

FEATURE ARTICLE: Shale Gas - Overnight Success 30 Years in the Making

Ed Kallio, Manager, Gas Consulting

The last two years have ushered in dramatic changes for the North American natural gas industry. Leaps in drilling, completion technology, and techniques have unlocked natural gas from very tight shale formations, gas the industry knew was there all along, yet had no way of tapping and exploiting economically. The conventional wisdom that development of the Barnett Shale was an overnight success is wrong. According to Ziff Energy's chief geologist Simon Mauger, "the Barnett Shale is an overnight success 30 years in the making".

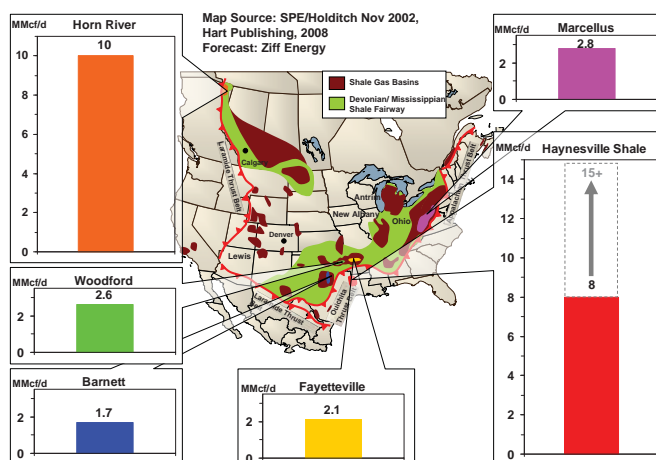
In 2007, the North American natural gas industry was chugging along, needing to find 17+ Bcf/d of natural gas every year to replace declines in conventional, coal bed methane and Tight Gas supplies. With initial production from new conventional gas wells declining, more drilling was required to add to annual production. Average initial well productivity across North America declined to 0.5 MMcf/d in 2006 from 0.8 MMcf/d in 2000. New wells were more expensive to drill, and produced less gas. With drilling and other costs spiralling, *new gas* was becoming increasingly expensive, averaging over US\$7/Mcf on a full cycle basis late in 2007.


Fast forward to 2010: the North American gas industry is now producing over 8 Bcf/d from Shale Gas plays, ranging from the Haynesville in Louisiana and East Texas, to the Marcellus in the US Northeast. Horizontal drilling and multi-stage fracturing techniques have begun to unlock the enormous gas potential of these reservoir shales, and production may grow to over 20 Bcf/d by 2020.

Not all shales are created equal. There are marked differences in Total Organic Content, gas liquids and CO₂ content, well depths, pay thickness, pressures, and temperatures. These differences can dramatically affect Initial Well Productivity ("IWP"), well decline rates, and the total amount of gas recoverable from a well. All of these factors impact the economics of developing Shale Gas.

Operators are learning the peculiarities inherent in each shale basin, perfecting frac and completion techniques, adding multiple wells to drilling pad locations, increasing the number of frac stages (up to 20), and lengthening the horizontal sections to optimize production and drive costs down. In some areas, new production can come onstream relatively quickly, as infrastructure is already mature. In other shales, (the Horn River in British Columbia) where infrastructure and environmental and logistical issues have to be overcome, Shale Gas production will take somewhat longer to ramp up.

Shale Gas Initial Well Productivity



In 2008, Ziff Energy published a ground-breaking study ranking the **full cycle cost of gas from major North American gas basins**, including several shale basins. The 2nd edition Cost Study will be published in **March 2010**, examining the full cycle cost of new and emerging Shale Gas plays, ranked against other North American gas supply, including Northern Gas and imported LNG. With better technology, and a better understanding of the basins, wells drilled in many shales now produce more gas than conventional wells, and the full cycle cost of Shale Gas is lower. However, the shale plays cannot provide all the gas needed for expected North American consumption growth. We will need conventional gas, coal bed methane, Tight Gas, and LNG, to help offset natural gas declines and to meet demand increases, especially for power generation, over the next decade. 

