatively high water steam content.

When supplying modern gas turbine units powered by converted methane with waste heat recovery units at compressor stations or power plants, the efficiency and capacity of such turbine units may grow by 50%. Through adding heating load, the efficiency of gas use may be increased to 60-62%, with the NOx emissions reduced below 10 ppm.

The use of MHM for producing various gas chemicals can be potentially advantageous through the application of AMC technology and installation of relevant facilities for the production of synthesis gas as the basis of gas chemical processes. This approach is especially efficient when applied to creating centralized MHM transportation networks connected to sources with a low cost of power generation.

In the transportation sector the pilot operation of MHM-fired cars has proven the expediency of converting vehicles to MHM with a hydrogen content of 5-10% by weight (20-40% by volume). Besides, the emission toxicity declines more than 2 to 4 times as compared to natural gas, while the fuel consumption falls by 35-40%.

Summarizing the above, the basic concept of the future hydrogen-based energy sector may seem as follows:

◆ Use MHM produced from natural gas (which is considerably cheaper) as a fuel instead of pure hydrogen.
◆ Apply the AMC technology for MHM production.
◆ Introduce this technology at gas facilities.
◆ Supply gas turbine drives with compact unit-wise plants producing a triple mixture: natural gas/hydrogen/water vapour to improve gas transmission efficiency.

It should be noted that MHM produced through AMC technology based on natural gas conversion looks more financially attractive than MHM produced through mixing natural gas and hydrogen (extracted from water by electrolysis using available excess electricity).

This fact provides ample opportunities for developing MHM production based on AMC technology in the gas industry.

**Conclusion**

As of today, a partial substitution of widely-used hydrocarbons by MHM is an essential and strategic move towards hydrogen-based power generation and the hydrogen-based economy.

Russia has developed an AMC technology, which produces methane-hydrogen fuel containing up to 48% hydrogen. This technology makes it much easier to produce hydrogen on a commercial scale, because the process needs zero production of oxygen and occurs at lower temperatures (to 680°C).

Two integrated technologies – i.e. flue gas treatment recovery and low temperature AMC – will make it possible to design a new type of gas turbine drive featuring high energy and eco-efficient properties (called the Tandem technology). In this case, the output of a gas turbine unit (compared to its standard version) may reach 70-80%, fuel consumption may go down by 35-40%, accompanied by a sharp decrease of NOx emissions (4-8 times) and CO emissions (approximately 10 times).

The application of MHM production technology and use of methane-hydrogen mixtures by compressor stations at gas fields and in gas chemistry, as well as sales of this hi-tech energy source abroad, provide a good option for diversification and serve as a means of enhancing natural gas efficiency.

*Oleg Aksyutin is a Member of the Management Committee and Head of Department at Gazprom; Alexander Ishkov is Deputy Head of Department – Head of Directorate at Gazprom and Konstantin Romanov is Head of Division at Gazprom. Valery Khloptsov is Director general at Gazprom Geotech and Varazdat Kazaryan is Deputy Director General at Gazprom Geotech. Anatoly Stolyarevsky is Director of the CORTES Center.*
We are responsible for delivering 30 million m³ of natural gas per day, which supplies local distribution companies, thermoelectric power plants and refineries in the Brazilian states of Mato Grosso do Sul, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul.

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The Convergence of Power, Gas & Renewables

By Prof.-Dr. Hartmut Krause, Prof.-Dr. Gerald Linke and Gert Müller-Syring

With its climate policy goals the German government has set the course for a fundamental transformation of energy supply systems. By 2050, CO₂ emissions in Germany are to be reduced by at least 80% and primary energy consumption by 50%. Higher shares of renewable energies, energy saving and better energy efficiencies are therefore at the top of the political agenda.

The impact of these political requirements is particularly felt in electricity generation. In the last two decades, green power generation has grown from less than 20 TWh to almost 160 TWh (Figure 1) reflecting more than 25% of total German power consumption. In regions with high production capacities and weaker residual demand, the share of renewable power far exceeds 100%, showing clearly that the power grids face severe challenges and have to transport electricity in the opposite direction than they have been designed for¹.

From today’s viewpoint, successful integration of increasing volumes of power from renewable sources requires expansion and reinforcement of electricity networks, additional load mitigation measures and alternative transportation and storage technologies. The existing gas infrastructure can contribute to make these measures a success, for example, for load mitigation by using bivalent gas assets or the storage of huge

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**Figure 1.**

**Development of renewable power production in Germany**

*Abbreviations:* SteG – Stromver Особенности
gesetz; BauBG – Baugesetzbuch; EEG – Erneuerbare-Energien-Gesetz


*solid, liquid, gaseous biomass, waste incl. landfill gas, biogenic fuels. Geothermal not included (share 2012: 25,24 GWh)*
There are several arguments supporting the power-to-gas concept: investigations by the German Energy Agency state that it is absolutely necessary to expand the electricity network by 850 km for the integration of renewable energy by 2015. Moreover, an additional need for electricity transportation capacities of 1,700-3,600 km may be required depending on the share of renewable energies.

Using the potential of the gas infrastructure will result in the beginning of the convergence of the power and gas infrastructures, and later in a combined energy infrastructure with outstanding performance that is significantly better than that of the optimized separate infrastructures. However, using this potential will require modifications in the gas infrastructure such as improving the capacity for green gases or the implementation of information and communication technologies. Depending on the topic, there is need for R&D, implementation activities and, in most cases, regulatory improvement.

Against this background DVGW, the German Technical and Scientific Association for Gas and Water, is examining the role of gas in the future energy system through an innovation initiative. The goal is to present the potential of natural gas as a suitable partner for renewable energies in order to pave the way for an optimised future energy system.

Challenges meet opportunities
The challenges we face in the transition process of the energy systems are diverse and expected to change with different shares of renewable energies. Nevertheless, for the time being, major challenges can be identified and appropriate mitigation opportunities with different strengths and weaknesses are available. Table 1 presents the challenges and opportunities of using the gas infrastructure.

Even though Table 1 shows remarkable potential leading to a convergence of power, gas and renewables, it is a fact that using this potential requires changes in the gas infrastructure. In some cases existing knowledge needs to be applied, in others the potential of technology has to be demonstrated or new knowledge has to be gained through R&D.

Here we give an overview on selected technologies (opportunities) and their potential for the convergence of the energy system.

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<tr>
<td>Long term energy storage</td>
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Power-to-gas as a basis for the convergence of power, gas and renewables
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Here we give an overview on selected technologies (opportunities) and their potential for the convergence of the energy system.
Power-to-gas as a technology offers to combine the power and gas grids by converting power to gases that, following injection into the existing gas infrastructure, can be reconverted into electricity, heat or fuel as required. Germany and the rest of Europe have already developed efficient gas networks. The German gas network has a storage volume corresponding to more than a third of Germany’s total annual electricity generation and offers high flexibility at high transportation capacities over large distances. The gas network transports an annual energy quantity of around 1 trillion kWh and thus about twice as much as the electricity network. Currently, a volume of 20% of the annual gas consumption is held available in underground storage facilities. Thus, the natural gas network is not only an extensive energy distribution system interconnected on a Europe-wide level but also offers substantial energy storage capacity; this is an important difference compared to the Germany’s total annual electricity generation and offers high flexibility at high transportation capacities over large distances. The gas network transports an annual energy quantity of around 1 trillion kWh and thus about twice as much as the electricity network. Currently, a volume of 20% of the annual gas consumption is held available in underground storage facilities. Thus, the natural gas network is not only an extensive energy distribution system interconnected on a Europe-wide level but also offers substantial energy storage capacity; this is an important difference compared to the
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electricity network where non-simultaneous injection and withdrawal of energy is not possible. Moreover, the gas infrastructure is an existing, socially accepted and very reliable infrastructure and therefore an important partner of the energy transition.

Beyond enabling the use of outstanding energy storage capacities, the implementation of power-to-gas can mitigate the load in the power grids. In order to quantify the possible effects, especially in rural areas with huge amounts of generated renewable electricity, a DVGW R&D project has been initiated. In the north of Germany, where renewable electricity production already exceeds demand at most times of the year, the effect of power-to-gas facilities has been investigated by a research group. The group members DBI Gas Technology Institute, University of Wuppertal, DVGW Research Center Engler-Bunte and RWTH Aachen University were coordinated for DVGW by Heinrich Busch. EWE Netz and E.ON Avacon strongly supported the project as industrial partners.

The investigations showed that installing power-to-gas units in the low voltage grid with a capacity of up to a few hundred kilowatts can significantly reduce critical situations in the power grid and subsequently the need for grid reinforcement. The calculations showed furthermore that this positive effect is being passed to higher voltage tiers as well. This is possible due to the reduced amount of power that is fed back into higher voltage tiers from the low voltage grid. In order to realize this potential, power-to-gas technology has to be implemented quickly (in less than ten years) otherwise the electricity grid reinforcement will have taken place, leaving no room for power-to-gas in terms of load mitigation. The precondition for implementing the technology in the coming years is to achieve investment costs in the magnitude of €1,000/kW installed, including the injection facility, which is an important technology goal.

Finally, the study revealed that adding up the individual benefits that power-to-gas offers, when implemented in the low voltage grid, for load mitigation and subsequent reduction of grid reinforcement, as well as better aligning forecast and real delivery of renewable energy, contributes to the viability of this technical solution.

This makes using power-to-gas competitive in comparison to reinforcing the power grid if cable reinforcement is needed, which is increasingly expected to be the case in future.7

**H₂ tolerance of the gas grid**

Hydrogen and methane are both chemical energy carriers that can be produced by power-to-gas technology. Both options have different strengths and weaknesses. Hydrogen production leads to lower capital and operational expenditures, but requires modifications of the gas infrastructure depending on the share of hydrogen. Converting hydrogen to methane reduces efficiency and results in increased production costs. On the other hand, modifications in the gas infrastructure are unnecessary. In order to decide how the installed power-to-gas capacity should be distributed in terms of hydrogen or methane injection, a macroeconomic evaluation is mandatory. This decision mainly depends on the production costs for the synthetic gases as well as the costs for modifying the gas infrastructure to host hydrogen. A significant level of knowledge has already been achieved regarding admissible hydrogen concentrations in the gas grid. But some questions remain, as earlier experiences with hydrogen in town gas

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are not fully transferable to the current situation and R&D performed more recently has not yet covered all of the components in the gas grid that may be sensitive to hydrogen. Nevertheless, available results, from a recently finalized GERG (European Gas Research Group) project (HIPS), and a DVGW project on hydrogen tolerance show that most parts of the existing gas grid are compatible with hydrogen concentrations up to 10% by volume (Figure 2). These projects identified:

- Porous underground gas storage
- Steel CNG vehicle tanks
- Gas turbines and engines
- Industrial burners

as sensitive components which require further research to determine their tolerance to hydrogen admixtures.

There are several research projects and initiatives, either under way or in preparation, to close the knowledge gaps, especially focusing on the above-mentioned key issues.

A European understanding of admissible hydrogen concentrations in gas infrastructure is urgently needed in order to create a sound basis for future standardization. This requires the collection and combination of results from the above-mentioned R&D projects. To achieve this goal DBI has initiated the “HIPS-NET” network, supported by GERG, to gather and share the available and expected research results in order to develop the needed European understanding of gas grid tolerance towards hydrogen. More than 30 international partners from various industries, e.g. gas grid operators, turbine and automobile manufacturers as well as research institutes,

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8 “Wasserstofftoleranz der Erdgasinfrastruktur inklusive aller assoziiert Anlagen” (February 2014) www.dvgw-innovation.de/die-projekte/archiv/wasserstofftoleranz/
Gas grid evolution

As mentioned before, the integration of green gases, e.g. biogas, hydrogen or synthetic natural gas, is an important task and precondition for a successful energy transition. In principle, the gas infrastructure can offer outstanding storage and transport capacities. Nevertheless, it can be challenging to inject green gases into the gas grid at the point of their production as this is often in rural areas with less sophisticated infrastructures and low gas demand.

There are technical measures such as recompression to higher-pressure tiers that enable gas injection into almost every grid section, but the cost-effectiveness of these solutions is questionable.

A very promising approach is the strategic use of the existing grid buffer (differences between highest and lowest allowable pressure) named “dynamic pressure control” (DPC).

In distribution and regional transportation grids with maximum operational pressures above 1 bar, a strategic pressure-driven operation may allow green gas injection without any additional measures, as well as in challenging situations such as summer-time nights when the load is exceptionally low in most areas. This could be achieved by a pressure reduction, for example in the evening hours, in order to enable uninterrupted green gas injection overnight, when the load is low, accompanied with a pressure build up. In order to properly assess the opportunities of this approach, it is also important to know what precondition (such as the needed pressure swing, geometric grid volume, customer distribution, etc.) has to be fulfilled.

These questions, as well as the suitability of this approach, were exemplarily answered by an R&D project carried out for EWE Netz GmbH by DBI. The R&D project shows the potential of dynamic pressure control for selected gas grids in the north of Germany.
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Biogas can be completely injected into the middle-pressure distribution network.

The compression and feed-in to the highpressure transmission network is no longer necessary.

Furthermore, the available grid flexibility leads to a cutting of peak demand by 5% in urban areas.

It can be concluded that dynamic pressure control can significantly improve the ability of rural gas grids to accommodate especially biogas. The required adoptions (setting injection pressure limits twice a year) can easily be achieved. Moreover, peak gas demand can be smoothed but this requires a daily adoption of the pressure limit and therefore technical adoption of the gas pressure regulating stations. Dynamic pressure control is considered an effective and easy-to-install measure to improve the integration capacity for biogas but its potential is location specific.

This study explored two network areas under different angles:

- Enhanced biogas feed-in in rural areas
- Optimized procurement of natural gas in urban areas

In order to evaluate the potential of the DPC approach, the gas flow in both networks was simulated using a program called STANET®. The current demand-orientated operation mode of the gas network has been compared with different scenarios (heavy, light, and medium gas demand). By varying the research conditions, for instance:

- Upper and lower pressure limits of the gas network
- Feed-in pressure of the gas pressure regulating station (GPRS)
- Feed-in pressure of the biogas grid injection station

The results (Figure 3) of the investigations for the weak load case in rural areas show that:

- DPC leads in the analyzed network to a gas supply solely of biogas
- The compression energy can be reduced by up to 89%

For the heavy load case:

- Biogas can be completely injected into the middle-pressure distribution network
- The compression and feed-in to the highpressure transmission network is no longer necessary

Furthermore, the available grid flexibility leads to a cutting of peak demand by 5% in urban areas.

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The convergence of power, gas and renewables

Conclusion

The energy transition is especially challenging to infrastructures because they have to accommodate renewable energies that are:
◆ Mainly produced decentralized
◆ Spatially and, in terms of the time of production, not aligned with demand
◆ Changing their contribution to feeding demand extremely quickly (production ramps in green power generation such as wind and solar)

The stress on power grids is currently very high and expected to increase steadily. The convergence of gas and power infrastructures forms a unique opportunity to integrate renewable energies into the existing energy infrastructure. This integration reduces the need for power grid extension and reinforcement, thus, the complementary strengths of both systems compensate their weaknesses.

An important integrating technology is power-to-gas. Providing a sensitive implementation, it enables the utilization of the huge storage capacities of the gas infrastructure that is needed in the medium and long term and offers load mitigation for the power grid with effects on all voltage tiers resulting in a reduced need for grid extension/reinforcement in the short term. The results of the DVGW investigations show, furthermore, that the benefits of load mitigation in the different power grids can support the viability of power-to-gas. In comparison to power grid reinforcement by ground cables, that are expected to be increasingly used due to societal pressure on infrastructure development, power-to-gas turned out to be the cost-efficient alternative.

Innovative approaches are available to prepare the gas infrastructure in order to make its potential available for the energy transition. The accommodation potential of biogas in rural gas distribution grids can be significantly improved by applying a dynamic pressure operation, which can be easily applied at low costs.

The important issue of establishing a European understanding of the admissible hydrogen concentration in the gas grid is addressed by various projects and initiatives such as HIPS-NET and HYREADY. Moreover, CEN and CENELEC are conducting, together with the JRC, a SFEM Working Group on Hydrogen aiming to prepare a European standardization.

It can be concluded that a significant effort is being made to prepare the gas infrastructure for an active role in the energy transition. Nevertheless, efforts have to be focused to address open issues and to bring already available high potential technologies/approaches into the market and establish them in the infrastructures.

Prof.-Dr. Hartmut Krause is Managing Director of DBI Gas- und Umwelttechnik GmbH.
Prof.-Dr. Gerald Linke is Managing Director of DVGW, IGU Executive Committee Member and Chair of the R&D and Innovation Committee.
Gert Müller-Syring is Head of Department Gas Grids/Gas Facilities, DBI Gas- und Umwelttechnik GmbH.
The National Gas Company of Trinidad and Tobago

When The National Gas Company of Trinidad and Tobago Limited (NGC) was incorporated in 1975, it was to act as a trigger for Government to capture value from natural gas development. Four decades on, NGC, at the heart of natural gas based development, has burgeoned into a dynamic, diversified group of companies.

