



## Gas and IT: The Operational Opportunity

By Adrian Bridgwater

The gas business is changing. Over the last 20 years the industry has been transformed in terms of its commercial delivery in many markets around the world. Global annual production has increased more than 50%, and there is wider public awareness of the merits of natural gas as the cleanest of the fossil fuels. But margins are always under pressure and companies that operate throughout the gas industry have had to examine their business models at a more granular level.

As this deeper level of operational analysis has been undertaken, the gas industry has looked to improvements in its technology layer as a route to cut costs and improve efficiencies while still maintaining standards. With every aspect of the gas

business open to potential IT improvement, companies that operate in the upstream end of exploration and production and the midstream stage of transmission pipelines and shipping can all bring about technology-driven business change if they grasp the opportunity.

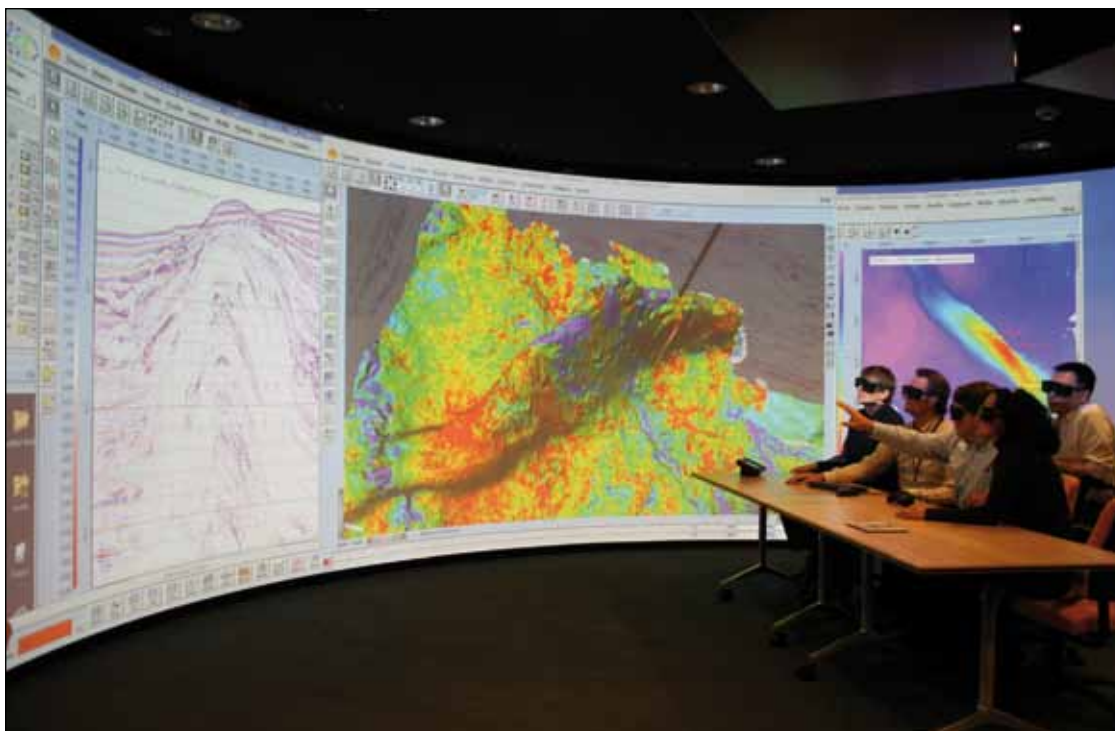
### ● Constant momentum in technology

As operational procedures of all kinds are refined and improved, the window of opportunity for incremental cost reductions becomes increasingly small. Business fixed costs in an industry that relies on such a high proportion of civil engineering infrastructure to function will always mean that the gas industry has a particularly static base from which to start. The fact that technology as an entity is constantly improving in terms of speed, capacity and agility does at least represent a dynamic channel of opportunity to tap into, if it is approached in a prudent and practical manner.

Gas exploration organisations have positively targeted new efficiencies arising from using cloud computing technologies. Put simply, the computing “cloud” is a collection of computer processors residing in geographically dispersed data centres all managed “virtually” from a central location. The Qatar Cloud Computing Initiative, which is being led by two local Qatari Universities in association with Carnegie Mellon University in Qatar, is aiming to provide a testing environment for companies wishing to experiment with cloud-based delivery of the software applications that they use.

According to IBM’s official statement on the Qatari initiative, the focus of the project will be directed towards: “Advanced research including data mining, scientific modelling and simulation, seismic modelling and exploration for oil and gas and also integrated production operation solutions for the oil and gas industries.” As a subset of cloud computing, Software-as-a-Service (SaaS) providers sit between the cloud and gas businesses to licence the software they require, just when they need it, at just the required level.





Seismic analysis in the 1950s (OPPOSITE) bears little resemblance to today's 3D visualisation suites (ABOVE).

### ● Why do gas companies need cloud computing?

But how would a gas production company need just an "exact amount" of software? Moreover, why would that amount change and how and why could that be quantified? The answer lies in operational efficiency. When a seismic survey encounters operational problems and the entire project is forced askew, the IT system underpinning all the tracking data needs to be flexible.

When more data storage is needed, that service needs to be modular so it can be brought to bear quickly. When data throughput unexpectedly escalates, processing power needs to be expandable as fast as possible. Cloud computing, virtualised servers (that are compound resources from connected data centres) and SaaS can provide the flexibility needed. Crucially, the inherent controllability from this approach means that the company is not paying for the services until they need them. Given the theory of material

elasticity upon which seismic geophysical research is based, this should be a comfortable fit.

