

From: [Bown, Charles](#)
To: [Kennedy, Jerome](#)
Subject: Fw: Ziff Paper and review
Date: Saturday, October 27, 2012 11:19:51 AM
Attachments: [Comments on Ziff report.docx](#)
[image001.gif](#)

This is draft. I only had a quick review yesterday and will be in this afternoon. The same points are made as we heard earlier. I need to review the LNG section with jim keating.

Charles

From: Bob Fleck [mailto:bob.fleck@woodmac.com]
Sent: Friday, October 26, 2012 04:03 PM
To: Bown, Charles W.
Subject: RE: Ziff Paper and review

Charles,

Here is the latest iteration, (not reviewed except by me). It's been like herding cats this week. We had expected the paper last week and everyone has been busy. I'm pretty happy with the body of the report, but the summary at the end may still need some work. Happy to get your comments and review/discuss next week.

Regards,

Bob

Bob Fleck
VP Americas Gas and Power Consulting

T +1 603 583 5176
M +1 603 265 0866
E Bob.Fleck@woodmac.com

Wood Mackenzie
5847 San Felipe
Suite 1000 T +1 713 470 1600
Houston, Texas E energy@woodmac.com
USA W www.woodmac.com

Global Offices

Australia - Brazil - Canada - China - India - Indonesia - Japan - Malaysia - Russia - Singapore - South Korea - United Arab Emirates - United Kingdom - United States



Consider the environment and business costs. Please don't print this e-mail unless you really need to.

From: Bown, Charles W. [mailto:cbown@gov.nl.ca]
Sent: Friday, October 26, 2012 2:21 PM
To: Bob Fleck
Subject: Re: Ziff Paper and review

Hi Bob
What's the status of your review letter?
Charles

From: Bob Fleck [<mailto:bob.fleck@woodmac.com>]
Sent: Saturday, October 20, 2012 11:11 AM
To: Bown, Charles W.
Subject: RE: Ziff Paper and review

OK,

I'll pass on to the team.

Bob Fleck
VP Americas Gas and Power Consulting

T +1 603 583 5176
M +1 603 265 0866
E Bob.Fleck@woodmac.com

Wood Mackenzie
5847 San Felipe
Suite 1000 T +1 713 470 1600
Houston, Texas E energy@woodmac.com
USA W www.woodmac.com

Global Offices

Australia - Brazil - Canada - China - India - Indonesia - Japan - Malaysia - Russia - Singapore - South Korea - United Arab Emirates - United Kingdom - United States



Consider the environment and business costs. Please don't print this e-mail unless you really need to.

From: Bown, Charles W. [<mailto:cbown@gov.nl.ca>]
Sent: Saturday, October 20, 2012 9:28 AM
To: Bob Fleck
Subject: RE: Ziff Paper and review

Final for commentary. Any change past this point would likely only be grammatical.

Charles

From: Bob Fleck [<mailto:bob.fleck@woodmac.com>]
Sent: Saturday, October 20, 2012 10:57 AM
To: Bown, Charles W.
Subject: RE: Ziff Paper and review

Charles,

Are these for simple review, or the final versions for us to write a commentary?

Bob

Bob Fleck

VP Americas Gas and Power Consulting

T +1 603 583 5176

M +1 603 265 0866

E Bob.Fleck@woodmac.com

Wood Mackenzie

5847 San Felipe

Suite 1000 **T** +1 713 470 1600

Houston, Texas **E** energy@woodmac.com

USA **W** www.woodmac.com

Global Offices

Australia - Brazil - Canada - China - India - Indonesia - Japan - Malaysia - Russia - Singapore - South Korea - United Arab Emirates - United Kingdom - United States



Consider the environment and business costs. Please don't print this e-mail unless you really need to.

From: Bown, Charles W. [<mailto:crown@gov.nl.ca>]

Sent: Saturday, October 20, 2012 8:53 AM

To: Bob Fleck

Cc: David Barrowman

Subject: RE: Ziff Paper and review

Bob;

Ziff has provided us with two new versions of the papers. They are attached for your review.

Charles

From: Bob Fleck [<mailto:bob.fleck@woodmac.com>]

Sent: Wednesday, October 17, 2012 4:53 PM

To: Bown, Charles W.