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NGC is a diversified group of companies with an asset base of over $6.5 billion, making it one of the largest in the Caribbean and Latin America when measured by assets. It is an internationally investment-rated company and its credit rating, as at January 2016, is A- from Standard & Poor’s, Baa2 from Moody's and AAA from CariCRIS.

The NGC Group
The parent, The National Gas Company of Trinidad and Tobago Limited is strategically positioned in the midstream of Trinidad and Tobago’s natural gas value chain and together with its subsidiaries operates in the downstream and upstream sectors. NGC core activities are in gas-based development and merchandizing; natural gas aggregation, transportation and distribution; natural gas pipeline construction, operation and maintenance; Liquefied Natural Gas (LNG) production, marketing and shipping; and oil and gas production and marketing. As the sole seller and distributor of natural gas in the country for local power generation and the domestic sector, NGC is fittingly headquartered in the Point Lisas Industrial Estate – a bustling hub of petrochemical and heavy industrial plants that rely on natural gas to fuel their operations.

The Company’s key infrastructure, however, extends far beyond the west-central coast industrial estate. NGC owns and operates a network of marine and onshore pipelines that span 1,000 km with a capacity of 4.4 billion cubic feet of gas per day. Its customers comprise power generation plants, world-scale petrochemical metal reduction plants, and a wide range of light manufacturing and commercial enterprises.

There are three main subsidiary companies: National Energy Corporation of Trinidad and Tobago Limited (National Energy) which conceptualizes, promotes, develops and manages industrial sites, port and marine; Phoenix Park Gas Processors Limited (PPGPL) is engaged in natural gas processing and the aggregation, fractionating and marketing of Natural Gas Liquids (NGLs) propane, butane and natural gasoline to Latin America and the Caribbean; and most recently, in a pioneering effort to impact the domestic integration of gas utilization, a campaign to promote Compressed Natural Gas (CNG) as a cleaner, cheaper fuel into the country’s transportation sector has been launched, and has tasked the NGC CNG Company Limited (NGC CNG), NGC’s newest subsidiary.

Corporate with a conscience
NGC’s raison d’être was to enable the nation at large to benefit from the country’s resource wealth, and today its enormous contribution to Trinidad and Tobago’s GDP sees this mandate being fulfilled. Beyond that contribution, however, the Company actively seeks to enrich the lives of citizens through various Corporate Social Responsibility programmes and initiatives under the areas of Sport, Civic Life Empowerment and the Environment. Among its many social activities, NGC supports cricket and athletics programmes, literary and arts festivals, training and education initiatives, musical ensembles, and facilities and community economic development.

As an entity engaged in resource development, the NGC Group also recognizes the need for operational sustainability and has made a commitment to reduce its ecological footprint through a reforestation initiative. As at the end of 2015, NGC has returned more than 260 hectares of deforested land under leaf and bark.

Going global
Trinidad and Tobago is a developing nation that has experienced significant growth in recent years, and the country is poised to lead others through its example. Well-endowed with oil and gas, the nation has been able to successfully manage the monetization of its resources.

The NGC Group’s operations have been integral to that success, and this makes it an ideal business partner. In fact, the expansion into new and global markets is one of the Company’s strategic pillars, and driven by this imperative, it is seeking to export Trinidad’s model of natural gas-based development to other countries. Specifically, options are currently being explored in jurisdictions wishing to replicate Trinidad and Tobago’s success at monetizing natural gas and related businesses. The NGC Group is also embarking on an initiative to establish a commodity trading business to manage the Group’s current energy-based commodities as well as to expand and grow the portfolio.
In the right hands, oil and natural gas are more than natural resources. They are a foundation. As prime architects of Trinidad and Tobago's natural gas-based energy sector, The National Gas Company of Trinidad and Tobago Limited (NGC) has helped build an industrial powerhouse from our nation's raw hydrocarbon wealth. Since 1975, we have pioneered a model of natural gas-based utilisation that adds maximum value for the benefit of the nation and its people. And though every nation is different, the principles and practices that guide our operations can be applied across the globe.

NGC is an integrated group of companies with an asset base of US$6 billion, making it one of the largest companies in the Caribbean and Latin America by assets. Strategically positioned in the midstream of the local natural gas value chain, its customers include power generation, global scale petrochemical and iron and steel plants, and a wide range of light manufacturing and commercial enterprises. Our credit rating is A- from Standard and Poor's, Baa2 from Moody's and AAA from CarriCrus rating agencies.

NGC is engaged in natural gas-based development and merchandising; natural gas compression, aggregation, transportation and distribution; natural gas pipeline construction, operation and maintenance; Liquid Natural Gas (LNG) production, marketing and shipping; offshore oil and gas production; development and management of industrial sites and port and marine infrastructure; aggregation, fractionation and marketing of Natural Gas Liquids (NGLs); and marketing of Compressed Natural Gas (CNG).

Through our strategic approach, we have successfully ensured both the profitability of the gas-based energy sector, as well as contributed to the social, economic and industrial development of Trinidad and Tobago. Through our investments, strategic partnerships and pioneering gas-pricing model, we have made a tremendous impact on the country’s natural gas sector and economy.

We are dedicated to sustainability, community and Corporate Social Responsibility (CSR). NGC’s CSR programme is one of the most extensive in the nation. We focus on Sports, Civic Life, Empowerment and the Environment, the latter being a 10-year ‘no net loss’ reforestation programme.

**NGC’s Mission**: To create exceptional national value from natural gas and energy business.

**NGC’s Vision**: To be a valued partner in the global energy business.
Evaluation of Biological Methanation for Power-to-Gas Applications

By Frank Graf and Gerald Linke

Germany has set a goal that by 2030, 30% of its gross final energy consumption and at least 50% of its power supply will be provided by renewable energy sources such as wind or solar energy. Nevertheless, these energies are fluctuating and intermittent and will need to be balanced for electric grid stability purposes. Furthermore, large storage capacities will be necessary to provide energy in periods with low production rates of renewable energy (especially in weak wind phases).

Electricity storage via Power-to-Gas (PtG) technology is a promising solution to tackle this issue. This process links the power grid with the gas grid by converting this surplus power into a grid compatible gas via a two-step process: H₂ production by water electrolysis and H₂ conversion with an external CO or CO₂ source to CH₄ via methanation. Both biological and catalytic methanation could be used for the methanation step. The coupling with biomass-based carbon sources is promising with respect to sustainability aspects and the decentralized production of renewable energy. The generated synthetic natural gas (SNG) can easily be injected into the existing gas distribution grid or gas storages, used as CNG fuel or utilized in all other well-established natural gas facilities.

In this article, the biological methanation connected with PtG processes will be evaluated technically and economically. Based on literature data and the authors’ own investigations, biological methanation concepts are compared with different thermochemical methanation technologies.

Technology and concepts for the application of biological methanation in PtG processes

In biological methanation (BM), a microorganism serves as a biocatalyst, converting H₂ and CO₂ into CH₄. This process is operated between 40-70°C. Catalytic methanation (CM) finds its application for the methanation of CO and/or CO₂. The reactors are typically operated at temperatures between 200-550°C and at pressures ranging from 1-100 bar.

Both concepts have been known since the beginning of the 20th century (CM from 1902 and BM from 1906). While catalytic methanation was developed for various
the calorific value of raw biogas, but is not limited to biogas as a carbon source. Another advantage is that the process conditions and the reactor design can be adjusted with respect to the requirements of the hydrogenotrophic methanogens. Currently, several reactor concepts are being developed (e.g. fixed-bed, trickle-bed, membrane reactors).

Digesters of biogas plants can also be used for the PtG process chain (see Figure 2). In Europe about 15,000 plants already exist, revealing an overall PtG potential of about

### Table 1.

<table>
<thead>
<tr>
<th>Institution</th>
<th>Concepts</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institute of Chemical Engineering, Division of Biochemical Engineering, Vienna University of Technology</td>
<td>Separate reactor</td>
<td>Austria</td>
</tr>
<tr>
<td>Department of Environmental Engineering, Technical University of Denmark</td>
<td>In situ digester, separate reactor</td>
<td>Denmark</td>
</tr>
<tr>
<td>Faculty of Environmental Science and Process Engineering, Brandenburg University of Technology Cottbus</td>
<td>Separate reactor</td>
<td>Germany</td>
</tr>
<tr>
<td>University of Mainz + Prüf-und Forschungsinstituts Pirmasens</td>
<td>Separate reactor</td>
<td>Germany</td>
</tr>
<tr>
<td>State Institute of Agricultural Engineering and Bioenergy, University of Hohenheim</td>
<td>In situ digester, separate reactor</td>
<td>Germany</td>
</tr>
<tr>
<td>Krajete GmbH</td>
<td>Separate reactor</td>
<td>Austria</td>
</tr>
<tr>
<td>Electrochaea GmbH</td>
<td>Separate reactor</td>
<td>Germany, Denmark, USA</td>
</tr>
<tr>
<td>MicrobEnergy GmbH</td>
<td>In situ digester, separate reactor</td>
<td>Germany</td>
</tr>
<tr>
<td>MicroPyros GmbH</td>
<td>Separate reactor</td>
<td>Germany</td>
</tr>
</tbody>
</table>

For BM two main process concepts are possible: methanation in situ in biogas digesters and methanation in a separate reactor. In a separate BM reactor, pure gases are converted by methanogen cultures into CH₄ (see Figure 1). This concept offers the possibility to increase the calorific value of raw biogas, but is not limited to biogas as a carbon source. Another advantage is that the process conditions and the reactor design can be adjusted with respect to the requirements of the hydrogenotrophic methanogens. Currently, several reactor concepts are being developed (e.g. fixed-bed, trickle-bed, membrane reactors).

Digesters of biogas plants can also be used for the PtG process chain (see Figure 2). In Europe about 15,000 plants already exist, revealing an overall PtG potential of about
Technical evaluation of biological methanation

To assess biological methanation different process engineering parameters and characteristics are analyzed and compared to catalytic methanation processes. A summary is given in Table 2.

Reactor size

The required reactor size is a crucial aspect regarding investment and operating costs (e.g. for stirring). A direct comparison of the required reactor volume is possible by comparing the Gas Hourly Space Velocity (GHSV). The GHSV is defined as the reactor volume divided by the volumetric feed gas flow (at standard temperature and pressure). In comparison to biological methanation, catalytic CO₂ methanation proceeds at a much faster rate. Hence, a biological methanation plant requires a reactor several orders of magnitude larger to convert a certain feed gas flow.

Tolerance of impurities

Biological methanation is very robust against impurities like H₂S, O₂ or siloxanes that are present in CO₂ rich gases (e.g. biogas). In contrast to catalytic methanation the feed gas must not be cleaned upstream of the methanation reactor. This is a strong advantage of biological methanation.

Process flexibility

For methanation to be operated dynamically as part of a PtG chain, both the minimum load and the load change rate need to be considered. Based on the available literature, all methanation concepts can be operated dynamically. It has been shown that the biology, the mass transfer, and/or the chemistry react very fast to load changes. Hence, the load change behaviour of a methanation plant is dominated by the rate at which the load changes.

Comparison of biological and catalytic methanation processes

<table>
<thead>
<tr>
<th>Reactor type</th>
<th>Biological methanation</th>
<th>Catalytic methanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature in °C</td>
<td>40 – 70</td>
<td>300 – 350</td>
</tr>
<tr>
<td>Pressure in bar</td>
<td>1 – 10</td>
<td>&gt; 5</td>
</tr>
<tr>
<td>Stage of development</td>
<td>Lab scale/pilot</td>
<td>Commercial</td>
</tr>
<tr>
<td>GHSV in h⁻¹ *</td>
<td>1 – 100</td>
<td>500 – 5,000</td>
</tr>
<tr>
<td>Tolerance of impurities</td>
<td>High</td>
<td>Low – Medium</td>
</tr>
<tr>
<td>Process flexibility</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Reaction heat utilization</td>
<td>Poor</td>
<td>Good – Very Good</td>
</tr>
<tr>
<td>Electricity demand for processing</td>
<td>High</td>
<td>Low – Medium</td>
</tr>
</tbody>
</table>

* GHSV which applies to a methane content in the product gas of > 90 vol.-% (dry basis)
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.

www.fluxys.com
Pilot and demonstration plants

During recent years numerous PtG demonstration projects have been realized. The first PtG pilot plant was probably the one built at the Tohoku Institute of Technology in Japan in 2003. The plant is relatively small, producing 1 m³/h of methane (electrical power at electrolyzer < 10 kW).

The Audi e-gas plant in Wertle, Germany is the biggest PtG plant worldwide. Hydrogen is produced from three alkaline electrolyzers with a total electrical power of 6 MW. The CO₂ is provided by a biogas plant. Operation began in 2013. Cooled, fixed-bed catalytic methanation reactors are used.

A demonstration project for biological methanation was realized by the Viessmann Group. The 400 kW PtG plant consisting of a high-pressure PEM electrolyzer connected to a high-pressure biological methanation reactor has been in operation at Allendorf in Germany since March 2015.

A pilot-scale plant built by PFI and based on a trickle bed reactor concept started operation in June 2015 at the Pirmasens-Winzeln Energy Park in Germany.

The BioCatProject aims to use the biological methanation developed by Electrochaea as part of the power-to-gas process chain. An alkaline electrolyser with an electrical power input of 1 MW will provide the hydrogen. At prestime the plant, which is located in Denmark, is undergoing commissioning and construction is scheduled to be complete by March 2016.
At the Audi plant’s inception, the e-gas produced at Werlte was planned to power 1,500 Audi A3 Sportback g-tron vehicles for 15,000 kilometres of CO₂-neutral driving every year. The vehicle’s engine can run on natural gas, biomethane and Audi e-gas as well as gasoline.

Viessmann Group’s biological methanation demonstration project. The biogas it produces is fed into the gas grid.

Electrochaea’s BioCatProject in Denmark is nearing completion.
by the plant design and the peripheral equipment. For biological CO₂ methanation, it is reported that there is no minimum load based on biology. However, the operation of the plant is not reasonable if the energy consumption of the stirrer exceeds the energy content of the produced SNG (approximation: minimum load > 10%). Immediate load change from 100 to 0% can be realized with no negative effect on the biological methanation process. It was also demonstrated that a restart following 560 hours of stagnant operation was also possible without harmful consequences.

**Reaction heat utilization**

The reaction heat of the exothermal biological methanation reaction is released at low temperature levels between 30-60°C. Compared to catalytic methanation, where the reaction heat can be integrated in other processes (e.g. biogas upgrading), limited options to valorize the heat exist (e.g. digester heating).

**Electricity demand for processing**

Because of the process conditions and requirements (limited mass transfer of hydrogen in liquid phase) the electricity demand of biological methanation reactors is very high compared to catalytic methanation. For the stirring systems, relevant power input is necessary.

In combination with the aforementioned aspect of heat utilization possibilities, biological methanation processes are unfavourable compared to catalytic methanation concepts in terms of overall energy efficiency, e.g. coupling catalytic methanation with biomethane offers an overall energy efficiency (utilized energy streams – SNG, heat – related to electricity input for electrolysis and processing) of more than 80% whereas concepts...
Conclusions

The PtG process is a promising way to transform electricity from renewable energy sources and store it as chemical energy carriers. The methanation reaction can be performed in biological and thermochemical reactors. Biological methanation is an attractive option for impure CO₂ sources and small- and medium-sized plants. The biggest challenges lie in the optimization of the reactor design especially in context with the minimization of the necessary process energy and in the increase of overall energy efficiency. DVGW promotes the technology through its own research activities in process development and energy system integration.

Frank Graf is a Department Head at the DVGW-Research Centre at the Engler-Bunte-Institut of the Karlsruhe Institute of Technology. Gerald Linke is Managing Director of DVGW, IGU Executive Committee Member and Chair of the R&D and Innovation Committee.

References


This issue’s features section has two main themes. Following the successful conclusion of last December’s COP 21 summit that resulted in the Paris Agreement we lead with an article discussing the opportunities and challenges the agreement presents to the natural gas industry in a carbon-constrained future. Closely tied to this we look at IGU’s research report *Case Studies in Improving Urban Air Quality* that was launched on the sidelines of the meeting. In an increasingly urbanized world, when set against other fossil fuel sources, natural gas can have an important and beneficial impact on the health of billions.

The other main theme of the section is LNG. With LNG 18 almost upon us, bringing industry leaders and professionals from across the globe to Perth, we have two articles that set the stage. Firstly an overview of the state of the industry and how it has changed since Perth last played host to the LNG X conferences with LNG 12 in 1998. Secondly a focus on the important LNG developments underway in Australia and the United States and the ramifications these will have on the future of the market. In conclusion the LNG 18 coordination committee outlines the event itself.

We follow with two articles from IGU’s affiliated organisations. Continuing the LNG theme, the International Group of Liquefied Natural Gas Importers (GIIGNL) outlines its history, then the International Pipeline and Offshore Contractors Association (IPLOCA) celebrates its 50 years of service to the industry.