Ex-chemical engineer and North Sea veteran Clive Longbottom is now Service Director of Business Process Analysis for IT analyst firm Quocirca. His unique joint combination of skills leads him to make the following comments: "The importance of the cloud to gas lies in flexibility and elasticity. Whereas the public's use of cloud computing has security issues that no gas business would consider as being adequate, a 'shared private' cloud using dedicated data links provides value that will leave any exploration, drilling and extraction company dead in the water if they don't use it. For example, a single seismic report can run to terabytes of data. Crunching this data to see if the rock formation is likely to cover an oil lake, a gas bubble or a methane crystal/oil mix is incredibly difficult.

"Historically, the approach has been to build a data centre that can deal with expected average loads, and peaks have to be ignored as best as



Enagás uses computer simulation, planning and other tools to run the gas pipeline network from its main control centre in Madrid.

possible. The cloud offers the means to deal with average and peak loads and to grow the basic resources as the work requires.”

Another example in the same vein is that of a shallow-sea gas exploration that has different number crunching requirements to that of a deep-sea project. As readers will know, the echoes are different and the whole issue of “reading” the data is far more complex in deep sea. So as shallow-sea and land-based oil and gas exploration decreases in years to come, the need for further data detailing is likely to surge. Trying to keep up with this in a cost-effective manner without the cloud would drive most companies towards minimal margins – or none.

“The cloud enables information and software application access from remote areas,” continues Quocirca’s Longbottom. “Gas exploration operations are generally out of the way of standard connectivity – and building a server room in Nigeria or Afghanistan carries with it a certain amount of geophysical and geopolitical risk. But

the cloud offers an opportunity for access from a single device if needed. A laptop, a ‘tablet PC unit’ or even a Smartphone along with some form of connectivity (such as a satellite modem) is all that’s needed. But best of all, if the access device gets damaged or stolen, it’s no problem – all the data is in the cloud, and the device can be locked out pretty simply.”

● **Data without quality is dangerous**

Mission-critical might well be an overused term, but it could not apply more pertinently than it does to the LNG shipping business. Not only does the data that these businesses operate with have to be accurate and very often real-time based on live operations, it also has to be high quality data. But what does this mean?

Charles Race is VP of Sales for Northern Europe for data integration company Informatica. His company’s position on data quality in the gas business is as follows: “The need for high levels of confidence in data is at an all time high for all

sectors of the oil and gas industry. The impact of invalid, incomplete and inaccurate data can have devastating effects on compliance, regulatory and financial reporting. Manual analysis and correction of data is not only time consuming and ineffective but it is also impractical to consider this approach. Gas businesses need to deploy software that will develop processes to certify the quality of data, ensuring that the data is correct, complete, conforms to standards and is consistent throughout the organisation.”

Informatica advocates the need for gas industry protagonists to discuss strategies that will reconcile data definitions across multiple software applications and silos to enable consistency in how data is defined and reported against. The company itself has a dedicated group focused on enabling technical and business users working in the oil and gas industry to conceive, plan and execute solutions involving data integrations, business intelligence, data warehousing and data quality.

Given the vast, expensive network of assets set across wide geographic areas, data captured in the field presents gas companies with perhaps the biggest opportunity to make significant operational efficiencies says Stewart Hill, Director of Corporate Marketing at workforce management software vendor ClickSoftware, “Over the last 10 years the operational efficiencies made from new technologies are transforming the industry. Workflow means that the right information is captured by mobile devices. Business intelligence provides insight into that data and this can be used to plan operational advances in safety, productivity, asset maintenance and cost reduction.”

### ● **Intelligent data management**

So we are beginning to see a pattern emerge here. Data is more complex and more varied than perhaps many of us might have thought. Drilling down into the subject areas we have already discussed different data delivery models (from the cloud for example), data quality issues, data processing and

storage considerations and “virtual” data control issues come to the surface. To make matters worse (or more problematic at least) gas industry data is increasingly produced in three or four dimensions, and this makes data archiving extremely challenging. Sitting on top of all these parameters has to be a layer of intelligent data management.

Enigma Data Solutions specialises in information management for the oil and gas industry and offers a tiered storage management solution to help seismic processing and exploration departments utilise lower data storage costs. Using a combination of multi-terabyte archiving and recovery to lower cost tape storage, the company separates these data silos from the primary storage servers to help gas companies capitalise on the fact that typically around 80% of unstructured data held on Network Attached Storage devices has not been accessed in six months.

A typical data archiving system in the gas business would archive two copies of data to tape media. One copy would remain at the client site, while the other copy would be taken off-site to a long-term “salt mine” storage facility. Enigma has tried to shake up this industry trend over the last couple of years by working with storage specialist company Network Appliance to use the company’s Virtual Tape Library (VTL) appliances so that seismic data formatted tapes can now be stored on disk and accessed more easily – as if they were on a very fast physical tape.

Network Appliance’s VTL appliance mimics tape-based systems, saving space and eliminating the need to maintain and operate a robotic automated tape storage facility on-site. “Our combined technologies provide geoscientists and data managers with not only fast access to valued data but also assurance of the reliability of their archived data, two key requirements in the oil and gas industry,” says Gavin Keeler, Global Energy Vertical Lead at Network Appliance.

The central issue here for the gas industry is not so much the quantity of data (although it is very



# Europe's Longest Underwater Pipeline Takes Shape

**The construction of the Nord Stream Pipeline through the Baltic Sea is progressing on schedule. By the beginning of 2011, the Nord Stream Pipeline system will deliver natural gas from Russia's vast reserves to Europe's ever-growing energy market via the European gas network.**

The Nord Stream Pipeline is a major feat of engineering, involving complex logistics, along with suppliers and contractors from all over the world. The project consists of two 1,224-kilometre pipelines running almost parallel to one another. The first line will be transporting 27.5 billion cubic metres (bcm) of gas in 2011. That same year, Nord Stream's contractors will begin laying the second pipeline, which will be on stream by late 2012 and will double annual capacity to around 55 bcm per year. Once both lines are on stream, enough energy will be produced to meet the demand of more than 26 million European households.

