ENERGY FOR YUKON: THE NATURAL GAS OPTION

Backgrounder, Summary of Case Study and Next Steps

Updated November, 2010

Yukon
Energy, Mines and Resources

ENERGY FOR YUKON: THE NATURAL GAS OPTION

Executive Summary

Background

Yukon has one of the highest economic growth rates in Canada driven in large part by investment in the mining sector. Sustaining this growth requires a reliable and competitive price source of energy. Yukon has abundant natural gas resources. This initiative, Energy for Yukon (E4Y): The Natural Gas Option, examines the feasibility of developing Yukon's significant natural gas resources to meet Yukon's current and future energy demands and examines what is required to develop these valuable resources.

As stated in the Energy Strategy for Yukon: "*The government's strategy for oil and gas is focused on how to best develop Yukon's resources and also meet Yukon's energy needs.*"[1] Unless new sources of renewable energy are developed, the current alternative is diesel generation which is costly and contrary to Yukon's Climate Change Action Plan. Reliance on diesel to meet future demand may stall proposed mining projects (due to cost) and likely increase the cost of energy for residential and commercial customers. It would also significantly increase Yukon's greenhouse gas (GHG) emissions.

This paper summarizes the findings of this initiative and suggests next steps. In doing so it presents Yukon's requirements for energy and the available energy options to enable continued economic development. The results of the Eagle Plain Case Study compares the relative cost of using natural gas with the cost of diesel generated electricity to meet the energy requirements of several proposed mining projects. The regulatory regime to enable natural gas electrical generation and distribution is explored, and the paper ends with suggested next steps.

Findings

Yukon's energy requirements may soon surpass Yukon's existing renewable energy. By 2012 Yukon will face a renewable energy deficit on its main electrical grid if current growth trends continue and the new mines are brought on line as projected. Off the main electrical grid there is a potential greater demand from the mining industry for 200 megawatts (MW) by 2021 where the current energy source is diesel fuel. The price of diesel fuel and the unpredictability of future pricing are major disincentives to the development of mines in the Yukon.

Yukon's natural gas is a substantial stranded resource that can meet the projected energy requirements of Yukon's economy and mining industry for decades. Natural gas generation of electricity is quick and easy to install/remove (as it relies on existing technology), is low in capital cost and carries a small footprint when compared to alternatives such as hydro which is capital intensive and requires a long lead time for permitting. Natural gas is the cleanest fossil fuel (34% less GHG emissions than diesel) and is considered the transition fuel to an energy matrix less reliant on fossil fuels. In addition it appears natural gas can be priced at a discount to diesel and offers the prospect of long-term price security if investment risk can be reduced.

The development of natural gas as an alternative to diesel is a win-win for industry, Yukon and Canada. The development of natural gas for industrial customers could include selling electricity

[1] Page 18, Yukon Government, Energy Strategy for Yukon, 2009

into Yukon's electrical grid. In this scenario, Yukon gains an additional source of relatively clean energy that is secure and reliable, and shares risk with a major anchor customer. The resulting development of Yukon's mining and oil and gas industries will generate significant job, training and business opportunities for Yukoners and all Canadians, as well as increase government revenues.

Meeting Yukon's future energy needs with Yukon's natural gas is not without risk. On the supply side Eagle Plain basin has been identified as the most logical resource to pursue. Development of this resource is reliant on the rights holder undertaking a drilling and development program. The permit holder will likely require a level of assurance that there is a market for the gas before proceeding with this investment. Significant investment in infrastructure is required to transport the natural gas from the well to the customer. No matter who builds the infrastructure, private or public, it will only proceed if there is a reasonable opportunity to achieve adequate return to justify the investment. Similarly the buyer for the energy will only invest in the generation plant if there is a market for the energy.

ENERGY FOR YUKON: THE NATURAL GAS OPTION

Introduction

Yukon is enjoying robust economic growth and a promising future led by a strong mining sector. Threatening this growth is the availability of reasonably priced energy. To address this issue Oil and Gas Resources Branch (OGR) is leading the "*Energy for Yukon (E4Y): The Natural Gas Option*" initiative. It examines the feasibility of developing Yukon's significant natural gas resources. This paper summarizes the findings of this initiative and suggests next steps. In doing so it examines Yukon's requirements for energy and the available energy options to enable continued economic development. The results of the Eagle Plain case study compares the cost of using natural gas with the cost of diesel generated electricity to meet the energy requirements of several proposed mining projects. The regulatory regime to enable natural gas electrical generation and distribution is explored, and the paper ends with suggested next steps.

Background

Yukon's economy and energy needs are growing. According to the Conference Board of Canada, Yukon's growth in GDP led Canada in 2009.[2] Fuelled primarily by investment in the mining sector, Yukon's annual exports could exceed $3 billion within a decade.[3] This growth is challenging the ability of Yukon's primary electrical generation utility, Yukon Energy Corporation (YEC), to provide electrical power from renewable energy sources to its industrial, commercial and residential customers. Based on demand projections YEC will be short of existing renewable energy by 2012 (See Figure 1). There are numerous mining prospects of which several are likely to proceed to operating mines in the near future provided they can acquire competitively priced dependable energy. These proposed mines will require up to 200 MW of electrical power over the next decade if they all proceed as planned. They include Selwyn Resources (Howard's Pass), MacTung (MacMillan Pass), Victoria Gold (Dublin Gulch near Mayo), Western Copper (Casino and William's Creek) and others. The provision of competitively priced energy with price certainty also contributes to extending the life of mining projects and assists them in weathering the cyclical nature of commodity prices.

Yukon has abundant natural gas resources - the estimated onshore potential is 17 trillion cubic feet of gas[4]. To date the assumption has been that development of Yukon's natural gas resources required the construction of one of the northern natural gas pipelines (Mackenzie Valley or Alaska Highway) to provide access to a large market. While the Government of Yukon (YG) continues to support the development of both pipelines, the projected in-service dates for either project will not meet Yukon's near-and medium-term energy needs. Yukon needs new energy today.

