

Shell's Wetselaar: Gas must satisfy four agenda items

KURT ABRAHAM, World Oil

According to Maarten Wetselaar, Shell's Integrated Gas and New Energies Director, "Just because gas should play a key role [in the global energy market], doesn't mean that it will." Those rather stark remarks were delivered at Tuesday morning's plenary session at Gastech.

The crux of Wetselaar's remarks was an argument for four agendas that industry must address to ensure that gas reaches its full potential as a lower-carbon, cost-competitive energy solution. These agendas include:

1. Encourage policies that target carbon emissions and air quality
2. Cut costs and price gas competitively to make it as attractive as possible to the consumer
3. Adopt a rigorous approach to measuring, reporting and repairing methane leaks
4. Relentlessly open new markets for gas.

To support his thesis, Wetselaar offered several pieces of supporting evidence. A recent article reported that, despite the growing global economy,



Maarten Wetselaar, Shell's Integrated Gas and New Energies Director, detailed methods to ensure that gas reaches its full potential as a lower-carbon, cost-competitive energy solution.

energy-related carbon dioxide emissions were flat for a third straight year, according to the International Energy Agency (IEA). He contrasted that situation with a second article that stated that carbon emissions in the UK have dropped to levels last seen in the late nineteenth century. Considering that the UK was the birthplace of the industrial revolution, Wetselaar called this a remarkable achievement.

"What's behind this?" Wetselaar teased the audience. "A big part of the answer is the reason we are all here today—gas. More and more, evidence is emerging that everywhere emissions are going down, gas—the cleanest-burning hydrocarbon—is replacing coal." He then told the audience to consider Europe. Last year, coal-fired power generation fell by 94 terawatt hours (TWh) in the region, while gas-fired power grew by 101 TWh. This helped bring about a 4.5% drop in CO₂ emissions from Europe's power sector when compared to 2015 levels.

Creating demand. Wetselaar instructed attendees to not be complacent. "Think back a few years. The 'Golden Age of Gas' was on all of our minds. There was an expectation that an automatic success story for gas was in the cards. However, this hasn't happened in the way we hoped. This is largely because rising costs and rising prices challenged the gas claim to be an affordable energy solution."

He also blamed poor energy policy in various places for discouraging greater gas use. More recently, Wetselaar added, the long-term role of gas in a low-carbon energy system is being challenged by methane emissions.

Wetselaar stressed the importance of not letting the opportunity pass

by to ensure that gas reaches its full potential as a lower-carbon, cost-competitive energy solution that will serve the world for decades to come. To that end, he reminded the audience of his four-point agenda and how to implement it.

Effective policies. Illustrating his first point about better government policies, the director pointed to the reduction in the UK's CO₂ emissions as a result of deliberate political and legislative commitments. Turning to China, he noted the result that policies there are having, with emissions falling 1% during 2016, even though the country's economy expanded 6.7%. A key reason for the emissions reduction is the switch from coal to gas in the industrial and construction sector.

Wetselaar lamented how, in Germany, despite government support for renewables, coal-fired generation remains unconstrained, despite its impact on CO₂ emissions and air quality. He assigned part of the blame to low wholesale coal prices, and decried the low price for carbon emissions derived from the EU Emissions Trading System. Therefore, CO₂ emissions in Germany increased 0.9% in 2016.

Cutting costs. On his second point, Wetselaar said that gas must be affordable when compared with cheap coal, but also when it is blended into a power mix with solar and wind energies, which continue to see deflationary business models. Of course, he added, valid reasons exist as to why gas project costs have increased: tighter regulations, more remote locations and higher prices for construction materials.

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Operators say cost-effective LNG projects must accommodate host countries

KURT ABRAHAM, World Oil

Successfully developing and operating new gas and LNG projects cost-effectively, while also harnessing staff knowledge and skills, and addressing the needs of host countries and their local populations, was the theme of Wednesday morning's first commercial session at Gastech.

A realization exists among operators that the new, lower-price structure in the LNG market will remain in place for some time, and companies are now striving to find ways to do things as cheaply as possible while still operating safely. As panel moderator Mary Hemmingsen, global head of LNG at KPMG, succinctly stated, "We can't keep doing the same thing and expect different results."

Chiyoda Corp. President and CEO Shogo Shibuya pointed to his firm's track record of successfully developing large LNG projects, including Qatar LNG, Sakhalin II and the PNG LNG effort that is harnessing gas from the Papua New Guinea Highlands. "Our success in past projects has been achieved through our One Team Collaboration method," said Mr. Shibuya. This collaboration method, he explained, has three basic components: 1) Lifecycle engineering, 2) making safety a core value, and 3) achieving operational reliability.

Chiyoda is now working on five additional major projects that will be completed between this year and 2020, including Tangguh LNG (Indonesia,

2017), Ichthys LNG (Australia, 2018), Cameron LNG (US, 2018) and Freeport LNG (US, 2018 and 2019). Every project is being implemented through One Team Collaboration.

Meanwhile, Steve Hill, Vice President for Gas and Energy Marketing and Trading at Shell, said that keeping costs contained is not the only factor operators must weigh when considering projects. "Future energy projects will need to not only be the cheapest projects; they also will need to have the lowest emissions." He added that when industry companies set out to develop LNG projects, they must understand the needs of the host government(s) in addition to ascertaining the energy needs of diverse populations.

For his part, Mike Utsler, COO of Woodside Energy, said that when it comes to developing people and projects, his firm looks at it "through the lens of the four Ps—people, plant, process and delivered performance. Really, if you think about it, this starts with people and ends with people." Mr. Utsler said that the first "P," people, relates to "ensuring that staff have the knowledge and tools to be agile and flexible" as they operate in today's ever-changing market.

The second "P," plant, refers to leveraging technologies to keep equipment and processes working efficiently and reliably. The third "P," process, is all about the various processes used in daily operations and workflow. "It's

looking at what we do and how we do it," said Mr. Utsler. "Over the years, we've become risk-adverse, and we have layered more and more processes to address this concern. Accordingly, we have forgotten how to take reasonable risks." The fourth "P," performance, relates to delivering a reliable product quickly and efficiently.

David Knipe, BP's head of International Gas, said that his company has worked hard to build "a high-quality,

flexible LNG portfolio. In so doing, we have established various sources of supply, spread across the globe." BP is not sitting on its hands when it comes to expanding this portfolio of sources, he added. "Our upstream is looking at new gas opportunities in places like Senegal and Mauritania."

Something else that Mr. Knipe quietly mentioned, but which indicates the

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Wednesday morning's first commercial session focused on finding ways to do things in the LNG market as cheaply as possible while still operating safely.

Gastech

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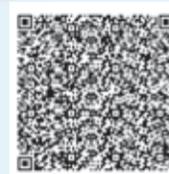
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Conference Program—Thursday, 6 April 2017

