



ation ready for carbon capture and storage (CCS), others expect merely limited support schemes for less carbon-intensive technologies, which will not penalise CO<sub>2</sub> emissions.

### South America

The Strategic Panel looking at Gas to Power in South America was moderated by Sylvie D'Apote, Associate Director in Brazil of Cambridge Energy Research Associates. South America has taken an impressive leap forward in gas-fired power generation in the last decade, with more than 20 GW of new gas-fired generation built. Nevertheless power generation is dominated by hydro and to a lesser extent oil. The continent has vast gas reserves, but lacks infrastructure connecting the main markets with the main fields. There are various pipeline projects in the planning stage, but the absence of a stable political framework seems to hinder the development of international trade. Instead, countries are focusing on optimising domestic resources and Brazil is even considering the construction of two LNG regasification terminals to be able to import gas from outside the Southern Cone.

In an ideal situation, countries in South America would benefit from a regional integration of gas and power networks, but in the current climate this cooperation seems difficult to achieve. Gas for power generation has to compete with a range of alternative fuels and some of the experts questioned whether the gas industry should not try to grow in other sectors apart from power.

### ● Natural Gas Vehicles

NGVs were the subject of three sessions at WGC2006. The first was a Strategic Panel on June 6 entitled "Natural Gas Vehicles: The Road Ahead?". Moderated by John Lyon, President and CEO of FuelMaker Corporation in Canada, this heard presentations from two vehicle manufacturers, Jürgen Banken of Daimler Chrysler

(light-duty vehicles) and Manuel Lage of Iveco (heavy-duty vehicles). They pointed out the availability of a wide range of vehicles, most of which are sold in small quantities. Of particular interest was their assertion that their vehicles could cope with varying gas qualities while still meeting emission standards. Pascal Zenneta of Gaz de France spoke of his company's work and Bernard Jeken of Erdgas mobil talked about Germany's aggressive programme to build a refuelling network. Jeff Seisler of the European NGV Association and Garth Harris of the International NGV Association between them gave an overview of the state of NGVs around the world, which covered numbers of vehicles and refuelling stations and government support programmes. Mr Seisler also presented information on EU activities.

Discussion following the panel presentations was about the government incentives in Europe, which revolve around tax reductions, grants for vehicle purchase or conversion, refuelling station grants and reductions in congestion charges. One questioner asked what was holding back the development of the light-duty vehicle market. Mr Banken replied that Mercedes offers a full range of vehicle types and that there is a marked increase in the desire to purchase NGVs – 30% of people questioned in a survey responded that they were interested in purchasing. It was noted that in Brazil all NGVs are light-duty vehicles and that all the cars are converted, i.e. there are no cars built as such by an original equipment manufacturer (OEM). In general, it was noted that older vehicles cannot meet today's emission standards, for which new vehicles are required, and that governments will need to provide support for the NGV industry for a lengthy period. There was discussion about globalisation and the degree to which harmonisation of best practices and standards was both possible and desirable. Finally, the question was raised as to what the NGV industry needs to do in order to raise awareness of the potential and benefits of NGVs.



New platforms' topsides



1600 km of oil & gas pipelines



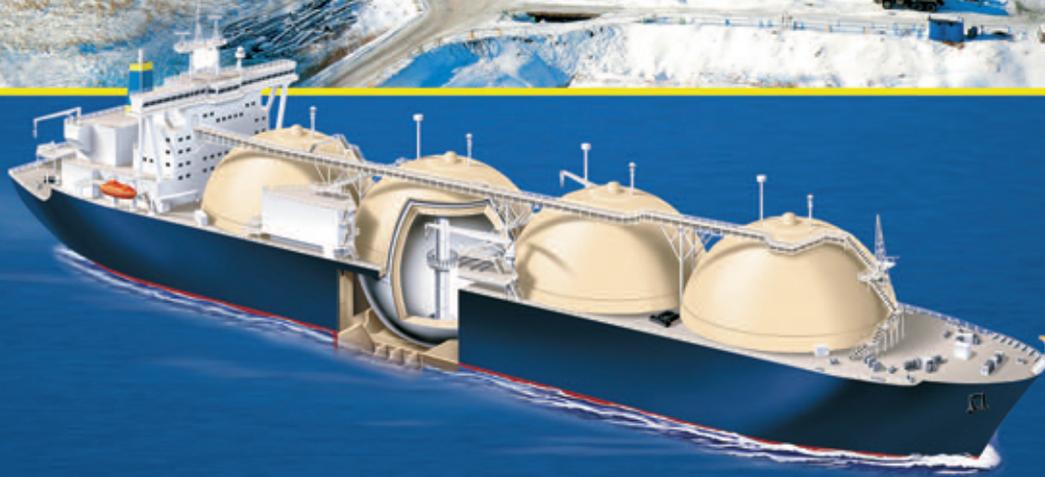
Onshore Processing Facility



LNG tank roof raising

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## Sakhalin Energy

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### Committee session

Following the Strategic Panel, a WOC 5 Committee session included the presentation of Study Group 5.3's report on "Global opportunities for natural gas as the transportation fuel for today and tomorrow". This was prepared by a team of 30 experts led by Davor Matic of the Energy Institute Hrvoje Pozar in Croatia and can be found at [www.iangv.org/component/option,com\\_docman/task,doc\\_details/gid,114/](http://www.iangv.org/component/option,com_docman/task,doc_details/gid,114/). The report contains the following sections:

- An overview of existing technologies from the simplest to the latest developments: light- and heavy-duty vehicles, fuelling, fuel production and storage. In the case of vehicle technologies, the same technology might be used for CNG and bio-methane; thus, the emphasis in the case of bio-methane was put on different ways for biogas production and upgrading. In this context, the term biogas is used for the raw product and bio-methane for the final purified and upgraded product (containing around 95%vol methane).
- An analysis of the latest technologies in 23 countries was made. For example, in the case of CNG, the existing technology in Argentina relates to converted cars; in Italy there is a combination of converted cars and OEM products; and in Austria there are only OEM vehicles. There are case studies for selected countries. (In the case of biogas, for example, the representative countries are Sweden and Switzerland.)
- Trend analysis has been provided for the same countries with observed trends in the number of new NGVs, fuelling stations etc., together with the influencing external factors. This identifies the key drivers for each specific case.
- Experts also provided their view on strengths, weaknesses, opportunities and challenges (a



Apart from the three working sessions, NGVs also had a dedicated area in the WGC2006 exhibition.

SWOC analysis) regarding their particular country/market.

This report and the associated databases will be used in a follow-up WOC 5 project over the next Triennium to look more closely at the national, regional and global potential and markets for NGVs. The emphasis of this new project is to develop a global strategy for NGV commercialisation using different and appropriate technologies, covering on- and off-road applications and taking into account CNG, LNG and bio-methane. The report will be presented at the next World Gas Conference in Argentina in 2009.

#### *Expert forum*

Finally, an expert forum included a round table on global activities and strategies for better efficiency in the “methane for vehicles business”. Seven experts discussed the effects of globalisation and harmonisation, which should result in lower costs due to economies of scale and uniformity of standards and codes of practice. They observed that emission rules vary from country to country at present, with some countries having lower requirements. There was discussion about different fuel connectors from country to country and the difficulties this creates when vehicles cross borders. This is a particular issue in South America and Mercosur is looking at a transitional solution for uniform connectors which will take about five years. It was also noted that the NGV sector will have to work with the LPG sector to ensure that common safety standards are applied.

The other event of great importance to the NGV business was the election of Datuk Abdul Rahim Hj Hashim as Vice President of IGU. Datuk Rahim is President of the Asia Pacific NGV Association and a Vice President of Petronas, Malaysia.

In summary, there is gradually rising interest in NGVs in the gas industry. The aim is to have an even greater NGV presence at the next World Gas Conference in Argentina in 2009.

#### ● **Capital for Gas: Sufficient and Transparent?**

This Strategic Panel was moderated by Tim Eggar, Chairman of Harrison Lovegrove & Co. Limited in the UK and a member of the President’s Wise Persons Group 2003-2006. Seven panellists from Europe and North America, including the Secretary General of the World Energy Council, discussed the level of investment upstream by oil and gas companies in new resources and downstream by refineries and power companies.

They started by emphasising that there is plenty of gas available in producing countries, and that there is more than enough money available at relatively cheap rates to finance the projects needed to bring sufficient gas to the market. However, they noted that risks in the gas chain have increased significantly in recent years, and this seems to have resulted in a postponement of proposed projects. Moreover, there is serious doubt about the future growth of the market for gas, in particular due to uncertainties regarding gas to power and the effects of the Kyoto Protocol. Nuclear, coal and renewables may (or may not) be important competitors.