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[2] "Yukon … led all provinces and territories last year with economic growth of 1.4 per cent. This year, metal mining output is projected to increase and the construction industry will benefit from non-residential investments of more than $400 million. In addition, industries that suffered during the recession, such as commercial services and retail trade, will begin to recover. All in all, real GDP is forecast to increase by 4.9 per cent in 2010." Conference Board of Canada, Territorial Outlook July 2010

[3] The Centre for Spatial Economics, Yukon Occupation Modelling System Outlook, Summer 2010

[4] Oil and Gas Resources, Yukon Oil and Gas Resources: A Northern Investment Opportunity, May 2010 Edition, http://www.emr.gov.yk.ca/oilandgas/pdf/YukonOilandGas-May10.pdf

The "*Energy for Yukon*" initiative assesses the feasibility of developing Yukon's natural gas resources to meet Yukon's current and future energy demands and examines what is required to develop these valuable resources. As stated in the *Energy Strategy for Yukon*: "*The government's strategy for oil and gas is focused on how to best develop Yukon's resources and also meet Yukon's energy needs.*"[5] Unless new sources of renewable energy are developed, the current alternative is diesel generation which is costly and contrary to the Government of Yukon's *Climate Change Action Plan*. Reliance on diesel to meet future demand may stall proposed mining projects (due to cost) and likely increase the cost of energy for residential and commercial customers. It would also significantly increase Yukon's GHG emissions.

A stated objective of the 2009 *Energy Strategy for Yukon* is: "*Support strategic opportunities to replace imported diesel fuel with Yukon's oil and gas resources.*" Natural gas is widely recognized as the cleanest hydrocarbon fuel source and an excellent complementary fuel source to renewable energy. For this reason natural gas is viewed as a transition fuel as the world moves to an economy less reliant on fossil fuels. Using natural gas results in 34% less GHG than using diesel.[6] Under its *Climate Change Action Plan* Yukon will be establishing GHG targets by 2012 which will provide greater incentive to move to cleaner energy sources such as natural gas.

The 2008 study, *Energy to Mines Project (E2M)*,[7] suggested there is an economic case for using natural gas when compared to diesel fuel for generating energy at the potential mine sites. If these resources were developed, Yukon could also supply energy that is less expensive and cleaner than fuel oil to provide heat and power to Yukon residents and Yukon industry for decades to come.

The *E2M* results and the YG priority to develop cleaner Yukon energy sources led to this discussion paper which summarizes the following:

- Yukon's projected demand for electricity and possible supply options;
- The natural gas supply option - the *E2M* paper assessed the economics of developing Eagle Plain. This case study is updated and its scope widened to assess a wider range of potential energy demand and supply scenarios;
- The required government policies and regulations to facilitate the development of stranded natural gas through a review of other jurisdictions which have utilized stranded natural gas reserves to meet a local demand;
- Yukon's existing government policy and regulatory framework; and
- Suggested next steps as priority items for the YG to advance the utilization of natural gas as an energy source for Yukon.

[5] Page 18, Yukon Government, Energy Strategy for Yukon, 2009
[6] Wolf Island Engineering, et-al, Eagle Plain Case Study, 2010
[7] Wolf Island Engineering, Energy to Mines Project – E2M, prepared for Department of Energy, Mines and Resources, Oil and Gas Resources, updated 2009

Yukon's Electrical Energy Infrastructure, Demand, and Supply Options

Electrical Generation

Yukon's electrical system is a stand alone system that is not connected to the North American Grid. The total Yukon capacity for electricity generation is 139 megawatts (MW) of which 124 MW are generated by YEC and 15.0 MW by the Yukon Electrical Company Limited (YECL). Total hydro-electric generating capacity in the territory is 77 MW (summer) and about 60.0 MW (winter). Total Yukon diesel capacity is 62 MW. Two wind turbines located at Haeckel Hill in Whitehorse provide an additional 0.81 MW of electrical generation capacity. Appendix 1 details the electrical generation capabilities of the various units in Yukon.

Transmission and Distribution System

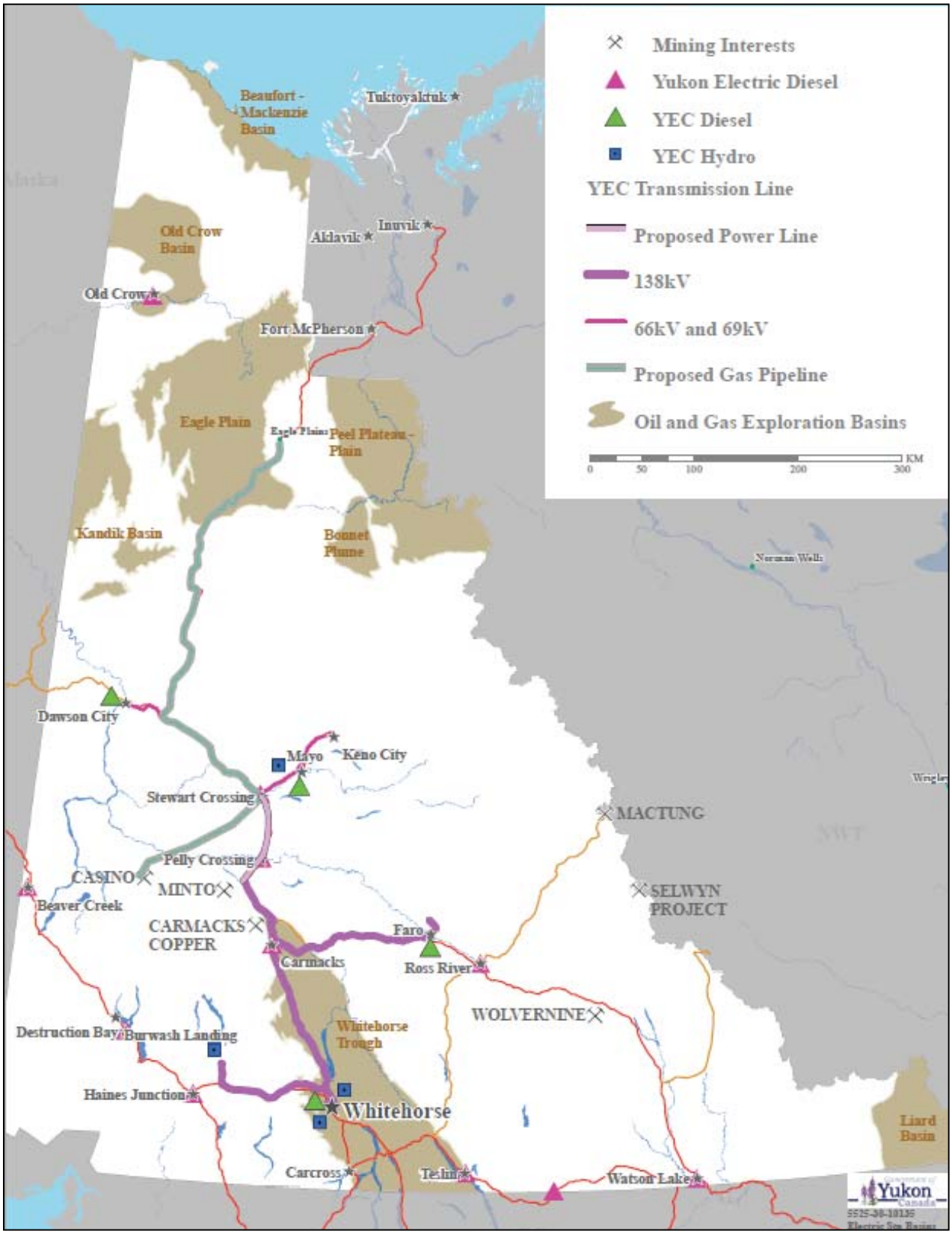
There are two hydro-based transmission grids in Yukon: the Whitehorse – Aishihik – Faro grid (WAF) and the Mayo – Dawson (MD) grid. Both are owned and operated by YEC. The WAF grid is a 510 kilometre, 138 kV line initially built to connect Whitehorse Rapids and the Aishihik hydro plants with the Faro mine site. The WAF grid was extended from Carmacks in 2008 to service Pelly Crossing and the nearby Minto mine site (Phase 1 of a Carmacks to Stewart Crossing interconnection).