COMMERCIAL SESSIONS

- 08:45–09:45 **Delivering Greater Efficiency and Cost-Savings through Improved Innovation and Technology**
- (Moderator) **Christopher Caswell**, Vice Director—LNG and FLNG, Engineering and Construction (Global), KBR
 - **Rod Christie**, President and CEO, Turbomachinery Solutions, GE Oil & Gas
 - **Marcelino Oreja**, Chief Executive Officer Enagás
 - **Masaharu Sano**, Senior Executive Vice President, INPEX
 - **Alasdair Cathcart**, President Bechtel Oil, Gas & Chemicals
 - **Kees van Seventer**, President LNG Vopak
- New Frontiers, Joint Partnerships and Investments (Session 3)**
- 10:00–10:20 **Natural Gas—the Natural ‘Renewables’ Partner**
- **Roger Bounds**, Vice President, Global Gas, Shell
- 10:20–10:40 **The Ship Owners’ Response to the Challenges and Opportunities Created by the Redrawing of the Gas Map**
- **Mike Rowley**, Director—LNG Division, Mitsui O.S.K Lines
- 10:40–11:10 **Networking refreshment break hosted by ExxonMobil**
- 11:10–11:30 **The Emerging Role for a Portfolio Player in a New Market**
- **Jonathan Shepard**, Chief Operating Officer, LNG, BP
- 11:30–11:50 **Donngi Senoro LNG—A New Prototype for LNG Development**
- **Juro Baba**, General Manager of Indonesia Oil and Gas Business Department, Mitsubishi Corporation
- 11:50–12:10 **Reducing Regulatory Risk to Stimulate Long-Term Investment in Projects: Two-Steps Forward, One-Step Back?**
- **Steven Miles**, Partner, Baker Botts LLP
- 12:10–12:30 **Post COP 21—What Does The Future Hold for Gas in ASEAN Countries?**
- **Geoffroy Hureau**, Secretary General, CEDIGAZ
- 12:30–12:50 **Gas Market Reform Across Asia: The Advent of Third Party Access?**
- **Richard Nelson**, Partner, King & Spalding
- 13:00–14:30 **Delegate networking lunch hosted by ExxonMobil**
- Gas and LNG Projects—Progress and Updates (Session 4)**
- 14:40–15:00 **LNG Marketing for Floating LNG: The Case of Coral South FLNG**
- **Alessandro Della Zoppa**, Executive Vice President, ENI
- 15:00–15:20 **ExxonMobil and Marketing Papua New Guinea LNG**
- **Stephen McCusker**, Vice President PNG Marketing, ExxonMobil Asia Pacific Pte. Ltd.
- 15:20–15:40 **The Tangguh Train 3 Expansion Project**
- **Andy Lane**, Head of Business Development—Gas Value Chains, Upstream, BP
- 15:40–16:10 **Networking refreshment break hosted by ExxonMobil**
- 16:10–16:30 **The World’s First Import/Export LNG Facility—Cheniere Energy**
- **Pradeep Pillai**, LNG Technology Manager, Bechtel; **Ed Lehotsky**, Senior Vice President, Engineering and Construction, Cheniere
- 16:30–16:50 **Taking an Integrated Approach to Unlock New Small-Scale LNG Markets Through Commercial and Technical Innovation**
- **Markus Hector**, Market Access Development Manager, Shell
- 16:50–17:10 **GNL Quintero Phase 2 Expansion Project: Developing in Times of Change**
- **Antonio Bacigalupo**, Chief Executive Officer, GNL Quintero
- 18:00–20:30 **Gastech 2018 Launch party, Hilton Tokyo Bay Hotel, Soara Ballroom hosted by Spain Gastech Consortium**

TECHNICAL SESSIONS

- 08:45–10:15 **Stream 1: Health, Safety and Environment: Asset Infrastructure**
1. The Risk of Cryogenic Liquid Release Could Still Be a Show Stopper for LNG Assets Without Appropriate Cost-Effective Solutions
 - **Robin Wade**, Chartek Segment Manager, AkzoNobel
 2. Visualization of Leaks for Getting Insights of Appropriate Judgement
 - **Teruo Hioki**, Senior Lead Engineer of Plant Diagnosis Unit, Chiyoda Corporation
 3. HSSE Challenges and Solutions in a New Built Natural Gas Mega-Plant in South Pars: Practice Review
 - **Gholamreza Bahmanna**, Manager of Gas Plant, National Iranian Gas Co.
- 12:30–14:00 **Delegate networking lunch hosted by ExxonMobil**
- 14:00–15:30 **Stream 1: Health, Safety, Environment: People**
1. Mind the Gap: The Real Truth about the Talent Shortage in Gas Shipping
 - **Mark Charman**, Chief Executive Officer, Faststream Recruitment Group
 2. Social Performance: Can You Get It Right?
 - **Mary Lou Lauria**, Vice President Environment and Society, WorleyParsons/Advisian
 3. Human Factor Engineering in FLNG Projects
 - **Danaraj Chandasegaran**, Section Head, Technip
- Stream 2: LNG and Gas for Transport—Land**
1. Innovation for LNG as a Fuel
 - **Marc Perrin**, Program Manager, ENGIE Lab CRIGEN
 2. An Accurate Octane Number for LNG as a Transportation Fuel
 - **Howard Levinsky**, Senior Principle Specialist—Combustion Processes, and Professor, DNV GL and University of Groningen
 3. LNG-Bunkers in SW-Europe
 - **Juan Carbayo Puig**, Business Development Manager, Cepsa Gas Comercializadora S.A.; **Antonio Melcon**, General Manager, Cepsa Gas Comercializadora S.A.
- Stream 3: Floating LNG and Infrastructure—Marine**
1. Inland Waterway Floating LNG Bunkering Stations in China: Safety, Design and Engineering Best-Practice
 - **Hongjun Fan**, Senior Engineer, China Classification Society
 2. LNG Infrastructure in the Baltic Sea Ports
 - **Emil Arolski**, Project Manager, Baltic Ports Organization
- Developing the Zeebrugge LNG Terminal into an International Hub for Small and Large-Scale LNG, Plus Trans-Shipments Services
- **Peter Verhaeghe**, Chief Technical Officer, Fluxys
- 15:30–16:00 **Networking refreshment break**
- 16:00–17:30 **Stream 1: Health, Safety and Environment: Improvements**
1. Further Verified Safety Enhancement for Blast and Fire-Rated Doors on Structures in Hazardous Environments
 - **Berend Groeneveld**, Managing Director, InterDam BV
 2. Local Resource Development Initiative (LRDITM): Creating Shared Value Between Projects and Local Stakeholders
 - **Andre Thivierge**, Vice-President Environment and Geotechnics, SNC-Lavalin
 3. Cogeneration: Energy Production, Maximising Efficiency and Minimising Environmental Impact at All Scales
 - **Michael Welch**, Marketing Manager, Siemens Industrial Turbomachinery Ltd.
- 16:00–17:45 **Stream 2: LNG and Gas for Transport—Marine and Bunkering**
1. Development of the SPB® LNG Fuel Tank
 - **Koji Takashima**, Assistant Manager, Japan Marine United Corporation
 2. LNG Transfer Systems for Bunker Ships
 - **Carlos Guerrero**, Business Development Manager, Bureau Veritas
 3. Interface Standards for FSRU, FSU and Small-Scale Sectors
 - **Andrew Stafford**, Technical Director, Bureau Trelleborg Marine Systems
- 18:00–20:30 **Gastech 2018 Launch party, Hilton Tokyo Bay Hotel, Soara Ballroom hosted by Spain Gastech Consortium**
- 08:45–10:15 **Stream 2: Floating LNG: Design and Technology**
1. The World’s Largest FLNG Facility Coming to Australia
 - **David Bird**, Vice President—Production, Shell Australia
 2. Competitive At-Shore FLNG Solutions
 - **Bill Breckenridge**, Project Manager, Black & Veatch
 3. Innovative Liquefaction Technology for Floating LNG
 - **Mark Roberts**, Engineering Associate, Air Products and Chemicals Inc.
 4. Sloshing Assessment of a Membrane LNG Carrier During Loading/Offloading at a FLNG Terminal
 - **Bo Wang**, Manager, ABS
- 10:15–10:45 **Networking refreshment break**
- 10:45–12:15 **Stream 1: Healthy, Safety and Environment—Pollution Reduction**
1. Flare Reduction and Availability Improvement Using Novel Automated Main Cryogenic Heat Exchanger Cooldown Technology
 - **Fei Chen**, Lead Engineer, Air Products and Chemicals Inc.
 2. Getting to “Near-Zero” Liquid Discharge: Qatargas’ Process Wastewater Treatment System
 - **Khalifa Ahmed Al-Sulaiti**, Safety & Risk Manager, Qatargas Operating Company Ltd.
 3. Feasibility Study of Flare Reduction Concept for Operating LNG Trains by Dynamic Simulation
 - **Kyoko Kamei**, Lead Engineer, Chiyoda Corporation
- Stream 2: Floating LNG—Marine Operations**
1. Unique Test-Commissioning of Barge FLNG before Sail-Out
 - **Sara O’Dell**, Project Engineer, Oil and Gas, Black & Veatch; **Frederik Van Nuffel**, Technical Director, Exmar
 2. Fully Electric Loading Arms
 - **Eric Morilhat**, Strategy Director, Loading Systems, TechnipFMC
 3. Mid to Large Scale Floating LNG Plant-Technology Development and JGC’s Contribution
 - **Naoyuki Takezawa**, Project Manager, LNG Projects, JGC Corporation
- Stream 3: Small-Scale LNG and Infrastructure—Land**
1. Small Scale LNG to Power: Clean and Affordable
 - **Frédéric Deybach**, Key Program Small Scale LNG, ENGIE
 2. MARLIN: The First Boil-Off Gas Reliquefaction Plant in an LNG Plant
 - **Ringo Lim**, Principal Liquefaction Engineer, PETRONAS

DNV GL launches online PKI Methane Number Calculator for pipeline gas

HOWARD LEVINSKY, DNV GL

The chemical composition of fuel in natural gas grids is becoming more diverse. DNV GL is launching an online calculator, the PKI Methane Number Calculator for pipeline gas, to ensure that pipeline gas fuel composition is fit for end-use engines.