The prospect of additional and secure gas supplies via the Nord Stream Pipeline comes at an opportune time for Europe. Currently, Europe is facing an energy shortfall as indigenous energy supplies run short and renewables are yet to be fully exploited. The Nord Stream Pipeline is designed to meet 25% of Europe's additional gas demand by the year 2025, increasing Russia's total proportion of deliveries to Europe to 28% by 2020.

As far as the European market is concerned, natural gas delivery contracts have been signed between European and Russian companies through to the year 2035. This strengthens the long-standing relationship between the two parties and brings deeper cooperation for decades to come.



The first 28-kilometre pipeline segment in German waters was completed in mid-August, then construction continued on the second string.

## ► A Major Energy Contribution to Europe

Both the European Parliament and European Council regard Nord Stream as a "project of European interest" with high priority for EU energy supplies. This underscores that the pipeline meets three main objectives of the EU energy policy: sustainability, competitiveness and security of supply. "Nord Stream is a EU priority energy project and important in complementing the European energy grid," said Günther Oettinger, EU Energy Commissioner at Nord Stream's start of construction event on April 9, 2010.

Construction of the first of two the pipelines began in April, and many milestones have been reached since that time. Most recently in July and August, the two pipe strings constructed near the German and Russian landfalls were pulled ashore. These segments will soon link Russia, the start of the pipeline, to the European mainland in Lubmin, Germany. Additionally, 100,000, or half of the pipes needed for the Nord Stream Pipeline were concrete coated as of the end of July, making them ready to weld on the main pipeline. Two pipelay vessels, Saipem's Castoro Sei and Castoro Dieci are currently working on the Nord Stream project. By September, the Allseas' Solitaire – the world's biggest pipelay vessel – will also be underway in the Gulf of Finland.

Nord Stream is on track to supply Europe with Russian gas in 2011.

Nord Stream is a project of five major energy companies, OAO Gazprom, E.ON Ruhrgas AG, Wintershall Holding GmbH, N.V.Nederlandse Gasunie, and GDF Suez S.A.



Pipes are welded into a double-joint segment on the Castoro Dieci in German waters. These double-joint segments will later be connected to the main pipeline.

# Respect. For Europe's energy needs.

Europe needs new sources of natural gas to maintain economic growth while meeting climate protection targets. The Nord Stream Pipeline is a timely and environmentally sound means of bringing large volumes of natural gas to Europe. Nord Stream will provide enough energy to satisfy the energy demand of more than 26 million households. [www.nord-stream.com](http://www.nord-stream.com)





Increases in information processing and storage needs are driving the importance of the data centre for all segments of the gas industry.

large), but the diversity of unstructured data, databases that must be captured for a useful archive. What makes Enigma's software different is that their PARS (Project Archiving and Retrieval) software is "application aware" so it can grab both the data that resides in live project files and also vital metadata (essentially summary information "about" information) for effective short- and long-term archiving, backup and restore.

"E&P projects typically reside on multiple file systems and may reference numerous databases. There could also be data from multiple operating systems; for example technical information on Unix, Linux and Windows machines, as well as reports and spreadsheets from Windows – and all this data requires management, integration and

storage," says Peter Copley, Managing Director of Enigma Data Solutions.

"This diverse environment must be considered so that the project storage paths and intra-project references are maintained for future restores. Dependable project archiving can only be achieved by understanding each software application's unique requirements. First, project data structures must be understood and the process for archiving these researched. The most appropriate information to describe a project dataset (the metadata) must be identified so that archives can be properly located in the future," adds Copely.

#### ● **Bringing everybody together**

Our analysis of technology in the gas industry has, up until now, not mentioned the one word that individual users and businesses everywhere generally associate with IT – internet. When we talk about the internet now, the expression web 2.0 comes to the fore as the *de facto* term used to describe the amalgamation of information sharing, interoperability and user interconnection. Crafted intelligently, web 2.0 collaboration technologies can bring significant enhancements to the modern gas industry, as we know it today.

Microsoft Corporation Chief Executive Steve Ballmer was in Houston early in 2010 to talk to oil and gas executives about the future of collaboration and cloud computing. "There's so much collaboration that spans company boundaries today, the way the service companies work with the oil [and gas] producers, and the way the producers work with one another in partnerships and joint ventures," he declared. "It's an environment where people want to share information across organisational boundaries in unique ways."

This swing towards increased collaboration is set to grow if you believe the IT industry analysts who repeatedly extol the virtues of the latest mobile devices and in particular "touch-enabled" tablet PC devices. Although many of these devices make the consumer press headlines such as

Apple's iPad, the development of so-called "ruggedised" versions for industrial use is inevitable.

Commenting on exactly this subject, Microsoft's Ballmer said: "You think about that now, stuck in the PC environment. In the future, you will get control over devices without touch, without a keyboard. You put that in some of the weird environments in which business gets done in the oil and natural gas industry, and I think it's pretty interesting."

### ● Social media and the gas industry

So the question arises, if gas industry professionals are going to engage in more connected and more highly collaborative work patterns, by what channels will these interchanges flow? While we logically and simplistically point to email and perhaps even video conferencing, the "connected" web 2.0 version of the internet is built around the theory of trusted peer group influence and collective opinion as well as free and open debate.

While this is not a suggestion that board-level executives across every segment of the gas industry will suddenly sign up to social media sites better known for their consumer-level popularity such as Facebook and Twitter, there are tools at this level that will be of use. According to a survey conducted by Microsoft and management consultancy Accenture, nearly 75% of oil and gas professionals value using social media and collaboration software tools at the office, but management approval of such tools seems to be lagging employee demand. Fears over security of company data and intellectual property are the main obstacles holding any widespread deployments in this area at this early stage.

Johan Krebbers, Group IT Architect at Shell, confirms the industry's need for better workforce collaboration. "The challenge we have with exploration is that we have people positioned globally to explore for oil and gas," he says. "Eighty per cent of our teams are global teams, with members in multiple locations around the



Steve Ballmer: people want to share information across organisational boundaries in unique ways.

world. We must offer world-class collaboration capabilities so that our people can work at a global level."