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Strategies to Improve Field Energy Use: A Must in Today's Business Environment (Part 1)

Silvia Portnoy, Associate (Argentina) & Juan Carlos Alba, Vice President E&P

With an increasing cost focus worldwide, and a concern about Greenhouse Gas Emissions, many operators are looking closer at their energy use. By having an energy management system in place, companies benefit by having lower operational costs, less exposure to the volatility of energy prices, and lower Greenhouse Gas Emissions.

A sound energy management strategy requires operators to understand the performance baseline of their company's fields. Ziff Energy was engaged by an international oil company to conduct an Energy Efficiency Evaluation & Emissions Inventory Pilot Study for significant producing fields in Argentina.

The energy efficiency evaluation focused on energy management and conservation for all forms of energy (electricity, fuel gas, and oil) used in field operations. The main elements of the evaluation encompassed the following aspects:

- understanding how, what, and where energy is produced and consumed within a facility or field, through the collection of energy use data
- identifying *energy reduction opportunities* and associated operating cost reductions

- developing an energy monitoring and targeting system for facilities and fields
- training staff to raise awareness of energy usage and costs, and to maintain the initial effort of setting up a sound energy management program/system.

The deliverables of this project were organized into activity modules, with the resulting findings:

1. **Energy Usage Assessment for Well Sites:** data was collected for producing wells, and analysis performed to determine the efficiency and effectiveness of the pumping and ancillary equipment.
2. **Energy Usage Assessment for Main Facilities:** Ziff Energy reviewed the process design and operations of main field facilities and water injection operations. This information helped determine the optimum operation of the existing processes and major pieces of energy-consuming equipment, and associated operating cost savings.

The results of this work enhanced the ability of the field's operating team to manage their energy use and to integrate their energy production, adding value from more efficient electricity utilization and a reduction in fuel gas consumption.

Next Comment Issue:

Greenhouse Gas Emissions Evaluation & Results (Part 2) 

DID YOU KNOW?

- hurricanes reduce Gulf of Mexico offshore gas production by an average 10%/year, although the GOM only supplies 9% of total North American gas demand
- North America LNG imports vary between 1 and 2 Bcf/d, however also imports the equivalent of 1 Bcf/d in Urea and Ammonia
- processing gas demand at the Alberta oil sands is more than 1.1 Bcf/d, and will rise to nearly 3 Bcf/d by 2020
- 2009 cost of newly installed North America pipeline is US\$89,000/inch-mile
- estimated peak North America gas storage withdrawals exceed 45 Bcf/d, equivalent to 2/3 of North America average daily gas production

ZIFF ENERGY EXPANSION TO 30th COUNTRY --- Ecuador

Ziff Energy was recently awarded a project by a large operator in Ecuador to benchmark **production and drilling operations**.

The firm has now completed work in every country but one in South America with oil & gas production. **Ecuador becomes the 30th country where Ziff Energy has benchmarked upstream operations.**

Production Reliability & Efficiency Benchmarking --- What is 'Best in Class' Production Performance?

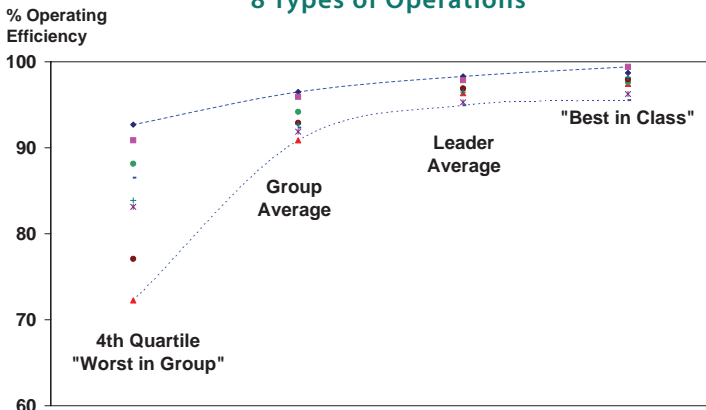
Min Yang, E&P Project Manager

Ziff Energy has included the assessment of field production reliability & efficiency in its Improving Field Performance studies since 2007. Over the last 3 years, 480 fields from various regions around the world have been assessed; some fields multiple times. Ziff Energy's approach is to analyze daily production data of oil & gas fields and benchmark the key performance metrics. The results prove this approach provides a consistent base for field production performance benchmarking.