The 229 kilometre, 69 kV Mayo-Dawson transmission line was completed in 2003 to form the MD grid. The line connects the Mayo hydro facility, and its then surplus energy, with Dawson City which relied on diesel generation. YEC is in the process of completing Phase 2 of the Carmacks to Stewart Crossing interconnection from Pelly to Stewart Crossing to connect the two hydro grids. Connecting the two grids will improve the reliability as they both gain additional sources of electrical generation.

These grids are shown on Map 1 on the following page.

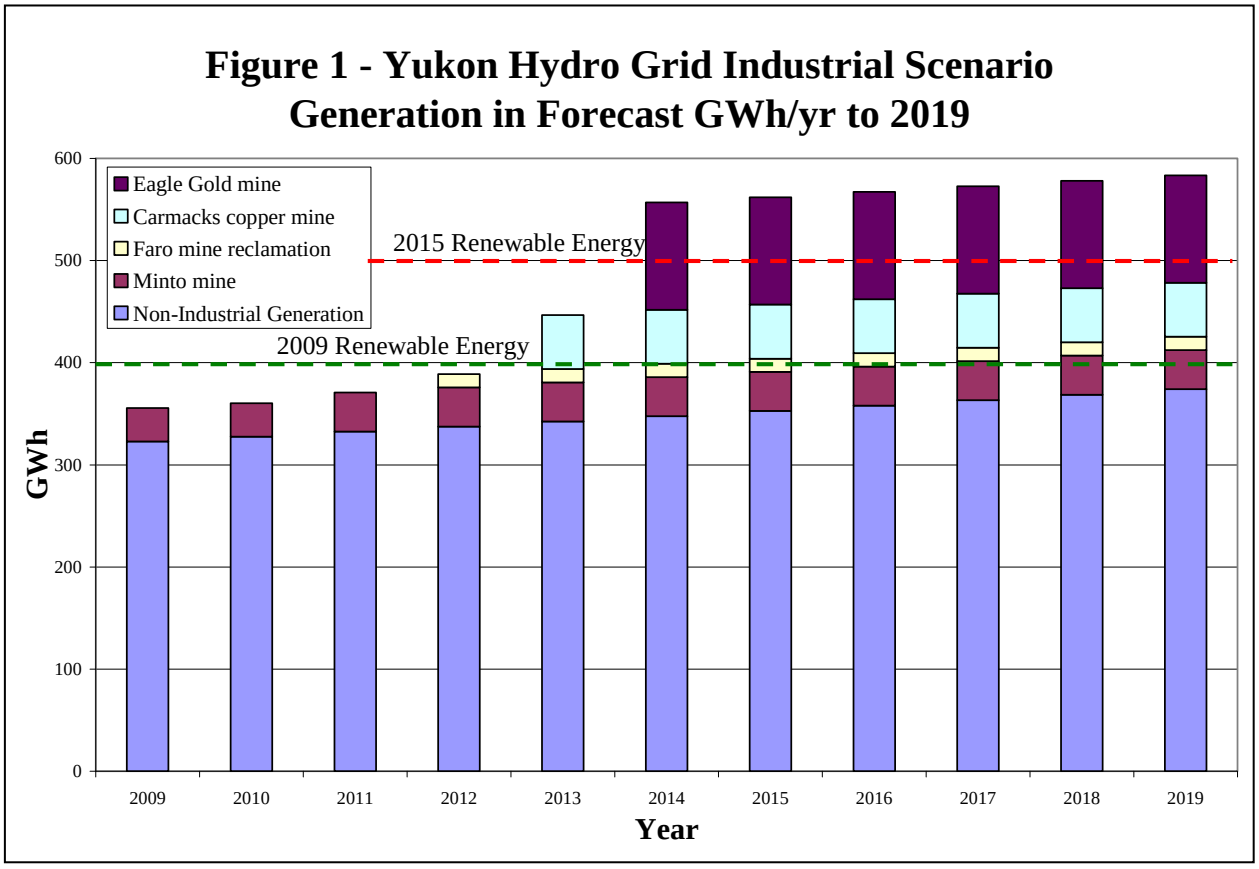
YECL, as the primary distributor of electricity at the retail level, owns and manages the community distribution systems within its service areas which encompass all Yukon communities except for Dawson City, Mayo, Faro and a few small rural areas.