Cc: David Barrowman

Subject: RE: Ziff Paper and review

Thank you for the update Charles...I'll inform the team so they can work on that piece.

Regards,

Bob

Bob Fleck

VP Americas Gas and Power Consulting

T +1 603 583 5176

M +1 603 265 0866

E Bob.Fleck@woodmac.com

Wood Mackenzie

5847 San Felipe
Suite 1000 T +1 713 470 1600
Houston, Texas E energy@woodmac.com
USA W www.woodmac.com

Global Offices

Australia - Brazil - Canada - China - India - Indonesia - Japan - Malaysia - Russia - Singapore - South Korea - United Arab Emirates - United Kingdom - United States



Consider the environment and business costs. Please don't print this e-mail unless you really need to.

From: Bown, Charles W. [<mailto:crown@gov.nl.ca>]
Sent: Wednesday, October 17, 2012 3:22 PM
To: Bob Fleck
Cc: David Barrowman
Subject: RE: Ziff Paper and review

Bob;

We are working through a couple of technical issues on the pipeline paper and expect to have something for the end of the week. The LNG paper looks to be static and you can proceed to conclude your review on that document. The deadline can be relaxed until I give you further notice.

Charles

From: Bob Fleck [<mailto:bob.fleck@woodmac.com>]
Sent: Wednesday, October 17, 2012 4:47 PM
To: Bown, Charles W.
Cc: David Barrowman
Subject: Ziff Paper and review

Dear Charles,

David is traveling this week and asked that I stay on top of the Ziff paper review. I have not received anything and am concerned about meeting the deadlines indicated last week.

Please advise the current status of things.

Kindest regards,

Bob

Bob Fleck
VP Americas Gas and Power Consulting

T +1 603 583 5176
M +1 603 265 0866

E Bob.Fleck@woodmac.com

Wood Mackenzie

5847 San Felipe
Suite 1000 T +1 713 470 1600
Houston, Texas E energy@woodmac.com
USA W www.woodmac.com

Global Offices

Australia - Brazil - Canada - China - India - Indonesia - Japan - Malaysia - Russia - Singapore - South Korea - United Arab Emirates - United Kingdom - United States



Consider the environment and business costs. Please don't print this e-mail unless you really need to.

This e-mail transmission is strictly confidential. It is intended solely for the addressee. If you are not the addressee, please delete the e-mail and notify us by return email or by contacting our systems administrator on +44 131 243 4444 forthwith.

Moreover if you are not the addressee, you must not copy, use, act or rely on, disclose or distribute this e-mail. Wood Mackenzie Limited accepts no responsibility or liability for any harm to your, or any third party's, system or data caused by this e-mail or its attachments or any viruses or similar contained in it.

Wood Mackenzie Limited may monitor and record e-mails and their content passing through its network.

“This email and any attached files are intended for the sole use of the primary and copied addressee(s) and may contain privileged and/or confidential information. Any distribution, use or copying by any means of this information is strictly prohibited. If you received this email in error, please delete it immediately and notify the sender.”

This e-mail transmission is strictly confidential. It is intended solely for the addressee. If you are not the addressee, please delete the e-mail and notify us by return email or by contacting our systems administrator on +44 131 243 4444 forthwith.

Moreover if you are not the addressee, you must not copy, use, act or rely on, disclose or distribute this e-mail. Wood Mackenzie Limited accepts no responsibility or liability for any harm to your, or any third party's, system or data caused by this e-mail or its attachments or any viruses or similar contained in it.

Wood Mackenzie Limited may monitor and record e-mails and their content

The logo for Wood Mackenzie, featuring the company name in white text on a dark blue background with abstract light blue streaks.

Wood Mackenzie

Introduction

Wood Mackenzie has been engaged by the Newfoundland and Labrador Department of Natural Resources (DNR) for the purpose of reviewing and commenting on two reports prepared for the DNR by Ziff Energy Group (Ziff). Wood Mackenzie has used its independent views on the LNG markets and its in-depth knowledge of the costs of production and transportation of natural gas from off-shore plays, such as the White Rose field to reach the conclusions herein. Wood Mackenzie has not reviewed Ziff's modeling or internal processes, rather we have compared our independent views on the issues as compared to the conclusions reported by Ziff.