If social media collaboration tools are brought online to an increasing extent, then the gas industry may benefit from productivity gains and improved work flexibility, which if leveraged intelligently may lead to more projects being brought in on time and on budget. The caveat to be aware of here is that the technology industry is extremely proficient at viral marketing, branding and information share, so exhaustive analysis of any solution will be a prerequisite.

In summary, it is probably safe to say that the gas industry is becoming more connected. This in itself demands compatibility and interoperability at the core of the new technology infrastructures that are being built. Creating this infrastructure on a platform of open standards-based technologies with unrestricted usage conditions is essential. As suppliers, partners and customers throughout the gas chain start to weave new interconnected processes, security will be key, but connectivity will reign.

*Adrian Bridgwater is a freelance journalist specialising in cross platform software application development as well as all related aspects of software engineering and project management.*



# TNO: Top expertise in gas research

Global economic developments cause an increase in the demand for energy and an increase in the volatility of energy production (notably wind energy).

Therefore, it becomes increasingly challenging for society to balance the conflicting energy policy goals affordability (cost), security of supply and sustainability. Together with the industry, TNO develops and implements innovative gas technologies to enable a smooth transition to an affordable, secure and sustainable energy supply. This is done in a number of focus areas:

- ▶ Exploration & Production
- ▶ European Gas Hub
- ▶ CCS & Sour Gas Treatment
- ▶ Gas Transport and Storage
- ▶ LNG Test & Technology Centre

## ▶ Exploration and production

Exploration research focuses on improvements for estimating and risk assessment of remaining exploration potential for both mature areas, such as the Netherlands, and frontier basin areas, such as the Caribbean and deep water. Coal bed methane, shale gas and tight gas become more and more important. Therefore, TNO performs feasibility studies for the applicability of these unconventional resources in Europe. Production research mostly focuses on production optimisation. Smart technology is developed and applied to expand gas production from known reservoirs (End-Of-Field-Life optimisation) as well as to facilitate production from tight or complex reservoirs. To this purpose a “closed-loop” approach is applied: based on the integrated “asset-data-model-decision” chain TNO improves the internal decision-making process.

## ▶ European Gas Hub

With the use of our system knowledge and niche technologies for gas exploitation and supply we look for logistic solutions to make energy supply more efficient and fossil fuels more “climate-neutral”. This contributes to the ambition of the Netherlands to become an important logistics hub in Northwest and West Europe for gas production, storage, transport and transfer. Also, CCS technologies are being explored to enhance capture and storage capacity and reduce costs.

Furthermore, TNO is involved as project manager in the selection, environmental impact assessment, planning and subsurface modelling of UGS projects. Ways to minimise the expensive cushion volume whilst ensuring a minimum send-out capacity at the end of the production cycle are being researched.

With gas market liberalisation, governments have to understand the functioning of the gas market to be able to optimise their regulatory frameworks, while private companies look for new strategies to operate successfully in the restructured market. TNO develops gas market models integrating technical and economic models so that, for example, the security of supply can be studied locally, and as a function of different regulatory framework conditions.

## ▶ LNG

Growing global demand for gas has also increased interest in monetising gas fields which were previously not economically attractive. The majority of these so-called stranded gas fields are located offshore. Liquefying the natural gas offshore is seen as one of the most feasible solutions to develop these fields. Movement of onshore LNG technology towards offshore provides many technological challenges. With over 40 years of experience in measuring, modelling, testing and optimising installations in combination with experience in material behaviour, fluid and structural dynamics, TNO maximises the uptime and safety of offshore LNG operations. TNO’s LNG Test and Technology Centre aims to enhance LNG technology development and to remove entrance barriers for suppliers and equipment.

## ▶ About TNO

TNO is an independent Dutch R&T organisation with around 4,600 researchers and annual revenues of about €600 million. Our mission is to apply and transfer scientific knowledge as well as provide top quality advice with the aim of strengthening the innovative power of industry and government. With over 600 staff, TNO’s Energy section is specialised in research and consultancy services for the oil and gas industry and governments.

Contact us at [www.tno.nl/oil&gas](http://www.tno.nl/oil&gas).

# Top expertise in gas research

Sustainable energy supply is the key for the future. Together with industry, TNO develops and implements innovative gas technologies to enable a smooth transition to a sustainable energy supply.



## TNO | Innovation for Life

TNO is actively involved in innovative processes to increase energy efficiency, to produce renewable energy, to reduce CO<sub>2</sub> emissions and to optimize oil and gas exploration and production.

### Gas related research

- Exploration & Production
- European Gas Hub
- LNG Test & Technology Centre
- CCS & Sour Gas Treatment
- Gas Transport & Storage



## Collaboration and Technology Usher in an Era of Global Unconventional Gas

By Trevor Smith

The world has within its grasp the possibility of realising energy security, economic prosperity and environmental sustainability – on a national, regional and global scale – by understanding and utilising our vast unconventional gas resources. The key to unlocking gas shales, tight gas sands and coal-bed methane (CBM) has been and continues to be collaboration and advanced technology, which enable the identification, development and deployment of solutions that reduce the risks and costs of production and minimise the environmental footprint of developing these vital resources.

### ● An unconventional breakthrough

Development of unconventional gas (UCG) was launched in the early 1980s with the help of a large collaborative research programme led by the Gas Technology Institute (GTI). Their effort

along with efforts by other organisations, notably the US Department of Energy and independent gas producers, became a catalyst for experimentation and state-of-the-art technology development that has unlocked the vast potential of America's "new" natural gas and provided the world with a promising new energy future.

Research started in 1982 with a GTI- (as the Gas Research Institute) led collaborative research programme initially targeting CBM. GTI managed a world-class team of experts from industry and academia and developed several technologies that have enabled CBM to grow from virtually zero to now making up fully 12% of total US gas supply. GTI's collaborative model was also applied to parallel programmes for gas shale and tight sands production. Together, these three programmes led to the development of hydraulic fracturing technology and a fundamental understanding of gas adsorption/desorption in rock formations. Hydraulic fracturing and recent advances in horizontal drilling are two key technologies critical to unlocking UCG resources today.