To date, production performance of 190 Western Canadian Sedimentary Basin properties have been assessed. These properties can be classified into 4 types of gas fields: Sweet Gas - High Productivity, Sweet Gas - Low Productivity, Sour Gas - High Productivity, and Sour Gas - Low Productivity, and 4 types of oil fields: Primary Production, Water Flood - Medium Watercut, Water Flood - High Watercut, and Heavy Oil.

The graph below presents the operations efficiency of the worst and the best performing fields from each of the 8 types of operations. Average and Leader (the top 1/3 fields with the highest efficiency) operating efficiency for each of these groups are illustrated. Although wide variance exists for the worst performing fields, the efficiency of leaders and best performing fields are closer. This observation demonstrates that operating conditions are different for the 8 types of fields. Oil and gas operators of all types of fields should set their goal to achieve the Leader or "Best in Class" performance for their type of operation.

**Production Performance
8 Types of Operations**



Paul Ziff at 'Young Professionals in Energy' Breakfast (Houston)



On January 13, Paul Ziff spoke at a Young Professionals in Energy Breakfast held in Houston. In addition to the trends in gas & oil prices, Mr. Ziff addressed sinking gas fortunes, economics of drilling, and the outlook for North American gas supply (Shale Gas) and demand (including power generation and the Alberta oil sands). The event was attended by over 100 young professionals from all facets of the energy industry. ☺

4th International Operations Excellence Seminar - Oct 13 & 14, Houston

Ziff Energy is pleased to announce the 4th International Operations Excellence Seminar will be held in Houston on October 13 & 14, 2010. The theme this year will be "Production Reliability: Achieving Operations Excellence" and will focus on Uptime & Maximizing Production, Offshore & Deepwater Operations, and will include case studies.

Our 3rd OpEx Seminar, held May 28 & 29, 2008 in Houston, was a great success. Attendees and speakers represented 35 companies, including Super-Majors, Independents and National Oil Companies, from 16 countries on 5 continents.

To obtain information, contact Kirsten Dunbar at 1 (403) 234-4297 or visit our website at www.ziffenergy.com/events/opex.

Economic Ranking of North American Gas Basins

Bill Gwozd, P.Eng., VP, Gas Services


When discussing natural gas prices, people may think of Henry Hub or another gas trading hub. However, when discussing natural gas costs, there is no accepted measure to turn to. A simple analogy to consider is to examine the cost of a backyard do-it-yourself BBQ hamburger that you cook at home with the family. The layers are fairly simple: a bun, green lettuce, red tomato, meat, pickle, and cheese to top it all off. The cost to buy these ingredients might come to \$1.25. Similarly, the cost of the natural gas hamburger includes: Royalties/Taxes, Operating Costs, Finding & Development expenses, Overhead, some Profit (the Return to Investors), and the cost of Transportation to get the gas to market. The total of these increments added to over \$7.00/Mcf in 2008, far more than the price realized at the trading hubs.

A good handle on the relative cost to explore, develop, produce, and market natural gas across the various gas basins in North America is important to an investor who wants to determine where to direct funding for the best return. For years, getting accurate cost data for gas from various producing basins was very challenging, if at all possible. Based on ground-breaking research, in early 2008, Ziff Energy published the first complete full-cycle gas analysis of 85 plays from 2 dozen gas basins. The next cost study of North America gas basins is currently being finalized using cost data as of late 2009 (the current low gas price / low cost environment). Economic ranking of the gas basins across North America will determine which regions Producers get funding and which basins will see continued slow down.

For mergers, acquisitions, and divestitures, is it better to buy gas reserves, or is it better to explore, develop, produce, and market? The answer depends on the specific gas basin. This age-old question is being asked by Boards of Directors and by executive managements conducting due diligence on pending deals. Even service companies such as drillers, pipelines, and suppliers would benefit by knowing the economic ranking of the major gas basins so they can focus their services and equipment to where Producers need it most, i.e. to the more profitable basins.