We close with an introduction to the three newest members of IGU.
The historic climate agreement reached in Paris last December at the 21st Conference of the Parties to the UN Framework Convention on Climate Change (COP 21) was unquestionably a triumph of diplomacy – for which the French hosts deserved the acclaim they received. No one who attended the talks at the Le Bourget airfield in the northern suburbs of the City of Light will forget the intensity of the event, nor the jubilation that finally came down. Now, as the 195 countries that are signatories grapple with ratification and implementation, what are the Paris Agreement’s implications for the energy industry in general and the natural gas industry in particular?

A striking aspect of the Paris Agreement on climate change – considering how keenly it was anticipated by the energy industry – is that the 16,504-word text barely mentions energy. The word “energy” itself appears just three times. The phrase “carbon pricing” appears just once. There is no mention at all of “fossil fuels”, “coal”, “oil” or “natural gas”.

This has surprised some people in the energy industry, who appear to have been expecting specifics on the phase-out of fossil fuels, the accelerated implementation of zero-carbon energy sources such as renewable and nuclear power, and the adoption of carbon pricing schemes like cap-and-trade mechanisms and straightforward taxes. But such specifics were never on the table.

The great strength of the outcome of COP 21, in terms of the mitigation of climate change, was that the negotiators were able to agree a single, unambiguous target: to limit anthropogenic climate change to “well below 2°C above pre-industrial levels”.

According to the now widely – though still not universally – accepted science behind
climate change, this is the limit beyond which the effects of climate change are likely to be catastrophic. To a very great extent, this single number will affect the prospects for all sources of energy for the rest of this century.

**Good news, bad news**

In the words of Laurent Fabius, the French Foreign Minister who presided so impressively over the COP 21 negotiations, the Paris Agreement is “an ambitious agreement, a binding agreement, a universal agreement”.

It is unalloyed good news for renewable energy sources such as wind and solar power, and the enabling technologies they require to maximise their impact, such as smart grids and cost-effective electricity storage at small and utility scales. It is good news too for the nuclear industry.

It is unquestionably bad news for the coal industry, which, though it currently has a huge share of world electricity generation, faces a future of inexorable decline unless carbon capture and storage (CCS) becomes an economic reality. And many are sceptical about the prospects of that happening.

It is bad news too for oil, which also faces a future of decline, according to prominent forecasters, though its role in transportation will be difficult and take a long time to usurp.

So what about natural gas? This article will argue that the 2°C limit presents the natural gas industry with both opportunities and challenges, with the opportunities most obvious in the decades to 2050, and the challenges manifesting primarily in the decades thereafter.

At the triennial World Gas Conference held in Paris in June 2015 many senior figures in the industry – among them the IGU’s outgoing President, Jérôme Ferrier, Total CEO Patrick Pouyanné, and the CEO of Engie, Gerard Mestrallet – reaffirmed their faith in natural gas being the “fuel of the future”, not least because of the role it should play in the mitigation of climate change.

Mestrallet in particular stressed the importance of a meaningful agreement being reached at COP 21: “Along with many other members of the business community, we wish that there be a clear multilateral agreement to restrict global warming to 2°C. I have the conviction that it’s in companies’ interests to have a clear, stable framework rather than no agreement at all – because no agreement at all would be synonymous with uncertainty and possibly chaos.” He got his wish.

There is no longer any question that gas will play a crucial role as a “transition fuel”, to use the industry’s own terminology, in the transition – already under way and turbo-charged by the Paris agreement – to the zero-carbon economy implied by the 2°C target. However, its role as a “destination fuel” will depend on how successful the industry is in rising to the challenges of mitigating natural gas’s carbon dioxide emissions in the post-2050 era.

Highly relevant to this is the wording in Article 4 of the Paris Agreement, which was the subject of much debate and is very carefully drafted: “In order to achieve the long-term temperature goal … parties aim to reach global peaking of greenhouse gas [GHG] emissions as soon as possible … and to undertake rapid reductions thereafter … so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of GHGs in the second half of this century.”
In other words, net emissions should be zero post-2050. That poses a huge challenge for natural gas in the second half of this century.

“Adaptation” and “loss and damage”
There were, of course, many other important aspects to the COP 21 climate change negotiations. Two issues in particular were the subject of long and heated debate: “adaptation”, to strengthen the ability of countries vulnerable to climate impacts to deal with the effects; and “loss and damage”, to provide assistance to enable countries to recover from climate impacts. The prominence of these two issues in the negotiations was an acknowledgement that climate change is already well under way and that mitigation alone is no longer a realistic response.

But it is the 2°C mitigation target, clearly and unambiguously agreed by the governments of 195 countries, and the recognition that achieving it will require action on the part of all signatories, that makes the agreement – in the words of UN secretary general Ban Ki-moon – “a resounding success for multilateralism”.

To fully appreciate the importance of the Paris Agreement for the energy industry, it helps to look back briefly at the history of international climate change negotiations.

According to UN Secretary-General Ban Ki-moon, the Paris Agreement is “a resounding success for multilateralism”.

A brief history of climate talks
The United Nations Framework Convention on Climate Change (UNFCCC) treaty was established at the Earth Summit in Rio de Janeiro, Brazil, in 1992. It led in 1997 to the adoption of the Kyoto Protocol, which bound developed countries to emissions reduction targets. The first commitment period started in 2008 and ended in 2012. The second will end in 2020.

The big drawback of the Kyoto Protocol was the concept that countries could be neatly divided into “developed” and “developing”, with only the developed countries having to take action to mitigate global warming. The United States, the biggest GHG emitter at that time, signed the protocol but never ratified it. Today, such a divided approach would be problematic, as developing nations are amongst the largest emitters of GHG, with China now the largest, having overtaken the United States.

The next big milestone came with COP 15 in Copenhagen in 2009. In the run-up to that conference, hopes were running high that a truly global agreement on the mitigation of climate change would be the eventual outcome. It turned out to be a political shambles and a grave disappointment. That said, some important lessons were learned, lessons that have contributed significantly to the success of COP 21.

In the run-up to Copenhagen, a number of countries and regions, notably the European Union, made pledges to take action to mitigate climate change in the hope that such pledges would help to catalyse a successful outcome. This concept of countries making voluntary pledges was enshrined in the non-binding Copenhagen Accord that resulted from COP 15 (which also gave international currency to the 2°C target, in principle). By May 2010 nearly 100 parties, counting the EU as a single party, had filed submissions with the UN secretariat.

As part of the process that led to the COP 21 negotiations, all countries were asked to submit climate action pledges well in advance of the
The answer to climate change, is change.

Change, from the way we now produce and consume energy, to a greener mix of oil and coal-powered energy coupled with the use of natural gas as an energy source. Natural gas emits an estimated 40-70% less carbon dioxide than other fuels, reducing the growing pressure on our ecosystem. Moreover, natural gas produces less sulphur dioxide, nitrogen oxides and particulate matter.

Petronet LNG is leading the change for a better environment by meeting about 30% of India’s total gas requirement and continuously striving to do things the greener way.
The importance of these Intended Nationally Determined Contributions (INDCs), as they are known in the UNFCCC jargon, cannot be overstated.

Anyone disappointed at the lack of specifics in the Paris Agreement itself will find plenty of specifics in the 190 or so INDCs that had been submitted to the UNFCCC by the close of the COP 21 talks. They are all readily available on the UNFCCC website. The binding Paris Agreement and the non-binding INDCs should be seen as a single package, with the INDCs acting as the foundation for the targets set out in the Paris Agreement. The agreement has renamed these pledges, dropping the word “intended”, so they are now known at NDCs.

**Analysing the impact of the NDCs**

There was much discussion in Paris about the aggregate impact of the NDCs submitted in the run-up to COP 21. In advance of the talks two studies appeared that quantified that impact, the first published by the International Energy Agency (IEA) in June 2015 and updated in October, the other published by the UNFCCC at the end of October. Some of the findings of these studies are illustrated in the following Figures.

The headline number is that together the pledges put us on a trajectory to some 2.7°C of global warming. So some of the most intense negotiations in Paris focused on how ambition could be ramped up and the processes needed for that to happen. It was agreed that there would be a five-yearly “global stocktake” to assess progress in meeting climate goals, thus providing a basis for the ratcheting up of ambition in future NDCs. The first is due in 2023.

But, even in their current form, the NDC pledges are a big improvement on the 4.8°C of global warming that business-as-usual (BAU) would lead to, and, if implemented as pledged, would have major impacts on all forms on energy, not least natural gas.

**“Enormous opportunities”**

In Paris, leading climate economist Nicholas Stern said the agreement “creates enormous opportunities as countries begin to accelerate along the path towards low-carbon economic development and growth”. He added: “This agreement, together with the [UN’s] Sustainable Development Goals, should allow countries to overcome both climate change and poverty, the two defining challenges of our generation.”

At the same press conference, Edward Cameron, Managing Director of Business for Social Responsibility, commented that: “The [NDCs] are really important to bear in mind [because] a whole new climate economy is created in the space between 4.8°C and 2.7°C.”

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**Priority areas for implementation highlighted in the intended nationally determined contributions**

<table>
<thead>
<tr>
<th>Area</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable energies</td>
<td>High</td>
</tr>
<tr>
<td>Energy efficiency</td>
<td>High</td>
</tr>
<tr>
<td>Transport</td>
<td>High</td>
</tr>
<tr>
<td>Methane and other non-CO₂ gases</td>
<td>Medium</td>
</tr>
<tr>
<td>Land-use and forestry</td>
<td>Low</td>
</tr>
<tr>
<td>Carbon capture, use and storage</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

Source: UNFCCC

**Types of mitigation target communicated in the intended nationally determined contributions**

<table>
<thead>
<tr>
<th>Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction relative to BAU</td>
<td>High</td>
</tr>
<tr>
<td>Absolute emission target</td>
<td>Medium</td>
</tr>
<tr>
<td>Policies and actions</td>
<td>Low</td>
</tr>
<tr>
<td>Intensity</td>
<td>High</td>
</tr>
<tr>
<td>Peak target</td>
<td>Medium</td>
</tr>
<tr>
<td>Other</td>
<td>Low</td>
</tr>
</tbody>
</table>

Source: UNFCCC
Energy production and use account for two-thirds of the world’s GHG emissions so energy will be central to achieving ambitious GHG reductions. The flexibility that the Paris Agreement provides by not being prescriptive about how emissions reductions should be implemented is a source of opportunity for natural gas.

According to the UNFCCC synthesis report on the aggregate effect of the NDCs as they currently stand, to have a 50% chance of limiting global warming to 2°C, humankind now has a “budget” of CO₂ that can be emitted into the atmosphere after 2011 of some 1,300 gigatonnes (Gt) (see Figure 3).

Of the possible ways of staying within this limit, the most obvious is to use energy that emits no carbon at all, which is what most environmental NGOs are urging. But to continue to meet growing demand for energy using only zero-carbon sources will simply not be possible for the foreseeable future – so other choices will have to be made.

One of the most effective ways of reducing carbon emissions per unit of energy consumed is to substitute a carbon-intensive fuel (such as coal, which is almost all carbon) with one that is less carbon-intensive (such as natural gas, which, along with carbon, contains a lot of hydrogen).

Indeed, the argument has already been accepted by a number of major economies, notably the United States – with its new Clean Power Plan, which favours gas over coal in electricity generation – and the UK, which recently proposed to phase out all coal-fired electricity generation by 2025.

**Impact of the NDCs on natural gas**

So how likely it is that the NDCs will be implemented in their present form? And by how much is their ambition likely to be ramped up? The following scenarios are possible:

- The pledges end up becoming mere good intentions, leaving the world on a trajectory to global warming of 2.7-4.8°C.
- The NDCs are implemented, putting the world on a 2.7°C trajectory.
- Ambition is ramped up in five-yearly NDC cycles sufficiently to meet the 2°C target of 450 parts per million (ppm) of GHGs in the atmosphere. This is the scenario that the IEA has been advocating for years in its 450 Scenario.
- One of the biggest surprises of the COP 21 outcome is that, alongside the scientifically agreed limit of “well-below 2°C” of warming above pre-industrial levels, there is the aspiration to keep warming below 1.5°C. It is one of several fundamental compromises.
what are the implications for natural gas in these two scenarios?

The IEA, in its analysis of the INDC pledges, concludes that full implementation would lead to annual energy and process-related GHG emissions increasing by 3.7 gigatonnes of carbon dioxide equivalents between 2014 and 2030. This is one-third of the increase since 2000, “as fossil fuel demand growth slows down considerably and low-carbon fuels increase their share in the energy mix to around one quarter in 2030” (from less than 20% today). The agency adds: “Natural gas ... increases its share in the energy mix, while that of coal and oil declines.”

Despite the improvement over business-as-usual, the UNFCCC report shows how quickly the remaining budget of carbon emissions implied by the 2°C target is used up. Figure 3 shows that 52-56% is used up by 2025 and 72-77% by 2030. Clearly, much greater ambition is needed if the target is to be met. This is an opportunity for natural gas because of how quickly gas could be substituted for coal, given sufficient political will.

So what about the impacts on gas of a ramp-up in ambition to scenario number three – the 2°C target?

Figure 4, from the IEA report, shows how steeply emissions need to fall, starting in 2020,
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Paris Agreement presents both opportunities and challenges for gas marked the end of the fossil fuel era are clearly debatable. All the major forecasters project that the world will still be heavily dependent on coal, oil and gas by 2050 – and natural gas, because of its relatively high hydrogen content, will play a particularly important role, reflected in projections that gas use will continue to grow while coal and oil decline.

How that role will develop will depend to a large extent on the detail contained within the NDC pledges of individual countries and regions; it is now vital that the gas industry monitors closely how these pledges develop in existing and potential gas markets. But it will also depend on how successful the industry is in persuading policymakers that it is a vital part of solving the climate change mitigation challenge. Now, more than ever, the gas industry needs to get its advocacy act together.

Alex Forbes is an independent journalist and consultant who has been reporting on energy developments and analysing trends for three decades.
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On the sidelines of COP 21 in Paris, the International Gas Union took a risk. We decided not to strictly focus on carbon, but rather on clean air, an environmental issue that affects the well-being of billions of people around the world today.

This is not to dismiss the danger that global warming holds for the world's population, nor that natural gas can be a major agent of change for the lowering of GHG emissions, which contribute to global warming. However we wanted to demonstrate that natural gas can solve the problems of the world today, as well as tomorrow.

Outdoor air pollution is among the most significant environmental threats to human health. According to the World Health Organization, air pollution contributed to 3.7 million premature deaths each year — and this may be an underestimate since it does not include deaths from exposure to long-term pollutants other than particulate matter. As more people move to cities, health issues — including hospitalization and premature death — from urban air pollution could increase substantially.

Adoption of natural gas in applications such as energy generation, heating and industry will drastically reduce emissions, mercury and particulate matter, thereby providing enhanced quality of life for virtually everyone in urban society. A particular public health benefit would be the reduction in incidences of respiratory diseases such as emphysema and asthma. It may sound like a grand claim but it is no exaggeration to say that natural gas is a life saver when it replaces dirtier fuels.

When used to generate electricity and heat or to fuel industrial processes, natural gas results in negligible emissions of sulphur oxides (SOx), nitrogen oxides (NOx), mercury (Hg) and fine particulates 2.5 microns or less in size (PM2.5) compared with other fuels. Switching from coal- to gas-fired power is often the fastest and cheapest way for countries to reduce the aforementioned emissions and particulates that are detrimental to the environment and have a significant impact on human health.

As we revealed on the sidelines of COP 21 in Paris, this is not just theory; the experiences of cities as diverse as Istanbul, New York, and Toronto are tangible proof of our claims.

Istanbul
◆ In the early 1990s, Istanbul's air was dangerously dirty — SOx concentration was 11 times higher than WHO guidelines. The switch to gas transformed the city and helped facilitate both economic growth and made Istanbul a far more livable city for its 14 million inhabitants.

New York
◆ In 2007, the levels of ozone and PM2.5 exceeded United States Environmental Protection Agency (EPA) standards. That same year, New York City launched PlaNYC, its first long-term sustainability plan.
By the autumn of 2013, approximately 30% of heavy fuel-burning buildings in New York City converted to cleaner fuels. Approximately 75% of those that made the switch converted to natural gas or ultra-low sulphur No. 2 oil.

These efforts have led to 780 fewer deaths in the city and over 2,000 fewer emergency room visits each year.

**Toronto**

In 2004, Toronto Public Health estimated that air pollution in the city contributed to 1,700 premature deaths and 6,000 hospitalizations per year.

The removal of coal-fired power generation was completed in 2014, with gas as the major replacement fuel. Premature deaths and hospitalizations were reduced by 23% and 40% respectively.

IGU will press ahead with these crucial messages among others. More detail can be found in our recently published research report *Case Studies in Improving Urban Air Quality* ([www.igu.org/research/case-studies-improving-urban-air-quality](http://www.igu.org/research/case-studies-improving-urban-air-quality)).