Credit for economically extracting gas from shale goes in large part to George Mitchell, former head of Mitchell Energy and Development Corporation, and this was recognised earlier this

### GEORGE P. MITCHELL

GTI presented George P. Mitchell, former Chairman of Mitchell Energy & Development Corp., with a Lifetime Achievement Award for pioneering drilling and completion technologies that created a shale gas revolution. His unconventional thinking and passion changed the energy future in the United States and now has the potential to significantly impact the world.

For 17 years, Mitchell insisted the impossible was possible. The geologist and petroleum engineer believed in extracting gas from shale when the term "shale play" did not even exist. He drilled for gas in a rock formation known as the Barnett Shale found across northern Texas and enabled viable production through the first successful application of the hydraulic fracturing technique to dense shale formations.







Early US UCG research efforts focused on CBM. (INSET) Gas desorption (bubbles) from a coal sample.

year when GTI presented him with a Lifetime Achievement Award.

Mitchell began experimenting in the 1980s with hydraulic fracturing – the 60-year-old process of pumping a mixture of water, chemicals and sand under high pressure underground – applied to dense shale formations to crack the rock and allow gas to flow freely from the formation.

Technology developed by GTI including micro seismic for measuring fracture performance and fracture modelling software were leveraged by Mitchell and dramatically improved their production results. Today, these technologies are key components in the operations of all fracturing service companies.

In 2002, Devon Energy Corporation acquired Mitchell and combined hydraulic fracturing with horizontal drilling to make shale gas wells more productive. Horizontal drilling enables a single vertical well to turn horizontally and follow a seam of shale for up to three kilometres. Devon's success freed the gas to flow in greater volumes

and at a much lower unit cost than previously thought possible.

#### ● **Collaboration, knowledge transfer and technology development**

The key that brought about the UCG revolution in the US was bringing together the right partners and technology-based solutions to make these resources productive. Today's focus is on identifying, developing, and deploying technologies that enhance the economic efficiency and reduce the environmental footprint of field production activities. No two UCG plays have the exact same geological characteristics, so technology known to work effectively in one play may have to be adapted or re-invented altogether to make another play productive and economical.

#### *Research partnerships*

In 2007, the Research Partnership to Secure Energy for America (RPSEA) was awarded a contract to manage the "Ultra-deepwater and



Unconventional Natural Gas and Other Petroleum Resources Research and Development Program” created by the United States Energy Policy Act of 2005. GTI played a pivotal role in the start-up of RPSEA, a non-profit corporation composed of a consortium of over 150 top US related entities dedicated to increasing America’s supply of energy. This role included development of a technology road-map for the UCG R&D programme. GTI administers the UCG portion of the RPSEA programme, which is now the largest UCG technology programme in the world.

**Resource assessment and technology development**

Collaborative projects underway today such as GTI’s New Albany Shale and Marcellus Shale research projects are working to better understand these play’s unique characteristics, their gas production potential and the techno-economic and societal challenges to their development. *Figure 1* is an example of how a collaborative project is typically structured.

BELOW  
Figure 1.

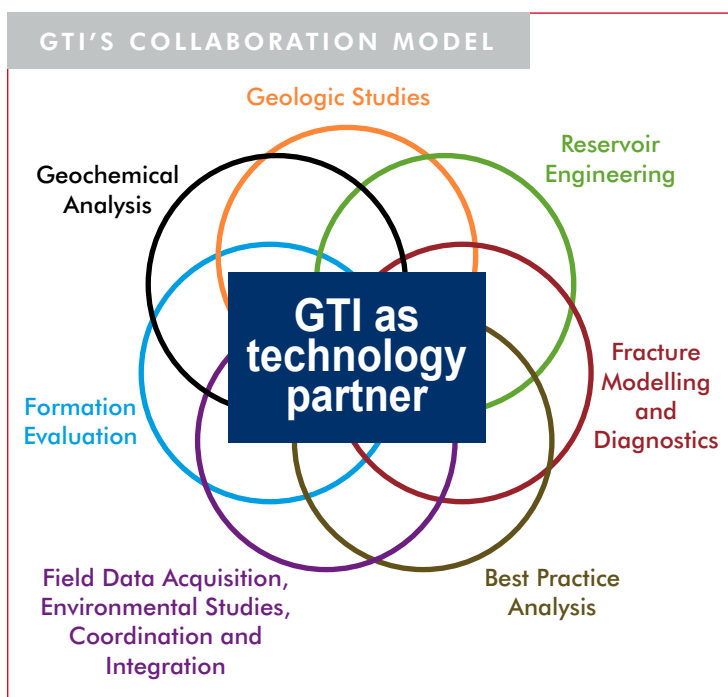
The approach is based on 30 years of working with the global industry, academia and government policymakers to develop solutions for converting UCG potential into productive energy resources. Programme participants might include personnel from E&P operators and service companies, universities, consulting firms, private research organisations, oil and gas associations, national labs and public geological surveys. GTI leverages its own capabilities with an extensive network of subject experts and focuses this talent on understanding and solving the specific challenges of a particular play.

GTI is currently seeking participants in a new collaborative on hydraulic fracturing and waste-water management. The project will create a “joined-up conversation” between gas producers, water management solutions providers and public stakeholders. The work will define best practices and emerging solutions, map them according to GTI’s flow sheet model, identify gaps in technology development and determine cost reduction and efficiency opportunities taking account of full life-cycle costs. The intent of the project is to identify near- and long-term cost savings, reduce commercial uncertainty and prevent issues associated with water use from becoming an obstacle to the sustainable development of vital UCG resources.