Investments in the new gas producing countries are difficult to achieve and require long lead times due to political uncertainty and various forms of bribery and corruption. There is insufficient transparency about the decision-making processes in these countries.

In the liberalising markets, there is a significant regulatory risk. Even existing contracts are at risk with regard to regulatory intervention. New projects require a long-term vision, while regulators usually only look at the short term. As regards commercial risk, the timing of new projects is at least three to four years, while (switching) customers look only one to two years ahead. This makes suppliers nervous about entering into new long-term purchase contracts.

In many countries, there is increased public resistance to large-scale industrial projects. This

# Execution of Nuon's Gas Strategy: A Foundation to Build Upon.

As the European Gas market has been relatively closed, Nuon since 2002 has been consistent in striving to acquire or develop flexibility for its customer books. To that end, Nuon evaluated the market from a bottom up approach. This approach led to an analytical approach to gas commodity sourcing, gas flexibility and portfolio management.

Nuon decided that the most critical aspect to its long term value proposition was to develop its own flexibility instruments that could be utilized as the market was opening. Currently a majority of Nuon's gas that is sold to retail, business and the power assets is purchased from Gasunie Trade and Supply. Nuon's strategy has been to develop a long term business approach that would allow a more balanced approach to gas sourcing.

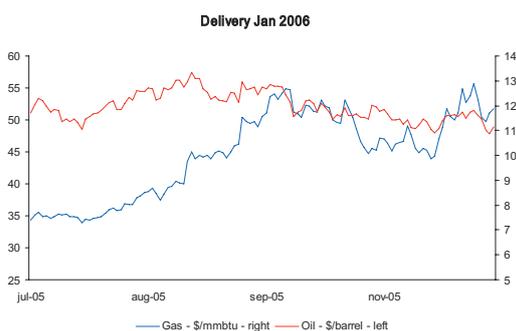
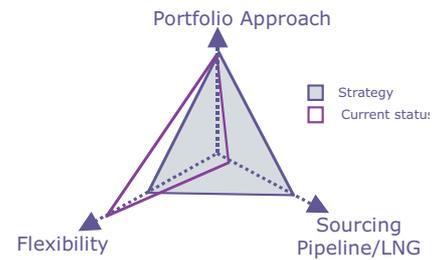
Consequently, Nuon decided in 2004 to develop Epe Gas Storage. In late 2005, Nuon further committed to this strategy by agreeing to co-develop Zuidwending Gas Storage in a joint-venture with Gasunie B.V.

## Assets

These storage assets are positioned to balance NL customer demand at the Title Transfer Facility and are designed to provide peak deliverability for the retail clients, to bundle gas sales to power assets and industrial consumers and to allow potential diversification via the growing LNG business, plus benefit from potential arbitrage opportunities in the different European Gas market with its diverse price drivers. An additional criterion that is inherent in our strategy is the connectability of the NL market to the UK market. LNG, existing pipeline gas as well as new pipeline projects have convinced us that by 2010 the market will be a real Northwest European gas market. The two storage projects form a solid foundation for Nuon to go forward in the ever changing European energy market and will allow Nuon to pull 1,100,000 m<sup>3</sup>/hr out of storage and inject 260,000m<sup>3</sup>/hr initially with a total working gas capacity of 238 million m<sup>3</sup>. Effectively it is possible to withdraw the total volume in 9 days and fill the caverns in 38 days.

## Diversification

Pipeline gas from outside of the Netherlands and/or LNG will play an increasing role for the Dutch State as it attempts to manage the production from the Groningen gas field via legal production cap on the field. This cap was introduced due to the decline in production from the small fields, reservoir management concerns and a strong desire to manage the Groningen field for the long term. Following this cap, the Ministry of Economic Affairs is extremely favorable to the addition of one of more regasification terminal (s) to the Dutch coast. Nuon has developed an LNG strategy and is in negotiations discussions with the developers of regasification capacity in the Netherlands but most importantly with suppliers in the producing countries. Nuon is convinced that a successful LNG supply contract will allow for diversion of LNG to the most attractively priced market and that the pricing structure in Europe as well as Nuon's unique asset and geographic position will allow Nuon to participate in a type of sink and source role. Even in an illiquid market, Nuon can effectuate diversion due to its storage facilities, pipeline capacity and power plant optionality.



Thus, Nuon's historic investment decisions make it well positioned and able to make use of its integrated vertical model and portfolio of plants, storage, entry capacity and customer books to make an attractive offer to the producing community. In the next four years, the successful companies will primarily consist of those companies with the right assets, the right strategy and the ability to execute.

Rick Lorio  
 Director Origination/LNG at Nuon  
 Jippe van Eynatten  
 Senior Deal Structurer at Nuon

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maintain this lead, Nuon is developing a 1200 MW multi-fuel power plant. Supported by a stable 10 bcm end-user customer gas portfolio, Nuon is executing a significant capital investment programme in gas storage assets to optimally respond to customer demand as well as the future demand of a LNG terminal in the Netherlands. Like to find out more? Visit [www.nuon.com](http://www.nuon.com)



“NIMBY” phenomenon tends to postpone or even eliminate investments.

It was also noted that a stable gas market including sufficient security of supply requires some form of over-investment, but that it is not clear who should be responsible for this in a liberalised market. Consequently, the security of supply problem is continuously in the news and there are serious doubts about the reliability of gas supplies.

The increased risks for new projects have forced gas companies (and banks) to use a higher weighted average cost of capital (WACC) for gas projects, which will ultimately result in higher gas prices. The irony is that, while governments expected and promised lower gas prices due to liberalisation, prices may be higher than necessary due to the increased risks in the gas chain.

Higher gas prices and continuous discussion about the reliability of gas supplies will ultimately harm the gas industry as it may eliminate growth opportunities. It is therefore of utmost importance that the gas industry and governments find ways to reduce risks in the gas chain and to maintain the perception of gas as a reliable energy source.

IGU is playing an important role in finding solutions. It has embraced the initiative against bribery and corruption. It has started discussions

with the regulators, in an attempt to orientate regulatory regimes towards a long-run, incentive-based approach instead of cost-plus in the short run. And, for example, via the Special Project Gas to Power, it has tried to throw light on the future of gas to power and has opened the debate with power producers.

It was concluded that IGU should continue to act in this way with the objective of removing any obstacle that may hinder gas continuing as the preferred energy source for the world.