Dwindling local reserves of natural gas mean that more gas must be imported—either by pipeline or by ship, as LNG—to meet demand (FIG. 1). Globalization of the energy supply means that natural gas is produced from different reserves around the world and intended for a variety of markets with varying compositions being offered. Therefore, imported natural gases generally have a different composition than traditionally distributed gases. In this case, “different” often means that the new gases have more ethane, propane and butane than the traditional supply.

At the same time, the drive toward a “greener” natural gas infrastructure by introducing renewable gases into the gas grid has resulted in a steady increase in the injection of gaseous fuels from biomass into the grid, with other renewable gases being planned. Hydrogen (H₂) from power to gas, syngas [H₂/carbon monoxide (CO) mixtures] from biomass gasification, and substantial fractions of carbon dioxide (CO₂) in fermentation gases add fuel components that do not occur in the normal range of natural gas compositions.

Mismatching fuel quality to a given engine can cause engine knock, which can lead to loss of performance and even engine shutdown. Assessing the knock characteristics of the gas being supplied to the end user is crucial, and DNV GL is now launching an online calculator for pipeline gas quality. The calculator will help ensure that the end user can reliably and safely use the gas being distributed.

Different gas compositions have different combustion properties, which can adversely affect the performance of end-use equipment, such as gas engines. The key question is whether the combustion properties of a “new” gas composition gas are

so different from those for which the equipment has been specified, that the fitness-for-purpose and safety for the end user are at risk.

Quantifying pipeline gas quality effects. One important combustion aspect that is impacted by fuel composition is engine knock. Engine knock is characterized by auto-ignition of the unburned fuel mixture, known as the end gas, ahead of the propagating flame in the engine cylinder. The occurrence of knock can severely compromise engine performance, varying from increased pollutant emissions and reduced fuel efficiency to engine failure. When assessing the potential impact of introducing new fuels into the natural gas infrastructure, it is essential that the risk of causing knock in the population of end-user equipment be assessed quantitatively.

To assess the fitness-for-purpose of new gaseous fuels, DNV GL has developed a verified algorithm to quantify the effect of pipeline gas quality on engine knock, thereby helping to ensure safe and efficient engine operations. A comparison with experiments using a high-speed, lean-burn, medium-break mean effective pressure (BMEP) engine shows that the algorithm provides a significantly more accurate reflection of the impact of variations in fuel quality on engine knock than traditional tools. Similar to the PKI Methane Number Calculator for LNG (available for use on the DNV GL website), the PKI Methane Number Calculator for pipeline gas computes a PKI methane number to quantify the so-called “knock resistance” of the fuel on a 0–100 scale, analogous to the octane number for gasoline.

The range of compositions that the new DNV GL pipeline gas calculator considers is substantially extended compared to the calculator for LNG. In addition to the alkanes from methane through the pentanes and nitrogen, the pipeline gas calculator also computes the effects of CO₂, H₂ and CO. The new pipeline gas calculator accu-

rately assesses the impact of butanes, pentanes and their isomers, as well as the components from renewable gases.

Using the PKI Methane Number Calculator for pipeline gas, governments, gas network operators, engine manufacturers and end users can quickly assess the risk of changing fuel compositions for installed gas engines. With an eye toward adapting engines for future, compositionally more diverse supplies of gas, the

algorithm behind the tool can also be readily incorporated into an engine-control system to maximize knock-free performance when supplied with a wide range of fuel.

Howard Levinsky, Senior Principle Specialist (O&G) and Professor, DNV GL and University of Groningen, will present, “An accurate octane number for LNG as a transportation fuel,” on Thursday, 6 April. Visit the DNV GL team at stand 13-125 in Hall 3. ■



FIG. 1. DNV GL has developed a verified algorithm to quantify the effects of pipeline gas quality on engine knock.

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LNG PROJECTS, continued from page 3

company's intention to expand its LNG presence, is the fact that BP presently manages seven LNG vessels and has another nine LNG carriers on order. Mr. Knipe summarized the firm's overall gas portfolio approach as “involving a team of experts, bringing multiple skills to meet customer needs.”

During the question-and-answer portion of the session, Shell's Mr. Hill pointed out the magnitude of the market being affected by these people and process concerns. “You have to remember that we see energy demand growing 1%/yr, but we also see gas demand growing 2%/yr. Then, we see LNG demand growing 4%/yr.”

Furthermore, he observed, “Many different customers have many different requirements. The traditional LNG market was not always helpful to meet that need. So, we see much more flexibility in the LNG market now. We, as an industry, are much better at meeting the needs of small-demand customers.” ■

Courtesy of Oelargas Operating Company Limited

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Women in Energy: Driving diversity for success

This year's program theme is fundamental to the future of the gas industry, and highlights the importance of leveraging the benefits and resilience that diverse teams bring to organizations. The Steering Committee, which consists of professional women and men who are dedicated to empowering women in the energy sector, has shaped a program that features speakers, moderators, delegates and guests (women, men and younger professionals) from around the world.

It is only through open dialogue with key decision-makers and the future

workforce that a better understanding of the issues and increased diversity at all levels in the gas industry can be achieved.

The speakers and moderators, comprised of thought leaders from government, producers and consultants, are highly qualified to discuss the success that diversity brings, and are keen to share their insights. Through networking and the exchange of ideas and best practices, the Women in Energy event enables present and future leaders to create a more successful global gas industry. ■

THURSDAY, 6 APRIL	
09:00-09:05	Organizer's Welcome remarks
09:05-09:10	WIE Chairperson Welcome remarks ■ Barbara Jinks , Program Manager—Gastech Women in Energy, dmg :: events
09:10-09:30	Opening Keynote Address ■ Akie Abe , Wife of Prime Minister of Japan
09:30-10:30	How to champion gender diversity in the workplace and engage with leadership—examples of success from around the world ■ (Moderator) Kerry Anne Shanks , Head of Gas and LNG, Research, Asia-Pacific, Wood Mackenzie ■ Maarten Wetselaar , Integrated Gas and New Energies Director, Shell ■ Yenni Andayani , Director Gas, New and Renewable Energy, Pertamina ■ Robert S. Franklin , President, ExxonMobil Gas & Power Marketing Company
10:30-11:30	Networking refreshment break sponsored by Petromina
11:30-12:30	Womenomics in Japan—Is it blossoming? Update on the Prime Minister's initiative to increase participation of women in the workforce, including case studies from the gas industry ■ (Moderator) Elizabeth Spomer , President, Jordan Cove LNG ■ Momoyo Yuki , Senior Manager, Gas Business Group and Business Solution Office, Japan Petroleum Exploration Co., Ltd (JAPEX) ■ Yasuko Yoshida , Country Representative Myanmar, Shell ■ Yukari Yamashita , Director of Energy Data and Modelling Centre, The Institute of Energy Economics, Japan (IEEJ) ■ Anne Hung , Principal, Baker & McKenzie Tokyo
12:30-14:00	Networking lunch hosted by ExxonMobil
14:00-14:30	Outside Looking In—Perspectives on Gender diversity from Industries outside the Gas Sector
14:30-15:30	Leadership During Market Volatility—Initiatives Around the World to Create More Resilient Organisations ■ (Moderator) Steve Hill , Executive Vice President for Gas and Energy Marketing and Trading, Shell Eastern Trading (Pte) Ltd ■ Gloria Guo , General Manager of LNG Marketing, Singapore, Gas Supply and Trading, Chevron ■ Meg Gentle , President and Chief Executive Officer, Tellurian ■ Peter Coleman , Chief Executive Officer and Managing Director, Woodside Energy Ltd ■ Jane Liao , Chief Executive Officer of Natural Gas Business Unit, CPC Corporation, Taiwan
15:30-16:00	Networking refreshment break sponsored by Petromina
16:00-16:55	Personal Stories From Successful Women in the Gas Industry About Their Career Paths and Obstacles Overcome ■ (Moderator) Mariam Al Hendi , Senior Mechanical Engineer, Abu Dhabi Gas Industries Ltd.—GASCO ■ Regina Mayor , Global Sector Head and U.S. National Sector Leader of Energy and Natural Resources, KPMG ■ Yang-Mi Choi , Vice President, Facility Technology Department, Technology Planning Division, Korea Gas Corporation, (KOGAS) ■ Che Lixin , Executive Committee/Deputy General Manager, Beijing Gas Group ■ Katie Mehnert , Founder and Chief Executive Officer, PinkPetro ■ Ibu Ira Miriawati , VP Assessment and Development Management, SKK Migas Indonesia
16:55-17:00	WIE Chairperson Closing Remarks ■ Barbara Jinks , Program Manager—Gastech Women in Energy, dmg :: events
17:00-19:00	Networking drinks reception sponsored by NextDecade

LNG Procurement Forum: Adapting to market needs

This year's LNG Procurement Forum is hosted by the largest LNG purchasing nation on earth, which is appropriate for such a setting. The interest in this event has been unprecedented, even compared to the huge success of the inaugural event at Gastech Singapore.