Review of “Grand Banks Natural Gas As An Island Electric Generation Option”

Cost analysis of offshore infrastructure

The Ziff report examines three scenarios for the development of gas resources in the Grand Banks. Cost estimates relate to the expense to produce gas in addition to existing oil production and are all in 2012 terms.

General cost assumptions

Ziff assumes the costs of wells for gas production will be Cdn\$50 million each. Wood Mackenzie believes this is a reasonable representation of expected well costs in this environment. For an oil and gas reservoir, operators may have the option to drill and complete wells that produce both oil and gas, thus reducing the element of costs per well that would be related to gas production. However, given the need for a reliable source of gas, dedicated gas wells would be more appropriate, thereby justifying the approach of assuming gas-only production wells.

An assumption of Cdn\$400 million for an offshore gas conditioning plant has been indicated. Ziff states that this will cost around twice the amount of an equivalent plant located onshore in Alberta. We feel that this is a reasonable assumption, given the more complex and sophisticated technology that would be required to install the facilities offshore with more limited space. There is however significant risk of higher costs, which could arise in particular due to regulatory specification requirements and installation.

Stand Alone Development

Ziff assumes the cost for a Gravity Based Structure (GBS) to manage gas production would be between Cdn\$1.5 and 2.4 billion. GBS facilities are notoriously expensive – Wood Mackenzie estimates that ExxonMobil's Hebron GBS, due onstream in 2018, will cost

approximately Cdn\$6 billion. The structure proposed in the Ziff paper would be smaller in scale and therefore less costly. Nevertheless, we expect costs would be right at the top end of Ziff's estimated range, and expect Cdn\$2.5 billion to be a more representative conservative estimate.

FPSO

To use the existing White Rose FPSO, Ziff assumes a refit would cost Cdn\$600 million (including Cdn\$400 million for the gas plant). Ziff states that turret and vessel modifications would make up the balancing Cdn\$200 million, and likely exceed this amount. We also feel that these modifications would likely be higher – a total cost of Cdn\$800 million would be more representative of a conservative estimate for FPSO refit.

The report assumes vessel replacement would be required by 2030, assigning a cost to represent the gas element of Cdn\$450 million. This is split as Cdn\$250 million for refit of an existing oil FPSO, and Cdn\$200 million to transfer the gas plant. This is representative of current costs that could be achieved, but there is considerable upside risk to these cost estimates. In addition to the cost risks in common with any offshore development, there is presently increasing demand in the FPSO market. While it is difficult to state the condition of the FPSO market in 2030, we feel it may be more prudent to assume a higher cost for the gas element of an FPSO replacement, in the order of Cdn\$600 million.

Integrated West White Rose

Ziff considers the scenario of expanding Husky's West White Rose GBS to incorporate gas production. Additional costs of 50% are assumed, equating to Cdn\$1.1 billion. We agree that an incremental cost factor of 50% is appropriate. However, the implied total cost of Cdn\$2.2 billion would represent the lowest end of the likely cost range. Ultimately the specifications of this smaller GBS will determine cost, but for a base estimate, Cdn\$3 billion would be more representative and better cover upside cost risks. Consequently, we feel the incremental cost for gas production would equate to Cdn\$1.5 billion.

Pipeline

Ziff estimates that a pipeline from production to shore would cost Cdn\$640 to 1,165 million. This estimate is based on an estimate of Cdn\$182,000/inch-mile which, under the assumption of a 16-inch diameter, equates to around Cdn\$1.8 million per kilometre. This is a reasonable representation of offshore pipeline costs.

The length of pipeline required ranges from 350 to 640 kilometres, depending on the route chosen. The choices are a short route to shore, or longer deeper route to avoid potential iceberg scour. Ziff rightly states that in the case of a short route, there would be additional cost for trenching the pipeline to avoid iceberg scour. Pipeline trenching costs would depend on requirements specific to the environment, and as such it is hard to place a definitive cost on them. Nevertheless, given that the shorter route would require more trenching, it is fair to say that the lower cost estimate provided should be used as a guide only and does not reflect this uncertainty, indicating a likely higher cost for the pipeline.