### ● Sustainable Development: It’s Up to Gas

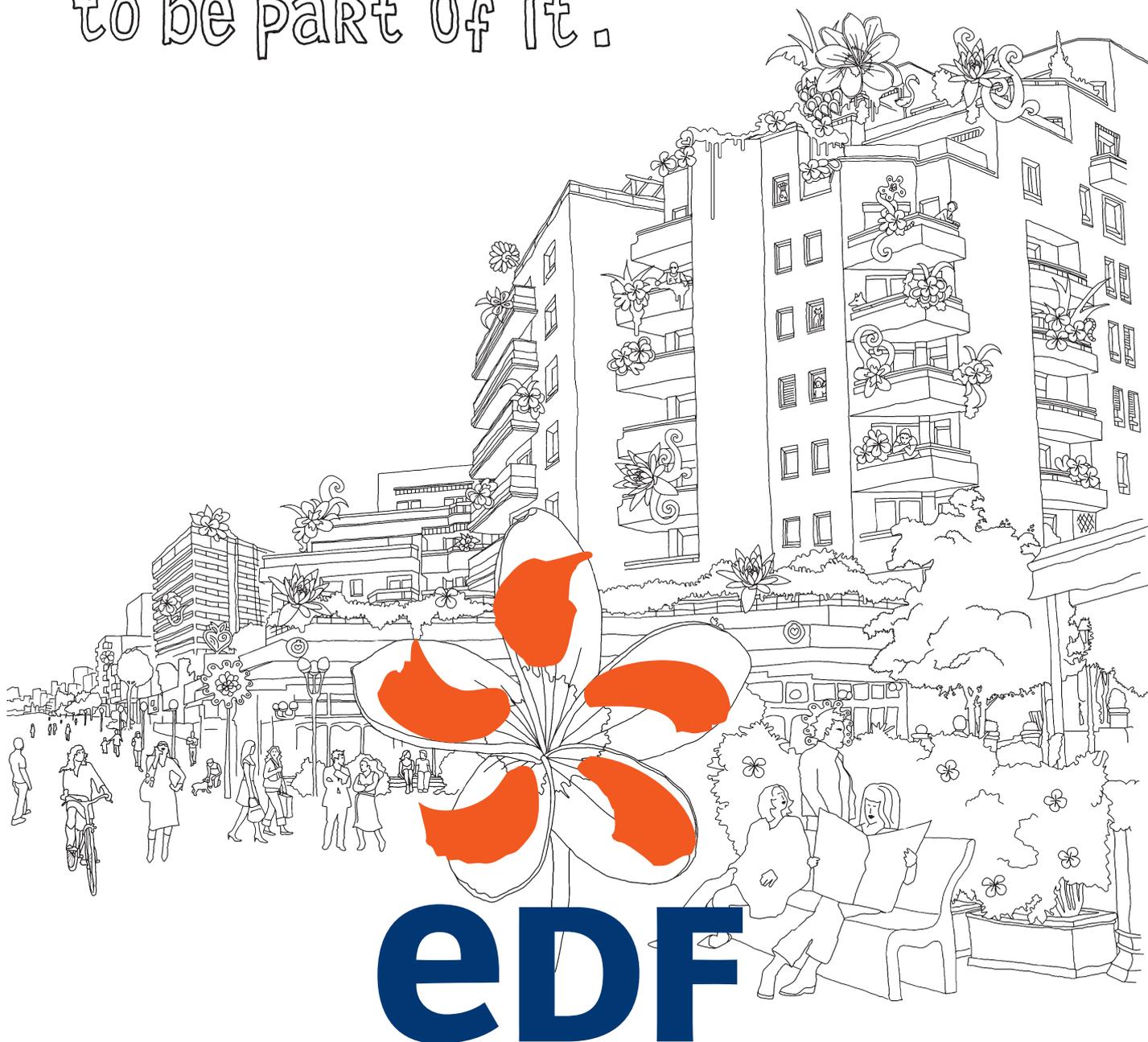
Society is at a crossroads with respect to the structure of global energy supply; radical change is needed, but what kind of change? This Strategic Panel was moderated by Ged Davis, Managing Director of the Centre for Strategic Insight, World Economic Forum, and was based on a recent report by Catrinus Jepma and Nebojša Nakićenović. The report analyses four scenarios or “story lines”, each focusing on a different issue that may become of direct concern to the development of the gas industry:

- 1 Climate change and local air pollution are the major concerns in the coming decades. Gas has an advantage over other fossil fuels as regards both concerns, but carbon capture and sequestration may be applied to all fossil fuels and possibly more easily to coal.
- 2 Security of supply is the major concern; “incidents” occur and with the largest natural gas reserves situated in very few countries, gas is seen as an unreliable source of energy.
- 3 The competition of other fuels becomes more “vocal”; coal makes a come-back with carbon capture and sequestration and a nuclear renaissance is unfolding. Underestimating the competition could be dangerous.
- 4 The situation for investors is insecure; investments for natural gas are typically high and lacking confidence in long-term incentives and price stability, the investors are not taking risks.



The Strategic Panel on Sustainable Development was held on Wednesday June 7.

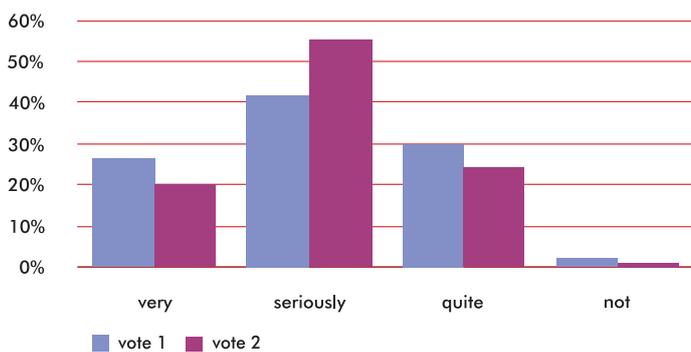
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### HOW SERIOUSLY SHOULD WE TAKE SUSTAINABLE DEVELOPMENT AS A BASIS FOR STRATEGY FOR THE NATURAL GAS INDUSTRY?



ABOVE  
Figure 1.

The session started with a film showing the audience that in 50 years the world could still be a nice place to live in if the right cards are dealt now. Then Mr Davis interviewed the two authors.

They highlighted the fact that reducing environmental impacts and improving efficiency – both at the combustion (end-user) stage and in the production chain – are paramount; especially as all people should have access to modern energy services and energy demand is expected to rise significantly. While natural gas may play a role in this – as outlined by the “positive” story line number 1 – threats exist as outlined by the other story lines. Building confidence, both in terms of security of supply and in terms of competitive investments, is crucial if the gas industry wants to be able to play this role. This should be accompanied by a vocal public relations campaign.

The authors also pointed out that while the discussion so far seems to focus on power generation, there are many more ways to employ gas as an energy source – such as transport fuel and direct end use (heat) – and thus even more cards to play. For instance, small-scale, local combined heat-and-power generation may provide access to clean power as well as heat for many people.

Before going on to introduce the panel of six experts, which included the Chairman of the World Energy Council and the Director General of the World Petroleum Council, Mr Davis led a first round of audience voting. The question was “how seriously should we take sustainable development as a basis for strategy for the natural gas industry?” and the results are shown in *Figure 1*.

#### *Panel and audience discussion*

All the panel members subscribed to the validity of the four story lines. They saw clear price signals, market confidence and political stability as the key factors for gas to be the transition fuel of choice. They also highlighted the issue of innovation and R&D. In the words of panellist Ravi Batra, a Distinguished Fellow of India’s Energy and Resources Institute, global R&D should go into “lunar mission mode” on energy solutions such as gas hydrates. Current reinvestment in the energy sector is about 0.5% compared to more than 5% in truly innovative sectors. Public-private partnerships are essential in such R&D, both nationally and internationally.

From the audience Ernst von Weizsäcker of Donald Ben School in the US asked what had happened to energy efficiency. Theoretically a lot is to be gained here, but in practice efficiency improvements are no higher than a few per cent per year and so far they have always been outpaced by increasing consumption.

Views diverged on the topic of oil-based pricing. Although current high prices are good drivers for investments and efficiency improvements, the coupling is a market distortion. The call to create a true level playing field is strong: perverse subsidies to energy carriers should be removed and internalisation of externalities – e.g. carbon taxing – strived for. This is where regulators should play a role and regulation should be transparent and predictable.

Panellist André Caillé, Chairman of the World Energy Council, remarked that the general idea

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that deregulation would lower prices and thus be detrimental to efficiency and innovation has turned out to be wrong in practice: the electricity price went up after deregulation.

A “level playing field” with internalised external environmental costs would create advantages for natural gas but, as consultant Winfried Fruehauf from the audience remarked, even with natural gas as the dominant energy source, climate change will not be halted. It was generally agreed in discussion that natural gas is only part of the solution and probably a temporary part. The final aim is a carbon-neutral energy supply. Changing to gas will help lower emissions, but at the same time the introduction of biotic energy sources and hydrogen should be facilitated. As panellist Vijay Vaitheeswaran, a correspondent for *The Economist*, put it, there is a need to “recognise renewables as partners and help hydrogen from hype to hope”.

By the time of the second audience vote (see *Figure 1 again*), the discussions had led several people to take sustainability “more than quite seriously” as a basis for a gas industry strategy.

Summing up the key points, Mr Davis said that the gas industry should: build confidence, regarding investments and security of supply; get

the market right, by both deregulation and internalisation; and make this the era of innovation of gas and energy supply.

### ● The Art of Regulation

Billed as a Strategic Roundtable rather than a Panel, this session was attended by approximately 450 delegates and was moderated by Dieter Helm, Fellow in Economics at New College, University of Oxford, UK.

In his introduction Mr Helm stated that regulatory solutions must be found to the many regulatory challenges resulting from the emergence of a global gas market. He emphasised the need to rethink the impact of regulatory measures on the gas chain, since the chains are crossing ever more borders. The main gas resources are located in a limited number of main producing countries, with Russia, Iran and Qatar alone accounting for 58% of reserves, and recent market developments and the debate on import dependencies have made the paradigm shift apparent.

This raises questions such as: How will regulatory measures impact the distribution of economic rent along the gas chain? How will wholesale and retail prices be affected? Are liberalised and liquid gas markets capable of providing timely price signals for investments and what impact do regulatory measures have on the investment climate and the security of supply? Should the regulatory framework be based on a broad or a detailed mandate to translate energy policy objectives effectively and efficiently into regulatory measures? This might have implications for the flexibility of regulatory measures to adapt to changing market circumstances. Moreover, for developing gas markets, a different regulatory framework is required to start initial investments and foster market growth compared to maturing markets; how can the right measures be set according to the circumstances?