In conclusion, IGU supports policies that reduce GHG emissions and emissions of health-damaging air pollutants such as:

- Improve end-use energy efficiency;
- Increase combustion efficiency (reducing or eliminating black carbon and other products of incomplete combustion);
- Encourage fuel switching from dirtier fuels to gas, which provides the necessary base load attributes while also being far cleaner than coal or oil; and
- Increase usage of non-combustion renewable energies — gas is the best partner for renewable energy generation systems in the absence of viable electricity storage options.

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Supply and pricing upheavals thrust LNG industry into uncharted territory

By Alex Forbes

The LNG industry is no stranger to change. Over the past two decades it has grown astonishingly quickly. From being a niche fuel serving mostly a handful of markets without access to pipeline gas, LNG has become a mainstream source of natural gas supply, accounting for a growing share of inter-regional trade. Today, however, the industry faces unprecedented uncertainties. As its major players converge on Perth, Australia for LNG 18 – the triennial conference that is the industry’s largest gathering – they face big questions: How will markets react to the new waves of supply coming from Australia and the US? What impact will the oil price collapse ultimately have on gas/LNG pricing? What are the prospects for final investment decisions on new supply projects? How will the Paris Agreement on climate impact demand? And perhaps the biggest question of all: will Europe’s gas market now become the battleground that determines the future of not just LNG but the whole gas industry?

In 1998 – when I travelled to the Australian city of Perth to attend the LNG 12 conference, the last time it was held there – global production of LNG was around 90 million tonnes. By last year, according to preliminary data from Gas Strategies, output had grown to almost 250 million tonnes. This near-trebling of production represents an average annual growth rate of 6%.

And there is plenty more growth to come. As numerous new liquefaction projects come due to start up in mid-2017, the Wheatstone LNG project will form part of the remarkable growth in Australian liquefaction capacity.
on stream in Australia, the United States and elsewhere over the coming five years, LNG production could grow to more than 350 million tonnes by 2020, according to a forecast in the most recent Medium-Term Gas Markets Report (MTGMR) from the International Energy Agency (IEA). That would put LNG’s annual average growth rate between 1998 and 2020 at 6.5% – a rate that few other industries have matched, and close to three times faster than the annual growth in total natural gas production over the past decade.

But LNG’s importance stems not just from its rapid growth, impressive though that has been. Just as important has been its growing role in connecting markets with distant sources of supply, unreachable with pipelines.

This reach, combined with the flexibility inherent in transporting gas by LNG – given that ships, unlike pipelines, can choose which destination they will deliver gas to – has led to price signals being communicated between what once were separate regional markets. LNG’s role in creating connections between regional markets, as flexible supply is attracted to the markets of highest value, will become ever more important in the evolution of the world’s natural gas markets over the coming decade. The IEA forecasts that inter-regional gas trade will grow by 40% between 2014 and 2020, surpassing 780 billion cubic metres (bcm) by 2020, with LNG accounting for 65% of the increase.
Unforeseen market shifts
Over the past two decades, the LNG industry has, every few years, had to adapt to major, often unforeseen, market shifts, for example:
◆ At LNG 12 in 1998 no one could have conceived that the tiny emirate of Qatar – which had only recently started up its first liquefaction project, Qatargas 1 – would by 2011 dominate global LNG production with 77 million tonnes per annum (mtpa) of capacity.
◆ The widely held assumption during the first half of the 2000s that the United States would one day become the largest importer of LNG – overtaking Japan – was turned on its head by the North American shale gas revolution of 2007/08. The US is now well on its way to becoming the third-largest LNG exporter by 2020.
◆ Before 2010 Australia appeared to be set on an LNG trajectory that would keep it well within the second league of producers. Today there are seven new export projects in various stages of construction, commissioning and production ramp-up that together with existing projects will make Australia a bigger producer than Qatar before 2020.
◆ Before the Fukushima nuclear accident in Japan in March 2011, the idea that all 54 of Japan’s nuclear reactors would be shut down by September 2013 was unthinkable. Even today only three have re-started, leaving Japan still much more dependent on imported LNG for electricity generation than anyone would have forecast before Fukushima. It remains to be seen how many more reactors will re-start and over what timescale.
◆ Finally, the oil price collapse that began in the second half of 2014 and which continues to batter the oil and gas industry, with no end in sight, has major implications for the

LNG by numbers

Global LNG trade
LNG trade rose marginally in 2014 to 241.1 million tonnes, according to the IGU’s World LNG Report – 2015 Edition*, launched at the World Gas Conference in June 2015. This was just short of the 241.5 million tonnes traded in 2011, the highest year for LNG trade on record. LNG accounted for 10% of global gas supply, up from 4% in 1990. Preliminary figures from Gas Strategies suggest that LNG trade in 2015 reached 248.6 million tonnes.
Long-term contracts accounted for 69% of global trade in 2014 while spot and short-term trade accounted for 27%; the remaining 4% was medium-term trade.

Liquefaction capacity
Global natural gas liquefaction capacity at the end of 2014 was 301 mtpa, up by more than 10 mtpa on the previous year, following the start-up of PNG LNG in Papua New Guinea, Arzew GL3Z in Algeria, and Queensland Curtis LNG in Australia.

Regasification terminals
Global nominal regasification capacity at the end of 2014 was 724 mtpa, up from 693 mtpa in 2013. During 2014, Lithuania became the 30th country to enter the LNG market. Floating regasification capacity reached 54 mtpa with 16 active terminals in 11 countries.

Shipping fleet
The global shipping fleet at the end of 2014 numbered 373 carriers with a combined capacity of 55 million cubic metres. Twenty-eight vessels were delivered during the year as speculative new builds entered the market. With ample tonnage open for charter, short-term charter rates came under pressure throughout the year.

Mozambique LNG is emerging as a leader in the global LNG industry, with 75+ trillion cubic feet of estimated recoverable natural gas discovered in Mozambique’s Offshore Area 1.

The project is advancing an onshore liquefied natural gas (LNG) park on the Afungi peninsula in Cabo Delgado province. This is the first-of-its-kind LNG facility on the east coast of Africa.

The independently certified reserves are sufficient to support two initial LNG trains, each with capacity of 6 million tonnes per annum (MMTPA), as well as to accommodate expansions, including multiple additional trains capable of producing approximately 50 MMTPA of LNG in future years.

The Project Participants have the expertise, skill, commitment and knowledge to safety deliver this world-class LNG Project.
LNG industry, not least because a lot of LNG is still sold under long-term contracts indexed to oil price. The many proposed LNG export projects that were hoping to take final investment decision (FID) in 2015 or 2016 now face a highly uncertain future, amidst intense pressure to reduce project costs. Some will not go ahead while others will literally have to go back to the drawing board.

Supply glut meets downgraded demand expectations

As industry players gather in Perth for LNG 18 in April, they will be confronting the impacts of all the factors above, compounded by downgraded expectations of demand for LNG over the short-to-medium term, in the face of a looming LNG supply glut.

The charts in Figure 1 from the IEA’s MTGMR show just how rapidly LNG production is forecast to grow over the coming five years, with much of the growth taking place during this year and next – as several new Australian liquefaction trains, and a couple in the United States, ramp up production (see separate article on p126).

In general, forecasting LNG supply over a five-year period can be done with reasonable certainty because it takes around that long for projects to go from FID to start up. So projects should already have reached FID by now if they are to start up by 2020.

Moreover, it remains unusual for projects that have reached FID to then be cancelled. That said, the scale of the oil price plunge means that that could conceivably happen to projects in the early stages of construction; those in the latter stages are unlikely to be cancelled because most of their capital cost is sunk and the short-run marginal cost (SRMC) of producing LNG is generally low.

Together, the “Magnificent Seven” new projects in Australia add 62.3 mtpa to the 24.3 mtpa capacity of earlier projects, giving a total of 86.6 mtpa, all of which should have ramped up to full production by around 2019. In the US, five projects have reached FID and are under construction, together totalling 64.5 mtpa of capacity – probably all on stream by 2020, making the US the third-largest producer after Australia and Qatar by the end of the decade.

Also likely to come on stream in this timeframe are: the re-built 5.2 mtpa Angola LNG project, which had to shut down soon after it started up in mid-2013 because remedial work was needed; three projects totalling 6.3 mtpa in Malaysia, consisting of two Floating LNG (FLNG) vessels and MLNG Train 9; and the 16.5 mtpa Yamal LNG project in Russia.

Several other projects are hoping to reach FID this year but in most cases the chances of that happening are slim, meaning these
projects are unlikely to start up before 2020. They include several projects in the US and Canada, two in eastern Africa, the Fortuna LNG project in Equatorial Guinea, and the third train at Tangguh in Indonesia.

In its MTGMR, the IEA does not expect any of these to start up before 2020, partly because of the impact of the oil price plunge on project economics, and partly because finding buyers will be difficult as the industry moves into a period of oversupply that is not expected to ease until the end of the decade.

The charts in Figure 2 from the IEA’s MTGMR show how LNG imports are likely to evolve in the various markets over the period from 2014 to 2020. Overall, the IEA sees LNG trade rising

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**LNG imports by region, 2014-20**

**2014**

- OECD Americas 4%
- Latin America 5%
- Middle East 1%
- OECD Europe 14%
- China 8%
- Non-OECD Asia 14%
- OECD Asia Oceania 54%

**2020**

- OECD Americas 4%
- Latin America 5%
- FSU/Non-OECD Europe 0%
- China 14%
- OECD Europe 19%
- Middle East 2%
- Non-OECD Asia 21%
- OECD Asia Oceania 37%

**Source:** IEA, Medium-Term Gas Markets Report 2015.
Supply and pricing upheavals thrust LNG industry into uncharted territory

by 45%, in line with forecast production, to reach 473 bcm (around 350 mtpa) in 2020,
led by China, non-OECD Asia and Europe.

Europe once again emerges as a “residual market” (or market of last resort) “importing
what other regions do not take due to its capability to arbitrage between LNG and
pipeline flows”. The IEA sees its imports doubling to 91 bcm by 2020. Growth
elsewhere means its share of the total rises from 14% to 19%.

China’s imports are forecast to grow rapidly,
particularly in 2016-17 as large new sources of
supply come on stream, though the recent
economic slowdown in China – the full extent
of which did not become clear until after
publication of the MTGMR – means a high level
of uncertainty over just how much it will
import. This uncertainty spills over into Europe,
of course, because of its perceived role as
market of last resort.

Overpriced?
Despite the impressive rate of LNG demand
growth forecast by the IEA, projected growth
will not meet the industry’s expectations.
This is partly because of economic difficulties –
notably in Europe and more recently in some
of the big emerging economies, such as China
and Brazil – but also because in some markets
gas has been simply too expensive.

At a natural gas summit in Paris towards
the end of last year, Total CEO Patrick Pouyanné
said: “We are shifting in the LNG business, in
particular, from what was a sellers’ market to a
buyers’ market. Following Fukushima we had
some golden years because of the call for LNG
by Japan, mainly, and so gas prices rocketed.
However, when you have high prices you are
happy as a producer but in terms of develop-
ment of future demand you are not helping it
to grow. And what we face today is that in
most of the countries in Asia we did not
develop the customer base at the pace that
was anticipated.”

In some key markets, notably Asia and
Europe, gas has been losing out to competition
from coal, and increasingly from renewables,
partly because of price differentials and partly
because of subsidies – because policymakers
have failed to create conditions conducive to
gas market development.

A key message from Pouyanné was that Total
– like the other major international oil and gas
companies (IOGCs) – is well on its way to
becoming more of a gas company than an oil
company. Shell is already a bigger producer of
gas than oil, while gas accounts for around half
of BP’s upstream production globally and it
won’t be long before that reaches 60%. “50%
of our production is gas,” said Pouyanné, “and
40% of our revenues are linked to the gas busi-
ness. We are more and more a gas company.
And why? Because the gas market is growing
quicker than the oil market.”

In this context it is important to remember
that LNG trade is projected to grow at a much
faster rate than the overall gas market – so
much so that all the major IOGCs are putting
increasing emphasis on growing their LNG
activities. Shell’s decision to acquire BG was
largely predicated on the world-leading LNG
position that such a move would create.
From Oman to the World

For centuries, this beautiful coast-bound nation of Oman was a trade centre linking different parts of the world through vibrant, flourishing commerce. Trade that supported lives in distant lands.

At Oman LNG, we continue that tradition of seafarers and commerce through supplying energy to many corners of the world.

From powering large industries to keeping homes warm and the lights on, Oman LNG is your reliable energy partner.
Referring to the COP 21 climate talks, Pouyanné also had plenty to say about the role natural gas should be playing in the transition to a low-carbon energy economy:

“Gas is part of the solution for climate change if we are all serious about it. I know plenty of people consider all fossil fuels should be discarded, but the truth is that humanity needs energy; we need to bring that energy in a secure affordable way; and we need to advocate for gas.”

(For a detailed look at the implications of the COP 21 Paris Agreement on climate for the natural gas industry, see pages 100-108).

Getting the price right
While the oil price plunge has created severe cash flow difficulties for oil and gas companies, it has, ironically, helped to bring down the price of gas – directly in the case of oil-indexed contracts, whether delivered by pipeline or LNG, and indirectly in the case of spot LNG cargoes and market hubs. In so doing, it has highlighted two key issues that the gas industry now has to confront.

The first is the indexation of many gas contracts to oil prices – a link that once was logical but increasingly looks an anachronism. In the words of former Cheniere CEO Charif Souki, speaking at the same Paris gas summit as Pouyanné:

“Our opinion is that it’s never made sense to use oil indexation because it’s fictitious. You really do need price as a signal from the consumer to the producer to either add capacity or stop. If you’re tying the price signal to a different commodity, the signal is not valid.

“And this is [one of the reasons] that we’ve been as successful as we’ve been. Because while we were introducing a new [commercial] model, the existing players stuck stubbornly to the old model, at a $100/barrel oil price, which made our marketing efforts much easier to accomplish.”

It is, of course, one thing to say that oil indexation is no longer appropriate and quite another to come up with a rational set of alternatives for those markets where oil indexation still prevails – such as long-term contracts for LNG imported into Asia.

That said, oil prices of around $30/barrel or less are helping to concentrate minds. A growing number of people in the industry appear to believe that it is time to free natural gas from “the tyranny of oil price volatility”.

It happened long ago in North America, and – as the IGU’s regular reports on wholesale gas pricing graphically show – has been happening, albeit gradually, in Europe.

Pressure on project costs
The second issue highlighted by the oil price plunge, and by the struggle gas has been facing to compete against coal and renewables, is the need to bring down the costs of new LNG projects, especially liquefaction projects.

Even before the oil price plunge, the escalating costs of gas projects were a concern. Between 2004 and 2014, average capital expenditure on upstream and mid-stream gas projects more than doubled, while the cost of complex technologies such as LNG and gas-to-liquids (GTL) in some cases quadrupled.

There is a growing consensus within the oil and gas industry that there needs to be much more emphasis on driving down the intrinsic costs of projects, by careful consideration of design, engineering, procurement and construction activities. At last year’s World Gas Conference in Paris, Shell CEO Ben van Beurden said capital cost trends over the past two decades had become unsustainable, adding that the industry needed to become better at driving them down.

“The most important focus areas are design, engineering and construction,” he said. “Gas plants got more expensive largely because we make them more complex ... because we take
more time to engineer them … and because we face lower productivity when we build them.

“So the core challenge is driving down cost inflation in design, construction and engineering. This won’t be easy, but it’s not impossible. Standardization and supply chain integration are key factors. Shell is stepping up its game in this field.”

Possible approaches to project cost reduction are many and varied but the ones being quoted most often at the moment are: simplification, standardization, modularization, integration, technology innovation, the use of controlled environments for construction, and, especially in the case of LNG projects, re-consideration of the use of expensive design competitions at the front-end engineering design (FEED) stage.

Most of these approaches are not new in themselves, and there is considerable overlap between them. But what some in the industry are arguing is that they need to be rediscovered and implemented in innovative ways.

“Our clients demonstrate increasing willingness to engage earlier and work differently with contractors,” says Thierry Pilenko, the CEO of Technip, a global engineering, procurement and construction (EPC) contractor with a extensive track record of executing natural gas projects, especially LNG, and most recently FLNG. “They want to make new projects viable and seem likely to accelerate the standardization and simplification of projects.

“These major changes in our environment are triggering new ways of thinking, new ways of working. You can see that the word integration is becoming more and more important across the board.”

How quickly companies will reverse their policy of delaying and cancelling projects is impossible to say, especially as the oil price outlook in the medium term continues to worsen – putting increasing pressure on dividend and investment policies. But, sooner or later, oil and gas companies will need to invest in new projects or see their production plummet.

“All our clients are telling us that at some stage the delays on projects or the cancellation on projects will impact their production,” says Pilenko. “Everybody agrees and everybody has started to model this impact.

“So it is clear that at some stage projects will have to start again – but they will have to start in a cost environment which has to be different.

The trigger for new projects to move forward will be when clients see that they have a cost environment which is predictable and which is structurally lower than it is today.”