**Water management and reuse technologies**

GTI is developing water management methods and technologies that reduce demands for fresh-water, reduce environmental impact of brine disposal and ensure supplies of water for well drilling and completion for natural gas development in the Barnett and Marcellus Shale plays. Areas of emphasis include:

- Evaluation of promising commercially-available technologies for water reuse;
- Development of novel coatings to improve performance and cost of ultrafiltration, nanofiltration and reverse osmosis treatment



technologies in the demineralisation of flowback waters;

- Development of electrodialysis reversal for low-cost produced water and flow-back water demineralisation; and
- Identification and evaluation of alternate sources of water that may be useful as replacements for groundwater or surface waters that serve as community water supplies.

### *The Global Unconventional Gas Conference*

Global interest is high in the natural gas potential from unconventional resources. To support the dissemination of the US industry experience, GTI with the cooperation of RPSEA, IGU and many industry sponsors hosted "Global Unconventional Gas 2010: Unlocking Your Potential" in Amsterdam, The Netherlands, June 15-17. Over 40 top US and international professionals presented and over 150 professionals from 25 countries attended.

Several key outcomes resulted from this conference including initial discussions with over a

dozen European gas developers to help identify and overcome perceived challenges to UCG development in Europe. GTI fully intends to support the global industry in developing these resources and continue the conversations started in Amsterdam.

GTI has been invited by Gazprom to present at its October 28-29 "World Gas Resources and Reserves & Advanced Development Technologies" conference in Moscow.

There will be a dedicated GTI-led one-day session on unconventional gas at Gastech, March 2011, Amsterdam, The Netherlands.

The next Global Unconventional Gas Conference is tentatively scheduled for the second half of 2011 in Asia.

### *Global Unconventional Gas on LinkedIn*

Another way to collaborate is through electronic social media. LinkedIn, the online professional networking site, hosts a number of interesting industry groups. GTI manages a LinkedIn group specifically for professionals interested in working to realise the full potential of UCG resources. The



GTI is working to prevent issues associated with water use from becoming an obstacle to the sustainable development of UCG resources – drilling in the Haynesville Shale.





group can be found by typing “Global Unconventional Gas” in the group search box. In just a few short weeks, group membership has grown to over 400. Membership is free.

### ● A world of abundant supply

#### *North American gas shale and other UCG*

In the United States UCG contributed about 10% of total production in 1990. Today it is over 40% and by 2020 it is expected to supply well over 50%. Gas shales are driving this growth.

North American gas shales already contribute over 9 billion cubic feet per day (bcf/d) or 250 mcm/d and are projected to grow rapidly (Kuuskraa, et. al. 2009). In 10 years, gas shales alone are expected to account for a third of North American natural gas production.

#### *World gas shale and other UCG*

The worldwide pursuit of UCG including gas shales has only just begun. All currently published resource estimates for world supplies start with H.H. Rogner’s 1997 “top-down” study of world hydrocarbon resources. Rogner estimated the world gas shale resource endowment to be 16,110 tcf (456 tcm).

If the dramatic increases in projections of technically recoverable gas in North America hold for other plays around the world, Rogner’s resource endowment estimate for gas shales will prove to be very conservative.

A true “bottom-up” assessment is required as a next step in defining this potential. As a result, GTI and RPSEA participants are planning and initiating a Global Gas Assessment to characterise the UCG resources around the world.

#### *Europe*

Europe’s UCG resource endowment and supply potential are large and production holds promise. Exploration is underway in several European basins including the Alum Shale of Sweden, the Silurian Shale of Poland, the Posidonia Shale in Germany, the Carboniferous sediments in The Netherlands and Germany, and the Mikulov Shale of Austria. Several companies are also seeking permits for shale gas prospects in south-east France in Languedoc Roussillon, the Cevennes mountains region and the Savoie area near the Swiss border. Other significant efforts have been underway in Hungary’s Mako Trough to



| Australia is a global leader in CBM production – the Fairview field in Queensland.

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understand the potential of its unconventional resources.

Europe's UCG geology is challenging. Therefore the development and deployment of technology tailored to each play is crucial for making Europe's unconventional resources economically productive.

#### **China and India**

China and India have numerous UCG basins that are only now starting to be evaluated. Recently, Shell and PetroChina announced plans to jointly evaluate and develop the gas shales in Sichuan Province.

#### **Other countries**

There are initial efforts underway in Venezuela, Argentina and Chile to understand the resource potential of tight sands and gas shale.

UCG exploration is underway in many other parts of the world, including Australia (a global leader in CBM production), New Zealand and South Africa where Statoil, Chesapeake and Sasol recently announced joint plans.

#### **● What clean, abundant, affordable gas makes possible**

The "discovery" of UCG has transformed the conversation around natural gas in the US from one of declining reserves, high prices and a future reliance on LNG imports to one of abundance, affordability and domestic energy security. As development occurs throughout the world, it opens up tremendous opportunities for energy security, reducing climate change risk and economic prosperity through wealth creation, capital investment and high paying jobs.

#### **Providing energy security**

An abundant supply of "home-grown" gas has the potential to change the energy trade balance between nations. It may be that those countries around the world who have traditionally imported

the bulk of their energy from elsewhere may instead become self-reliant or even energy exporters.

#### **Reducing climate change risk**

Abundant supplies of UCG transform global debates over climate change abatement strategies. With a carbon footprint at least 30% lower per BTU than oil and 45% cleaner-burning than coal, natural gas is highly desirable bridge fuel to a low-carbon, sustainable energy future and will play a prominent role in the energy mix for decades to come.

New climate regulations that place a price on carbon emissions will shift relative economics in favour of more natural gas consumption rather than coal in electric power generation. Natural gas power plants can also be built more quickly than coal-fired plants.

Gas facilitates the development of renewable energy. Because gas plants can be fired up and down quickly (unlike coal and nuclear) natural gas can better supplement wind and solar power facilities, whose output varies with the weather. New gas supplies leading to more stable prices could also support more transportation fleets being converted to natural gas without requiring major infrastructure improvements. Additional technology developments could also make the economics of passenger car utilisation more attractive over time.