Prior to WGC2006, these questions were discussed in a number of high-level workshops



Professor Coby van der Linde (RIGHT) presented the regulation report in a separate press conference.

# Together for a better future

*Brunei LNG has been recognised as a pioneer in the LNG Business when it became the first established LNG production facility in the Western Pacific in 1972. It became the first LNG Plant in this region to undergo a major rejuvenation in 1994. Brunei LNG is leading the industry again by being the first LNG plant to replace the Main Cryogenic Heat Exchangers in 2004 and 2005. It clearly demonstrated that implementing complex engineering activities in an operating plant can be undertaken safely, ahead of schedule and with quality results. This forms a sound basis to improve reliability and extend the plant technical life by another 30 years.*



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organised by IGU around the world, with the debates serving as a basis for an IGU report “The paradigm change in international natural gas markets and the impact of regulation” prepared by the Clingendael Institute in The Netherlands.

The report was made available at the conference and introduced before the start of the debate by Professor Coby van der Linde of the Clingendael Institute, who also served as a member of the President’s Wise Persons Group 2003-2006. In connection with this report, an IGU/McKinsey survey was presented by Dieuwert Inia of McKinsey giving an overview of opinions and the perceived effectiveness of regulatory measures. It also gave insight into the differences perceived by regulators and stakeholders on the effectiveness of regulation and its problems.

After that, the moderator made a tour of the table allowing the panellists from around the world and with different backgrounds to give concise statements. A lively debate was fuelled by questions from the audience.

Enrique Grotz of Ernst & Young in Argentina stressed the need for regional cooperation between governments and the alignment of regulatory regimes to overcome the specific cross-border problems in the region.

Yasuo Ryoki of Osaka Gas emphasised the specific market conditions of the Asian region, with its dependency on LNG and bilateral contracting. Asia is only just starting with gas market liberalisation compared to the EU and US, and destination clauses are a main topic of debate. These factors translate into the need for a different and less detailed regulatory approach.

Alexander Medvedev of Gazprom made it clear that Russian gas deliveries have been reliable over a long period of time and that investments to meet market needs will come forward. But he said that security of demand is needed and this is highly influenced by regulatory measures and energy policies in consumer markets like the EU. Russia also has a choice when developing new projects to

seek diversified outlets in the globalising gas market.

Jorge Vasconcelos, President of the Portuguese energy regulator ERSE, declared that freedom of customer choice has to be the driving force for gas market reforms and that harmonised regulation for non-discriminatory access to transmission, distribution and LNG is at the top of the EU priority list to implement the internal market. Access to production regions on a non-discriminatory basis is an essential element where LNG could play the role of a catalyst for other production regions.

Mark Robinson of the US Federal Energy Regulatory Commission explained the recent regulatory developments in the US to encourage investment in LNG regasification and storage capacity. Indeed, there has been a boom in LNG terminal plans since these changes were introduced. Regulation should be in the interest of the end consumer, but this means that regulation should primarily focus on the correct investment climate for investors (not by asset sweating but by supporting competing infrastructure investments). Without investments there can be no supply and without sufficient supply there will be no customer choice.

Mr Helm summed up by stating that the debate supported the notion of a paradigm change and that a rethink of regulatory policies is needed to foster the needed investments.

### ● Other Fuels

This Strategic Panel sought to inform the audience about the status and future development in fuels other than natural gas. Evan Solomon, journalist and writer of several books on energy (*Fuelling the Future* among others), moderated the discussion.

Panel members were Andre Peterhans, Venture Manager with Sasol Chevron in Qatar, focusing on GTL; Hubert Veringa, Energy Research Centre of The Netherlands, talking about synthetic natural gas production; Jens Bo Holm-Nielsen, Head of the Department of Bio-energy, Aalborg University

and the University of Southern Denmark, who explained the role of biogas for a sustainable clean environment; and Kaoru Fujimoto of the University of Kitakyushu, Japan, who talked about the prospect of synthetic liquefied gas – dimethyl ether (DME) and LPG – explaining a new synthetic fuel system.

From the presentations and discussions it became clear that solar power is the source abundant enough in the long run to accommodate the increasing (with 1-2% per year) global annual energy demand of 400 Exa Joules ( $400 \times 10^{18}$  Joules). For this century, fossil fuels will still play the dominant role. It is not envisaged that the production of GTL, DME and LPG from natural gas, although of high importance for environmental reasons in local markets, will acquire a market share over a few per cent of the total natural gas market in the coming years. DME is expected to become a major player in the far future. Gas from syn-gas production and biogas sources may grow in potential in the future and may eventually reach a market share in the order of 25% by 2015. In some countries, such as Sweden and Denmark, it is expected that this share could be higher since they have opted for a fossil free energy system to be accomplished in the next 20 years. It is envisaged that hydrogen may become of importance as an energy carrier after 2050, although the present low efficiency of hydrogen production is still a barrier.

### ● Gas R&D

This Strategic Panel was moderated by Peter Lehmann, a member of the Board of Directors of Gaz de France. It started with a presentation of the findings of IGU's R&D Task Force by its Chairman, Dr Bob Harris. The Task Force was established because of concerns arising from a perceived reduction in R&D being conducted either directly by, or on behalf of, gas companies in many countries. The Task Force's remit and objectives were: firstly, to establish and confirm recent trends

in the conduct and financing of gas-related R&D and to determine the reasons behind the changes; secondly, to review priorities for R&D spending by the industry; and thirdly, to recommend any actions which might be taken by IGU. These objectives were met successfully.

### *Review of the conduct and financing of R&D*

Trends in R&D were established through "position surveys", whereby individual members of the Task Force reported on the situation in their own country, through invited expert presentations relating to different sectors of the gas chain, and from the literature. Clear evidence was found of a



The Task Force report found that the lowest R&D decline was in the exploration and production sector.

# Enel

Enel is Italy's biggest power company, and Europe's third-largest listed utility for market capitalisation. Listed on the Milan and New York stock exchanges since 1999, Enel is the European company with the largest number of shareholders, at some 2.3 million. It has a market capitalisation of about €41 billion at current prices.

Enel produces and sells electricity mostly in Europe, North and Latin America. In the power business, Enel has 53,000 MW of generating capacity and has 32 million electricity customers.

Enel is also the second-largest Italian distributor and vendor of natural gas, with over 2.2 million customers and a 12% market share. In 2005 Enel sold 5.1 bcm on the domestic market and it aims at reaching 2.5 million end-users connected by 2010.

The company has about 52,000 employees and operates 46 thermal plants, 500 hydro facilities, 32 geothermal plants, 17 wind farms and 4 photovoltaic plants, in addition to more than a million kilometres of power lines, in Italy and abroad.

In 2005, Enel posted revenues of €34 billion. Earnings before interest and taxes reached

€7.7 billion in 2005, while net income stood at €3.9 billion in the same period.

Enel was the first utility in the world to replace its customers' traditional electromechanical meters with modern electronic devices that make it possible to take meter readings in real time and manage contractual relationships remotely.

This innovation has enabled Enel to implement time-of-use electricity charges, which offer customer savings for evening and weekend electricity use, an initiative that has attracted interest from many utilities around the world.

Enel is actively seeking expansion abroad in the power and gas market after having completed the sale of non-core assets.

Enel has a strong commitment to grow internationally and is already active in Europe (Bulgaria, Romania, Russia, the Slovak Republic and Spain), North America (Canada, the United States) and Latin America (Chile, Costa Rica, El Salvador, Guatemala).



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ENERGY IN TUNE WITH YOU.



decline in gas-related R&D, with R&D intensity falling from an average of just under 1% to below 0.4% of turnover. The decline was greatest in countries where energy/gas markets had been opened to competition, i.e. had been liberalised. The decline occurred across all sectors of the gas chain, but was most pronounced in respect of utilisation and longer-term R&D. The lowest decline was in the exploration and production sector. Moreover, in this latter area there was evidence that expenditure had increased recently, with rising energy prices encouraging oil companies to take a greater interest and involvement in natural gas.