**Will Europe become a pricing battleground?**

The dynamics of global gas markets are undergoing fundamental shifts that could potentially alter the behaviour of influential players in ways that even a couple of years ago would have seemed unlikely.

The softening of gas demand in Asian markets, combined with the big waves of new LNG that are on the way, first from Australia and later from the US, means that a lot of LNG could soon be looking for a market. With Europe seen as the market of last resort, several commentators have been speculating that Russia’s Gazprom might choose to preserve its market share in Europe, where it makes most of its pipeline gas export revenues, by radically altering its pricing strategy.

A detailed commentary on why and how this might come about was published by the Oxford Institute for Energy Studies in January 2016.

In it, author James Henderson writes:

“Gazprom’s defence of its core European market will be of fundamental importance both to its own performance and to the Kremlin’s ability to use gas as a geopolitical tool.

“However, multiple threats now face the company’s business model in Europe. Many have been emerging over the past few years,
but a combination of warm weather in the 2015 winter, the potential impact of the COP 21 discussions in Paris in December 2015, the imminent export of LNG from the US, the continuing expansion of Australian LNG exports, and the ongoing antipathy towards Russian gas in Europe mean that 2016 could mark a turning point for Gazprom."

In short, Henderson argues that Gazprom could choose to move away from its policy of indexing its gas exports to oil prices and instead move towards full participation in European hubs or even price its gas aggressively at or just below the SRMC of US LNG into Europe.

In so doing it could, says Henderson, pursue a number of objectives: price US LNG out of the European market; push coal out of European electricity generation; and even “announce and demonstrate a commitment to keeping prices below the level required for new LNG projects to attain FID, and hence defend and grow market share through the 2020s”.

At its extreme, such a strategy would have global ramifications. Qatar, for example, still has a significant proportion of LNG production...
capacity that is not committed to long-term contracts. It has been selling this successfully in Asia but some of that supply could be pushed out as Australian LNG bought on take-or-pay terms comes on stream. So it would not be just US LNG looking for a market of last resort in Europe.

Figure 3, compiled by Henderson, shows how Russia’s gas export revenues would evolve in scenarios – based on the assumptions in the table – that Gazprom could adopt to defend its share of Europe’s gas market.

Two of the three worst outcomes (yellow and dark blue) emerge from the low-volume scenarios, in which volume is the minimum take-or-pay level of 70% of the Annual Contract Quantity (ACQ) in Gazprom’s long-term sales contracts.

The best outcome (light blue) comes from cutting price to the SRMC of US LNG exports and growing volumes to the full ACQ level.

Gazprom would be better off defending its current volumes by reducing its price to the US SRMC rather than seeking to maintain a National Balancing Point (NBP) forward price of just over $5/MMBtu and accepting a reduction in volumes to the 70% take-or-pay level.

In other words, writes Henderson: “Price competition with US LNG, based on full participation in European hubs and an acceptance of spot pricing, now looks like a logical defensive tactic, with potential upside if volumes can be increased towards the ACQ level.”

For now, Henderson’s suggestions are hypothetical. But they underline how the medium-term future of LNG in particular and natural gas in general could evolve along several possible paths, depending on how industry players and policymakers choose to react to the challenges they are facing.

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

Energy is one of the most important resources required in the development and growth of global economies as well as local communities. As the world's population and economic prosperity continue to grow, so does the demand for energy. The challenge is to satisfy this demand in a responsible and sustainable manner. Through the provision of reliable and cost-effective energy, Qatargas is playing an integral role in supporting the needs of economies and local communities all around the world. Energy from Qatargas has reached almost two billion people to date. By supplying cleaner burning natural gas, Qatargas is also playing a critical role in supporting countries to lower their emissions, improve their air quality and transition to a low-carbon economy.

As set out in the Qatar National Vision 2030 (QNV 2030), Qatargas is committed to the optimum use of Qatar’s natural hydrocarbon resources, establishing a balance between reserves and production. Qatargas seeks to use technology and innovation to efficiently and responsibly convert these resources into national revenue which is then invested into the development and growth of Qatar. The Qatargas Direction Statement clearly outlines the company’s approach to delivering on its vision, with a focus on the integrated management of economic, environmental and social factors.

Qatargas has been in a continuous drive toward excellence in its operations, as it seeks to minimize carbon emissions. State-of-the-art solutions are being used to further improve the environmental performance of its production facilities. A Greenhouse Gas Management Programme and a Wastewater Recycling and Reuse Project are also currently under implementation.

The Jetty Boil-Off Gas (JBOG) Recovery facility, which started operations in October 2014, is already contributing to the reduction of flaring and greenhouse gas emissions. It results in a 90% reduction in flaring at the six LNG loading berths at Ras Laffan – a level equivalent to annual Green House Gas (GHG) savings of 1.6 million tonnes of CO₂. The project also helps recover 29 billion standard cubic feet (bcf) of gas per year, which is enough gas to produce 750 MW of power or to power 300,000 homes.

The JBOG Project demonstrates the commitment of the State of Qatar to balance industrial development with care for the environment and reinforces Qatargas’ pioneering and leadership role in the energy industry.

Qatargas 1 has reduced its NOₓ emissions by 30% since 2011, driven by the installation of a low NOₓ combustion system in the older LNG trains. The positive environmental impact of Qatargas reducing its NOₓ emissions by a third cannot be overstated: those gases – that is, nitric oxide (NO) and nitrogen dioxide (NO₂) – are potentially dangerous pollutants, which react to form smog and acid rain.

Another interesting and pioneering environmental project is the recent introduction of a Main Engine Gas Injection (MEGI) Project which sees the first slow speed two-stroke marine diesel engine to run on LNG on a Qatargas Q-Max type LNG carrier.

Qatargas’ approach to environmental management is aligned with the QNV 2030 objective of sustaining the environment for our future generations. Maintaining the highest standards for environmental protection and responsible resource utilization are fundamental requirements of the Qatargas Direction Statement and represent the premier ‘Qatargas way’ of doing business. We continue to promote the use of state-of-the-art solutions to further improve the environmental performance of our production facilities. Our key environmental focus areas have been compliance, flare reduction, GHG and air emissions management, wastewater recycling and reuse and waste management.

These are just some of the efforts Qatargas is making as part of its unwavering commitment to environmental sustainability and towards delivering on Qatar’s National Vision to produce and supply clean energy to the world.

As the world’s largest liquefied natural gas producer, Qatargas has emerged as the global leader in producing and supplying this valuable natural resource. Qatargas, with its large asset base in liquefaction and shipping capacity, is able to deliver to more than 28 countries. This has included delivering over 4,000 LNG cargoes safely and reliably, and currently, Qatargas delivers approximately 500 cargoes per year around the world. That’s a fact we are very proud of.
DELIVERING ALMOST A FIFTH OF THE WORLD’S LNG

IT’S WHAT MAKES A WORLD LEADER

We deliver 42 million tons of Liquefied Natural Gas a year to our customers safely and reliably, making us the largest producer in the world. This achievement together with a commitment to operating excellence, innovation and CSR makes Qatargas the World’s Premier LNG Company.

The World’s Premier LNG Company
www.qatargas.com.qa
Why new waves of LNG from Australia and the US will re-shape the industry

By Alex Forbes

The LNG industry is projected to grow by close to 50% between 2014 and 2020 as new waves of natural gas liquefaction capacity come on stream in Australia and the United States. If all goes to plan, by 2020 their combined production capacity will reach over 150 million tonnes per annum (mtpa), with Australia overtaking Qatar to become the world’s biggest supplier in 2018. But scale is not the only important factor. These new waves of supply will change the way LNG business is done. In the case of Australia, LNG indexed to oil price will be coming on stream at very low oil prices. This will be painful for producers but it will make LNG more competitive in Asia than it has been for a long while, with obvious implications for demand growth. As for the US, new commercial models will increase flexibility and pricing diversity. Five years from now the industry is likely to look very different to how it does today.

In January 2012 the LNG industry passed an historic milestone when the Japanese company Inpex announced that, along with its partners, it had reached final investment decision (FID) on Ichthys LNG. It was noteworthy because Ichthys is the first large-scale LNG liquefaction project to be operated by a Japanese company. It was also noteworthy because Ichthys is the largest-ever project financing in the LNG industry. But it was especially noteworthy because from that point on Australia had more LNG capacity in operation and under construction than Qatar – currently by far the world’s largest LNG producer, with 77 mtpa of capacity.

Inpex’s announcement brought to a close a remarkable 13 months – from January 2011 to January 2012 – during which seven onshore liquefaction trains and a floating LNG (FLNG) project, with a combined capacity of 33.7 mtpa, reached successful FIDs in Australia. Never before had so much LNG production capacity been sanctioned in such a short time – not even in Qatar, whose LNG achievements once looked unassailable.

The first two of those trains, sanctioned in January 2011, comprised the GLNG project in Queensland, one of three to be supplied with coal-seam gas (CSG, or coal-bed methane as it is called elsewhere). The following May, Shell announced FID on Prelude, the first implementation of its new FLNG technology. In July the partners in Australia Pacific LNG (APLNG), led by Origin Energy and ConocoPhillips, sanctioned the first train of their two-train CSG-supplied project. In September the partners in Wheatstone LNG, led by Chevron, sanctioned another two-train project. And in January 2012 Inpex made its announcement about the two-train Ichthys project.

Contenders for the “new Qatar”
During the latter half of the 2000s, when it was becoming increasingly clear that Qatar was determined to reach its 77 mtpa target, there was much speculation about which country might become the “new Qatar”. In other words, where might the next big wave of LNG production capacity come from? Two nations stood out as contenders – Nigeria and Australia. But both looked to be in a different league to Qatar.

Nigeria, already a major LNG player thanks to the multi-train Nigeria LNG project, had
several new projects on the drawing board, but not enough to challenge Qatar’s LNG primacy. Several years on, those proposed new projects remain on the drawing board. Australia too had several projects in the planning stage but, again, not enough to challenge Qatar’s lead, and most were making slow progress. A decade ago, Australia had just one LNG project, the North West Shelf venture. Its five trains today have a total capacity of 16.3 mtpa. It was joined in 2006 by Darwin LNG, a single-train project that added 3.7 mtpa and in April 2012 by Pluto LNG, another single-train project that added 4.3 mtpa, taking Australia’s total capacity to 24.3 mtpa. The “Magnificent Seven” However, as the 2000s began to draw to a close, a new wave of Australian projects began with the FID on the Chevron-led Gorgon project in 2009. In 2010 BG Group, as it then was, announced FID on the world’s first liquefaction project to be supplied with CSG – Queensland Curtis LNG (QCLNG). Then came the wave of FIDs outlined above, to be followed by FID on the second train of APLNG in July 2012. Together these projects make up what some in the industry have taken to calling the “Magnificent Seven” (Table 1). As the chart on page 128 shows, their combined capacity of 62.3 mtpa, when combined with the capacity
## Australia’s LNG projects (March 2016)

<table>
<thead>
<tr>
<th>Project company</th>
<th>Operating company</th>
<th>Location</th>
<th>Train</th>
<th>Capacity (mtpa)</th>
<th>Shareholders</th>
<th>Status</th>
<th>Target start-up date</th>
</tr>
</thead>
<tbody>
<tr>
<td>North West Shelf Venture</td>
<td>Woodside Energy</td>
<td>Karatha, Western Australia</td>
<td>Train 1</td>
<td>2.5</td>
<td>BHP Billiton Petroleum, BP Developments Australia, Chevron Australia, Japan Australia LNG (MIMI), Shell Development (Australia) and Woodside Energy. Each has a one-sixth share.</td>
<td>Operational</td>
<td>1989</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 2</td>
<td>2.5</td>
<td></td>
<td></td>
<td>1989</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 3</td>
<td>2.5</td>
<td></td>
<td></td>
<td>1992</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 4</td>
<td>4.4</td>
<td></td>
<td></td>
<td>2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 5</td>
<td>4.4</td>
<td></td>
<td></td>
<td>2008</td>
</tr>
<tr>
<td>Darwin LNG</td>
<td>ConocoPhillips</td>
<td>Darwin, Northern Territory</td>
<td>Train 1</td>
<td>3.7</td>
<td>ConocoPhillips 57.2%, Eni Australia 11.0%, Santos 11.4%, Inpex 11.3%, Tokyo Gas/Tokyo Electric 9.2%</td>
<td>Operational</td>
<td>2006</td>
</tr>
<tr>
<td>Pluto LNG</td>
<td>Woodside Energy</td>
<td>Burrup Peninsula, Western Australia</td>
<td>Train 1</td>
<td>4.3</td>
<td>Woodside 90%, Tokyo Gas 5%, Kansai Electric 5%</td>
<td>Operational</td>
<td>April 2012</td>
</tr>
<tr>
<td>Gorgon</td>
<td>Chevron</td>
<td>Barrow Island, Western Australia</td>
<td>Train 1</td>
<td>5.2</td>
<td>Chevron (47.3%), ExxonMobil (25%), Shell (25%), Osaka Gas (1.25%), Tokyo Gas (1%) and Chubu Electric Power Company (0.417%)</td>
<td>Under construction</td>
<td>First LNG cargo expected in “early 2016”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 2</td>
<td>5.2</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Train 3</td>
<td>5.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Queensland Curtis LNG (QCLNG)</td>
<td>QGC (BG Group’s Australian subsidiary)</td>
<td>Curtis Island, near Gladstone, Queensland</td>
<td>Train 1</td>
<td>4.25</td>
<td>BG 50% and CNODC 50%</td>
<td>Operational</td>
<td>December 2014</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 2</td>
<td>4.25</td>
<td>BG 97.5% and Tokyo Gas 2.5%</td>
<td>Operational</td>
<td>July 2015</td>
</tr>
<tr>
<td>GLNG</td>
<td>GLNG Operations (upstream assets are operated by Santos)</td>
<td>Curtis Island, near Gladstone, Queensland</td>
<td>Train 1</td>
<td>3.9</td>
<td>Santos (30%), Petronas (27.5%), Total (27.5%) and Kogas (15%)</td>
<td>Operational</td>
<td>October 2015</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 2</td>
<td>3.9</td>
<td></td>
<td>Under construction</td>
<td>Q2, 2016</td>
</tr>
<tr>
<td>Prelude FLNG</td>
<td>Shell</td>
<td>Browse Basin, 200km offshore Western Australia</td>
<td>Train 1</td>
<td>3.6</td>
<td>Shell (67.5%), INPEX (17.5%), Kogas (10%), CPC (5%)</td>
<td>Under construction</td>
<td>Shell has not disclosed a date but shareholder INPEX has said around 2017</td>
</tr>
<tr>
<td>Australia Pacific LNG (APLNG)</td>
<td>ConocoPhillips</td>
<td>Curtis Island, near Gladstone, Queensland</td>
<td>Train 1</td>
<td>4.5</td>
<td>ConocoPhillips (37.5%), Origin Energy (37.5%), Sinopac (25%)</td>
<td>Operational</td>
<td>January 2016</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 2</td>
<td>4.5</td>
<td></td>
<td>Under construction</td>
<td>Q2, 2016</td>
</tr>
<tr>
<td>Wheatstone</td>
<td>Chevron</td>
<td>Ashburton North, Western Australia</td>
<td>Train 1</td>
<td>4.45</td>
<td>Chevron (64.14%), Kufpec (13.4%), Woodside Petroleum (13%), PE Wheatstone (8%), Kyushu Electric (1.46%)</td>
<td>Under construction</td>
<td>Mid-2017</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 2</td>
<td>4.45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ichthys LNG</td>
<td>INPEX</td>
<td>Darwin, Northern Territory</td>
<td>Train 1</td>
<td>4.45</td>
<td>INPEX (62.245%), Total (30%), CPC (2.625%), Tokyo Gas (1.575%), Osaka Gas (1.2%), Kansai Electric (1.2%), Chubu Electric (0.735%), Toho Gas (0.42%)</td>
<td>Under construction</td>
<td>Q3, 2017</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 2</td>
<td>4.45</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total capacity started up before 2013: 24.3
Total capacity to be started up after 2013: 62.3
Total capacity operational and under construction: 86.6
Natural gas is fast emerging as the ‘fuel of choice’ across the world, especially in developing countries like India. As India’s largest commercial enterprise with business interests in multiple forms of energy supply and distribution, IndianOil has been expanding its customer base in gas – large industrial customers, gas-based power plants, refineries, etc. – for over a decade by leveraging its inherent strengths and countrywide reach. With decades of expertise in cryogenic vessels, the Corporation offers customised solutions to bulk users located away from gas pipelines through its innovative ‘LNG at the doorstep’ initiative. As co-promoter of PLL (Petronet LNG Ltd.), which has set up LNG import terminals at Dahej and Kochi, the Corporation has marketing rights for 30% of the LNG procured by PLL, and is also sourcing more quantities of LNG directly. Considering the burgeoning growth of natural gas as a substitute fuel, IndianOil is expanding its gas infrastructure and associated pipeline networks, and is setting up a 5-million tonnes per annum LNG import terminal at Ennore near Chennai. The Corporation is currently setting up city gas distribution networks in several geographical areas jointly with consortium partners, and is committed to total fuel solutions for households, transport systems and industries.
of earlier projects, means that Australia is on a
trajectory towards total capacity of 86.6 mtpa,
perhaps as soon as 2020. At the time of
writing, four trains have begun operation –
two at QCLNG, one at GLNG and one at APLNG,
with several more on the verge of so doing.
All the trains are due on stream by 2018.