Map 1 – Yukon's Transmission System and Proposed Mines



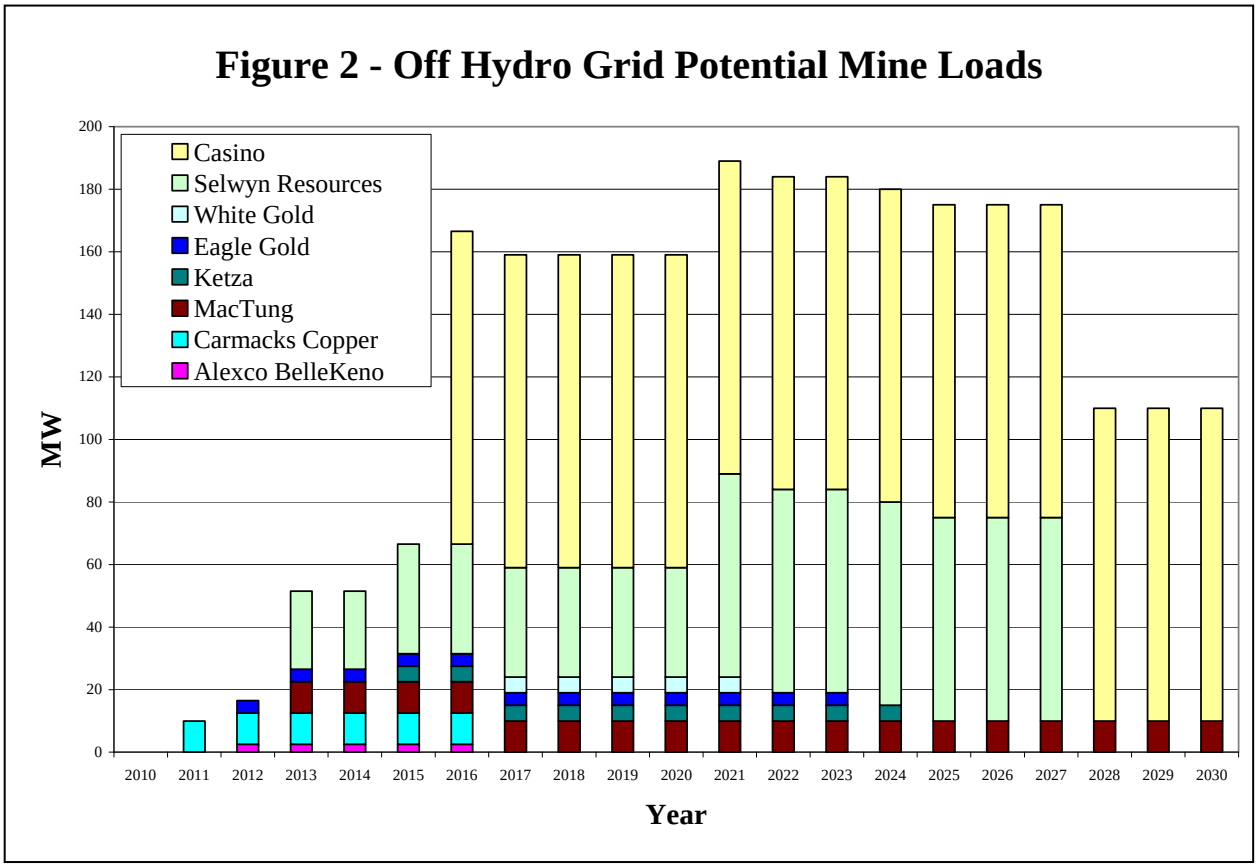
Yukon's Future Demand for Electricity and Supply Options

In September 2008, in its 2008-2009 General Rate Application (GRA) to the Yukon Utility Board (YUB), YEC noted a higher than expected load growth of up to 4.8% (excluding secondary sales and the Minto mine) which, if consumption trends continue, will result in no surplus hydro during the winter season by 2012. This conclusion was supported by the YUB which upon review of YEC's 20 Year Resource Plan in 2006 concluded: "It is imperative that new resources be added to the WAF system as soon as possible."[8] Figure 1 shows the industrial and non-industrial (residential and commercial) demand forecast to 2019.[9] It includes projected industrial clients in close proximity of the existing electrical grid. It does not include proposed mines which are outside the service range of the existing transmission grid. The Renewable Energy dashed lines in Fig 1 show the 2009 and 2015 annual energy capabilities, existing and planned or under construction by 2015. Figure 2 shows potential new off-grid industrial loads where the most realistic energy option is diesel generation. This chart shows Yukon would require up to an additional 120GWh per year of new electricity generation by 2020 to meet all the demand of new mines off the hydro grid (approximately 180 MW of generation capacity).[10] For this reason significant investment in mine development in the Yukon may not happen unless a less expensive and more stable priced energy source to diesel is developed in Yukon.



Source – YEC, Yukon Electrical needs to 2019, June 2, 2010

[8] YUB Report to Commissioner in Executive Council re YEC 20-Year Resource Plan, Jan. 15/07
[9] Yukon Energy Corporation, Yukon's Electrical Needs to 2019 Presentation, June 2,2010
[10] GWh refers to the energy used in an hour measured in billions of watts. MW refers to the installed available energy measured in millions of watts.



Potential Sources of Energy for Yukon

As Yukon's primary electrical generation utility, Yukon Energy has a responsibility to plan for new generation and transmission facilities to meet future demand. Yukon Energy also has a responsibility to not put its rate payers at risk by adding generation and transmission capacity for predicted demand which has a degree of uncertainty. This balancing of risk is managed in part through an adaptive planning process where YEC periodically updates its demand forecasts and development plans which are reviewed by the Yukon Utilities Board. This process includes the development of a number of alternative generation and transmission options to meet short (1-5 years) and long term (20 years) growth in a variety of industrial growth scenarios. In addition, Yukon Energy has a mandated responsibility for electrical system planning and is in constant contact with all significant potential energy suppliers.

To meet the anticipated growth in energy requirements and peak demand on its grid, YEC:

- has completed the first phase of the transmission line extension to connect the WAF and MD grids and is completing the second phase of the Carmacks to Stewart Crossing interconnection to connect the WAF and MD systems by 2011;
- is adding a third turbine (7MW and 5GWh per year) at Aishihik which will be in-service by 2011;
- is expanding the Mayo plant with the addition of Mayo B (10MW and about 35GWh per year) which will be in-service 2012; and

- is also in the planning stages of several enhancements to existing hydro operations including additional Marsh Lake and Atlin Lake storage for the Whitehorse Rapids hydro plant, additional Mayo Lake storage for the Mayo hydro plants and diversions of additional water sources into the Aishihik system for the Aishihik plant.

Successful completion of the above projects will still leave YEC short of renewable energy if all of the potential industrial customers close to the hydro grid are successful in becoming operating mines. This potential gap between energy supply and demand would likely be met in the short term by diesel generation.

For demand beyond 2015 YEC is exploring additional hydro sites, geothermal sources, bio-fuel options, in-stream hydro methods and wind energy. YEC is developing and is expected to implement a demand-side management (DSM) program, in cooperation with YECL, beginning in 2011 which will encourage customers to reduce their energy consumption. With the exception of DSM, any of these potential energy sources will require significant time to complete the feasibility studies and several years to aquire the necessary financing and permitting prior to construction.

Yukon's Natural Gas Potential

Yukon's natural gas is a substantial stranded resource that could meet the projected energy requirements of Yukon's economy and mining industry for decades. There are eight oil and gas basins in Yukon with a total resource potential of 17.1 trillion cubic feet (Tcf) of natural gas and 771 million barrels of oil. The Eagle Plain Basin is the best understood of Yukon's oil and gas basins and the most likely to be developed in the near future. Natural gas has been discovered at Eagle Plain and a median gas resource estimate of 6.05 Tcf is predicted.[11] This is a very large natural gas source situated in the central part of the Yukon alongside an existing highway corridor.