The review highlighted a number of contributory factors for the decline. Firstly, energy customers do not demand innovation, and stock markets favour a short-term “back to basics” approach. Thus, utilities focus on operating and maintaining their systems and usually lack an R&D culture. Secondly, market liberalisation makes R&D an irrelevance for firms competing on the basis of price where R&D is not aimed directly at gaining competitive advantage. Also, in liberalised gas markets firms have difficulty in appropriating the benefits of their R&D, i.e. ensuring the benefits are captured by themselves and not by “free-loading” competitors. Difficulty in appropriation means a likelihood of under-investment in R&D, with competition bringing a shorter-term focus and cutting R&D offering an easy option for cost avoidance. Thirdly, it is



The production of gas from methane hydrates is one of the R&D priorities.

counter-intuitive to expect utilities to invest in R&D which enables their customers to use less of the product they are selling. Also, regulated monopolies such as pipeline companies often operate under a cost recovery plus return on capital model, which means that if and when R&D costs are no longer recoverable within pipeline tariffs, R&D expenditure declines.

These changes have meant that within many gas companies internal R&D departments have been reduced, merged with other departments or disbanded, with some evidence of the loss of specific knowledge and expertise. Many utility and energy companies have moved to a different business model, where equipment needs and services including R&D are sub-contracted or bought wherever they are available at the best conditions of price and performance, retaining only sufficient technical capability to ensure the core competence required to negotiate with suppliers on an informed basis. There is anecdotal evidence of a larger share of gas-related R&D being conducted by service companies and equipment manufacturers. Moreover, while gas companies are increasingly finding themselves in competition there is some evidence, for example in the pipeline sector, that companies are undertaking R&D on a collaborative basis. The changes have also affected the nature of R&D with a focus on smaller and shorter-term projects, a focus on economic as opposed to scientific values, a move from research-driven to customer-driven projects, a move from R&D programmes to ad-hoc projects, a move from information exchange to information trading, and a move towards more competition between R&D providers.

Finally, regarding the financing of R&D there is a degree of disagreement between energy sector companies and governments as to where the balance of responsibility should lie for the funding of R&D for longer-term issues such as climate change, safety and security of supply. While the difficulties associated with appropriation in

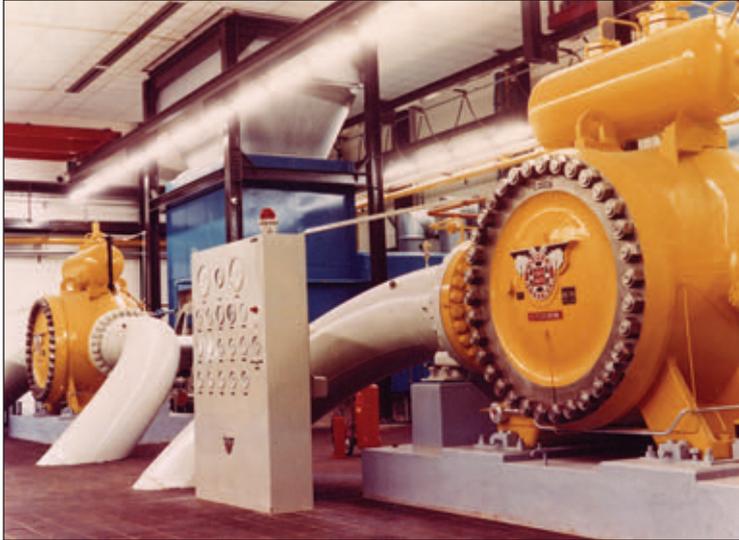
Natural gas is clean and abundant. That's why demand is growing. BG Group is one of the world's top performing exploration and production companies with experience across the gas chain. Wherever we are, we invest. Not just in the business, but in the environments and communities where we operate. From exploration to distribution, we're working with partners to connect gas to markets.

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**“Producing cleaner fuel – that’s what all the hard work is for.”**





liberalised markets argues for government support or incentives, in many countries there is a prevailing view that the energy sector is making so much profit from escalating prices that industry should pay rather than the tax payer. Of course in a fragmented, liberalised market a level playing field can be created by financing gas R&D via a levy based, for example, on pipeline throughput. However, in some countries this has either been

abandoned or actively discounted because of the difficulties in agreeing the allocation of project funds to meet the aspirations of different players, because of the costs of the bureaucracy involved, or simply because pipeline companies have no wish to act as tax collectors.

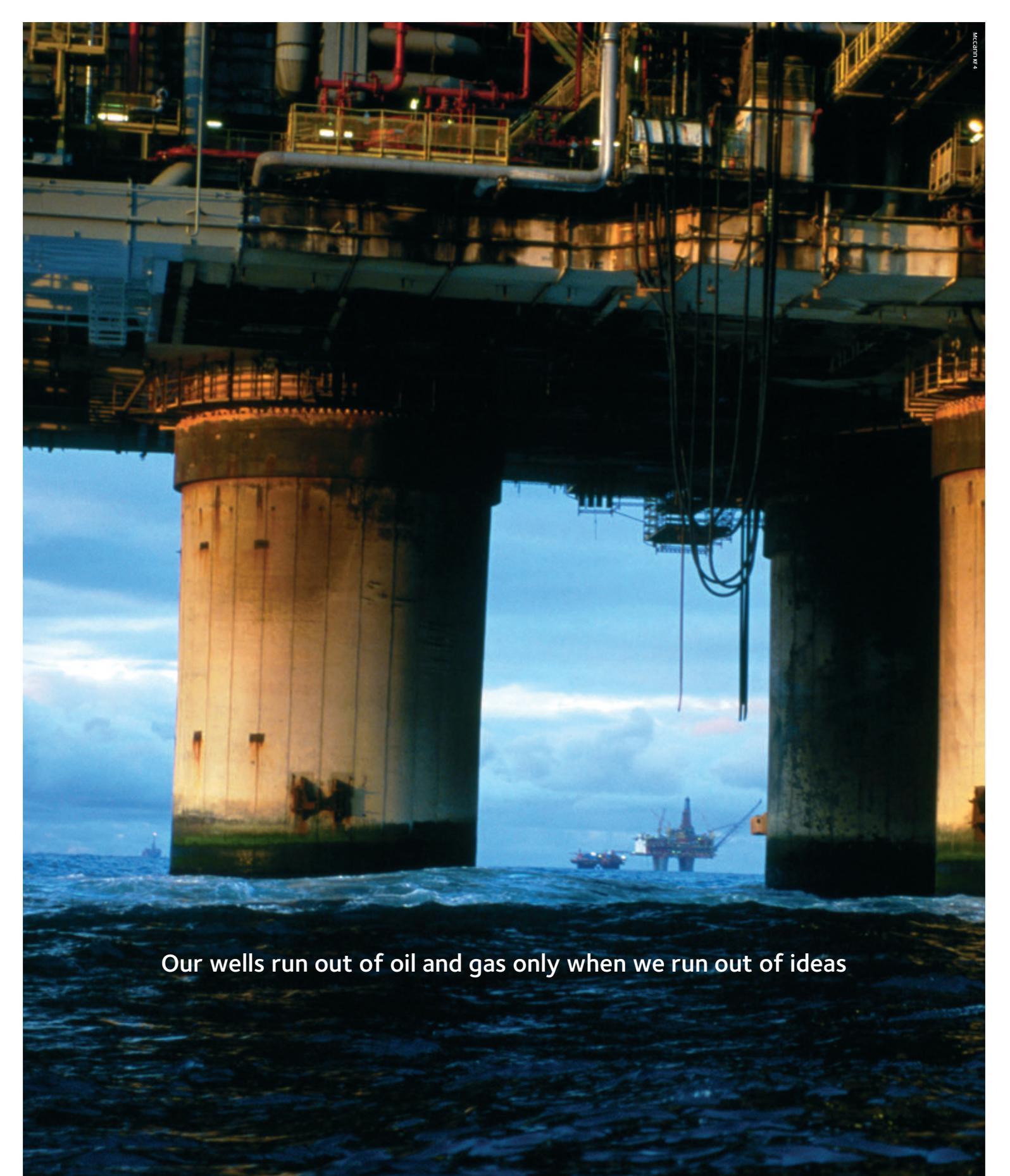
#### *Technology survey*

To address its second objective the Task Force sought the views of IGU members on the technology developments that would be needed by the natural gas industry to ensure future business success. These views were sought via a questionnaire inviting respondents to score the priority of over 50 key technology developments spanning the whole gas chain. More than 180 completed questionnaires were received representing an adequate statistical response and the top three technologies by sector in the gas chain are summarised below.

- In gas resources – technologies to further reduce the costs of LNG production, transport and use; methods to reduce operation and maintenance costs; and the production of gas from methane hydrates.



ABOVE AND TOP Equipment manufacturers and service providers are now undertaking a greater proportion of gas R&D.