This exclusive, invitation-only event welcomes 200 of the industry's most prominent and influential executives involved in the procurement, portfolio trade and end-use of LNG.

The 2017 event is supported by an array of key figures in the LNG industry from across the supply chain and

around the world. This global lineup, across speakers and delegates, brings together a multitude of industry experiences across a range of issues.

Through discourse and networking, attendees will share and draw on the collective wisdom of top industry decision-makers. The presence

of such established powerhouses and emerging players on both the supply and procurement sides demonstrates the importance of meetings such as this one, in a world where game-changing developments continue apace and new players continually come to the table. ■

THURSDAY, 6 APRIL	
14:00-14:10	Moderator Welcome and Introduction ■ Andrew Seck , Vice President, LNG Marketing and Shipping, Anadarko Petroleum Corporation
14:10-14:25	Keynote Address: Global LNG Market Unpredictability—What Might Happen Next? ■ Kentaro Kimoto , Executive Officer, Tokyo Gas Co., Ltd
14:25-14:40	Procurement Leader's Interview: The New Dawn For Demand Dynamics: What Impact Will Increased Supply And Weaker Demand Have On The 'Lower For Longer' Global LNG Market Outlook? ■ Hiroki Sato , Senior Executive Vice President, Chief Fuel Transactions Officer, JERA Co., Inc. ■ Subir Purkayastha , Director of Finance and Marketing, GAIL
14:40-15:20	Insights Panel Debate: The Rise of the LNG Portfolio Player—Winners and Losers? ■ (Moderator) Alexander Woody , Partner, White & Case ■ Andree Stracke , Chief Commercial Officer (Origination and Gas Supply), RWE Supply & Trading GmbH ■ Ezhar Yazid Jaafar , Chief Marketing Officer, PETRONAS LNG Ltd
15:20-15:50	Networking Refreshment Break
15:50-16:20	Collaboration and Competition Discussion: Risk Management, Trade Finance and Credit Risk within Emerging Markets ■ Yoven Mooroooven , Head of International—Global Energy Management, ENGIE ■ Luca Tonello , Deputy General Manager and Head of Project Finance Asia, SMBC
16:20-16:50	The Hub Debate: How Will Asia Move Beyond Oil Indexed Gas Contracts and Establish a Truly Liquid Regional LNG Market? ■ Fernando Impuesto , Commercial and Technical Services Director, Enagás S.A. ■ Kosuke Araki , Senior Manager, New Market Development Department, Tokyo Commodity Exchange (TOCOM)
16:50-17:30	The LNG Procurement Panel Debate: The changing supply/demand balance and adapting to market needs ■ (Moderator) Andy Cox , Head of Energy, KPMG, UK ■ Darshan Hiranandani , Chief Executive Officer, H-Energy ■ Kathleen Eisbrenner , Founder and CEO, NextDecade LLC ■ Dr. Phan Ngoc Trung , Member of Board of Management, Vietnam Oil and Gas Group (PetroVietnam) ■ Ratnesh Bedi , President, Pacific Oil & Gas (Woodfibre LNG) ■ Djohardi Angga Kusumah , Senior Vice President Gas and Power, Pertamina (Persero), PT
17:30-18:30	Close, followed by private networking drinks reception hosted by Mozambique LNG

CHENIERE ENERGY SHIPS 100TH LNG CARGO

Cheniere Energy Partners LP, a subsidiary of Cheniere Energy Inc., announced that the 100th cargo of LNG has left the company's Sabine Pass liquefaction facility, marking a milestone in Cheniere's ramp-up of LNG operations.

Including the 100th cargo, which departed on Saturday from the Sabine Pass liquefaction facility, Cheniere has delivered cargoes to 18 countries on five continents since the first shipment on 24 February 2016.

"This milestone for Cheniere is a testament to the global demand for American LNG, the hard work and dedication of Cheniere's workforce, and our unique business model that enables customers large and small to access this fuel," said Jack Fusco, Cheniere's President and CEO. "Our entire workforce shares in this milestone and in Cheniere's future success."

In February 2016, Cheniere became the first company to ship LNG from the contiguous US in more than 50 yr, and is now the only exporter of US LNG. In addition to three fully operational LNG trains at Sabine Pass, Train 4 has entered the commissioning process and is expected to reach substantial completion in the second half of 2017. Train 5 is now under construction and is expected to become operational in 2019. Train 6 is fully permitted and being commercialized. In addition, Cheniere Energy has two trains under construction at its liquefaction project near Corpus Christi, Texas, with operations at both trains expected to begin in 2019.

Across the liquefaction projects at Sabine Pass and Corpus Christi, Cheniere and its subsidiaries are expected to invest approximately \$30 B in US energy infrastructure, create tens of thousands of jobs, promote domestic energy production and reduce the US trade deficit.

CNOOC'S SOUTH CHINA LNG TERMINAL TO BEGIN OPERATIONS

A new terminal operated by China National Offshore Oil Co. (CNOOC) to receive LNG is expected to start full operations this year, according to a Reuters report.

The Quedong terminal in south China's Guangdong province has a receiving capacity of 2 MMtpy. The terminal has completed regulatory clearances with authorities, including Chinese customs and public security agencies, and become qualified for receiving imports.

CNOOC is China's largest investor and operator of LNG terminals, and the largest importer of the super-chilled natural gas. ■

ExxonMobil's HoloLens LNG Value Chain experience

ExxonMobil has introduced an app that allows viewers to build their own LNG value chain. It provides multiple options for customization, as well as the ability to begin a dialog with ExxonMobil for more information. The company is using cutting-edge technology to virtually immerse viewers through its LNG Value Chain, demonstrating how it can provide LNG to the marketplace.

The LNG App is delivered on Microsoft's HoloLens Mixed Reality Headset, the first self-contained, holographic computer, which enables viewers to interact with digital con-

tent and holograms. The user controls the experience through hand movements, including the "air tap" motion.

The ExxonMobil LNG experience takes the user on a four-minute journey through ExxonMobil's LNG Value Chain lifecycle, from liquefaction through to delivery to the end-user. At key points, the experience stops and asks the user how the gas should be transported, how the LNG should be regasified and, finally, where it should be delivered.

To dive into ExxonMobil's LNG experience, visit the team at stand 12-000. ■



ExxonMobil uses cutting-edge technology to virtually immerse two Gastech attendees in its LNG Value Chain experience.

SHELL, continued from page 1

Wetselaar also blamed escalating gas costs on operators. He said that the industry needs to be competitive, attractive and affordable for its customers. To achieve these goals through the price cycle, the director said that companies must exercise greater innovation and cost control by:

1. Getting the competitive scoping of a project right
2. Executing a project efficiently
3. Using technology to reduce costs or improve reliability, productivity and profitability
4. Transform the supply chain, where vendors are more open to sharing risks, to arrive at a win-win situation.

Environmental footprint. On his third point, Wetselaar said that the industry must make every effort to reduce the greenhouse gas intensity of the gas supply chain, particularly methane leaks. "We are at risk of undermining the credibility of the place of gas in the future energy mix, if high levels of methane are emitted across the value chain of delivery of our product. So, it is on every company in the game to do their bit—to detect leaks, to repair them and to reduce venting."

He declared that the industry must take control of this issue. "Measure, report, improve. That is the methane agenda," said Wetselaar.

New markets. On his fourth and final point, the director said that if the industry works on the other three agendas, then executives can confidently target demand growth. Since 2015, six new countries have joined the ranks of gas consumers. "As an industry, we can unlock far more demand by investing in import and distribution infrastructure, serving new customers and playing a key role in addressing energy poverty."

Looking at another dimension to new gas demand, Wetselaar pointed out that electricity meets only around 20% of global energy demand. With a gradual transition toward a lower-carbon energy system by 2050, electricity could make up 30% of the market share, according to Shell Scenarios.

Ultimately, Wetselaar thinks that electricity will be able to handle around 50% of total consumption toward the end of the century. That still leaves a considerable percentage of energy demand that cannot be met by electricity, opening a large market for gas over the next several decades.