State and Provincial Governments will be better stewards of their producing communities if they understand the relative economics of basins. They will be better able to assess the impact of tax/royalty options and development issues which will impact (positively or negatively) incremental investment by operators, and therefore encourage or discourage increased regional gas production.

Exploding growth among various Shale Gas basins leads to a similar question – which Shale Gas Basin is most attractive to invest in from a total cost perspective? Cost assessments of Barnett (Ft. Worth), Arkoma, Haynesville, Marcellus, Appalachian, and Canadian Shales will be included in the upcoming study.

Graphically impressive, the new edition of the North American gas basins study will help to explain the cost structure of all the significant conventional and unconventional gas basins. If you'd like to obtain the 1st Edition now, or the 2nd Edition shortly, contact Bill Gwozd, P. Eng., VP Gas Services at 1 (403) 234-4299, or bill.gwozd@ziffenergy.com. 

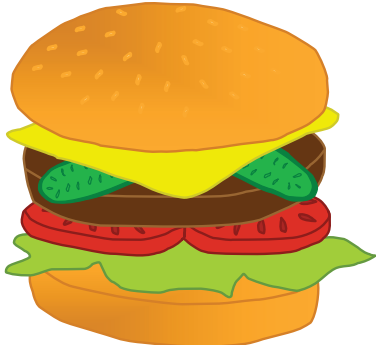






PRICE:	\$4.00 / Hamburger		US\$4.00 / Mcf Gas
		\$	\$
	Bun	0.25	 Basis Differential 0.50
	Cheese	0.20	 Return: 15% BIT 1.40
	Pickle	0.15	 Overhead 0.40
	Beef	0.50	 Finding & Development 2.50
	Tomato	0.10	 Operating 1.40
	Lettuce	0.05	 Royalty & Production Taxes 1.00
COST:	Total	\$1.25	Total US\$7.20

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'Elevating Operations Performance' Case Study

Jacques Duchesne, Director, Operations Excellence


In mid-2009, Ziff Energy undertook an evaluation of the opportunities to improve the production and operating cost performance of a conventional gas property located in Central Alberta. The daily production was 30 MMcfe/d, with an annual OpEx of \$18 MM.

The baseline for the evaluation was a detailed assessment of all aspects of the management and day-to-day operations of the field and facilities, using the results of Ziff Energy's 2008 IFP (Improving Field Performance) Study for this specific property as a guideline.

The Elevating Operating Performance (EOP) follows a thorough process comprising the following key steps:

- data gathering and analysis for the past two full operating years, and current YTD activities

- kickoff meeting and initial brainstorming session with the field personnel
- documentation and review of an initial long list of opportunities
- review of work practices, business processes, operating and maintenance policies and procedures, and 3rd party contractual arrangements
- Opportunities Prioritization Workshop, selection of top opportunities for deeper analysis, and estimation of economic value
- training support for designated core team members to conduct the deeper analyses
- analysis, opportunity and action plan write-ups, and benefit/cost estimations of top opportunities, both field operational and corporate management/administrative
- Implementation Planning Workshop, to ensure a prompt and successful kickoff!

For more information on how you can benefit from this type of study for your properties, please contact Jacques Duchesne, Director, Operations Excellence at 1 (403) 234-6558 or jacques.duchesne@ziffenergy.com. 

NEW ZIFF ENERGY STAFF



Joe Kilchrist, P.E. - Director, Offshore Operations, has 3 decades of upstream operations experience in the oil & gas industry, encompassing technical audits, economic evaluations, contract issues, and legal/regulatory requirements. Mr. Kilchrist's consulting, drilling/

production, and engineering experience spans USA, the Gulf of Mexico, offshore California, offshore Alaska, Turkey, Indonesia, and Kazakhstan. He holds a Bachelor of Science in Petroleum Engineering from the University of Louisiana, is a registered professional engineer, and holds an International Well Control Forum combined surface and subsurface BOP stack drilling supervisor certificate. He is an accomplished author with published professional papers.