#### **Creating wealth, jobs and investment**

Energy development means economic development. Penn State University (PSU) recently estimated that the Marcellus Shale gas industry in Pennsylvania will generate \$9 billion of economic output, \$800 million in state and local tax revenues and create 110,000 new jobs in that state alone in 2010. By 2020, the study estimates the gas industry will generate \$13.5 billion in added value, \$12 billion in state and local tax revenues (cumulative) and create 175,000 new jobs. The PSU study captures job creation in just





one state and from just one resource.

In addition, energy-intensive manufacturing companies often relocate in search of cheaper energy in order to remain globally competitive. Regions with abundant supplies of natural gas will be more successful at attracting and retaining direct capital investment and the secure high-paying jobs that come with it.

● **The road ahead**

The potential benefits of developing global unconventional gas are not guaranteed. There are distinct and diverse challenges facing each of these resources in addition to the need for technology transfer and support. Collaboration between producers, service companies, NGOs, policymakers, thought leaders, industry associations, universities and investors combined with the right advances in technology will be crucial for these resources to reach their full potential.

*Trevor Smith is Business Development Manager at GTI — a leading non-profit research, technology development and training organisation that has been solving important energy and environmental challenges for the global natural gas and energy industry for nearly 70 years ([www.gastechnology.org](http://www.gastechnology.org)).*

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### Conferences

- > Dedicated GTI-led one-day session on unconventional gas at **Gastech March 2011, Amsterdam**
- > **GUG 2011**, Global Unconventional Gas **Second half 2011, Asia**
- > **tcbiomass2011**, the International Conference on Thermochemical Conversion Science **September 2011, Chicago**



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## UCG – The New American Revolution

By Mark Blacklock

The exploitation of unconventional gas (UCG) has revolutionised the US natural gas industry by offering the country the potential for long-term self-sufficiency in gas. And as the US is the world's largest gas producer and consumer, domestic developments there have a significant impact on global trade. Now the US is seeking to share its expertise with other countries. As part of this initiative "Global Unconventional Gas 2010: Unlocking Your Potential" was held in Amsterdam, June 15-17.

The conference was organised by the Gas Technology Institute (GTI), which is affiliated to IGU and has been working on UCG research since 1982. IGU was also one of the co-sponsors of the conference, which was held in the 17th century Koepelzaal of the Renaissance Hotel, formerly a Lutheran church. The EU is one of the key areas for new UCG developments and The Netherlands was an appropriate venue being the EU's top gas producer.



GTI's President & CEO David Carroll welcomes delegates.

"The impact of UCG has been nothing short of extraordinary," declared Guy Lewis, GTI's Managing Director Exploration & Production, in his welcome address to delegates. He said that UCG now accounts for 46% of US gas production with 24% being tight gas, 12% coal-bed methane (CBM) and 10% shale gas.

Current UCG efforts are focusing on shale gas using the latest technological developments – particularly in terms of hydraulic fracturing and horizontal drilling – and Lewis forecast that its share of US production would grow to 45% by 2030. Hydraulic fracturing was first used commercially in the petroleum industry in 1949, while horizontal drilling was introduced in the early 1980s; what is innovative is the refinement of these techniques, their combination and their application to UCG exploitation.

Thanks to the UCG revolution the US has at least 100 and perhaps 200 years of technically recoverable gas resources and the surge in LNG imports that was being forecast only a few years ago will not happen. This is having a dramatic knock-on effect on the global LNG business as exporters targeting the US switch to other markets. Moreover, the US may well increase LNG exports over the small Alaska-Japan trade. Cheniere Energy, for example, is looking at installing 7 mtpa of liquefaction capacity at its Sabine Pass receiving terminal in Louisiana. Meanwhile, net pipeline imports are also falling (see Table 1).

The flood of gas into the US market combined with a weakening in demand due to the economic crisis has led not just to reduced prices but to a greater disconnect with oil. Gas prices dived in 2009 with an average Henry Hub price of \$3.95/mmbtu representing about a 60% discount to WTI oil on an energy equivalent basis. In 2008 the average price of \$8.85/mmbtu represented a 50% discount. Gas prices in 2010 have recovered somewhat and at the time of the conference the Henry Hub price was \$4.80/mmbtu, but the 60% discount to oil remained.



Following trials at the Hugoton field in Kansas in 1947, the petroleum industry's first commercial hydraulic fracturing was carried out in Oklahoma in 1949 by Halliburton under a Stanolind patent.

The pricing environment has spurred efforts to reduce costs and improve recovery rates, and the latest technology and best practices – characterised by speakers as UCG phase 2 – are now available to export.

become the largest gas field in the US,” he said, referring to the shale formation in the US north-east. “Four of the world’s largest gas fields have been found in the US in recent years and there is enormous potential around the world.”

BELOW  
Table 1.

● **From the US to the rest of the world**

The big question is to what extent the US experience can be replicated in the rest of the world. Speakers identified significant potential – with the immediate attention focused on tight gas and CBM projects – but noted that differing legal, fiscal and gas pricing environments would affect developments in each national market. They also pointed out that it would take time for other countries to develop the necessary support infrastructure.

Jan Rune Schjøpp, Statoil’s Vice President in charge of Natural Gas Strategy & Analysis, quoted estimates of global in-place UCG resources of 920 tcm. “If only 10% is added to reserves this represents a significant opportunity,” he pointed out.

Aubrey McClendon, Chairman & CEO of Chesapeake Energy, agreed. “Marcellus is likely to

US GAS STATISTICS (BCM)			
Year	2009	2008	2007
Production	593.4	574.4	545.6
Pipeline imports	93.03	104.41	108.9
Pipeline exports	29.46	26.18	22.01
LNG imports	12.8	9.94	21.82
LNG exports	0.86	0.97	1.18
Net imports	75.51	87.2	107.53
Consumption	646.6	657.7	654

**Note:** Differences between supply (production + net imports) and consumption are due to variations in stocks at storage facilities together with unavoidable disparities in data collection/conversion. In particular, consumption in 2009 was down due to the economic crisis with more gas going into storage.