In closing, Wetselaar said, "The power to do all of this is in our hands. So, let's embrace the opportunity, and in so doing, we will ensure that gas is a central part of the solution to the challenge of providing much more energy while emitting far fewer emissions." ■

Deploying technology in the “new normal” of low oil prices

HAVARD DEVOLD, ABB

Market dynamics are forcing a massive change in the industry’s approach to technology. Given the rise in unconventional sources and difficulties in reaching conventional deposits, it is likely that the current oil price downturn is a forewarning of a new status quo. Indicators including shale production metrics and renewable growth suggest that future oil prices will be in the \$40/bbl to \$60/bbl range.

Traditional responses to the “new normal” of low oil prices may be insufficient for long-term viability. For example, research from Strategy& shows that, while the revenues of upstream, midstream and oilfield services companies declined 40% between 2014 and 2015, operating expenses (OPEX) fell only 9%.

Digitalization offers new solutions. Today’s fourth industrial revolution is making “dumb” machines smart. Advances in secure cloud storage, improvements in wireless and computing capabilities, and sensor price declines are making it easy to use large-scale digital information to transform operations.

The Internet of Things (IoT) facilitates a granular view of company assets which, when viewed in conjunction with data from more traditional business systems (such as demand forecasting), generates quicker and deeper insights to drive competitiveness. Smart ecosystems help by aggregating, visualizing, analyzing and prioritizing big data sets to help people make better decisions and solve problems more quickly.

Four factors will distinguish the winners from the losers in this new era. First, leaders will pursue **enterprise-wide digitalization**. It will no longer be sufficient to have pockets of machine intelligence. For maximum

results, an entire ecosystem of smart equipment and appropriately informed human operators must be created.

Real-time information will help operators achieve more efficient and profitable production through demand-driven planning, reduced energy consumption and data-driven responses to asset conditions.

Processes and equipment will need to be **simplified and standardized**. Simple solutions are easier to replicate than complex ones, while standardized approaches and equipment are more straightforward and cheaper to monitor, manage, maintain and upgrade. This approach also significantly mitigates risk by eliminating disparate interfaces and data, and by having single-source accountability.

Pursuing integrated solutions from one supplier often reduces direct and indirect costs initially and across the lifecycle by streamlining the effort, space and equipment needed. ABB, for example, can deliver 20%–30% CAPEX and OPEX savings in most projects through integration across electrical, control, instruments and telecoms (ECIT) technology.

Winners will form **deeper relationships with suppliers**. In addition to the benefits of standardization and simplification, the scale of changes to come will be so large and disruptive that succeeding alone will be difficult.

Companies must carefully select their long-term partners to ensure that their portfolio is sufficiently large, and that they have a robust technology pipeline to keep operators ahead of the curve. An extensive track record and service offering will also be key, given the costliness of downtime.

Finally, **CEO leadership** will be critical. Important decisions will need to be made and priorities firmly com-

municated down the decision chain. Employee and supplier performance packages, for example, may need to be linked to longer-term results.

Applying digitalization in midstream, gas and LNG. Many companies already utilize digital components with measurement devices, such as electric flowmetering and data-intensive pipeline inspection gauges. However, further optimization is possible by using even more advanced analytics to increase profits via improved pressure monitoring, more efficient transportation fuel cost management, more accurate forecasting and a better view of overall operations.

The environment has changed significantly with the growth in unconventional energy that must be transported—particularly in the form of LNG and natural gas—from well sites to refineries, processors or storage facilities. Companies must expand or adapt aging infrastructure to track and optimize greater flows of an increasingly complex array of products from and to a variety of new locations.

Pipelines can fail for a variety of reasons, many of which can be minimized through increased automation and real-time surveillance.

Cloud-based systems can track and manage thousands of miles of pipelines. Machine and sensor data, weather information and geolocation data can be better mined to improve predictability and performance. Additionally, surveillance of electricity market indicators may signal increased future gas demand. On the supply side, by analyzing flow history and better tracking conditions, companies may improve predictions of where, and at what pressure and volume, the product to be transported will arrive.

Improved theft protection and leakage detection is also achievable. Theft from pipelines and other sources is estimated to cost more than \$37 B globally. Given that tankers can be filled in less than 15 min, prompt detection through real-time monitoring is useful.

Case study: Queensland Gas Co. (QGC), Australia. ABB’s collaborative operations approach focuses on the integration of telecoms, automation and electrification infrastructure, engineering, applications and service. This approach has enabled fewer than four people to oversee a complex operation via a single operator interface: ABB’s System 800xA. A 24-hr control room in Chinchilla allows operators to monitor and regulate the operations of wells, processing facilities and a 336-mile pipeline consisting of more than 6,000 wells spread over 1,352 square miles. Information is also shared with the Brisbane center, which oversees operations in Gladstone, where the two liquefaction plants are located.

QGC benefits from minimized operational costs and the ability to make real-time decisions to optimize production and respond quickly to alarms. It also maintains a stable energy supply through load shedding, load sharing, generator control and synchronization.

Staff and site safety are ensured via a full range of CCTV, intruder detection and hotline services enabled by a resilient fiber-optic infrastructure. Other assets are protected from cyber security incidents through a secure system architecture with advanced user control, host-based firewalls, continuous security patches and a secure-by-design philosophy.

This is the world’s first project to turn coal seam gas into LNG (FIG. 1). The two-train liquefaction plants produce up to 8.5 MMtpy of LNG. An estimated 250 Tcf of gas reserves lie beneath Queensland and New South Wales. Coal seam gas produces up to 70% fewer greenhouse gas (GHG) emissions than coal, and 20% fewer CO₂ emissions than oil, to create the same amount of electricity.

The project, which began construction in 2010, started producing LNG in 2013 and continues development today. ABB has worked more than 750,000 hr without lost-time incidents.

Moving forward. When thoroughly integrated, network-connected assets significantly decrease risk and cost, and improve scheduling. Operators must scrutinize how their technology is deployed to transform their operations to reduce costs and drive sustained profitability in the “new normal” of low oil prices. ■



FIG. 1. The world’s first project to turn coal seam gas into LNG is producing up to 8.5 MMtpy.

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FSRU/FSU market standards and growing small-scale compatibility

ANDREW STAFFORD, Trelleborg Marine Systems

When managing floating storage regasification unit (FSRU) operations, the ship-to-shore interfaces for gas output, and the interfaces between an LNG carrier (LNGC) and an FSRU for liquid transfer, are mission critical. The ship-shore link (SSL) is part of the emergency shutdown (ESD) and safety chain across this interface, carrying communications and data between ship and shore or between floating assets (FIG. 1).

A backward-compatible, high-speed digital design was developed in 2005–2007 to overcome the limited functionality of legacy SSL systems. With the implementation of FSRUs and floating storage units (FSUs) in 2007–2008, which required transfer support for multiple processes, this digital design



FIG. 1. The ship-shore link (SSL) is part of the emergency shutdown (ESD) and carries communications and data between ship and shore or between floating assets.

proved to be an ideal solution. However, regulatory standards took a while to catch up. In 2011, an ISO standard was released covering key compatibility aspects of the traditional large-scale LNGC ship-shore interface, but no standard emerged to cover the FSU/FSRU interface.

FSRUs/FSUs: Considering compatibility. In the absence of relevant standards, new FSRU/FSU projects are being designed in isolation. Arbitrary, bespoke interfaces have been developed without thought for wider compatibility. Requirements for ultra-fast Ethernet links via legacy fiber-optic infrastructure, as well as via standard instrument cable, have been seen without regard for feasibility of implementation or compatibility with other applications.

The further development of mooring arrangements for double bank and direct ship-to-ship transfers have introduced the installation of quick release hooks (QRHs) with integrated load monitoring onboard vessels. These require more complex interfacing between FSRU/FSU and the LNGC, in effect turning an FSRU/FSU ship into a shore, while always retaining the flexibility for the

FSRU/FSU ship to return to trade as an LNG carrier (FIG. 2). Meanwhile, the emergence of small-scale and LNG bunkering is only adding to the debate.

Looking back at large-scale transfer. The large-scale LNG marine transfer industry has used linked shutdown systems since the mid-1970s. The primary function of the link is to mutually shut down the connected counterpart system in the case of an ESD condition being raised on the local system. A number of the connectors began to offer additional functionality, beginning with telecoms and followed by mooring load with environmental data and, more recently, Ethernet and process data.

Although the actual connectors used ended up being quite standard, the pin configurations within the connectors were open to interpretation by the original system integrators, resulting in the majority of pre-2000 terminal installations using bespoke configurations.

Work on standardization of ship-shore links was undertaken in 2009, with the publication of the Society of International Gas Tanker and Terminal Operators (SIGTTO) document, “ESD arrangements and linked ship/shore systems for liquefied gas carriers.” This was followed by the publication of ISO 28460:2010, which defined standard pin-outs for the 37 pin and Miyaki-type systems.