Our wells run out of oil and gas only when we run out of ideas

Facing the world's growing demand for energy has become one of the biggest challenges of our time. In addition to finding and developing new oil and gas fields, it is crucial to recover as much oil and gas from the reservoirs as possible. Statoil is strongly dedicated to this approach and our efforts within improved oil recovery (IOR) have yielded excellent results, for instance an extra

1.5 billion barrels of oil from the Statfjord and Gullfaks fields alone. Statoil has also launched an extensive IOR strategy for increasing production from subsea fields, which present tremendous technical and operational challenges. When world demand for energy is rocketing, resources cannot be left underground.



- In transmission – technologies to extend the life of existing pipelines; improved integrity management systems; and means to increase pipeline capacity.
- In distribution – improved leak detection; use of new materials; and keyhole technologies for installation and repair.
- In utilisation – methods to further reduce emissions of NO<sub>x</sub>; methods for the capture and storage of CO<sub>2</sub>; and development of fuel cells using natural gas.

Statistical methods were used to assess the significance of differences in response relating to the views of respondents from different business sectors, in different job functions (specifically between those in business management as opposed to technology roles) and of respondents from different regions. Only in the latter case of geographic regions was there any statistically significant difference of view. The results reflect different priorities as seen in different regions of the world shaped by access to and availability of gas supplies, concern for safety and cost efficiency in bringing gas to market, and the influence of government and public opinion in respect of emissions arising from natural gas use.

#### *Strategic debate*

Following the presentation, five panellists representing different sectors of the industry and from different regions of the world each made a brief presentation setting out their views on the need or otherwise for R&D in a liberalised gas market.

Professor Chris Beckervordersandforth (E.ON Ruhrgas and GERG) pointed out that the introduction of regulation and competition in gas sales has led to a relative decline in R&D, and argued that while this may not matter in the short to medium term, in the longer term it would affect both business performance and the image of the industry as a responsible player. He also noted that while private companies have a right to choose

how much or little R&D they carry out, developments should be financed by industry itself without relying on government incentives, with the possible exception of some long-term issues.

Hikaru Hirayama (Osaka Gas) argued that R&D is definitely essential for the gas industry and should be promoted with a specific focus on promising projects. He also said that governments should play a role in promoting basic R&D and long-term projects, and that there is a need for greater international collaboration in addressing global environmental problems.

Mary Jane McCartney (Consolidated Edison, USA) felt that the greatest need for gas R&D is in upstream supply. She explained that federal US funding of R&D through interstate pipeline surcharges has been replaced by state-by-state funding, and that collaborative research among distribution companies focused on infrastructure integrity and cost reduction is growing.

Ton Hoff (Energy Research Centre of The Netherlands) stated that R&D is essential but a long-term view is required, and that issues such as security of supply and climate change need to be addressed. He noted that while natural gas produces less CO<sub>2</sub> than coal or oil, the amount produced is not zero, and argued too little is happening in many areas including developing biomass as a source of supply, hydrogen and strategies for CO<sub>2</sub> storage and enhanced gas recovery. He pointed out that the response time needed to deal with many of these issues is long and work needs to start now. Since meeting these challenges is a prerequisite for its survival, the natural gas industry should bear a large share of the costs.

Mark Howard (BP) argued that R&D is clearly needed to support the gas value chain, but pointed out that priorities change as the industry evolves and should drive further innovation. He also noted that many organisations are now involved in these priorities, not just the traditional gas companies and their successors. Finally, he explained that in

his view today's priorities include safety and reliability of supply, connecting distant resources with established and growing markets, and maximising exploitation and efficiency of use of both conventional and unconventional resources in established markets.

There followed a very lively interactive debate during which the audience was asked to vote on whether the greatest (although not exclusive) need for R&D was currently upstream (reducing the costs of finding and producing gas), midstream (reducing the costs of building and maintaining infrastructure) or downstream (improving efficiency and utility in use and reducing emissions). While persuasive arguments in favour of each were expressed, 45% voted in favour of downstream, 34% upstream and 21% midstream. In revealing reasons behind their choices, many who voted for downstream stressed the prime importance of ensuring efficiency in the use of energy and the link to corporate responsibility.

At the end of the session Mr Lehmann reviewed the key points emerging from the debate. Firstly, company culture is an important factor in influencing R&D spending and depends significantly on the attitude and support, or otherwise, of the CEO. Secondly, many gas companies adopt a conservative view of technology development and innovation influenced by the long life needed by gas industry assets and equipment, and the need to be sure that in a safety conscious industry, technical developments are robust. This affects attitudes to innovation and the willingness to accept and introduce new technology. Others questioned the view that in a liberalised market natural gas is a purely commodity business requiring little if any technical innovation, arguing that it will be increasingly necessary for energy companies to realise that really they are not selling gas but personal comfort (warmth, air conditioning) for which developments will be needed for competitive advantage. Equipment manufacturers and service providers are now undertaking a greater proportion of gas R&D than

pre-liberalisation, and there is some evidence that in this sector and in the upstream sector R&D spending has increased. Indeed, representatives from these sectors should be included in the next Task Force. Concerns were raised that too little is being done by both governments and industry on technologies which support sustainable development and the need to mitigate climate change. Finally, Mr Lehmann noted a consensus that the industry should not look for, or expect, increased financial support from governments, but should finance its own R&D developments – with some comments that recent high energy prices offer an opportunity to address a number of longer-term challenges.

#### *Recommendations*

The following recommendations have been made by the Task Force:

- 1** There is a continuing need to draw attention to the conduct and financing of R&D. IGU should therefore continue to monitor developments by establishing a new Task Force in the next Triennium.
- 2** In addition to including the participation of Charter Members, IGU should invite representation on this Task Force from the upstream, service and equipment manufacturing sectors of the industry.
- 3** IGU should continue to support the former International Gas Research Conference programme as a means to encourage the conduct of R&D for and by the natural gas industry, and as a means to stimulate technology transfer.
- 4** The financing of pre-competitive and longer-term R&D could be helped by encouraging greater (international) collaboration. IGU could play an important role in this regard and in ensuring there is a gas industry voice in any wider debate on the future need for energy-related R&D.

Please direct any questions or comments to either the Chairman of the 2003-2006 R&D Task Force – Dr R. J. Harris (Broadfern Consultants Ltd, UK) or the Secretary Dr Erich Jurdik (Stork Industries/Gasunie, The Netherlands).

# Indian Oil Corporation Ltd



Indian Oil Corporation Limited (IndianOil) is India's largest company by sales with a turnover of US\$41 billion and profits of US\$1.1 billion for fiscal 2005-06. It is ranked 170th in the *Fortune* "Global 500" listing. It is also the 18th largest petroleum company in the world and the #1 petroleum trading company among the national oil companies in the Asia-Pacific region.

IndianOil's corporate vision is "to become a major diversified, transnational, integrated energy company, with national leadership and a strong environment conscience".

In the short term, IndianOil aims to achieve a target of US\$60 billion revenue by the year 2011-12. The road map to attain this milestone has been laid through vertical integration – forward into petrochemicals and backwards into exploration and production of crude oil – besides diversification into the natural gas business and globalisation of marketing operations.

The use of natural gas as a fuel is growing at a rapid pace in India. Its share in the country's energy mix is expected to rise from the present level of 8% to 20% in the next two decades. To ensure its continued dominance in the petroleum sector, IndianOil has taken several initiatives to expand and strengthen its gas business.

IndianOil is one of the promoters of Petronet LNG Limited (PLL), engaged in the import and re-gasification of LNG. It has executed a Gas Sale and Purchase Agreement with PLL for 1.5 MMTPA (5.26 MMSCMD) of re-gasified LNG from the Dahej Terminal on the west coast of India. In March 2004, IndianOil began marketing re-gasified LNG to customers in the states of Gujarat, Madhya Pradesh, Rajasthan, Uttar Pradesh and the National Capital Region.

To further strengthen its presence in the LNG business, it has finalised an import deal for 1.75 MMTPA of LNG with Iran for supplies from the year 2009 onwards.

As in the case of the Dahej terminal of PLL, IndianOil will also be one of the offtakers of re-gasified LNG from the Kochi LNG import Terminal of PLL in south India. This terminal is expected to become operational by 2010.

IndianOil has also proposed partnering Petropars, a subsidiary of National Iranian Oil Company, in developing gas blocks in the North Pars fields of Iran jointly. The project envisages the setting up of a liquefaction plant in Iran and marketing rights for up to 9 MMTPA of LNG.

IndianOil is also focusing on developing gas-related infrastructure in India and to this end, has plans to develop an LNG import terminal at Ennore, near Chennai in south India, along with its subsidiary, Chennai Petroleum Corporation Ltd. (CPCL).