To put this resource potential into perspective, the Fekete Report[12] confirmed that this gas potential was sufficient to supply 410 million cubic feet per day (MMcf/d) for more than 20 years to the Mackenzie Valley Pipeline at Inuvik. The 2008 *E2M* report used approximately 1/10th of this flow rate in its analysis. It is safe to say that this Yukon resource has the potential to supply Yukoners and Yukon industries with cleaner burning energy for many decades.[13] In addition to Eagle Plain, there are three other hydrocarbon basins - the Peel Plateau, the Whitehorse Trough and Liard - with the potential for significant natural gas discoveries.

The Natural Gas Supply Option: Eagle Plain Case Study 2010 Update

Project Description

This study is based on the original *E2M* report. It compared the costs of various options to supply energy to three different potential Yukon mine sites utilizing natural gas. The potential mines studied are: the Casino Mine located west of Pelly Crossing; the Selwyn and MacTung Mines on the eastern border of the Territory; and a hypothetical mine located 25 km from the existing Yukon energy electrical grid with a demand of five MW. The latter is representative of

[11] YGS Eagle Plain Resource Assessment, YGS open file 2005-2.

[12] Page 30, Fekete Engineering, North Yukon Conceptual Oil and Gas Development Scenario and Local Benefits Assessment, November 2005

[13] 6.05 Tcf is the energy equivalent of running the Whitehorse hydro plant (40 MW) continuously for 2,000 years or a 100 MW generator for 800 years

previous mine developments in the Yukon. The selected mines represent a range of energy demand options and locations. Their selection is not an indication of their potential to become mines.

Several of the delivery options are based on transporting natural gas to a gas-fired generation station at Stewart Crossing and utilizing the extended WAF grid to deliver power to customers. The WAF grid currently has the capacity to transmit an additional 40 MW. A significant benefit of this option is the provision of energy to Yukon Energy Corporation to meet the grid's electrical load requirements.

While many scenarios were initially modelled, this paper presents a range of plausible energy supply options based on a high level preliminary assessment. It is recognized that with more detailed analysis there may be other scenarios which make more sense. The scenarios modelled are as follows:

- Electrical generation at the mine sites using diesel delivered by truck (the base case for all mines);
- Electrical generation at the Casino mine site using natural gas delivered by pipeline from Eagle Plain via Stewart Crossing;
- Electrical generation at the Casino mine site using natural gas delivered as liquefied natural gas (LNG) by truck from Eagle Plain;
- Electrical generation at the Casino mine site using natural gas delivered as LNG by truck from Stewart Crossing after being transported by pipeline from Eagle Plain to Stewart Crossing;
- Electrical generation at the Selwyn and MacTung mine sites using natural gas delivered as LNG by truck from Ft. Nelson, BC;
- Electrical generation by YEC at Stewart Crossing using natural gas delivered by pipeline from Eagle Plain. The energy is then distributed through the existing and new transmission line (Casino) to the potential mines; and
- Electrical generation at Whitehorse using natural gas delivered by pipeline from the Alaska Highway Pipeline Project (AHPP) into new or expanded transmission lines from Whitehorse to Casino.

Results

Each energy supply scenario assumes a mine life of 10 years and a fuel inflation rate of 3% per year (1% above inflation). The price of diesel fuel reflects 2009 delivered fuel prices for Yukon Energy and The Yukon Electrical Co. Ltd.[14] For the purpose of this study the price of natural gas is based on an estimate of the cost of development and production at the wellhead and is estimated to be $5.23/Mcf in 2006 dollars.[15] The actual Eagle Plain gas price will be negotiated between the gas provider and its customer. The AHPP option would be a North American market price for natural gas, netted back to Yukon. All of the analyses are compared on the basis of the real levelized cost of energy over the mine's project life.

[14] Page 26, Eagle Plain Case Study 2010 Update. YEC/YECL filing to the YUB dated February 2010 estimated the 2009 average rate for the incremental cost of diesel is 27.99 cents/kwh with the exception of Old Crow.

[15] Confer Consulting Ltd., Estimates of Delivered Costs of Natural Gas – Eagle Plain to Central Yukon, February 26, 2010 – revised July 29, 2010. (The current North American price for natural gas is in the $4.00 range and is expected to remain depressed for the immediate future due to the large reserves of shale gas close to North American markets).

The full cost comparison results can be found in the *Eagle Plain Case Study*. The following Figures highlight the key comparisons.