These have had a positive influence on newbuild facilities. However, existing terminals have not moved to the standard pin-out, meaning that vessels are still required to configure per terminal. Additionally, both of these publications are limited to the transfer of LNG in bulk, and do not directly cover the newer application of FSRUs, FSUs and small-scale LNG fueling. Therefore, these newer markets are subject to interpretation of existing guidance with project-by-project developments being made.

FSRU compatibility. The first FSRU vessels were delivered in 2005 and, at that time, were installed with traditional SSL equipment. This was more than adequate for the initial applications of FSRU compressed natural gas (CNG) discharge at a jetty, or for offshore buoy with LNG reloading taking place via ship-ship transfer while removed from the jetty.

Increasingly complex operations soon required concurrent, and independent, discharge of CNG and reloading of LNG. This requirement introduced the concept of dual-ESD, which was not possible using existing SSL systems. Additionally, with FSRU terminals being built by and for domestic utility companies, a requirement existed for gas volumes and qualities to

be shared by the FSRU to the terminal.

Newer implementations are now being conceived to simplify the terminal to a simple tie-in location, with the entire process being managed by the FSRU (FIG. 3). This started with sending a few shore data values for temperature and pressure at a national grid tie-in point. More recent discussions center around the level of control the FSRU should have at the jetty, and specifications are being written and implemented to allow the FSRU to release both the shore QRHs and the shore-side loading arm powered emergency release couplings (PERCs).

FSU compatibility. FSU applications typically originate from conversions of existing LNG carriers. During conversion, it is preferable to reuse as much of the pre-existing installation as possible. In terms of ship-shore links, there will be an existing SSL “ship” system onboard, but techniques used in the original fiber-optic links mean that an LNG carrier link can only ever connect fully to a “terminal” system.

Historically, the optical fiber has never offered a ship-ship mode for both ESD and telephony due to these compatibility issues. Since an FSU is effectively the storage extension of an onshore facility, increased integration between the FSU and terminal is critical. Existing fiber-optic cabling performance must be addressed, as the original SSL fiber-optic specification is for a 50/125µm OM2 offering limited bandwidth over distance. User expectations for high speed and long distances must be managed, as it may not be possible to implement this link using existing infrastructure.

Depending on the facility, an enhanced input/output (I/O) signaling between terminal and vessel may be required. If the signal is required to have high integrity, such as an additional level of shutdown, then a hardware-based I/O channel within the core SONET packet structure can be implemented. However, for process control I/O, if serial data is not an option, then third-party distributed I/O hardware modules can be implemented with the SONET Ethernet.

Small-scale compatibility. Emerging small-scale LNG applications have presented the industry with a crossroads in terms of ship-shore link compatibilities and functionality. The first option is retaining the bespoke links and allowing the small-scale market to inherit existing large-scale system types with their limited functionalities. Alternatively, the opportunity to globally standardize and simplify new vessels by using up-to-date and international standard technologies both

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future-proofs the industry and creates flexible trading assets.

Building on the SONET technology, now well-proven in the FSRU market, small-scale shutdown links have the opportunity to integrate the ESD, telecoms and process control functions together within a simple link. The Trelleborg Universal Safety Link is installed on some of the leading projects in the sector, and offers operators a level of oversight and control not previously seen in the LNG transfer market. Process data for the remotely connected system can be displayed and made available to the local operator, and the network link has enabled full control DCS interlink between vessels and terminals.

Special case considerations for intermediate vessels could load from an existing large-scale facility and then distribute to a number of smaller customers. In this case, the asset would need to be equipped for connection to the legacy system, as well as for the new small-scale systems. As the small-scale technology is based on that contained in FSRU applications, cost-effective solutions allowing connection to all applications exist.

Need for a standard interface.

The piecemeal evolution of the large-scale LNG market has led to the proliferation of standards that the industry is still addressing today. Although ISO standards are now in place, no proactive modifications have been made to the configuration of existing terminals, which do not conform to the standard

pin-out. This is forcing LNG carriers to continue to install complicated configurable systems that could lead to delayed connections.

As newer fleets of FSRU and FSU vessels are constructed, they are not being built to a common standard. Although much attention has been paid to ensure that links are physically compatible in terms of connectors and signal transmission format, application data is being implemented at a local level, which does not lead to standardization. In an industry that requires worldwide compatibility, this represents a major challenge.

Consideration should be given to forming an industry working group that looks at the requirements of standard data and interfacing to generate a core specification. This core specification could then be adopted as standard practice into future guidelines, helping reduce project timeframes and simplify integration between systems.

Andrew Stafford, Technical Director at Trelleborg's marine systems operation, will be presenting a paper titled, "Interface standards for FSRU, FSU and small-scale sectors," on Thursday, April 6 at 4 p.m. at the Main Conference Center.

Trelleborg's marine systems operation and Teekay Marine Solutions will launch a new, premium pneumatic fender offering. Representatives from both companies will be available at exhibit 16-320 to discuss the new HALO Fender offering for the ship-to-ship (STS) transfer market and the wider marine industry. ■



FIG. 2. Integrated load monitoring onboard vessels retains the flexibility for the FSRU/FSU ship to return to trade as an LNG carrier.

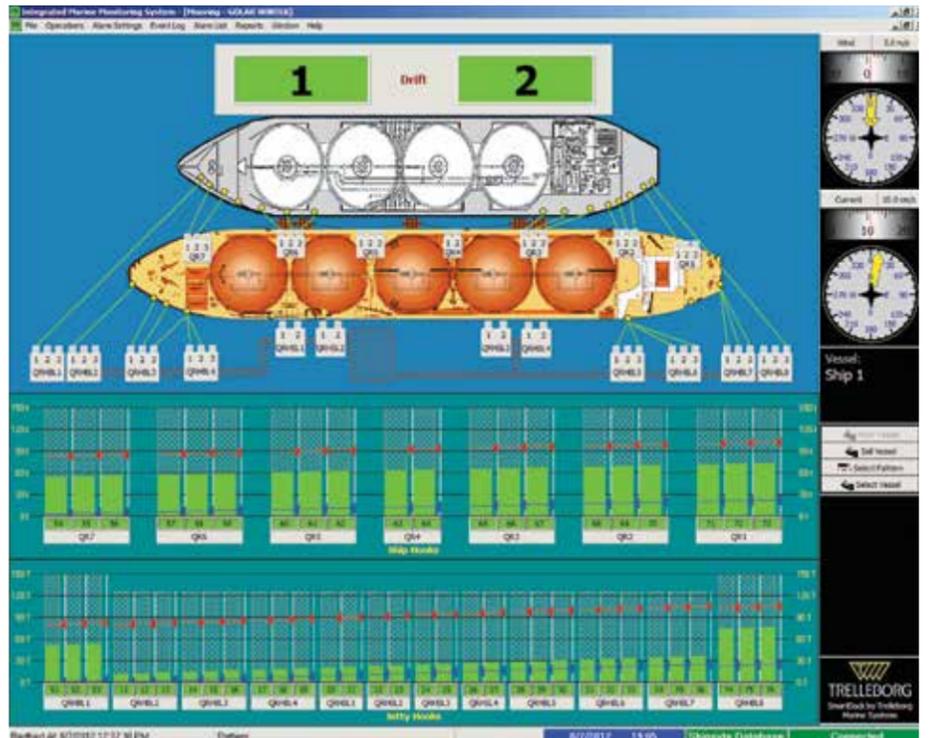


FIG. 3. Newer implementations are now being conceived to provide the FSRU with an increased level of control and to send shore data values for temperature and pressure at a national grid tie-in point.

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Yokogawa collaboration to develop IIoT architecture

MITS SAGAE, Yokogawa

Yokogawa Electric Corp. has announced that it will work with Microsoft Corp., FogHorn Systems Inc., Bayshore Networks Inc. and Telit IoT Platforms LLC to integrate their technologies into an IIoT architecture for the delivery of new services. These four companies each possess technologies that will be key components of this IIoT architecture.

Outline of the tie-up. IIoT technology is now ready for practical use

thanks to advances in network technology, the availability of low-cost, large-capacity data communications, and the shifting of corporate information systems to the cloud. However, the use of IIoT technology presents many technical challenges in areas that include sensing, automation and security, and it is also costly to build such systems and develop the necessary applications (FIG. 1). With its wide range of expertise in fields ranging from sensor technology to

control logic and applications technology, Yokogawa aims to transform its business model and expand its business scope, and to help its customers address issues by providing end-to-end solutions that incorporate sensing, control and cloud-based processing.