As a strategy for participation in the entire gas value chain, IndianOil plans to diversify into shipping, a critical component of the supply chain for transportation of LNG. It is actively pursuing entry into the shipping business through participation in a joint venture.

City gas distribution is another area that has been identified for growth. IndianOil is actively pursuing projects that envisage the distribution of natural gas to industries, domestic consumers and commercial establishments in the country. IndianOil has formed a joint venture company with GAIL (India) Limited for undertaking city gas distribution projects at Agra and Lucknow in north India.

The existing system of natural gas supply through pipelines has deprived customers located at some distance from the pipelines of the advantage of this low-cost and environmentally-friendly fuel. Keeping this in view and being aware of the technology available in developed countries, IndianOil has envisaged a business opportunity to supply natural gas to these customers using the concept of "virtual pipelines" that involves the transport of natural gas in liquid form by cryogenic containers.

# ONE COMPANY, MANY FACES.

For over four decades now, IndianOil has been energising India. Meeting the country's vital petroleum product needs. Enriching the lives of over one billion Indians. Everyday. And round the year. Earning the status of India's largest commercial enterprise. And moving up the Fortune 'Global 500' rankings steadily. But that's only part of the story. We are the first Indian oil company to set marketing base outside India; in Sri Lanka and

Mauritius. The first to launch high-octane branded fuels in India. The first Indian petroleum company to offer technology solutions. With our interests spread across the hydrocarbon value chain, from upstream to downstream into petrochemicals and gas, we have truly come of age. With several successful global ventures behind us and many more to come, IndianOil is well on its way to emerge as a truly integrated, transnational energy major.



**IndianOil**

REFINING | MARKETING & DISTRIBUTION | PIPELINE TRANSPORTATION | RESEARCH & DEVELOPMENT  
TECHNOLOGY SOLUTIONS | PETROCHEMICALS | GAS MARKETING | EXPLORATION & PRODUCTION  
GREEN FUELS : CNG, LNG, AUTO GAS (LPG), ETHANOL-BLENDED PETROL, BIO-DIESEL, HYDROGEN-CNG

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## Committee Sessions

This chapter contains edited versions of the final reports of IGU's Working and Programme Committees for the 2003-2006 Triennium. The full reports have been published on CD-ROM as part of the WGC2006 proceedings.

### ● Working Committee 1 Exploration and Production

*Chairman:* Colin Lyle, Gas Market Insights, UK  
*Vice-Chair:* Vladimir Yakuchev, Gazprom, Russia  
*Secretary:* Adam Hinds, Centrica, UK

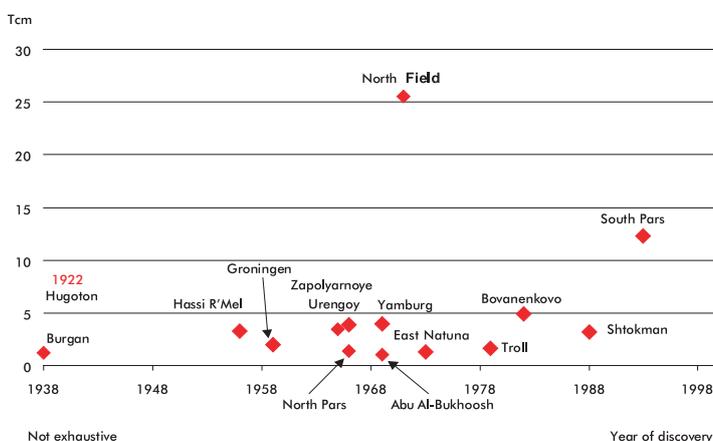
WOC 1's work over the past Triennium encompassed the exploration, production and processing of gas, and was divided between two Study Groups.

#### SG 1.1 The world's most significant gas fields

*Leader:* Djaouid Bencherif, Sonatrach, Algeria  
*Technical Advisor:* Marie Françoise Chabrelie, Cedigaz,

BELOW  
Figure 1.

### GIANT AND SUPER-GIANT GAS DISCOVERIES: YEAR OF DISCOVERY AND ORIGINAL IN-PLACE RESERVES



SG 1.1 aimed to put together a unique selection of the world's most significant gas fields by applying a number of specific criteria gauging significance. These criteria included technical advances and challenges, market impact, sustainable development and future potential. Through their specific characteristics, these selected reservoirs provided a panorama of the world's most significant developments in E&P over time, each providing its own set of prominent features or lessons on field development.

#### SG 1.2 New horizons for exploration, production and treatment of gas

*Leader:* Dominique Copin, Total, France  
*Technical Advisor:* Mark Howard, BP

SG 1.2's goals were diverse and included: identifying the most interesting and current developments in E&P and gas treatment; looking at new geographical and geological areas of gas exploration; and considering new management approaches and political and commercial arrangements for licensing and for the sale of the production stream.

Committee sessions for each Study Group were held and additionally two expert fora were organised. Colin Lyle chaired the session on the world's most significant gas fields and Dominique Copin chaired the session on new horizons in the exploration, production and treatment of natural gas. One expert forum dealt with "Making the most of mature fields" and was chaired by Stan Rychlicki, while the other covering "Challenges of new frontier gas" was chaired by Mark Howard and Nahum Schneidermann. In total, 19 speakers from 10 countries gave oral presentations on outstanding issues and trends and technological breakthroughs that already impact the industry and that will increasingly affect the global gas business. The major outcomes from the sessions and expert fora are summarised below.

Prior to WGC2006, SG 1.1 had organised an online vote among registered delegates asking

them to select their outstanding fields. The results were announced during the first WOC 1 session by Djaouid Bencherif as follows:

- Market impact: Groningen (The Netherlands) with 52.8% of votes
- Technical advances: Troll (Norway) with 59.2%
- Sustainable development: In Salah (Algeria) with 35.7%
- Future potential: North Dome (Qatar) with 40.5%

#### *Developing the potential of gas to fuel expansion*

Around 310 giant and super-giant gas fields, holding about 65% of proven gas reserves worldwide, have been discovered to date (see *Figure 1*). Most of them are not yet producing and their development will, in some cases, involve tremendous challenges. Case studies on giant gas fields were presented, highlighting the main opportunities and obstacles to be overcome.

#### *Deep water production and pipeline transportation*

Ormen Lange field is the first deepwater project on the Norwegian Continental Shelf, which has moved offshore developments out of the medium-water depths in the North Sea to the new deepwater areas of the Norwegian Sea with strong sea currents. The associated pipeline, Langeled, running to the east coast of England, will be the longest and largest subsea pipeline ever built, with a 42-44 inch diameter (106.7-111.8 cm) and a length exceeding 1200 kilometres.

#### *Phased development*

Iran's South Pars field, 100 kilometres off the country's south coast in Persian Gulf waters, is slated to be developed in 28 phases. Five of these are already onstream and 2005 production was 40.2 bcm. The impact of the development of South Pars on the market has been substantial. It supplies natural gas to almost 4.9 million new households in 150 cities in addition to gas delivery to several new power plants and industries throughout the

country. Two major pipelines, Iranian trunk lines 3 and 4 (IGAT 3 and 4), have been on stream since 2000 and 2004 respectively. As the development of South Pars accelerates, it will fuel domestic and global markets in the decades to come.

#### *Innovative gas marketing approach*

The Greater Gorgon area, located off Australia's north-west coast will provide gas to an LNG facility with a nominal capacity of 10 million tonnes per annum. Approximately 2000 cubic metres per day of condensate will also be produced. The Gorgon joint venture partners have adopted an "equity marketing" model where each owner separately sells its share of the LNG produced, allowing more flexibility in the offerings that can be made to customers and more freedom for the owners to pursue the markets that meet their requirements.

#### *Extending field life with technology*

In order to ensure access to the remaining reserves and continue its role of swing producer to cover peaks in demand, NAM launched the "Groningen long-term field renovation and compression project" in 1998. This modernisation programme aimed to rejuvenate the production facilities, improve the environmental performance of the plant and install a total of 500 MW of gas compression. The regeneration programme will put the production capacity of the renovated field at around 340 mcm per day. With about 1060 bcm of gas remaining, Groningen is expected to be a key producer for up to another 25 years.

#### *Exploration to increase the resource base of a producing field*

Additional exploration in the developed areas around Russia's Urengoy field aims to transfer probable reserves to proven reserves, increasing the commercial gas reserves by 12.2%, gas-condensate by 26.2% and oil reserves by 128% in the near-term.



WOC 1's work included looking at exploration to increase the resource base of a producing field – Russia's Urengoy field.