Comment on inflation

The Ziff report does not factor in any assumption for future cost inflation. In the Canadian upstream oil and gas sector there is ongoing expansion of operations in several sectors, most notably within tight/shale gas and oil sands. We expect inflationary pressures in the

sector to remain into the future, impacting the economics of an offshore development. This warrants a mention in the report.

Comments on presentation by Dr. Brunneau

Ziff's report comments on some of the assertions made by Dr Brunneau's presentation regarding the viability of natural gas production in the Grand Banks. For comments relating to the feasibility of an offshore gas production development, we find Ziff's comments to be reasonable. We will add to Ziff's comments that Dr. Brunneau's assumption that producers will sell gas to Newfoundland at a Henry Hub price is pure speculation, as the price must support the costs plus a reasonable profit in order for a producer to be incentivized to produce the gas.

Review of "Newfoundland and Labrador LNG Viability and Analysis"

The development of a LNG import and regasification facility, with associated infrastructure is one proposal for providing natural gas as a fuel for generation on Newfoundland. Once constructed, the facility would need a viable source of LNG to be available for import. To reflect these two independent, but mutually necessary costs, Ziff builds up the total cost of delivering LNG to the Holyrood gas plant into two elements and explores the moving components of these elements.

The delivered cost of LNG to the regasification plant

Ziff looks at the cost of delivering LNG from potential new liquefaction facilities in the US Gulf Coast to a regasification plant at Holyrood and defines it to be formed as the sum of: "The Henry Hub (HH) price + 15% + Liquefaction tolling fee + shipping cost + NBP premium", where:

- **HH price** - Ziff identifies a number of elements that could influence natural gas prices in North America and suggests that the "equilibrium price" between 2012 and 2020 should fall in the high \$4 per mmbtu to the mid-\$6 per mmbtu range (although the chart shows a different range than in the text) and in the \$4 and \$8 per mmbtu range between 2020 and 2035. The base case price is between \$5 and \$6 per mmbtu, respectively (all prices in US 2011\$). These base price assumptions are not substantially different, though somewhat higher than Wood Mackenzie's HH price forecast.
- **15%** - The "mark up", as understood, for the premium to HH to be paid for LNG delivered into ships. This is consistent with assumed levels of recent contracts signed from LNG off-takers at Sabine Pass, located in the US Gulf Coast.
- **Liquefaction tolling fee** – Ziff's estimate is consistent with the agreements signed by off-takers with Sabine Pass. However, we believe this represents the lowest tolling fee possible, with other deals signed at Sabine Pass showing higher fees and future liquefaction development potentially resulting in fees up to US\$ 1 mcf higher.

- **Shipping cost** - Ziff's assumption is consistent with Wood Mackenzie's shipping model for a small LNG carrier of 75,000m³.
- **NBP premium** – Ziff's argument about the need for a NBP premium is correct, but seems to be superseded by the argument about the requirement of a long term contract for ensuring supply certainty. This interpretation seems to be supported by the fact that the conclusion paragraph does not contain the NBP premium argument. We believe there would need to be a NBP premium to secure reliable supply for the long-term.

The sum of these elements equates to a delivered cost at the regasification terminal of US\$ 8.85/mmbtu for the 2020 timeframe (with no "NBP premium" considered). This would be consistent with Wood Mackenzie's view to the extent no premium were needed, with some potential upside likely materialising from higher tolling fees.

This delivered LNG cost would materialise should the Province be successful in buying LNG directly from a US Gulf Coast LNG developer. However, as Ziff correctly points out, this is an unlikely scenario given the small volumes of LNG required. Moreover, we agree with the argument that Ziff makes about the inappropriateness of relying on the LNG spot market for reliable supply because of its inherent risk. Securing a reliable supply of LNG would oblige the Province to enter into a long term contract with globally competitive pricing.