Through this architecture, business process applications can be configured that enable plug-and-play sensors (the ability to automatically detect sensors and other instruments connected to a network, make appropriate settings and enable them to work immediately), sensing clouds with automatic provisioning (for the efficient utilization of cloud platforms, the process of connecting sensors and other devices to the cloud via a network, and dynamically making the necessary changes for the exchange of data), database clouds, historian (data storage) clouds, and application development environments that foster collaboration.

This undertaking will be led by the Architecture Development Division California, which was set up in November 2016. Yokogawa's IIoT architecture will integrate the cloud-based Microsoft Azure IoT Suite; FogHorn's fog computing software; Bayshore's security technology for layer 7 (the application layer—the top layer in the open systems interconnection reference model) of the OSI reference model (a model in which the functions of communication devices are divided into seven layers, and defined by the ISO to facilitate data communication among different communication systems); and Telit's com-

munication modules, sensor onboarding and device management.

The cloud-based Microsoft Azure IoT Suite platform, which provides businesses with globally scalable, pre-configured IoT solutions, will enable Yokogawa to connect its devices, analyze previously untapped data and integrate business systems.

FogHorn Systems is a Silicon Valley-based startup that has been deeply involved in developing core software for fog computing and that owns advanced technology in this field. Yokogawa invested in the company in July 2016. Fog computing is an architectural concept designed to avoid communication congestion by establishing a “fog” distributed computing layer between the cloud and devices in the field. Fog computing eliminates communication delays and fluctuations by locating the processing of certain data near the field devices and sending only essential information to the cloud. This technology is expected to lead to a number of new IoT applications.

Founded in 2012 and headquartered in the Washington D.C. area, Bayshore develops industrial cyber security solutions, offering visibility, control and protection for operational technology infrastructure and applications. Yokogawa invested in this company in November 2016.

Telit is a leading enabler of end-to-end IoT solutions. The company offers a broad portfolio of integrated IoT products and services, including cellular communications modules, IoT connectivity plans and IoT platform services. ■



FIG. 1. IIoT technologies are becoming vital to successful operations in the oil and gas, LNG and LPG industries.

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As a one-stop solution for blast-resistant buildings, HUNTER buildings can be configured for numerous applications, including compressor, operator, and metering and instrumentation stations. ■



Changing lanes for NGL

The emergence of new trade lanes—made possible by new sources of natural gas and liquids—and changes to shipping and logistics infrastructure are reshaping the dynamics of the global gas market.

Demand for very large gas carriers (VLGCs) is being driven in part by the surplus of natural gas liquids, such as ethane produced as a byproduct of shale oil and gas in North America. The export of these ethane cargoes is pushing the limits on vessel sizes and placing new demands on technology providers.

Meanwhile, the expansion of the Panama Canal is driving a revolution that will see the US move from being a net importer to a net exporter of LNG, particularly to Asian markets. In response to the shifting supply/demand picture, ship designers are developing new vessel and containment system concepts as owners and shippers look to move cargoes to new destinations.

The launch of the world's first very large ethane carrier (VLEC), the *Ethane Crystal* (FIG. 1), in November of last year marked a milestone for the gas market and ABS.

The *Ethane Crystal*, the first of a series of six VLECs, is serving a new trade route between North America and India, carrying ethane that will be used as feedstock for petrochemical production by its owner, India's Reliance Industries.

This series of state-of-the-art liquefied gas carriers are able to carry cargoes such as ethane and liquefied petroleum gas (LPG). With an 87-Mm³ (thousands of cubic meters) cargo carrying capacity, the vessels are the first to be built with a specially designed GTT Mark III membrane cargo containment system.

"Vessels like this VLEC can help make expansion into new and emerging markets scalable and economical for the entire supply chain," said ABS Execu-

tive Vice President for Global Marine, Kirsi Tikka. "ABS provides support to owners and operators throughout the design, construction, delivery and operational life of their vessels to advance safer and more sustainable shipping."

The Reliance vessels represent a significant step up in size from the largest ethane carriers delivered to date, the 37-Mm³ ABS-classed *Navigator Aurora* and *Navigator Eclipse*. The new VLECs are comparable in size to

today's VLGCs, and support a more efficient level of operation that helps make large-scale ethane transportation practical for the first time.

Built by Samsung Heavy Industries, the *Ethane Crystal* and its sister vessels combine multi-cargo capability with an "eco-friendly" design. ABS provided dedicated technical support to the shipyard during design and construction, as well as to containment system provider GTT. ■



FIG. 1. The ABS-classed *Ethane Crystal* (the world's first VLEC), was delivered to India's Reliance Industries Ltd. by Samsung Heavy Industries (SHI) of South Korea. Photo courtesy of SHI.

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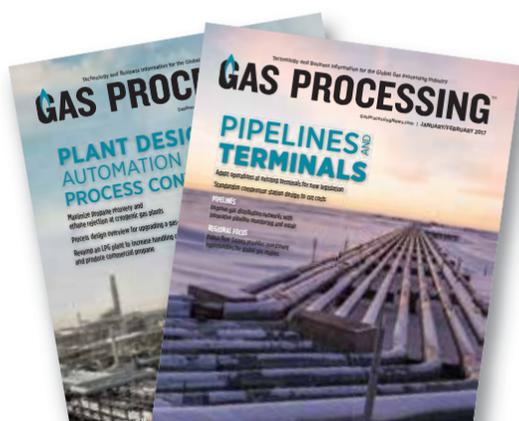
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Glimmers beyond the glut

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The gas liquefaction construction boom is here—millions of tonnes (MMt) of capacity are coming onstream over the next two or three years from the US to Malaysia and the Russian Arctic to Australia. However, it is not going to last. With supply poised to outstrip demand, some developers are delaying final investment decisions (FIDs) on fresh capacity until a rebalancing of the LNG market is in sight, and that is unlikely to happen before the early-to-mid 2020s (TABLE 1 and FIG. 1).

More than 140 MMtpy of global LNG capacity is due to be added between the start of 2016 and the end of 2019, with 51 MMtpy scheduled to start up this year alone, according to consultancy Energy Aspects. Much of this capacity originates from Australia, which is set to surpass market leader Qatar's 77 MMtpy of LNG capacity this year; and the US, where capacity is forecast to reach 65 MMtpy by the end of the decade.

Much of this capacity was sanctioned in the aftermath of the Fukushima disaster of March 2011, which prompted both a shutdown of all Japanese nuclear capacity while safety checks were carried out, and a scramble among Japanese power companies to secure LNG import contracts. This, plus healthy gas demand growth in South Korea—the world's second-largest LNG importer after Japan—and the huge potential of the Chinese

and Indian markets, gave the sector a rosy looking future.

With Japanese demand now expected to fall as nuclear plants come back online and demand flattens in South Korea, the picture has changed. Increased demand from China, India and elsewhere can be expected to help fill the gap, but the installation of import and pipeline infrastructure to enable those countries to switch from coal to gas will take time.

The result is that many LNG developers are already retracting their horns and delaying the sanctioning of new capacity until they can be sure of finding buyers. The trend is clearly visible in the recent fall-off in FIDs. Only two projects in Indonesia and the US, adding approximately 6 MMtpy of new capacity, reached FID in 2016—the lowest figure since 2008, according to Wood Mackenzie.

Tipping point. At present, supply and demand in the global LNG market remains broadly in balance, even if nominal liquefaction capacity is higher. In the northern hemisphere winter, LNG demand for big importers, such as Japan and South Korea, has been enough to push up spot prices to a ceiling set largely by the cost of switching to oil for peakshaving in the power markets of northern Asia.

Meanwhile, as demand eases in the shoulder season of April–May, the LNG market is expected to move to

oversupply, with a falling price taking its lead from European demand. Consumption in Europe is partly linked to the cost of coal-to-gas switching in the power sector.

While expectations of a cold 2016–2017 winter in China and northern Asia, a recent spike in Japanese LNG demand and strong growth in emerging markets (e.g. Pakistan and Egypt) have all given a leg to the market, this state of affairs will not last.

“The market is going to move into an oversupplied position through the back of 2017 and into 2018, but it will not be until mid-2018 that we will see substantial oversupply coming into the market,” said Giles Farrer, an LNG market analyst at consultancy Wood Mackenzie.

Export capacity already exceeds demand, a situation that is not likely to change this decade. Oversupply will contribute to downward pressure on LNG prices around the globe next year and beyond. Energy Aspects forecasts that the average annual price of LNG into Japan in 2018 will be \$4/MMBtu, compared to \$5.50/MMBtu in 2016 (FIG. 2).