**Source:** BP Statistical Review of World Energy, 2008-2010





Small pads minimise the surface impact of UCG operations – this drilling rig was set up in the middle of the Arlington Campus of the University of Texas.

However, Schøpp expected UCG developments in the rest of the world to be evolutionary rather than revolutionary, a view with which many of his fellow speakers agreed. “Asian UCG is not such a global game changer,” said John Harris, IHS Cera’s Global Gas Director, “it will have more of a local/country-level impact.” He pointed out that gas self-sufficiency for the major Asian importers is not on the cards and that the CBM to LNG developments in Australia will complement the country’s conventional LNG business.

From the Middle East George Yeung, Principal Professional at Saudi Aramco, explained: “Our strategy is to use UCG resources to backfill the conventional resources. We know the gas is there, we just don’t know how much we can get out and at what cost.”

Indeed, speakers stressed that there is tremendous variability in UCG resources and that understanding the geology on a play-by-play basis is essential. This means investing in intensive data acquisition and analysis in order to understand the resource and drill the optimum number of wells. “Our first year in the Marcellus has been [spent] data gathering,” said Dr John McGinnis, Senior

Vice President for Exploration & Development at NFG/Seneca Resources.

In the case of CBM plays historical data from the coal mining era can be useful, a point made by both Andrew Austin, CEO of IGas Energy which is working on CBM pilots in the UK, and Dr Mart van Bracht, TNO’s Director for the Built Environment & Energy. The latter added that as a Dutch state-owned enterprise TNO makes its data freely available.

“For us in Europe UCG is very much unknown territory ... US experience can provide a lot of lessons,” said Jan Panek, Head of the European Commission’s Oil & Gas Unit. He cautioned that production of indigenous UCG, “has to be both economically and environmentally viable”, while acknowledging its strategic significance against the background of the EU’s increasing dependency on gas imports.

#### ● Environmental concerns

With the Macondo well still gushing into the Gulf of Mexico, environmental impact and public reactions were at the forefront of everyone’s minds. Indeed, while all aspects of UCG were addressed



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Water is a sensitive issue – drilling in the Permian Basin in Carlsbad, New Mexico.

during the conference, the key message was that geological, engineering and financial activities have to be backed up by comprehensive outreach programmes.

“Communication with the local communities is essential,” said Jan Dirk Bokhoven, Chairman of the Executive Board of EBN. This is especially the case in countries where mineral rights are separate from land ownership. “You have to start talking to local inhabitants as soon as possible and make clear there is something in it for them,” said TNO’s van Bracht.

“I don’t think our industry has got out and talked to people enough,” conceded Dr Jennifer Miskimms, Director of the UCG Institute at the Colorado School of Mines, while IGU’s President, Datuk (Dr) Abdul Rahim Hashim, declared “the global gas industry today is in danger of an image deficit”.

Addressing that image deficit means addressing the concerns of the general public as regards the

amount of land required for drilling sites, the road traffic generated and the implications for the local water supply, and the UCG sector has a good record to promote.

Today’s UCG drilling sites are dubbed “pads” precisely because the refinement of horizontal drilling techniques means that many wells – up to 40 in some cases – can be operated from one pad. Careful project management minimises road traffic movements during the drilling phase and pipelines can be connected for the production phase. Indeed, there are several examples of socially-accepted urban UCG operations in the US, notably in the Fort Worth area.

Water is the most sensitive issue with concerns about contamination of potable supplies and – in areas of scarcity – excessive use. But Steve Wolhart, Vice President, Fracture Diagnostics at Halliburton subsidiary Pinnacle Technologies, pointed out that the US shale plays are much deeper than aquifers and that following best practices in terms of cementing and steel casing protects the groundwater. Since that first commercial hydraulic fracturing in 1949, he said, “more than a million frac jobs have been pumped and there has been no documented case of contamination”. He added that sand and water represent the bulk of the fracturing fluids with chemical additives accounting for only around 0.5%.

Moreover, research efforts to further reduce the environmental impact continue. Schlumberger’s Vice President of Unconventional Resources, Chris Hopkins, highlighted, “a big focus on the best way to stimulate these wells [using] less water and chemicals”. And Encana’s Executive Advisor, Alastair Nichol, said he was looking for sub-surface non-potable water sources which could be treated and used for fracturing, while Vello Kuuskraa, President & Chairman of ARI, highlighted the potential to recycle produced frac water.

Dr Tom Hayes, GTI’s Institute Engineer Exploration & Production, argued that most





industrial processes need water and that UCG's use of water should be considered in relative terms. As an example, he pointed out that replacing a coal-fired power station with a CCGT fuelled by shale gas would result in an overall decline in water consumption.

● **UCG checklist**

Given the right geology, adoption of best practices and a good communications strategy, what other factors are important in developing UCG resources? Speakers highlighted the need for a positive government attitude in terms of supporting R&D, creating fiscal incentives and maintaining a stable regulatory regime.

In the US, for example, the Department of Energy funded early R&D into UCG and there was a tax credit for CBM between 1980 and 2002. In

Poland, fiscal terms are designed to encourage indigenous supplies. "Poland is a very good place to do business," said Rowen Bainbridge, CEO of Aurelian Oil & Gas, which is working on a tight gas project there.

Speakers also stressed the importance of a developed service company infrastructure – there is a shortage of horizontal drilling rigs in Europe for example – access to transport infrastructure to take the gas to customers and open markets.

All-in-all the more than 150 participants had a productive two days, and perhaps the final word should go to a representative of the host country, EBN's Jan Dirk Bokhoven, who told delegates: "We believe in an unconventional future".


*Mark Blacklock is the Editor-in-Chief of International Systems & Communications Ltd.*



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