### *Challenges already overcome by the industry in order to exploit gas at the geological, geographical and technical "frontiers"*

Mark Howard, who manages the BP central engineering group which supports the company's major oil and gas projects, showed some examples of solutions which are being developed by offshore upstream gas operators in order to deal with the characteristics of the new developments to come. These characteristics include challenging climatic conditions, particularly in the arctic area, high pressure/high temperature (HP/HT) reservoir fluids and water depths up to 3000 metres. Subsea developments will be increasingly important. Advances in flow assurance have been essential in these high pressure, cold environments and, combined with subsea processing, are creating a comprehensive capability for long-distance subsea tie-backs.

Among major breakthroughs, successful production at the current limits of HP/HT in the UK North Sea show that in-field developments to increase reserves recovery have now become feasible. The care needed to manage materials issues in fabrication and detailed design has been crucial.

### *Gas exploration looks to new horizons*

The significant yet-to-be discovered gas potential laying in Arctic areas, fold belt provinces and deep sedimentary basins was discussed. While deep exploration peaked in the 1980s, thereafter declining because discovered fields were not large enough to justify developments, from now on the increase in gas prices and the application of new techniques should help decrease the minimum gas field size which makes gas development economically viable.

### *Exploration and extraction of gas in Arctic areas*

The Arctic is an environment where the industry has limited practical experience. However, prospects for safe exploration and extraction, as well as environmental monitoring have improved. Studies carried out by Russian companies in association with their strategy to develop gas reserves in the Yamal Peninsula indicate a high degree of knowledge and good chances of success in today's price regime. Studies of permafrost stability allow the location of well pads in stable regions where environmental damage is minimised. Deployment of deviated and horizontal drilling can reduce estimated well stock by 20%. The Ob and Taz region of Arctic Russia is thought to contain some 70 billion tonnes of hydrocarbon resource, 80% of which is gas. With its relative proximity to the Yamburg infrastructure, this counts as one of the most promising near-term development targets (Bovanenkovo field).

Some of the challenges of working in this shallow offshore region, where drilling rigs must resist ice and subsea architecture must be protected from ice scour more than 6 metres deep were pointed out. Some of the concepts being designed and deployed were described, including mobile offshore drilling caissons capable of drilling all year round and resisting 100,000t ice loads. A cluster of subsea wells can be installed under the drilling caisson deep into the sea bed (>6 metres) and protected from ice scour before the drill rig moves on to install the next well cluster.



**US \$1,488 million**

Term Loan Facility  
Qatar Liquefied Gas Company (3) ("Qatargas 3")  
Mandated Lead Arranger  
Qatar 2005



**US \$880 million**

Project Finance Facility Train 2  
Egyptian LNG  
Mandated Lead Arranger  
Egypt 2005



**US \$166.6 million**

GIEK Covered Credit, Commercial  
Loan and L/C Facility  
CJSC Sevmorneftegaz/OAO Gazprom  
Mandated Lead Arranger  
Russia 2005



**US \$1,305 million**

Term Loan and L/C Facility  
Oman LNG LLC  
Mandated Lead Arranger  
Oman 2005



**US \$114.75 million**

LNG Vessel Financing Facility  
Skikda LNG Transport Corporation  
Sole Mandated Lead Arranger and Bookrunner  
Algeria 2005



**US \$822 million**

Term Loan Facility  
Sabine Pass LNG L.P.  
Mandated Lead Arranger  
US 2005



**US \$198.56 million**

Project Finance Facility Cross Island Pipeline  
NGC Pipeline Company  
Mandated Lead Arranger  
Trinidad/Tobago 2005



**US \$310 million**

Project Finance Facility  
Pertamina  
Lead Arranger  
Indonesia 2005



**US \$688 million**

Term Loan and L/C Facility  
Qalhat LNG  
Mandated Lead Arranger and Bookrunner  
Oman 2005



**£420 million**

Project Finance Facility  
South Hook LNG Terminal Company Ltd.  
Mandated Lead Arranger  
England/Wales 2004



**US \$1,100 million**

Secured Medium Term Loan Facility  
OAO Gazprom  
Mandated Lead Arranger  
Russia 2004



**US \$950 million**

Project Finance Facility Train 1  
Egyptian LNG  
Lead Arranger  
Egypt 2004

## Success through partnership

Our Natural Resources Sector teams have established a strong track record globally in the financing of the natural gas industry particularly the LNG chain including upstream,

pipelines, liquefaction, shipping and regasification. Let us apply this expertise to your gas project financing needs. For more information please contact Michael Klemme +31 20 563 5509, Richard Ennis +1 646 424 6000 or Bert van der Toorn +65 6232 6145.

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### *New means and transportation methods to commercialise remote gas*

Companies are making considerable investments in natural gas transformation into new chemical species, such as gas-to-liquids (GTL) and dimethyl ether (DME).

Emphasis was placed on the merits of the GTL option. From the consumer side, the product combines high energy efficiency performance with urban air quality benefits, while from the producer side, GTL allows the monetisation of stranded gas reserves. The Oryx project start-up in Qatar on the second day of WGC2006 (34,000 bpd) was mentioned as a milestone for the GTL industry as it enters a new, large commercial phase. The overall performance of GTL in terms of CO<sub>2</sub> emissions was said to be equal to or lower than the emissions due to the classic production of diesel through the refining process.



The Emir of Qatar, HH Sheikh Hamad bin Khalifa Al Thani, inaugurated the Oryx GTL plant on June 6.

Large-scale manufacturing units for DME derived from coal are now being built and operated in China at up to 210,000 tonnes/year scale. However, estimates show that a scale of 1-2 million tonnes per year is required for DME to compete in the fuels market (LPG and diesel fuel). Collaborative work on a new direct process (JFE process) from synthesis gas (CO/H<sub>2</sub>) to DME was described, which has now completed a three-year demonstration programme at 100 tonnes/day scale.

### *Safety and environmental impact (HSE) in downsizing, restructuring operation and field decommissioning*

The Frigg field is one of the first major fields about to complete a full life cycle. The removal operations are expected to be completed in 2008, followed by further onshore disposal. The objective is to obtain less than 2% (weight) of removed material disposed of in a landfill. Useful lessons learnt from the experience were detailed. Particular emphasis was placed on improving information dissemination to decision-makers and stakeholders.

Environmental risk assessment, safety issues and societal considerations emerged as outstanding issues.

### *Sustainable development and geological CO<sub>2</sub> sequestration*

A comprehensive review of CO<sub>2</sub> sequestration projects was presented. CO<sub>2</sub> emissions must be reduced by an estimated 25 gigatonnes (Gt) per annum by the mid-to-late century in order to stabilise CO<sub>2</sub> levels at the 550ppm recommended by the Inter-Governmental Panel on Climate Change (IPCC). The capacity of depleted oil and gas fields is estimated at 450 Gt, of coal beds at 60-150 Gt and of saline aquifers at 300-10,000 Gt, with a likely figure being 2000 Gt. The use of saline aquifers for CO<sub>2</sub> storage will therefore be essential.



## Nature invented skin

# BlueJetty® Perfection in Pipe protection

A smart, flexible and economical solution

In natural gas transport and liquified gas transmission systems certain pipes require special protection. In order to fulfil these requirements in an economically effective and durable way, a new and flexible protection system has been introduced on the gas market by Dutch specialists.



Over 30 years of experience in research, engineering and development of glass fibre reinforced products laid the foundation of *Blue Jetty*, a unique system of top quality pipe protection. The system protects pipes:

- for *insulation* of hot or cryogenic transmission systems (LNG),
- *mechanically* for horizontal directional drilling (HDD),
- or for the *prevention of corrosion* (CP).

### Mill applied GRP and GRE

The principle of this new pipe protection system, named *Blue Jetty*, is smart.

A spray winding machine moves gradually alongside a rotating pipe to apply one or more layers of glass reinforced composites homogeneously on to the pipe.

The various combinations of glass fibre, resins and special fillers determine, together with the thickness of the applied layers, the technical properties of the mechanical, insulation or anti corrosion protection.



The *Blue Jetty* GRP/GRE system guarantees a constantly superb quality of the required protection properties.

Cryogenic applications demand a high fire retardancy and thermal performance. The GRP protection layers applied by the *Blue Jetty* are highly recommended for temperatures down to  $-165^{\circ}\text{C}$  ( $-265^{\circ}\text{F}$ ).

### Mobility

The *Blue Jetty* is a mobile unit, i.e. the machine is transported by container and can easily be installed on locations around the world, where skilled specialists operate the machine.

The unit can protect pipes with a diameter up to 56", a length of 20 meter and a weight of 20 ton.