The upshot is that some LNG plants may not run at capacity for the next few years. In the US, despite the first cargoes reaching Asian markets from Sabine Pass through the Panama Canal this year, offtake is likely to be determined by prices in Europe. Prices may not always be attractive enough to warrant shipping all the LNG that buyers are entitled to take (FIG. 3).

In Australia, companies are weighing whether the economics stack up for the drilling of new coalbed methane (CBM) wells to provide feedstock for Queensland's LNG facilities, some of which have been running under capacity. Meanwhile, the pressure is on to use more of the country's gas reserves for domestic consumption. Both factors could potentially limit feedstock supply to export facilities, although Wood Mackenzie thinks that CBM drilling

for export is likely to remain viable.

Few forecasters predict that the LNG market will return to a more balanced situation before the early-to-mid 2020s. “We think that the window starts to reopen in 2023, but it will really take off in 2024–2025. That is when big new trains will be required in the market,” Farrer said.

In a recent report, Moody's Analytics stated that it expected the temporary excess of global supply to peak at 55 MMtpy in 2019, with significant volumes of US LNG potentially destined for Europe. As global demand and LNG import infrastructure catch up with supply, the market will rebalance in the early 2020s.

The timing of these estimates suggests that the amount of export capacity reaching FID will remain limited until 2019–2020, although some hotspots will remain, such as the US, and East and West Africa, where floating LNG projects are being planned in Mozambique, Cameroon and Equatorial Guinea. Incremental capacity increases at existing plants, such as ExxonMobil's PNG LNG in Papua New Guinea and US plants, are also in the cards.

Fresh pastures. On the demand side, major LNG offtakers and portfolio players, such as Shell, Total, Engie and Gas Natural Fenosa, will be busy seeking to increase uptake in emerging markets. They have an expanding field to work in: 38 countries were importing LNG in 2016, compared with just 10 in 2008.

The main centers for LNG demand growth will be obvious, such as China and India. However, significant market growth is also likely for some new and growing importers, such as Pakistan, Egypt, Caribbean countries and south-east European states. Latin American countries are also likely to take more LNG, even if Brazilian LNG imports have fallen recently due to higher-than-expected domestic hydropower generation. Colombia, Peru and Chile are among South American countries beefing up their regasification capacity.

Beyond 2020, a new LNG boom could be in the offing but, until then, most investors are likely to be sitting on their hands, waiting to seize the right moment to act. ■



FIG. 3. The oversupplied LNG market will continue to pressure prices.

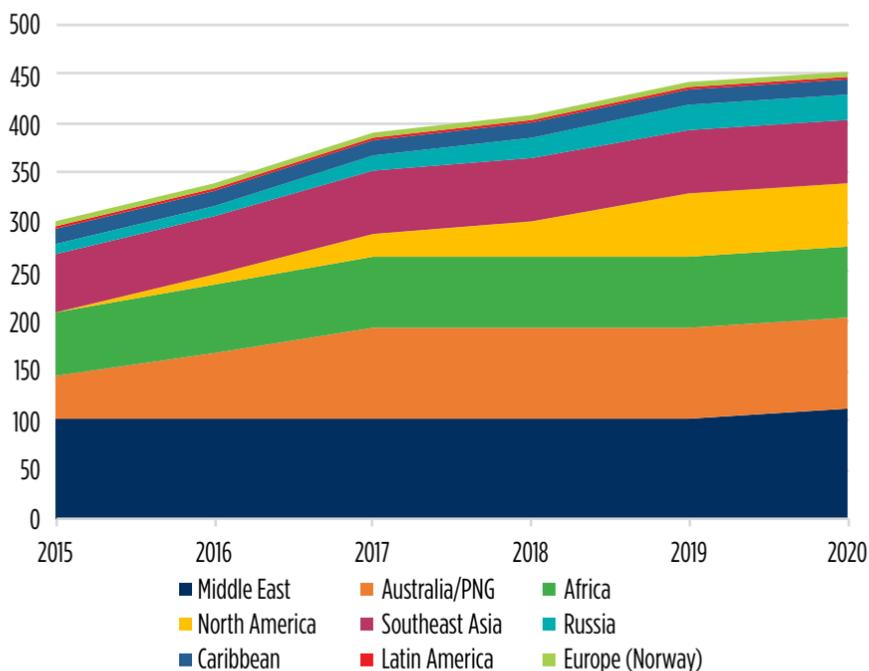


FIG. 1. Projected LNG demand, MMtpy. Source: Wood Mackenzie.

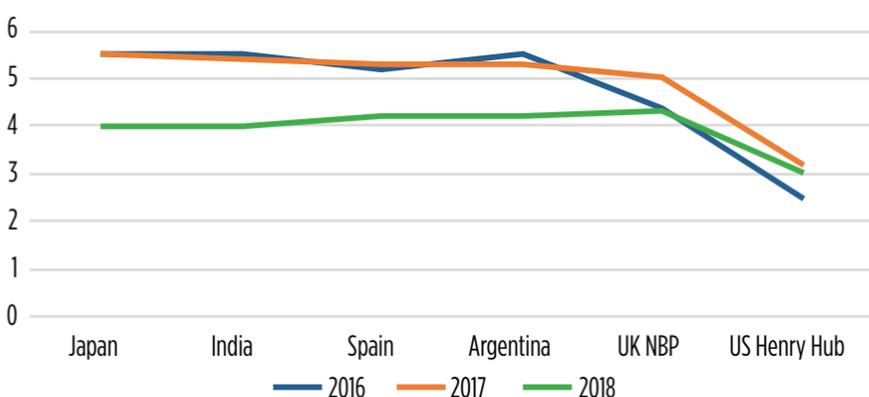
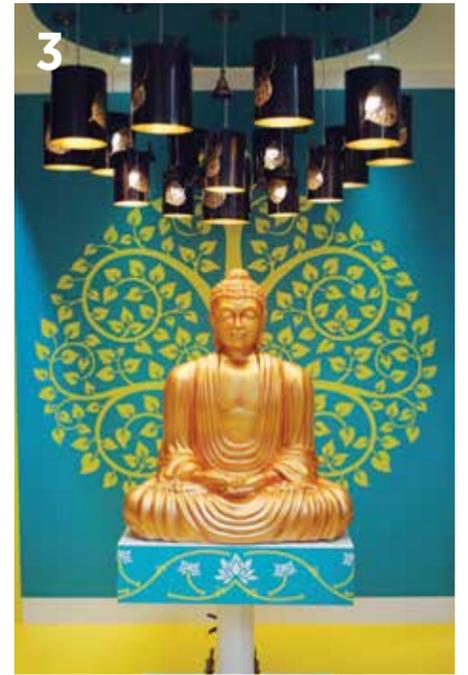


FIG. 2. Softening market, average annual LNG price forecasts, \$/MMBtu.

Table 1. LNG demand is growing, but too slowly, MMtpy						
	2015	2016	2017	2018	2019	2020
Asia-Pacific	176.67	192	194.9	212.82	231.97	243.25
Europe	37.28	36.47	55.02	66.52	71.28	73.24
Middle East	7.11	11	10.19	11.63	13.53	12.02
North America	8.92	7.35	6.91	7.45	8.06	8.69
South America	11.28	9.03	9.1	12.12	14.69	15.08
Africa	2.66	6.25	6.1	4.54	3.13	1.15
Global LNG demand	243.92	262.1	282.22	315.08	342.66	353.43

Source: Wood Mackenzie

Scenes from Gastech



- 1 On Wednesday afternoon, Gastech attendees, like these gentlemen visiting the KOGAS booth, really got down to business.
- 2 The Gastech Consortium and dmg :: events welcomed attendees to an incredible opening reception Tuesday evening, complete with Japanese epicurean delights, wine and spirits, and traditional music played on the Japanese harp, the koto.
- 3 A highlight of the GAIL (India) Ltd. stall design is the “Bodhi Corner,” which has a representation of the Buddha under a chandelier of Bodhi tree leaf-imprinted lights. The display is a signifier of enlightenment and continued growth, a source of inspiration for GAIL in its pursuit of excellence in business.
- 4 Samsung featured detailed models of its various facilities and vessels, including the Ichthys Explorer (foreground).
- 5 Gazprom Deputy Chairman Alexander Medvedev said during Tuesday’s plenary session that his company has supplied Western countries with 24 Tm³ of natural gas in its years of trading with those nations.
- 6 The future of the natural gas and LNG industries is in the capable (and exuberant) hands of the Young Gastech professionals.
- 7 The team from Nigeria LNG Ltd. are ready to discuss the abundant opportunities available in their country.



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