Ziff assumes a firm, long term agreement for LNG needs to be an oil indexed contract with a gas-to-oil relationship of 80%. Wood Mackenzie infers this comes from a view of a tight LNG market going forward. Such a market would maintain high global LNG prices, as expressed in the "LNG supply and demand forecast" paragraph. However, while LNG demand is growing rapidly, there has been an extraordinary amount of activity in the past 2 years in terms of global LNG supply developments. Australia has ~60 Mton of capacity currently under construction, North America, has ~160 Mton of new projects being proposed, and 100 tcf of reserves have been discovered in East Africa which is presumed to be for use in LNG export. These developments do not seem to be captured by the Ziff report. This supply upside is going to substantially increase the options that LNG buyers will have towards the end of this decade, likely resulting in downward pressure on prices and future contract arrangements. Wood Mackenzie believes that a gas-to-oil price arrangement in the range of 70% would be more reflective of these evolving market conditions. This would equate to a delivered price of around US\$ 12/mmbtu in a US\$100/bbl Brent price environment. This calculation already takes into account any premium over Atlantic Basin pricing dynamics that Newfoundland will inevitably need to pay for secure supply because of the small volume required.

The cost of regasification

Ziff estimates the per unit cost of regasification at US\$ 8.79/mcf in the low case (CAPEX US\$ 0.8 billion) and US\$ 13.90/mcf (CAPEX US\$ 1.2 billion) in the high case. Ziff correctly argues that low gas off-take requirements (37 mmcf/d) and seasonality of requirements will weigh heavily on the unit cost of regasification. They correctly warn that proportionally large storage capacity will be required to accommodate ship carriers of 2.5/5.5 bcf capacity and ensure that enough gas is stored for security of supply purposes. This requirement will add to the overall CAPEX. However, there are examples of recently built or under construction regasification terminals with lower CAPEX requirements and yet higher send out capacity (e.g. El Musil in Spain) which let us believe that a more reflective range of costs would be between US\$ 0.6 billion and US\$ 1.0 billion (the US\$ 1.2 billion proposed by Ziff Energy as the high case is not fully representative of the type of facility discussed here since their send

out capacity is 3 to 4 times greater – storage capacity is normally only one third of the overall cost of a regasification terminal). This does not consider pipeline capacity necessary to move gas to the power plant. It is not clear from the report whether pipeline costs have been included by Ziff.

Another concern regarding the cost of regasification as proposed, is the unit cost modelled. Standard Wood Mackenzie assumptions, in terms of inflation, discount rates, lifetime, equity/debt financing ratio, etc. suggest that the unit cost for regasification associated with a CAPEX of US\$ 0.8bln should be substantially lower. However, no details have been provided in the report to understand potential differences. It is also not clear if a fixed 37 mmcf/d throughput have been modelled (as Figure 6 of the report would seem to suggest) or if throughput is increasing according to gas requirements of the power plant, up to 69 mmcf/d in 2035, as it should have been effectively used.

The Ziff report does not explore alternative options to reduce the high unit cost of regasification, the one single item that weights on the unit cost of gas, once compared to other global gas pricing environments. For example, tailored commissioned floating regasification facilities (FSRU) could reduce the overall unit cost of regasification associated with the low gas requirement and docking the FSRU in the port would minimise extreme weather conditions influences. The daily lease cost for FSRU currently vary between US\$ 150,000 to US\$ 200,000 per day. Once other fixed and operational costs are included this could result in a unit cost of storage and regasification between US\$3.3/Mcf and US\$4.2Mcf, which is substantially lower than the US\$ 8.79/Mcf assumed as the low case by Ziff.

Wood Mackenzie's Conclusions

Wood Mackenzie generally finds Ziff's reports and conclusions relative to natural gas as a fuel source for Newfoundland to be reasonable, especially in regards to the use of natural gas produced in the White Rose fields. If anything, Wood Mackenzie's estimates of costs in this area would tend to be higher, rather than lower than those determined by Ziff. Additionally, we believe that the Government of Newfoundland may find it difficult to enter a contract for that gas that would make the producers interested in producing the gas for market due to the costs of production and the low level of requirements that Newfoundland will have for power generation.

Relative to the use of LNG imports as a fuel, Wood Mackenzie's research would tend to have lower costs than those determined by Ziff for the reasons stated within the report. Looking at the costs of some recently constructed facilities, and possibly evaluating the FSRU technology could lower the costs from Ziff's estimates. That said, we agree that it will be difficult for Newfoundland to secure LNG in the relatively low quantities required at other than globally competitive prices that are related to NBP. They may indeed have to pay a premium due to that fact.