Figure 3 - Levelized cost of electrical power delivered to the Casino Mine

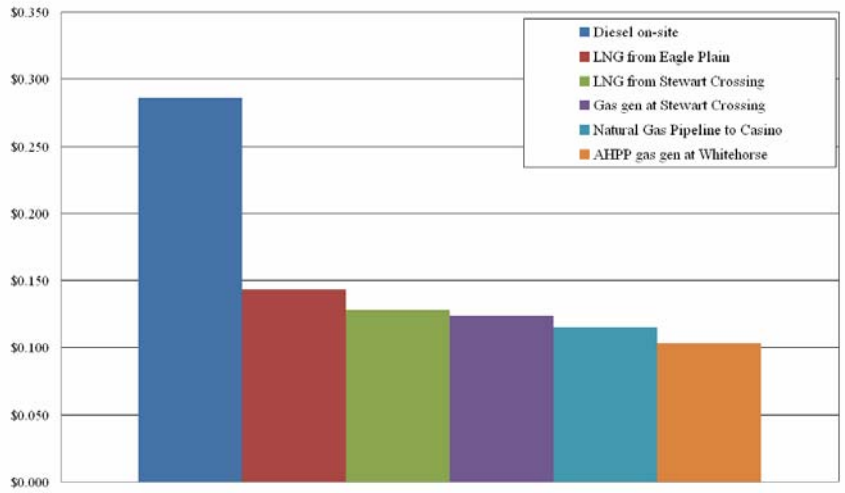


Figure 4 - Levelized cost of electrical power to the Selwyn and MacTung mines

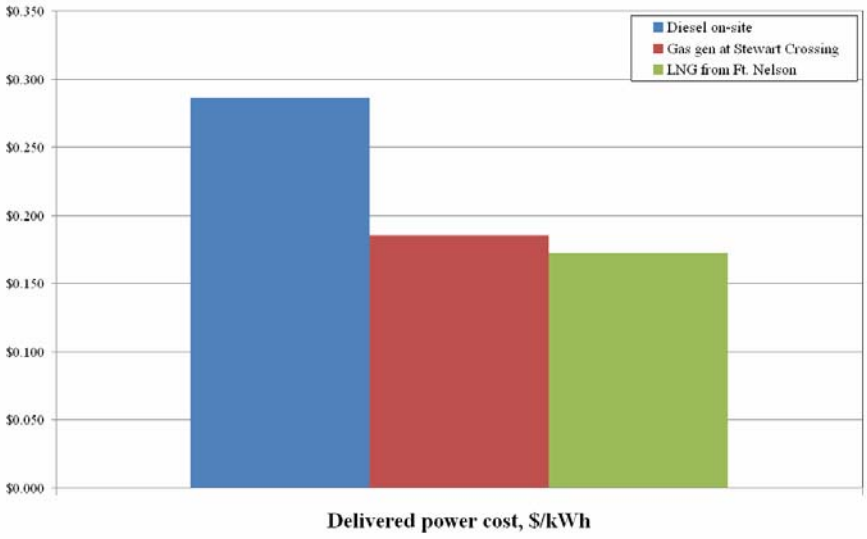
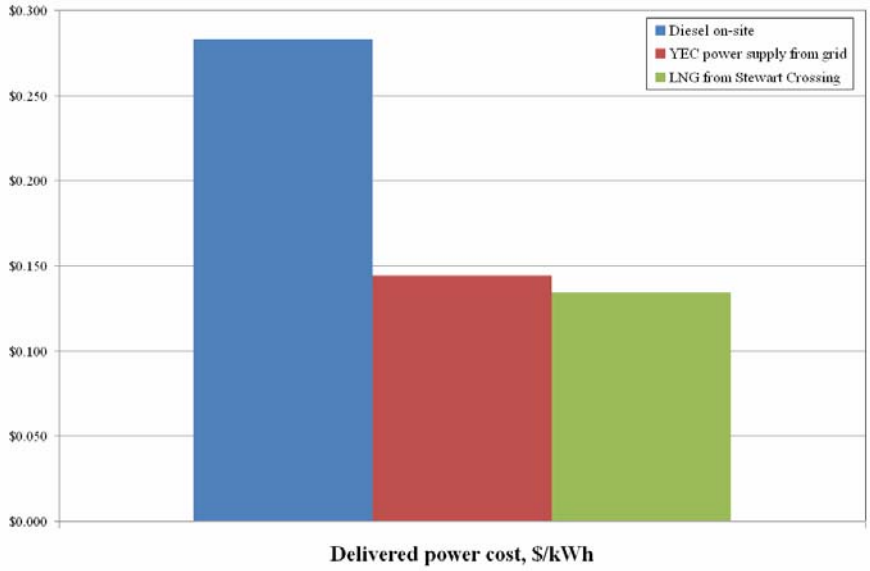


Figure 5 - Levelized cost of electrical power delivered to 5MW mine



To summarize, on a relative cost basis, using diesel fuel is more expensive than using the natural gas option no matter how the energy is delivered to the mine. This suggests there is opportunity for a supplier of natural gas and a customer to reach a mutually beneficial agreement. The supplier gains an opportunity to sell a stranded resource, the buyer gains an opportunity to realize lower energy costs and greater long term price certainty through contracts and Yukon receives direct and indirect benefits from increased economic activity and an additional energy source which will strengthen Yukon's energy supply system. In addition, 34% less GHG is generated than if diesel fuel had been used.

The study also found that for the size and duration of the energy loads envisioned it is less expensive in direct costs to build a small diameter pipeline than to build an electrical transmission line. Further, it is potentially feasible to utilize YEC's hydro grid to move energy from central Yukon to Eastern Yukon. This provides more options for servicing mine loads in the east with natural gas from Eagle Plain.

A final observation of the study is that the Alaska Highway Pipeline Project (AHPP) can materially assist in the commercialization of Eagle Plain gas to serve local markets. Rather than making the proposal redundant, the AHPP could provide impetus to construct a lateral pipeline to Eagle Plain which would significantly lower the cost of service of the Yukon gas pipeline because of economies of scale. The Eagle Plain basin could provide 300 to 400 MMcfd[16] through a lateral to the AHPP.

[16] Page 30, Figure 12, North Yukon Conceptual Oil and Gas Development Scenario and Local Benefits Assessment, November 2005

Barriers and Options for Developing Yukon's Natural Gas

Lessons from Previous Examples

A review[17] of other jurisdictions which have developed stranded gas reserves to meet a local demand concludes: *"the key challenges of this type of gas development are:*

- *Obtaining an anchor customer, and*
- *Determining an appropriate price, in the absence of being connected to a market price. If the gas development is for a single user, the gas price may simply be as agreed between the buyer and seller, with no government intervention in the pricing. If the sale is between parties that are not at arm's length… the government would need to deem a price, based on fair market value principles, for the gas for royalty and corporate income tax purposes. If the gas is to be used by more than a single user, it is likely that a gas distribution system will be established which normally implies a utility and regulated prices – at least on a complaints basis."*[18]

Regarding government incentive, the review finds a "*lack of evidence that remote gas developments, at least in developed countries, necessitate massive subsidies to make them happen. In fact, much of the incentive needed to make the transition to natural gas can be achieved by modest discounting of gas prices relative to competing fuels."*[19]

The most obvious and well-known example of remote gas development in Canada is the Ikhil Gas Project to serve the gas distribution system of Inuvik Gas Ltd (IGL) in the town of Inuvik. It also provides a good model of what could happen in Yukon. Inuvik Gas Ltd provides gas to residential and commercial customers as well as for power generation for a community of approximately 3,500 from two wells in the Ikhil Gas Project, located approximately 30 km northwest of Inuvik. IGL obtained approval for a development plan from the National Energy Board (NEB) in 1997 and proceeded to drill two additional wells, construct field facilities and a 6" pipeline to Inuvik to allow gas to begin flowing in 1999. The same joint venture owns the field, pipeline and gas distribution system.

The Government of Northwest Territories (GNWT) was supportive of the project from the outset, providing assistance to IGL for the testing program and pipeline routing studies. A Territorial Crown Corporation, NWT Power, became the anchor customer for power generation and the GNWT made early plans to convert government buildings to gas and to assist in a customer conversion program to gas. Conversion costs were paid 1/3 by GNWT, 1/3 by IGL and 1/3 by the customer (the latter could be paid over time on the gas bill).

Regulatory Framework for Inuvik Gas

Development of the Ikhil Gas Project was approved by the NEB under the *Canada Oil and Gas Operations Act (COGOA)* based on a development plan submitted by the joint venture partners. The development plan included both the field development and the pipeline from the field to Inuvik, as there are currently no pipeline regulations under *COGOA*.[20]

There are no regulations in the NWT that are specifically focused on gas distribution. A gas distribution system is defined as a public utility under the NWT *Public Utilities Act.* The Public

[17] Paul Precht Energy Economics ltd, Yukon Gas Development Strategies, July 2010
[18] Page 2, Paul Precht Energy Economics ltd, Yukon Gas Development Strategies, July 2010
[19] Paul Precht Ibid
[20] The *Onshore Pipeline Regulations*, administered by the NEB, are under the NEB Act not *COGOA* and apply to pipelines which cross inter-provincial or international borders, which this pipeline does not.