There have been no more liquefaction
project FIDs in Australia since mid-2012, despite
a still-long list of proposed projects, and none
are expected for the foreseeable future – partly
because of the oil price collapse and partly
because of the looming LNG supply glut.

Resource constraint concerns
The sanction of so much capacity over such a
short period raised concerns over whether it
would be feasible to construct so many projects
without resource shortages, not least of skilled
engineers – raising the spectre of lengthy and
costly delays.

In fact, delays – where they have occurred –
have tended to be pretty minimal, in most
cases just a matter of a few months. Only two
projects are facing substantial delays – about a
year-and-a-half in the case of Gorgon and six-
to-nine months in the case of Ichthys – but
delays on this scale are far from unusual in the
LNG industry.

Several of the projects have however
announced large cost overruns on what were
already very high costs when compared with
the projects launched a decade or so ago. High
salaries for skilled staff such as welders, and
even unskilled staff, have been compounded by
the remote locations of some of the projects.

For example, Gorgon’s onshore facilities are
on Barrow Island offshore Western Australia.
The expected project cost at the time of FID in
2009 was $37 billion; it is now expected to cost
$54 billion. In total, the Magnificent Seven are
now expected to cost close to $200 billion, an
overrun of more than $30 billion.

That said, the forward economics for projects
whose capital costs are sunk still look attractive
because operating costs will be low and because
the projects will have operational lives measured
in decades. Besides, not all the projects took
FID in a $100+/barrel oil price world. When
Gorgon took FID in 2009 and QCLNG in 2010
oil prices were well below that level.

Moreover, much of the LNG output from the
Magnificent Seven projects will go to share-
holders in the projects (Table 1) under long-
term contracts indexed to oil price. Depending
on shares in the projects and contract commit-
ments, some companies will find that their
reduced revenues from the project are partly or
ORIGIN

NATURAL GAS IS KEY TO THE FUTURE.

As the world transitions to a cleaner future, gas will play a prominent role not just for us, but for Australia and the rest of the world. This is why natural gas is a key component of Origin’s energy mix. With our broad investment in gas domestically, we’re able to supply more than 11% of Australia’s gas demands every day. And as the upstream operator and joint venture partner of Australia Pacific LNG in Queensland, we are helping Australia become one of the world’s largest gas exporters by 2018. With natural gas in our energy mix, Australia’s future looks clean and bright.

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Why new waves of LNG from Australia and the US will re-shape the industry

more than compensated by the lower prices in their sale and purchase agreements (SPAs).

For now, at least, there have been no suggestions that low oil prices will lead to any cancellations among the Magnificent Seven. So their impact on LNG markets – not just in Asia because of the growing interconnectedness of regional gas markets (see article on pages 112-123) – will be immense. A protracted period of low LNG prices in Asian and European markets would stimulate greater demand growth as natural gas becomes more competitive, especially in the power generation fuel mix.

The big US U-turn
The shift of the LNG spotlight from Qatar to Australia in the period 2009-2012 meant that it took a while for people to realise that something remarkable was happening in the United States.

In 2009, when the World Gas Conference took place in Buenos Aires, Argentina, the gas world was still coming to terms with the impact of the shale gas revolution on North American natural gas production. It was clear that previous expectations of the US becoming a major LNG importer were going to turn out to be wrong. But at that time there was no suggestion that the US was on track to become a major LNG exporter.

The first company to apply for approval to export LNG from the US was Cheniere Energy. In August 2010 it filed for approval to export LNG to countries with which the US has a Free Trade Agreement (FTA). The following month it applied for approval to export to non-FTA countries, a more significant development, given that the only FTA country that is a major importer of LNG is South Korea.

LNG export stampede
In the six years since then, the US Department of Energy (DoE) – the authority responsible for deciding on LNG export licences under the Natural Gas Act – has received numerous applications in what amounts to nothing less than a stampede (mirroring the stampede to develop LNG import terminals a decade earlier).

Cheniere’s 2010 application for LNG export approval took many people by surprise and attracted a lot of attention and opposition. Somewhat taken aback, the DoE eventually gave its approval in 2011 but put all the other non-FTA applications on hold, while it awaited the conclusions of two studies into the issue: one produced by the Energy Information Administration (EIA), which looked at how different export scenarios would affect domestic gas prices, and a report commissioned from NERA Economic Consulting, which examined the wider potential impacts on the US economy.

The EIA report, which concluded that LNG exports would not have an unacceptable impact on domestic gas bills, was controversial enough. But it was nowhere near as controversial as the NERA report published by the DoE in December 2012, after a number of delays. Entitled Macroeconomic Impacts of LNG Exports from the United States, it concluded that: “for every one of the market scenarios examined, net economic benefits increased as the level of LNG exports increased. In particular, scenarios with unlimited exports always had higher net

Figure 1.
EXECUTING AN INDUSTRY-LEADING LNG PLATFORM

Cheniere Energy, Inc. is a Houston-based energy company developing LNG facilities along the U.S. Gulf Coast at Sabine Pass in Cameron Parish, Louisiana and near Corpus Christi, Texas. Cheniere currently has 7 trains, or approximately 31.5 mtpa, under construction. With train 1 construction nearing completion, the first LNG is expected to be produced and first LNG cargo loaded in late February or March 2016. Cheniere is poised to become one of the top suppliers of LNG on a global basis and is offering remaining volumes on a more customized basis.
**US Lower 48 LNG projects (March 2016)**

<table>
<thead>
<tr>
<th>Project company</th>
<th>Operating company</th>
<th>Location</th>
<th>Train</th>
<th>Capacity (mtpa)</th>
<th>Shareholders</th>
<th>Target start-up date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sabine Pass Liquefaction Project</td>
<td>Sabine Pass Liquefaction, LLC (SPL)</td>
<td>Cameron Parish, Louisiana</td>
<td>Train 1</td>
<td>4.5</td>
<td>Project company is controlled by Cheniere Energy Partners LP, a subsidiary of Cheniere Energy, Inc. (Blackstone currently has a 29% ownership interest in Cheniere Energy Partners LP through its ownership of Class B units.)</td>
<td>Q1, 2016</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 2</td>
<td>4.5</td>
<td></td>
<td>H1, 2016</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 3</td>
<td>4.5</td>
<td></td>
<td>2017</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 4</td>
<td>4.5</td>
<td></td>
<td>2017</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 5</td>
<td>4.5</td>
<td></td>
<td>2019</td>
</tr>
<tr>
<td>Freeport LNG</td>
<td>Freeport LNG Expansion, L.P.</td>
<td>Quintana Island, near Freeport, Texas</td>
<td>Train 1</td>
<td>4.64</td>
<td>Freeport LNG Expansion, L.P. is a wholly owned subsidiary of Freeport LNG Development.</td>
<td>September 2018</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 2</td>
<td>4.64</td>
<td></td>
<td>February 2019</td>
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<td></td>
<td></td>
<td></td>
<td>Train 3</td>
<td>4.64</td>
<td></td>
<td>August 2019</td>
</tr>
<tr>
<td>Dominion Cove Point LNG</td>
<td>Dominion Cove Point LNG, LP (DCP)</td>
<td>Lusby, Calvert County, Maryland</td>
<td>Train 1</td>
<td>5.25</td>
<td>DCP is a subsidiary of Dominion Resources, Inc.</td>
<td>Late 2017</td>
</tr>
<tr>
<td>Cameron LNG</td>
<td>Cameron LNG Holdings, LLC</td>
<td>Hackberry, Cameron Parish, Louisiana</td>
<td>Train 1</td>
<td>5.0</td>
<td></td>
<td>Early 2018</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 2</td>
<td>5.0</td>
<td>Sempra Energy (50.2%), Engie (16.6%), Mitsui &amp; Company (16.6%), Japan LNG Investment, LLC, a joint venture formed by Mitsubishi Corporation and Nippon Yusen Kabushiki Kaisha (16.6%).</td>
<td>Mid 2018</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 3</td>
<td>5.0</td>
<td></td>
<td>End 2018</td>
</tr>
<tr>
<td>Corpus Christi Liquefaction Project</td>
<td>Corpus Christi Liquefaction, LLC</td>
<td>Corpus Christi, Texas</td>
<td>Train 1</td>
<td>4.5</td>
<td>Corpus Christi Liquefaction, LLC is a wholly owned subsidiary of Cheniere Energy, Inc.</td>
<td>Q1, 2019</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Train 2</td>
<td>4.5</td>
<td></td>
<td>Q2, 2019</td>
</tr>
</tbody>
</table>

Total capacity operational and under construction 65.7
Sempra LNG & Midstream develops and builds LNG receipt terminals, liquefaction facilities and integrated midstream natural gas infrastructure in North America and is active in the sale of LNG worldwide.

To learn more about Sempra LNG & Midstream, our projects in development and exciting career opportunities, visit: www.SempraLNGM.com.

QUICK FACTS
• Sempra LNG & Midstream developed one of the first liquefaction export facilities in the U.S., Cameron LNG in Louisiana
• We developed 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 at Energía Costa Azul

Sempra LNG & Midstream is not the same company as San Diego Gas & Electric (SDG&E) or Southern California Gas Co. (SoCalGas), and Sempra LNG is not regulated by the California Public Utilities Commission.
Why new waves of LNG from Australia and the US will re-shape the industry

For a long while the big question was: how large an LNG exporter would the US become? There were many interested parties, among them: consumers of gas in the US, some of whom feared that large-scale exports would drive up prices; LNG buyers, who hoped that US LNG could be a cheaper alternative to supplies from elsewhere; and the sponsors of proposed LNG projects in other countries, who worried that US LNG would amount to tough competition.

A clearer picture

Today, the answer looks pretty clear. As Table 2 shows, five projects have taken FID and begun construction, with aggregate capacity amounting to an astonishing 65.7 mtpa (this number has been changing slightly over time as projects announce new capacity figures for their trains, based on more detailed engineering).

Indeed, between August 2014 and June 2015, 47.7 mtpa of LNG capacity was sanctioned in the US – smashing even the record set by Australia in 2011/12.

Sabine Pass is currently commissioning its first of five trains, with a cool-down cargo already having arrived, and start up was due in late February or March. The project’s second train is expected to start up later this year.

There will then be a bit of a lull – because of the de facto moratorium on approvals imposed by the DoE after the Cheniere Energy approval – so that the next project to come on stream, Cameron LNG, is not due to do so until 2018, a year of very rapid growth as most of the other projects also start up trains. All the trains are due to have started up by 2019.
As for the lengthy queue of other projects, few are now expected to reach fruition for the same reasons that no more Australian FIDs are likely for some time, unless individual companies take a strategic decision to move ahead despite unfavourable-looking economics.

In short, the oil price collapse and the looming LNG glut together mean that we are unlikely to see capacity rise much higher than the 65.7 mtpa currently under construction for some time – though large uncertainties remain, not least because market development will depend to a large extent on policy decisions that have yet to be taken. For example, it will be some time before the full impacts of the COP 21 Paris Agreement on climate start to become clear (see article on pages 100-108).

Moreover, when new projects do start to move ahead in the US, the frontrunners are likely to be expansions of the projects already under construction, several of which already have permits – or have begun the permitting process – for more trains.

**Ch ... Ch ... Ch ... Changes**
The significance of US LNG exports stems not just from the impressive volumes due to come on stream but arguably, and more importantly, from the new commercial models that have been developed for these projects.

The business model that Cheniere has developed for its liquefaction capacity in the US has involved signing sale and purchase agreements with customers under which they pay a fee for capacity whether they use it or not. If they choose to use it, they pay a Henry Hub-related price for the necessary gas feedstock. If they choose not to use it, they do not pay for gas but still pay the capacity fee. Other US projects have gone for tolling models, which are similar in their effect in that they pass gas price risk to the buyers.

“That was successful,” says Charif Souki, who until recently was CEO of Cheniere, “and it put us in a position where we were able to sanction seven trains based on that model, and other people were able to follow with a bunch of trains of their own.

“That change in the existing business model brought its own issues. The first and most important one is it adds dramatically to the liquidity in the market. And, if you add liquidity to the market, then the consumer starts thinking, “Do I really need to enter into a 20-year contract, or can I rely on the market?”

“We are in that transition phase now, where yet another business model needs to be developed because the liquidity is sufficient. You can probably, with price signals, attract enough natural gas if you’re a utility, on a global basis, certainly for the next five years with all the new trains that are coming from Australia and the US – and maybe for longer than that.”

Quite how the dynamics of LNG trading will evolve over coming years is hard to say but it is reasonable to assume that some of the rigidities which restricted flexibility in the past will continue to become less rigid or disappear entirely – an obvious example being contract clauses that restricted the ability of buyers to send LNG to destinations other than specified in long-term SPAs.

Pricing mechanisms also look set to change, with oil indexation looking less and less rational in a world where gas competes more with coal than it does with oil, notably in electricity generation. Interestingly, people’s thinking has already been changed by the development of US LNG exports, long before a single drop of LNG left for foreign shores – and the changes are far from over.

If anything, the reality of physical LNG deliveries will accelerate the rate of change, as people realize and adapt to new possibilities.

*Alex Forbes is an independent journalist and consultant who has been reporting on energy developments and analysing trends for three decades.*
For close to fifty years, Technip has been a leader in providing conceptual design, engineering and construction services to the gas industry.

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Join the conversation to forge the future of our industry

Since LNG 17 in Houston, USA, the liquefied natural gas industry has undergone dramatic changes including a lower carbon economy and lower oil and LNG prices. The increased pressure on the future growth of LNG is a challenging question and a hot topic for all major players of the industry to look for answers. The lower commodity price environment will continue to dominate discussions in the upcoming months, making it timely that senior professionals come together from April 11-15 in Perth, Australia, for LNG 18. What better time to meet others and join the conversation to forge a stronger future for the LNG industry?

As the LNG X series continues to move towards a leadership position in the world LNG production and export industries, we look forward to welcoming some 2,500 delegates to LNG 18. The outstanding plenary, concurrent, workshop and poster sessions presented by CEO and equivalent level speakers will provide a global platform with up-to-the-minute information not previously available to the gas industry. The leading topic for the Opening Plenary session is “The Transformation of Gas” presented by John Watson, CEO and Chairman, Chevron; Ben van Beurden CEO, Royal Dutch Shell; and...
Mr Peter Coleman, CEO, Woodside Ltd. More than 250 speakers will follow, presenting the latest research findings, innovations and solutions during the four-day conference program.

Australia is developing the fastest growing LNG industry globally and is on track to become the largest LNG exporter in the world by 2020. As part of the Conference Program and Exhibition, LNG 18 will showcase current world-firsts and innovative projects in floating LNG, subsea technology and coal-bed methane to LNG.

With around 200 exhibitors from more than 40 countries covering the entire LNG value chain, LNG 18 is the largest dedicated LNG trade exhibition. This is your most effective opportunity to meet the senior technical and commercial decision makers and network with the thousands of exhibitor staff and delegates who attend. The exhibition is in close proximity to the session rooms as interaction and networking is a key focus of the event.

LNG 18 offers a range of exciting additional components such as the Thought Leadership Lunches, the LNG Basic Training Course and additional corporate events organised by LNG 18’s key sponsors and exhibitors. The Thought Leadership Lunches are designed to provide a unique platform for the industry’s most influential LNG and gas procurement executives. These luncheons provide a break from the format of the main sessions and a fantastic opportunity to network with colleagues. Speakers from the Australian government are invited to attend in addition to global industry leaders.

With five events planned over the week, the professionals can be sure to benefit from the networking opportunities. The Welcome Reception will be located at the State Reception Centre and Fraser’s Restaurant positioned in beautiful Kings Park, overlooking the majestic Perth city skyline. The Opening Ceremony will bring you to the outback of Australia with traditional and contemporary performances. Join in “A Taste of WA” during the Conference Networking Event at the Sir James Mitchell Park on the banks of the Swan River for a magical night exploring the flavours and culture of Western Australia. LNG 18 will conclude with a powerful Closing Ceremony summarising the week’s findings, followed by the Farewell Networking Event where participants once again have the opportunity to talk to old and new acquaintances and reflect on the week.

During your visit don’t miss out on the opportunity to experience some of the unique and breathtaking landscapes of Australia. The Conference Organizer has compiled a range of travelling and leisure options ranging from the Golf Day on Monday, a fabulous Accompanying Persons Program to Day, Pre-Conference and Post-Conference Tours.

Enhance your network, be energized by world-class speakers, be motivated by new ideas and gain that extra knowledge for your business and the future LNG industry by attending the “World’s Largest Global LNG event” – LNG 18 in April 2016 in Perth, Australia. This is your opportunity to join more than 2,500 global LNG industry professionals. Visit the LNG 18 website at www.lng18.org for a comprehensive overview of the event.