Dr. Lev Virine, Ph.D., Lead Analyst, has over 2 decades of technical experience, economic evaluation of oil and gas reserves, decision and risk analysis in oil and gas industry, portfolio management, and oil and gas reserves management. He assisted leading national

and international exploration and production companies in establishing reserves evaluation and decision analysis processes. Dr. Virine has authored more than 40 scientific papers and articles, 7 patents, and two books. His current focus is gas production outlooks, gas supply decline analysis, and full cycle cost assessment. He has spoken at conferences and symposiums around the world. Dr. Virine received his doctoral degree in engineering and computer science from Moscow State University of Engineering.

CASE STUDY RESULTS:

- 65 opportunities were identified
- 8 opportunities were prioritized, 6 field-led & 2 Corporate-led
- the reduction in OpEx was **\$6.1 MM per year**
- the one time incremental capital to achieve these savings was **\$1.03 MM**
- a one time opportunity revealed a yearly cost savings of **\$2.2 MM**
- the overall net is a **19% reduction in unit operating property cost**
- incremental production revenues were also identified.

North Sea Mature Hub Operations Benchmarking

Jacques Duchesne, Director Operations Excellence

In December 2009, Ziff Energy delivered a multi-client study for North Sea Operators of Mature Hubs. This study was prepared to provide operating costs and production efficiency benchmarking using Ziff Energy's proven methodology.

A critical core set of North Sea operators were committed to proceed with the comparison of their Mature Hubs. In addition, Ziff Energy included 'out of region' peer Hub fields operated by Majors & Independents in the Gulf of Mexico and Brazil.

We define 'Mature Hub' as:


- water depth is less than 200 meters
- having produced a significant portion of the original field reserves
- platforms are 10 to 30 years old
- serving one or more satellite reservoirs, connected by flowlines from other facilities, or via subsea tie backs.

The study assessed hubs for 21 fields, with a total of:

- 400 MBbl/d oil production
- 2 Bcf/d gas production
- US\$1.2 Billion annual operating cost.

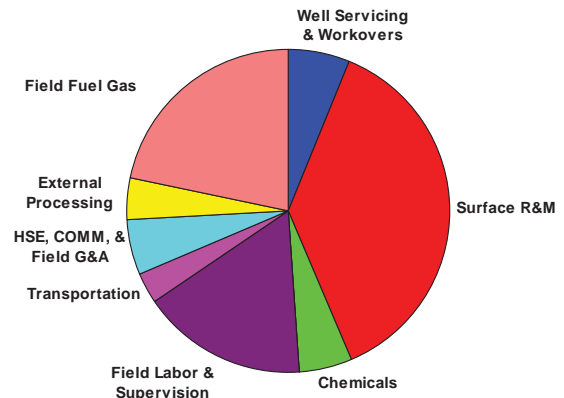
The study was customized for each participant to provide ranking and quantify potential dollar saving for each of 10 major cost categories. The adjacent graph shows the composition of costs.

There is still time to "back-in" to this study, or join future editions. Contact :

- Jacques Duchesne: 1 (403) 234-6558 or jacques.duchesne@ziffenergy.com
- Richard Tucker: 1 (713) 985-5183 or richard.tucker@ziffenergy.com. 

Composition of Costs

Total Cost: \$566 MM



UPCOMING SPEECHES

2010 Intl Deep Offshore Technology (Houston)

February 2-4

Tom Gray highlights the cost and performance issues that are unique to benchmarking operations in Deepwater including marine support, logistics, subsea maintenance, well maintenance, facilities maintenance, and staffing.

Society of Petroleum Engineers (Houston)

February 11

Bill Gwozd will showcase Ziff Energy's Gas Supply assessment and share how he foresees the outlook for gas demand.

CERI 2010 Natural Gas Conference (Calgary)

February 22-23

Paul Ziff will share his insight on the comparison of gas & oil, the influence of currency exchange, along with sinking gas fortunes at low gas prices.

Canadian Institute's Arctic Gas Symposium (Calgary)

March 2

Bill Gwozd will explore developments in Shale Gas, the current cost structure of gas, and its impact on the industry.

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