Utilities Board (PUB) has the authority to "determine and fix just and reasonable standards, classifications and practices respecting service to be used by a public utility" (*Public Utilities Act*, Section 60(a)).[21]

While the exact terms of the gas price formula have never been made public, the PUB decisions responding to complaints reference an objective of keeping gas prices at 85% of diesel prices, so the implication is the price of gas is directly tied to diesel prices, with a 15% discount.

Yukon's Existing Policy and Regulatory Framework

The commercialization of Yukon's natural gas requires a supporting government policy and regulatory framework in place. Investment by industry will only occur if there is a "rights" and regulatory process which is fair and transparent. Yukon requires development to occur in a safe manner and with minimal impact on the environment. Government and industry both want "fair" taxes, tolls and royalties.

Policy: Yukon's Energy Strategy

Yukon's Energy Strategy, published in January 2009, states "oil and gas resources will be developed responsibly for local use in Yukon and for export." An important part of the strategy is to support strategic opportunities to replace imported diesel fuel with Yukon's oil and gas resources and to promote private sector investment in the development of these resources: *"Yukon has made it a priority to develop Yukon oil and gas resources for local use to enable replacement of diesel with cleaner fuels such as natural gas."* One way to achieve this is for government to "support private sector initiatives to generate heat and power from Yukon's natural gas. Communities or large industrial projects such as mines that would otherwise depend on diesel fuel could use energy from natural gas instead." [22]

Policy: Northern Pipelines and Yukon's Pipeline Strategy[23]

YG has developed a pipeline strategy to ensure Yukon's interests are accounted for in the planning and development of either major pipeline. YG Pipeline Strategy has seven interests one of which is: "Connecting Yukon's Natural Gas and Access to Energy from Pipelines." Over the last 30 years, a pipeline connecting Northern Canada and Alaskan gas to southern markets was seen as the required infrastructure to kick start the exploration and development of Yukon's gas resources as well as providing a new energy source for communities and major industrial projects. Developing Yukon's internal market for natural gas (and the required regulatory framework and physical infrastructure) may be one way to achieve these two interests and be better prepared to take advantage of the pipeline when it does proceed.

Policy: Yukon's Climate Change Action Plan

One goal of the 2009 Yukon's Climate Change Action Plan is to reduce GHG emissions generated within Yukon. To accomplish this goal, YG has committed to reduce GHGs generated by its internal operations and to "Set a Yukon-wide emissions target within two years."[24] In addition to assessing energy supply options the *Eagle Plain Case Study* also generated GHG

[21] Paul Precht Ibid
[22] Energy Strategy for Yukon, Energy, Mines and Resources, Government of Yukon, January 2009
[23] Yukon Seven Key Pipeline Interests http://www.emr.gov.yk.ca/oilandgas/key_pipeline_interests.html
[24] Yukon Government Climate Change Action Plan, Environment Yukon, Government of Yukon, February, 2009

emissions operational outputs for the supply options. These outputs can be used to rank the various options as to their impact on GHG production in Yukon.

Policy: National Policy Direction which will Shape Yukon's Energy Supply

The Government of Canada is committed to reducing Canada's total greenhouse gas emissions by 17 per cent from 2005 levels by 2020. This includes establishing regulations to reduce GHGs from the electricity sector by 2015. (http://www.ec.gc.ca). This may result in a tax on CO_2 emissions which would contribute to the economic case of substituting diesel fuel with natural gas.

Regulatory Framework: YOGA

The Yukon *Oil and Gas Act* was enacted in 1997 as a result of the devolution of oil and gas resources from Canada to Yukon. The *Act* is structured to apply to all oil and gas operations in Yukon. In addition to the *Act*, the Yukon government has enacted five regulations: Disposition, Royalty, Drilling and Production, Geoscience Explorations and Licence Administration Regulations. Pipeline regulations are currently being drafted and will be followed by Gas Plant regulations.

Regulatory Framework: Yukon Utility Board (YUB)

Under Yukon's *Public Utility Act* a "public utility" "*means a person … who owns or operates in the Yukon equipment or facilities for the production, generation, storage, transmission, sale, delivery, or furnishing of electricity or gas to or for the public or a corporation for compensation."*[25] Exemptions include when the energy is generated for one's own use or when it is strictly a commercial venture between one supplier and one customer. In addition a person who "sells or delivers gas otherwise than by a pipeline"[26] is also exempted. This suggests gas distributed by LNG tanker truck might also escape being classified as a public utility.

If the resource is developed strictly as a commercial venture with one seller and buyer of the energy, YUB's role would be limited to resolving any pricing disputes between the producer and buyer of the energy. If the project includes selling energy to more than one customer, transporting energy via the transmission grid or selling energy to an existing utility, YUB will have a role in establishing the price and terms of the energy being sold. Providing guidance to YUB on establishing a fair price for natural gas will require careful consideration by the Government of Yukon.

Regulatory Framework: Yukon Environmental and Socio-economic Assessment Act (YESAA)

Any project to generate and transmit electricity will trigger a project review under *YESAA* as there is no minimum size threshold. This would capture most if not all stand-alone natural gas transmission and generation projects. Where the power generation is part of a mine project its assessment would likely be rolled into the mine assessment. Any project with the capacity to

[25] *PUBLIC UTILITIES ACT*, Interpretation, Revised Statutes Of The Yukon 2002. However, not withstanding whether or not an energy project complies with the definition of a public utility, under Part 3 of the *PUA* an "energy project" is only treated as a "regulated project" if CEC "consider the (energy project) to be significant in the matter of any form of energy and, by order, designates as a regulated project." This seems to suggest the Yukon government can provide direction to the YUB on regulating energy projects.

[26] Ibid

produce 5 MW of energy and larger will be subject to an Executive Committee level review under *YESAA* which requires more information and more time.

CONCLUSIONS

Yukon's Growing Demand for Energy and the Implication for Economic Development

Yukon's energy requirements may in short order surpass Yukon's existing renewable energy. By 2012 Yukon will face a renewable energy deficit on its hydro grid if current growth trends continue and new mines are brought on line as projected. Off the hydro grid there is a potentially greater demand from the mining industry for 200 MW of energy by 2021 where the current energy source is diesel fuel. The price of diesel fuel and the unpredictability of future pricing are major disincentives to the development of mines in Yukon.