We look forward to welcoming you to wonderful Perth in April 2016.

*Barbara Jinks is Executive Director for LNG 18.*
The History of GIIGNL

By Jean-Yves Robin

With this issue’s spotlight on LNG, Jean-Yves Robin looks back at the formation and history of the International Group of Liquefied Natural Gas Importers (GIIGNL) whose membership is composed of nearly all companies in the world active in the import and regasification terminalising of LNG.

In the late 1960s, Japan had received its first shipments and embarked down a path that would soon establish the country as the world’s number one LNG importer, while in the Atlantic basin, the US made preparations to receive Algerian volumes, and Italy and Spain pushed ahead with plans to join France and the UK as European LNG importers.

The technologies needed to create a safe and effective LNG supply chain were novel and complex for the time. The industry was opening up new realms of engineering as it introduced natural gas liquefaction, LNG storage and LNG regasification on a large scale, as well as LNG carrier containment systems and concepts such as cold recovery.

A club for top executives with common challenges

At that time, LNG importers faced formidable technical and economic challenges when purchasing, shipping and handling LNG in the volumes required to justify the commercial viability of the project and to satisfy the needs of their customers. All these activities needed to be developed and implemented in the context of their respective national energy policies and regulatory frameworks.

A few companies, including Gaz de France, took the initiative to try to bring together, from across the globe, the top executives of those gas companies involved in LNG imports and facing common challenges. The idea of creating an industry association of LNG importing companies received very favourable feedback from the interests concerned.

Thus were laid the foundations of a new association consisting of 19 founding members. The International Group of Liquefied Natural Gas Importers (GIIGNL) began in December 1971, just as the nascent LNG industry was taking its first tentative steps.

The association had, at least in its early stages, the character of a club without a rigid legal structure and statutory framework. The members exchanged information and developed studies covering the scientific, technical and economic aspects of issues such as purchasing, processing, transportation, storage, handling, regasification and the various uses of natural gas.

GIIGNL’s work was undertaken with the aims of promoting the development of the industry and pursuing objectives of common interest, including the development of safety and industry best practice guidelines. Delegates from the US member companies in particular, anxious not to breach any anti-trust laws, appreciated the association’s set-up and working methods.
The first meeting of the group was held in Paris in December 1971 under the leadership of Gaz de France. Jean Le Guellec, Honorary President of Gaz de France, accepted the presidency of GIIGNL while Hiroshi Anzai of Tokyo Gas and Howard Boyd of El Paso were appointed vice-presidents.

The association functioned well throughout the 1970s and 1980s. In tandem with the relatively slow expansion of the global LNG industry in those formative years, GIIGNL’s membership grew only slowly and did not rise above 25. The resignations of some US members whose projects had been discontinued were offset by new members joining from Asia.

Robert Venet, a former GIIGNL director, comments on the 1980s period of the association: “The late 1970s had been a very turbulent period for the LNG industry because many of the leading buyers of gas, especially in the US, had become rather disillusioned by the high prices being demanded by Algerian LNG producers.

“...In Europe some new players, like the Italian companies, wanted to enter the LNG scene by acquiring some supplies. However, eventually most opted instead for cheaper pipeline supplies, especially from Russia.

“The LNG boom happened in Asia and specifically in Japan when supplies from Indonesia began to flow.

“The International Group of LNG Importers was essentially an association which offered a meeting place for the top executives of our LNG importing member companies. At that time Howard Boyd, who was a leading personality in the US gas industry and had chaired El Paso, was GIIGNL president, while Pierre Alby from Gaz de France, Denis Rooke from British Gas and Hiroshi Anzai from Tokyo Gas were vice-presidents. All were distinguished captains of the gas industry in the 1980s and chief executives of leading gas companies.”

**The GIIGNL way of working**

“The activities of the association were mainly centred around two annual meetings. These gatherings allowed member representatives to meet, exchange views and commission joint studies on topics of specific interest. These projects were carried out by the members themselves, of which one would act as coordinator.

“The study topics selected covered a very wide range of technical, operational, regulatory and commercial issues. It goes without saying that those sensitive commercial issues which might have impinged on competition law were strictly off-limits.”

GIIGNL worked on the basis of rules which had been laid down by the founding members at the first General Assembly in Paris in 1971 (these rules have since been transformed into statutes, the current version being updated in 2008). Day-to-day functioning of the association was managed by a permanent chief officer or general delegate in consultation with and under the guidance of the group’s president.

The statutes require that at least two meetings a year are held. These are a General Assembly of all members, in which all decisions of statutory importance are taken and plenary discussions are held, and an Executive Committee meeting attended by a selection of member companies representing the three regions in which the industry operates, namely...
Europe, the Americas and Asia. The Executive Committee receives an update on the activities of the association and prepares proposals to be voted on by the annual general meeting.

At that time, during the meetings, the discussions were simultaneously translated into three languages – English, French and Japanese. Since 2009, English is commonly used for the meetings, with simultaneous interpretation in Japanese. Gaz de France, British Gas and Tokyo Gas had assumed clear leadership roles in the meetings and the organization in general. The first non-Japanese Asian members were Korea Gas in 1985 and CPC Corporation, headquartered in Taipei, in 1989.

**New milestones for the LNG industry, new opportunities for GIIGNL**

Over the past 20 years, GIIGNL’s membership has grown strongly. Today the Group has 76 member companies in 25 countries worldwide. The membership comprises nearly all the companies active in the import of LNG or in the operation of LNG import terminals. By region, 35 of the members are from Asia, 31 from Europe and 10 from the Americas, including North and Latin America.

It is a non-profit organization and its resources only come from membership fees. The association constitutes a forum for exchange of experience among its members, with the goal of enhancing the safety, reliability and efficiency of LNG import activities.

With the support of experts from member companies involved in its two study groups (Technical and Commercial), the association regularly produces reference publications covering a wide variety of topics, from safety of operations to standard agreements. Each spring GIIGNL also publishes its annual statistical report, *The LNG Industry*. The report gathers, in one single place, all the key figures of the last 12 months: LNG trade flows, spot and short-term traded volumes, recently concluded contracts as well as new plants (liquefaction and regasification).

In a fast-changing environment currently characterized by low oil prices and abundant new LNG supplies, GIIGNL has a great role to play in fostering dialogue between members, sharing best practices and experience with new LNG players, and continuously promoting the development of safe LNG import activities.

*Jean-Yves Robin is General Delegate at the International Group of Liquefied Natural Gas Importers.*
HERE COMES LNG AS A FUEL

When cost matters, when time matters, when space matters, GTT technologies for LNG as a fuel appear to be the best choice.

Building on its fifty years' experience at the service of the LNG industry, GTT provides state-of-the-art technologies for LNG fuel tanks for all ocean going vessels. It also develops innovative applications to facilitate bunkering operations. Its LNG transfer application system, Reach4, is able to bunker most of ships in sheltered area.

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Safety  Excellence  Innovation  Teamwork  Transparency
ROSEN Group successfully inspects high speed gas pipelines without reducing velocity of gas flow

By Johannes Keuter with Michael Rapp

New innovative tool from the ROSEN Group leads to successful completion of projects in Asia and Europe. The ROSEN Group has successfully completed several high speed gas pipeline inspection jobs in 20”, 28”, 34” and 36” pipelines for an operator mainly responsible for procuring and distributing gas supplies for domestic use via its vast gas pipeline network in Southeast Asia and for an operator in Europe. Hence, ROSEN has achieved another milestone in minimizing the influences of Inline Inspection (ILI) on the gas pipeline operation.

Within a couple of months, the developments of new Magnetic Flux Leakage (MFL) based 20”, 28”, 34” and 36” Corrosion Detection Tools (CDP) combined with new 20”, 28”, 34” and 36” Extra High Resolution Geometry Tools (XGP) were completed on a tight customer schedule.

The contract required the ILI package to include the following inspection capabilities without interrupting normal gas supply:
- Metal Loss Inspection (MFL)
- High-Resolution Geometry Survey (XGP)
- Location Mapping (XYZ Gyro)

The ROSEN Group already has a successful track record in building combined ILI tools that include the above-mentioned capabilities. However, the challenge in this project was the strict customer requirement to not reduce the gas flow velocity during the planned inspections. Usually, the gas flow during Inline Inspections has to be reduced to allow for accurate and reliable inspection data. This inevitably means a financial loss for the pipeline operator, as less gas is delivered to its end customers. Using a new, innovative tool design, ROSEN Group – once again – achieved a leading selling proposition in the market: No reduction of gas flow is necessary anymore, resulting in stable revenues for operators!

In these cases the pipelines were operated at gas velocities of up to 10 m/s. To guarantee a high data quality at given pipeline parameters, the maximum inspection velocity should not exceed 3 m/s. This resulted in the requirement to reduce the ILI tool velocity by up to 7 m/s, considering the given pressures. To achieve this goal the tool designs were optimized to allow more bypass along the units. In combination with the differential pressures of the ILI tools, more bypass allows a higher velocity reduction of the tool compared to the gas velocity. At the same time the design must still stabilize the tool and carry its weight.

Through close cooperation between the various R&D disciplines of ROSEN, a new approach has been developed. For instance, the sensors were mounted onto the pulling unit of the three-segment combined 28” MFL and Geometry Tool, instead of installing the XGP sensors on the rear unit of the tool. This design copes with the challenge to protect the sensors from the high gas flow. The sensors are not within the main gas flow any more, but are located between the cups of the pull unit, thus being protected by them. For the two-segment combined 34” and 36” MFL and Geometry tools, additional protection components were used. In parallel the design of the polyurethane cups and the tool layout were adjusted to maximize bypass. These solutions provide enough bypass area to route the gas flow around the tool and to avoid the back of the tool pushing forward at the same time (which is necessary for stable run conditions). These different design elements were used to find the optimal solution between stabilization, protection and bypass for ILI tool velocity reduction.

Additionally, the variable speed control unit (SCU) and its operation algorithm were improved. The automatically adaptive variable SCU of ROSEN is a well-known, proven and established solution to regulate ILI tool velocity during an inspection to get high quality data. After finalizing the inspections for the client, the data from the MFL and XGP were indeed of high quality. All reports have been handed over to the client and ROSEN has hereby come up with a unique solution, reinforcing the market position for “high speed inspections”.

The combination of a new bypass-optimized tool design and an improved speed control algorithm provides the optimal technical and commercial solution for the inline inspection of high speed gas pipelines.
LOOKING AHEAD.

We plan for the future. More than one-third of ROSEN employees work in research and development, creating innovative products needed by the industry. An investment we are proud of.
I P L O C A – 5 0 Ye a r s o f A c h i e v e m e n t

I P L O C A is a not for profit organization with the mission to provide value to members through a forum for sharing ideas, engaging the industry and its stakeholders, facilitating business opportunities and promoting the highest standards in the pipeline industry.

The association is committed to nurturing the cooperation and respect to guarantee the equitable sharing of risks and rewards, while maintaining the highest standards of safety, quality and care for the environment and the people impacted by pipeline projects.

I P L O C A’s origins

In 1966, companies active in the international pipeline construction industry recognised that they had many common interests and problems which could most effectively be addressed through the establishment of an industry association. That same year, during a meeting in Paris, France from June 20-21, the then leaders of the international pipeline construction industry established the International Pipe Line Contractors Association (IPLCA), as the international division of the Pipe Line Contractors Association (PLCA) of the United States.

Attending were 26 representatives of 13 contracting firms from France, Italy, Great Britain, West Germany and the Netherlands.

By-laws adopted at the meeting made membership in the international division the same as for those in the PLCA, with the

First elected Board of Directors of the International Division of the PLCA in 1966

Front row from left to right:
Rolf Koehler, Treasurer (Preussag, Germany); Stanley A. Wright, Second Vice President (CJB Pipelines, UK); Arthur E. Poole (President of PLCA, USA); Jean Guyot, President (President of Société Entrepose, France); Alfredo Manfredini, First Vice President (President of Techint, Italy).

Back row from left to right:
R. Mirone, Director (MONTUBI, Italy); Richard D. Cagney, Director (Director of PLCA, USA); Jacques Lesage, Director (SOCEA, France); R.E. Todd, Director (M.K. Rivers Constructie Maatschappij, Netherlands), Richard A. Gump, Managing Director (Managing Director of PLCA, USA); B.O. Butler, Executive Secretary.

Not in the picture:
P.D. Campbell, Director (Willbros Overseas Ltd, UK).
additional requirement that its members must have headquarters outside the United States. Members needed to have been engaged in mainline cross-country pipeline construction for at least two years and to have attained a reputation for skill, integrity and responsibility.

Provision was also made for Associate Members consisting of manufacturers and distributors of equipment and services.

Headquarters for the international division were established at 75-77 rue de Tocqueville, Paris 17e, France.

**Independence**

IPLOCA became fully independent in 1976 after a significant increase in membership. In 1988 the membership decided that with the growth of the offshore oil and gas industry, the association should become broader based and include those companies working offshore in the oil and gas industry. On 5 May 1989, the International Pipe Line and Offshore Contractors Association (IPLOCA) was officially established.

The association’s headquarters were later moved to Brussels, and then in 1992 to Gent, in Belgium. The Gent office was closed in June 2005, and the office was re-established in Geneva, Switzerland, where it remains today.

**Association’s original aims**

The aims of the association today have not changed much since those laid down in Paris in 1966:

◆ To make membership of the association a reasonable assurance to the public of the skill, integrity and responsibility of its members.

◆ To maintain the standards of the pipeline and offshore contracting business at the level necessitated by its professional character and to establish members of the association in the public mind as contractors who fulfil their obligations in all good faith.

◆ To promote more cordial and co-operative relations among pipeline and offshore contractors and between contractors and those with whom they have to deal or with whom they have contact.

◆ To encourage efficiency among contractors and their employees.

◆ To seek correction of injurious, discriminatory or unfair business practice by or against pipeline and offshore contractors.

◆ To eliminate as far as is humanly possible the occurrence of injury and death to contractor’s employees and others by following sound safety practices and by promoting the continued research and development into new, better and safer construction techniques.

◆ To follow the established codes of conduct set out by the industry and others with respect to working within a free and competitive market.

**International reach**

IPLOCA maintains a close relationship with its sister associations, Pipe Line Contractors Association (PLCA), Pipe Line Contractors Association of Canada (PLCAC), Distribution...
construction, rehabilitation and/or maintenance of pipelines and their associated facilities, onshore and offshore. These international companies contribute significantly to the development of new ideas, techniques and equipment essential to the execution of pipeline projects.

Other categories of membership were added as the association evolved, including Academic Members and Honorary Members. Academic Members include universities and research institutions whose activities encompass research and/or the study of pipes, materials, tools, supplies, welding, coating, testing and modus operandi associated with onshore and/or offshore pipelines and/or associated process engineering facilities.

Honorary Members are individuals who have performed distinguished services to the onshore and offshore pipeline industry and/or to the association.

The current challenging environment created by low oil prices is encouraging all players in the industry to work more closely together to come up with common solutions for a constructive way forward. IPLOCA maintains an ongoing dialogue with owners and operators including BP, Chevron, Eni, Petrobras, Petronas, Shell, Saudi Aramco, Total, TransCanada and others in promoting a more constructive relationship between client and contractor. At the IPLOCA 49th Annual Convention in Singapore in 2015, a new category of membership, Corresponding Member, was introduced, effective from January 1, 2016, to allow oil and gas onshore and offshore owners and operators to take a part in the association.

The Annual Convention
During the first IPLOCA Board of Directors meeting in Paris in September 1966, it was decided to organize and hold an annual convention where leaders of the pipeline construction industry could network and socialize in order to discuss business and current issues in a relaxed and comfortable setting.
A.Hak is an international family-owned Dutch company with over 50 years of experience in design, construction and maintenance of the infrastructures for transport and distribution of oil, gas, water and electricity. Experience it also puts to good use in the field of renewable energy. A.Hak designs, develops and builds sustainable energy systems that make the world less dependent on fossil fuels and invests in promising new technologies.

A.Hak consists of a group of independent companies that work from four complementary divisions. From locations on all five continents they contribute to the joint objective of optimally serving a wide array of clients. Whether A.Hak works with a small team of experts or has its companies join forces on a complex multidisciplinary project, they get the job done. Offering high quality with a typical Dutch hands-on mentality and solution-oriented attitude.

A.Hak is active in five markets: Oil & Gas, Water, Electricity, Communications and Renewable Energy. A.Hak Pipelines & Facilities constructs transport pipelines and all related facilities for the oil, gas and water industries. The Distribution & Networks division focusses on the smaller pipes and cables that distribute water, gas and electricity to individual homes and companies. A.Hak Renewable Energy is a construction partner, an investor and a consultant, and the Products & Services division consists of the companies that deliver the various products and services that allow A.Hak to be a truly all-round company. For instance, drilling experts, coating specialists, enormous experience in groundwater management and an array of integrated industrial services.

WWW.AHAK.NL/ALL-ROUND
The first IPLOCA Convention was held in Naples, Italy in October 1967. This annual event was then held in different European destinations up until 1975 when the convention ventured out to Mexico in Central America. It then returned to European soil for another 11 years before being held in Boston, USA in 1987.

The IPLOCA Board of Directors then installed a convention rotation scheme, whereby the convention would regularly be held in different regions of the world. To this date the convention has been held in North America, Central and South America, Europe, the Middle East and Asia Pacific.

Today’s conventions continue to focus on networking, providing platforms to allow dialogue between our members and bringing key speakers and leading industry professionals together.

The 50th Anniversary Convention from September 12-16, 2016 is the first IPLOCA Convention to be held in Paris, a return to the association’s origins.

Regional Meetings
To further engage its members around the world, in 2007, the Board of Directors decided to hold regional meetings, organized by the regional director with presentations from IPLOCA and the most important clients of the region as invited guest speakers.

These meetings open up the possibility of discussions on common issues and challenges, and provide the opportunity for IPLOCA to update its membership on its objectives, review new technologies and exchange on members’ needs at a local level. Non-member companies are also invited to become familiar with IPLOCA.

Introduction of Awards
To fulfil its commitment to the promotion of health and safety, IPLOCA publishes annual aggregated health & safety and environmental statistics submitted by its members and in 2001 presented the first annual IPLOCA Safety Award, re-named the IPLOCA Health and Safety Award, sponsored by Chevron, in 2007.

The biennial IPLOCA Environmental and Corporate Social Responsibility Awards were introduced in 2004 and in 2011, and are sponsored by Shell and Total, respectively. Incorporation of new technologies to improve the process and competitiveness of the industry is an important part of the work of the New Technologies Committee and its Novel Construction Initiative. To give recognition to a significant achievement in the development of new pipeline technologies, the biennial IPLOCA New Technologies Award, sponsored by BP, was first presented in 2001.

A new biennial award will be presented for the first time at IPLOCA’s 50th anniversary convention in Paris: for Excellence in Project...
Execution. This will be given for a particularly high standard of project execution, in recognition of a step change in both the company’s satisfaction and a trademark for the contractor’s execution capacity.

**Health & Safety and Environmental Statistics Reports**

IPLOCA collects safety statistics from its members, and publishes these annually in aggregate form. It has produced Safety and Environmental Guidelines and has set out basic safety and environmental policies to which members are committed to adhere. It regularly holds workshops on specific safety topics and has made available a safety DVD, the Safety Training Instructors Tool, in collaboration with the Canadian Construction Sector Council and PLCAC.

**Best Practices: “The Road to Success”**

The association participates in ongoing research for the benefit of the industry at large and in 2009 published the first edition of Onshore Pipelines: The Road to Success. This substantial document resulted from the collaborative work of many individuals and companies among the IPLOCA membership. It serves as a reference tool covering a pipeline project from development to commissioning and is of particular interest to senior management, project managers, safety experts, engineers and environmentalists involved in pipeline projects, and to the key personnel of contractors and subcontractors. It may also be used as a teaching tool for the pipeline industry.

Subsequent editions were published in 2010 and 2013 and made available on the association’s wiki and via the website. Completely revised and with new chapters, a fourth edition will be issued as an app in September 2016.

For further information on IPLOCA, please visit www.iploca.com

Juan Arzuaga is IPLOCA Executive Secretary.
Low Oil Prices: Impacts for Indonesia and its Strategies for Energy Security in the Future

Today, we are facing very challenging times. Recent downward pressures on international oil prices are posing new threats to oil and gas investments and economic development both globally and indeed in Indonesia. It was recently reported that the Indonesian economy expanded by only 4.73% in the third quarter of 2015, falling below target and posting its lowest growth in five years.

This slowed growth highlights the fact that our economy remains fundamentally dependent on the oil and gas sector. Our state budget and national development are intricately tied to our oil and gas production and exports. Falling oil and gas revenue, lower commodity prices and a weakened rupiah are hurting the economy and as a result a large budget shortfall is expected in 2015. A significant decrease in oil and gas revenue is not only eroding the gains from scrapping gasoline subsidies but could trigger economic and energy crises. Swift action is needed to mitigate the risks of a budget shortfall this year and to avert these potential crises.

The government’s strategy to meet increasing energy demand hinges on three factors: intensifying exploration, diversifying energy sources and accelerating development of unconventional gas resources. We know all too well that we need to intensify exploration. However, current oil prices are rendering numerous projects uneconomical. Our oil and gas contractors are being forced to cut their budgets and to reduce drilling and well activities by at least 20% from their initial work plans.

According to Indonesia upstream regulatory body, SKK Migas, this reduction in activities will result in a decline in national oil and gas production in 2015 and 2016. Under the 2015 state budget, oil production is projected to reach 825,000 barrels of oil per day, while gas output is projected to total 1,221 barrels of oil equivalent per day. Unless mitigation measures are taken quickly, we may not be able to achieve these targets.

It is projected that domestic gas supply will face shortages in the next few years with most of the additional supply being earmarked for new gas-fired power and fertilizer plants. According to the Energy and Mineral Resources Ministry, total gas demand will reach 9,643 million standard cubic feet per day (mmscfd) in 2019, up by 527 mmscfd or almost 6% from the estimated 9,116 mmscfd demand this year. During the period 2016-2019, the committed demand will rise by 60% for industry and up to 50% for electricity. This means that Indonesia must source its gas from overseas as our domestic supply would likely be insufficient to meet the demand in 2018. However, imports will only be possible if the gas infrastructures are in place.

The alarm has been sounding for some time and must no longer be ignored. The call is loud and clear. There is utmost urgency for the government to recognize the need to resuscitate the upstream oil and gas sector and to work with the industry to prevent Indonesia from slipping into an energy crisis. Without exploration and production, there will not be economic growth.

Today the industry is looking to the government to demonstrate strong leadership and political will to improve the oil and gas investment climate through sound mitigation measures. To enable the industry to survive,
strong governmental intervention is needed to create a more conducive business environment with clearer and more enabling regulations, simplified bureaucracy, streamlined business processes, more attractive fiscal and tax arrangements, economically feasible pricing mechanisms and facilitation of gas infrastructure development.

To ensure sustainability of gas supply, exploration and development must be expedited in a number of strategic hydrocarbon basins, such as the deep-sea Kutai basins and Masela field. Unleashing Indonesia’s new conventional and unconventional gas resources requires higher levels of technological capability, human resources and more capital. If gas prices do not reflect the higher investment costs needed for viable project economics, our gas will remain locked. How can we ensure economic gas pricing?

The government must continue to ramp up gas infrastructure development to build an integrated network of regasification terminals and transmission and distribution pipelines, and to leverage advanced technologies that can increase gas distribution and utilization efficiencies.

On the need to diversify our energy resources, Indonesia must follow in the footsteps of the G7 countries in harnessing renewable energies, most notably wind and solar. Just as shale extraction has reconfigured the world oil and gas market, utility-scale solar technology is expected to be coming closer to transforming power markets world-wide as new solar panel technologies enable tumbling production costs. Solar is already well-entrenched in Europe and North America, and is expected to boom in Asia as the largest energy consumers in Asia, such as Japan and China, begin to turn to solar power.

As with Indonesia, the rest of the world is also grappling with the impact of low oil prices. Market dynamics are in a state of flux and we seek to understand how Indonesia must position herself as a producer, an exporter and also a buyer of natural gas to ensure energy and economic security for her people. We must face the new realities and act now before it is too late. Indonesia is blessed with vast natural and human resources. Let us move beyond the rhetoric and rise now to take our place as Asia’s next economic powerhouse.
Presenting IGU’s New Members

At the Council meeting in Cartagana, Colombia in October, IGU welcomed three new Associate Members. Here is a brief introduction to the companies.

**COM-therm**

Founded in September 2003, COM-therm is the operator of the municipal heating system of Komárnö in Slovakia. The company now runs 19 heat-generation stations, 19 heat-transfer stations and an extensive heat-distribution network throughout the town. It supplies approximately 10,000 housing units with 370,000 GJ of energy per year, while also providing warm service water (WSW) for property-owner associations, educational facilities, pre-school centres and the trade network.

The aim of COM-therm is to provide a high-quality thermal power supply to its customers using modern technologies of thermal-power engineering. These are gradually being installed in all the company’s facilities. There is a focus, too, on natural gas and renewables, so COM-therm intends to participate in the IGU’s Research & Development and Innovation Committee.

Since 2014, the company has also been involved with research and development in trigeneration, the highly efficient, combined production of electricity, heat and cooling (CCHP). It is made possible by connecting a hot water absorption chiller unit to combined heat and power (CHP) technology, in combination with waste heat recovery (WHR) technology. The combined generation of heat and electricity can reduce the amount of fuel used by 40%, which, from a financial perspective, means a cost benefit to the customer. And as heat and electricity are generated on the site of usage, the price of long-distance distribution, with its inherent loss of energy (around 10%), can be avoided.

COM-therm is committed to the efficiency of heat and WSW consumption, development of conditions favourable to the adjustability of that consumption and assistance in creating an energetic conception of Komárnö itself.

For more information, visit www.comtherm.sk

**Energodiagnostika**

Formed in 2003 and based in Moscow, Energodiagnostika is one of the world’s leading expert diagnostic centres specializing in technical diagnostics, industrial safety expert appraisal, repair and maintenance of gas and oil industrial facilities, equipment and structures. It provides a full range of technology driven inspection services using conventional and advanced non-destructive testing (NDT) methods, third-party inspection (TPI), industrial safety expert evaluation, design engineering, commissioning and repair services.

The company’s vision is to be a recognized leader of the inspection-services industry. Being
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a leader means maintaining operational excellence, customer satisfaction and superior financial performance, and achieving profitable growth through superior service, innovation and commitment. Energodiagnostika is a growing company that confidently faces the future, looking for further opportunities, maintains high standards of work and its firm position in the domestic and international markets.

Its mission is to provide inspection and other services in a safe, efficient and environmentally sound manner. Satisfying customers with the appropriate level of quality is a primary goal and a fundamental element of its business operations. Energodiagnostika is a results-oriented company that builds value for its shareholders through an atmosphere of teamwork, creativity and resourcefulness and by dealing with people in an open and ethical manner.

Energodiagnostika has modern inspection and maintenance equipment from Russian, European and American manufacturers (it has more than 1,500 pieces of tooling and equipment in total). The company is constantly expanding its application range and investing in new equipment for advanced NDT methods like Time of Flight Diffraction (TOFD) and Long-Range Ultrasonic Testing (LRUT) – indeed, several types of NDT equipment have been manufactured by Energodiagnostika.

The company particularly prides itself on over 70 patents and pilot projects, including automated surveillance systems for potentially dangerous units: the system for controlling under-road and under-railway pipeline crossings (SKP21), and the system for control and regulation of pipeline support structures (SKR4), which also monitors the strain-stress distribution of potentially dangerous pipeline segments. The results of the company’s research are widely used in the field.

Energodiagnostika is well experienced in offshore projects: the Priazlomnaya ice-resistant fixed rig, jack-up drilling rigs Arkitchenskaya and Amazon, a semi-submersible drilling rig for the Shtokman project, the Ob-1 floating drilling unit (here the company provided cabling, electrical installation, commissioning of the drilling and processing zones; developing, agreeing and receiving authorization for the beginning of operation, etc.).

Ensuring environmental safety is one of the company priorities; here, the company offers services for industrial environmental monitoring of construction and upgrading projects for the oil and gas industry, research and analysis of the sensitivity of natural objects, assessment of the impact of industrial projects on the environment, compliance assessment of industrial design solutions with environmental legislation; developing the standards for maximum allowable pollutant emissions into the atmosphere.

Together with foreign microbiologists the company is developing an innovative method of using natural microorganisms (methanotrophic bacteria or methanotrophs) to minimize ecological risk by preventing dangerous methane concentration in the near-the-ground atmosphere.

As an active member of the World Wildlife Fund Business Club since 2012 Energodiagnostika has supported nature conservation projects.

The business has sufficient resources to fulfil clients’ requirements, including the development of regulatory and technical documentation. The company achieved its flagship position thanks to highly experiences scientists and managers, who quickly solve complex technical challenges.

With more than 600 skilled employees – many of whom have over 25 years of
experience on complex oil and gas projects – and modern equipment, Energodiagnostika has the resources to support the inspection needs of the client, whether they are large-scope projects or time-sensitive call-out jobs. For many years, the company has been successfully providing services and solutions that optimize customer performance for more than 100 clients worldwide. Activities extend not only to JSC Gazprom-affiliated companies but also to other customers’ facilities. Regular customers include Gazprom, AK Transneft, Gazflot, Vyborg Shipyard, Rosneft, LUKOIL, SPO Sevmash, SPO Arktika, Zvezdochka Ship Repair Center, Gazprom Neft Shelf, Sakhalin Energy Investment Company Ltd, the Beijing company (a subsidiary of PetroChina), Latvijas Gaze, and others.

We believe that active participation in the IGU working committees, the opportunity to work with technical, commercial and strategic experts from all over the world on the most pressing issues facing the natural gas industry, networking and educational opportunities, interaction, cultural and social experiences will provide significant added value for our company and employees. More importantly, it will give an impetus to further development of the gas industry in both Russia and the world.

For more information, visit www.gazprom-energy.ru

**Regas**

The Italian partner of major public utilities, Regas provides products and services dedicated to gas-distribution networks. Established in 1998, it has become one of the reference companies between natural-gas distributors. Its turnover is constantly growing and its product and service range is widening.

Since its foundation, Regas’ core business has been designing and manufacturing gas-decompression and measurement stations and the supply of equipment related to gas regulation. Through the years, Regas has built its skills to compete in the natural-gas odorization market, becoming the Italian market leader in gas-odorization technologies. Its direct-injection odorization system has been designed and patented by Regas and is the only system that is able to inject the exact amounts of odorants per square metre of natural gas. This guarantees the correct odorization in low capacity or continuous fluctuations of capacity.

Regas is also capable of developing custom-made solutions. Its know-how in the natural-gas distribution market is what matters to its customers, and this has been the key to Regas’ success.

Progress is vitally important in the natural-gas sector. With this in mind, Regas continually improves its existing skills while embracing innovation in order to promote company and market growth. Its commitment aims to create close relationships with customers, suppliers, unions, societies, universities and research centres and its hope is that any relationship can become a partnership.

In Regas’ view, it is essential to care about customers’ needs as a guidance for innovation and evolution, and to propose the best solutions for system and network safety. This enhances quality and safety and assists with protecting the environment. Regas is inspired by environmental-protection principles, believing it is a base from which all company employees can work from.

For more information, visit www.regasitalia.com
Publications Available from IGU

As a non-commercial organization 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.
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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 2016

April 5-7
IGU Executive Committee
Durban, South Africa

April 11-15
LNG 18
Perth, Australia

May 9-12
Flame Conference
Amsterdam, The Netherlands

September 12-16
IPLOCA 50th Anniversary Convention
Paris, France

September 21-23
GASEX 2016 Conference & Exhibition
Beijing, China

September 27-29
29th World LPG Forum & 2016 AEGPL Congress
Istanbul, Turkey

October 4-7
NGV Global 2016: 15th Biennial Conference & Exhibition
St Petersburg, Russia

October 9-13
23rd World Energy Congress
Istanbul, Turkey

October 18-21
IGU Coordination Committee, Executive Committee and Council Meetings
Amsterdam, The Netherlands

November 7-18
22nd Session of the Conference of the Parties to the UNFCCC (COP 22)
Marrakech, Morocco

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The Convergence of Power, Gas & Renewables:
E.ON (79 & 80) E.ON SE (87).
Evaluation of Biological Methanation for Power-to-Gas Applications:
Audi AG (94 upper, 94 lower and 95 upper), Viessmann Werke GmbH & Co. KG (95 middle), P2G-BioCat (95 lower).
Features:
KOGAS (98: A vessel delivers its cargo at Incheon LNG terminal).
Paris Agreement on Climate Presents both Opportunities and Challenges for Gas:
Supply and Pricing Upheavals Thrust LNG Industry into Uncharted Territory:
Chevron Australia (112), BG Group/Royal Dutch Shell (113 upper), (113 lower), Novatek (117), Petronas (118), Nord Stream AG (123).
Why New Waves of LNG from Australia and the US will Re-shape the Industry:
Santos GLNG (127), Chevron Australia (130), Cheniere Energy, Inc. (136).
Policy Makers and Industry Leaders will Discuss Dramatic Industry Changes and Challenges at LNG 18: PCEC.
The History of GIIGNL:
GIIGNL.
IPLOCA – 50 years of Achievement:
IPLOCA (all except Nord Stream AG, 153 lower).
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COM-therm (156), Energodiagnostika (157), Regas (158).
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ACCELERATING PERFORMANCE TO BECOME THE PRIDE OF THE NATION

With a vision to be a world-class energy company, we continuously improve our performance by increasing production of oil and gas, as well as renewable energy. It is why we received international recognition as one of the Fortune Global 500 companies.

Bringing Indonesia to the world stage is our pride.