The Natural Gas Solution

Yukon's natural gas is a substantial stranded resource that could meet the projected energy requirements of Yukon's economy and mining industry for decades. There are eight oil and gas basins in the Yukon with a total resource potential of 17.1 trillion cubic feet of natural gas. Of the eight basins, Eagle Plain is the most promising target for development. The basin contains significant natural gas resources (6.05 Tcf[27]), is centrally located, adjacent to a highway and has proven discoveries.

Natural gas generation of electrical energy is relatively quick and easy to install/remove (as it relies on existing off the shelf technology), is low in capital cost and carries a small footprint when compared to alternatives such as hydro which is capital intensive and requires a long lead time for permitting. Natural gas is the cleanest fossil fuel (34% less GHG emissions than diesel), and is considered a transition fuel to an energy matrix less reliant on fossil fuels. In addition natural gas can be priced at a discount to diesel and offers the benefit of long term price security if investment risk can be reduced.

The development of natural gas as an alternative to diesel fuel is a win-win for industry, Yukon and Canada. The development of natural gas for industrial customers could include selling energy into the Yukon electrical grid. In this scenario, Yukon gains an additional source of clean energy that is secure and reliable, and shares risk with a major anchor customer. The resulting development of Yukon's mining and oil and gas industries will generate significant job, training and business opportunities for Yukoners and all Canadians, as well as increases in government revenue at all levels.

Managing Risk

Meeting Yukon's future energy needs with Yukon's natural gas is not without risk. On the supply side Eagle Plain basin has been identified as the most logical resource to exploit. Development of this resource is reliant on the permit holder undertaking a drilling and development program. The permit holder will likely require a level of assurance that there is a

[27] 6.05 Tcf is the energy equivalent of running the Whitehorse hydro plant (40 MW) continuously for 2,000 years or a 100 MW generator for 800 years.

market for the gas before proceeding with this investment. Significant investment in infrastructure is required to transport the natural gas from the well to the customer. No matter who builds the infrastructure, private or public, it will only proceed if there is a reasonable opportunity to achieve an adequate return to justify the investment. Similarly the buyer for the energy will only invest in the generation plant if there is a market for the electricity.

Options for managing risk: Risk can be mitigated. While beyond the scope of this study there are options to manage risk. One option is incremental growth. If a Casino size project does not materialize there may be an opportunity to do a small scale project using LNG. LNG trucks are relatively easy to add or dispose of allowing the capital investment to better match the demand. Commercial risk can also be mitigated through public support or investment. The Mayo B hydro project would likely not have been built at this time without the Government of Canada contributing $53 million to the project.[28] Private-Public Partnership or P3 is another potential approach to manage risk especially if infrastructure serving the public good is being constructed. There may also be financing options which would spread the risk. For example, accelerated amortization through a higher initial toll would spread the risk between supplier and purchaser of the energy.

Next Steps

Regulatory Development

The Government of Yukon is responsible for regulating Yukon's oil and gas resources. The development of natural gas will require a regulatory framework and a pricing mechanism to ensure safe and orderly development of the resource. The priority for new regulations to facilitate the development of this resource is pipeline regulations, currently under development with a completion target of spring 2011. Gas plant regulations will be developed next. Yukon Utilities Board will have a role in regulating the monetization of the resource. If the resource is developed strictly as a commercial venture with one seller and buyer of the energy, YUB's role would be limited to resolving any pricing disputes between the producer and buyer of the energy. If the project includes selling energy to more than one customer, transporting energy via the transmission grid, or selling energy to an existing utility, YUB will have a role in establishing the price and terms of the energy being sold and transported along the powerlines. Providing guidance to YUB on establishing a fair price for natural gas will require careful consideration by the Government of Yukon.

Policy and Business Development

As stated in the *2009 Energy Strategy*, it is a priority of the Government of Yukon to foster development of Yukon's natural gas resources. The viability of commercializing Eagle Plain's natural gas is being assessed by the four affected First Nations. The Government of Yukon is working with these First Nations to determine the economic viability of developing Eagle Plain's natural gas resources. A proposal is being prepared to undertake a pre-feasibility study and

[28] Funding for the Mayo B project is being made affordable by contributions from both the Federal government and the Yukon Development Corporation. The breakdown is as follows: Federal grant $53.35 million, Yukon Development Corporation/First Nation of Na-Cho Nyak Dun contribution $30.15 million, Yukon Energy (electrical customers) $36.50 million. Contribution from customers will be spread out over the life of the project approximately 50+ years). Without Mayo B, electrical customers will be faced with paying for the necessary amount of diesel generated. Annual diesel costs would range from $3.8 million in Year 1 to $5.7 million by Year 5, fall to $1.6 million in Year 8 (2019) when no industrial loads are assumed to be connected, with higher costs in each subsequent year (e.g. $2.6 million in Year 10 and $9.3 million in Year 20, YEC website; http://www.yukonenergy.ca/about/projects/mayob/ .

formulate a “business case” for developing these resources for Yukon markets, and more specifically the energy needs of the resource economy. Likely the next step will be a funding request to P3 Canada or a similar mechanism to mitigate the upfront risk to move the project forward.

In addition to assisting with the pre-feasibility study and business case, the Government of Yukon has issued well licences and signed benefits agreements with First Nations and industry to advance exploration of Eagle Plain resources. The Government of Yukon will continue to discuss the concept with key stakeholders, promote the concept to commercial interests and seek input on what role government should play in order to expedite the process while ensuring safe and responsible development.

Appendix 1: Yukon Electricity Generation Capacity (megawatts)

Yukon Electricity Generation Capacity (megawatts)

Yukon Energy Corporation		**The Yukon Electrical Company Ltd.**	
Hydro		**Hydro**	
Whitehorse	40.0	Fish Lake	1.3
Aishihik*	30.0	**Diesel**	
Mayo	5.4	Carmacks	1.3
Total	**75.4**	Haines Junction	1.3
Diesel		Teslin	1.3
Whitehorse	25	Ross River	1.0
Faro	10.4	Watson Lake	5.0
Dawson	4.3	Beaver Creek	0.9
Mayo	2.0	Destruction Bay	0.9
Minto Mine	6.4	Swift River	0.3
Total	**48.1**	Old Crow	0.7
Wind		Pelly Crossing	0.7
Haeckel Hill	0.8	Stewart Crossing	0.3
Total (YEC)	**124.3**	**Total (YECL)**	**15**
		Total Capacity	139.3 MW
		Total Hydro Capacity – Summer	76.7 MW
		Total Hydro Capacity – Winter	60.0 MW
		Total Diesel Capacity	61.8 MW
		Total Yukon Wind Capacity	0.8 MW

Source: Yukon Energy Corporation *2008 Annual Report*

**Note:* the installation of the third turbine at the Aishihik Hydro facility will add 7 MW of generating capacity to the Aishihik facility and the Mayo B project will add 10 MW.

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