

**Mackenzie Valley Development Planning Committee
Secondary Industries and Value Added Activities Subcommittee**

Secondary Industries and Value Added Activities Study



**2000 Edition
Aurora Research Institute
By
K.W. Putt Consulting Inc.**

**2008 Update Report
By K.W. Putt**

**Mackenzie Valley Development Planning Committee
Mackenzie Valley Pipeline Office Update of
Secondary Industries and Value Added Activities Subcommittee
Secondary Industries and Value Added Activities Study**

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Executive Summary

The Government of the Northwest Territories (GNWT) has recognized that oil & gas development in particular and other natural resource developments in general are accelerating within its jurisdiction. In order to anticipate the potential benefits and impacts and optimize the benefits to the people of the Northwest Territories, K.W. Putt was requested to update his 2000 study that looked at ways that increased value might be added from primary oil & gas and resource extraction and initial processing for transport in order to create more benefits for the North.

The original Report, done under the auspices of The Aurora Research Institute, was conducted by K.W. Putt Consulting Inc. and endorsed by the GNWT Secondary Industries and Value Added Activities Subcommittee, by mutual agreement of the parties. This is an abbreviated update of that Study.

This update looks at the previous identification of some of the possibilities for further economic utilization arising from the Mackenzie Gas Project (MGP) Application currently before the National Energy Board (NEB) for a Mackenzie Gathering System (MGS) from the Applicant's three foundation gas fields, through a gas liquids extraction plant near Inuvik and thence via two pipelines; a natural gas pipeline passing from the Inuvik area south along the Mackenzie Valley transportation corridor to an existing pipeline system in Alberta and a separate natural gas liquids line joining the Enbridge Inc. crude oil pipeline at Norman Wells, NWT.

The potential benefits from secondary industries, value-added activities and the usefulness of community access to affordable natural gas in the region cannot be achieved if the Producer/Developer doesn't have an adequate risk-adjusted economic return. Hence, any additional economic burdens suggested to the Producer/Developer (the Applicant(s)) and pipeline contractors, owners and operator, to more evenly balance the power, risks and benefits, must not preclude the economic viability of the overall proposed project.

With that in mind, the GNWT and the Applicant(s) have negotiated a Socio-Economic Agreement (SEA) that spells out the rights and obligations of the Applicant(s), their agents and contractors, the GNWT, and the settlement areas and local government jurisdictions which are affected by the Mackenzie Gas Project.

Within that context, major potential business entities to capture economic benefits as secondary industries and value-added business, as well as social and educational/training activities that can be achieved have been established during the feasibility, planning and approval stages since the original study. Two major enterprises have been created since the first study (the Aboriginal Pipeline Group, created to own a significant equity interest in the Mackenzie Gas Project, and the Mackenzie Aboriginal Corporation (MAC) created to construct major infrastructure projects and bid on the MGP construction) and many secondary Aboriginal joint venture enterprises have been created, policy development has advanced and the Socio-Economic Agreement between the parties has brought clarity and common understanding.

Still, some policy development / enhancement work remains, or is not known to the author, as follows:

- The assurance of provision of Natural Gas Liquids (NGL's) to Northwest Territories communities and industries along the pipeline right of way on a wellhead netback, plus pro-rata cost-of-service basis (with 50% credit for Producers'/Shippers' demand charges), with Pipeline "access point valves" to designated communities or major industrial terminals. Since the original study, agreement has been reached for the provision of natural gas "access point valves" from the MGP mainline for natural gas supply to Fort Good Hope, Fort Simpson and Tulita in the Agreements and Applicant(s) commitments, however, I have seen no agreements on access in the NWT to any of the NGL's.
- Negotiation of the option of the GNWT taking the Federal Government royalty gas (and/or NGL's) "in-kind" to permit it to be used for the "highest and best use" within the Northwest Territories or beyond. (This is part of a larger, more comprehensive devolution of powers from the Federal Government to the NWT Government, including natural resources royalties as a major government revenue stream.)
- Review Northwest Territories Power / Electric Utilities Board policies to ensure that excess power generated by industrial, commercial or Community users, who install their own gas-fired cogeneration units to take advantage of new natural gas (and NGL) availability from the proposed pipeline(s) aren't prevented from or at an economic disadvantage from selling such local surplus power generated back into the NWT Power electrical grid (where a community or larger grid exists).
- Continue to pursue with the Federal Government an enhanced financial program to encourage entrepreneurial Aboriginal and Northern business development and creation of new investment opportunities.

Business opportunities surrounding oil and gas exploration, production, drilling and well servicing are dealt with extensively in this report, as are learnings from other organizations and relevant stakeholders, who have experienced valuable business development lessons that can be applied to any proposed Mackenzie Valley pipeline development. The drilling joint venture information has been updated via conversations with a cross-section of operators. The drilling cost structure has not been re-estimated, other than a nominal aggregate cost increase indication from 2000 to 2008.

Some of the areas warranting further study in the 2000 report have since been implemented, as follows:

- *Organization and implementation of a secondary industries and value-added activities Workshop to be attended by all key stakeholders.* This was organized by the Denendeh, who created the NWT Aboriginal Business Association and held their initial Annual General Meeting in Yellowknife in 2007
- *Study application of natural gas and NGL-fired Microturbine power generation and power and heat cogeneration versus conversion of existing diesel fuelled power generation for the 9-10 communities within 50 miles of the likely Mackenzie Valley Pipeline route.* Subsequent to the 2000 Study, a commercial prototype project was

completed by Northwest Territories Power Corporation with the installation of two Capstone 60.30 Heat Plus Power microturbine cogeneration units at the Inuvik Midnight Sun Recreation Centre in 2002. Importantly, three communities are to be provided with “access point valves” for MGP natural gas access under the SEA. The GNWT has contracted a community gasification feasibility study which is scheduled for completion in the spring of 2008 to assess the economic and engineering viability of community gasification.

- *Conduct a comprehensive geological and engineering study of aggregate resources in the Mackenzie Valley pipeline/transportation corridor from the Mackenzie Delta South to the Alberta border.* The MGP Applicants identified their own sources of gravel for pipeline and facilities construction purposes, with community consultation.
- *Conduct an investigative geological study of salt cavern resources potentially suitable for NGL storage in the Mackenzie Valley pipeline/transportation corridor from the Mackenzie Delta south to the Alberta border.* This was not done as Petrochemicals production in the Northwest Territories was not indicated.
- *Now that NGL extraction processing and the mainline pipeline gas composition have been firmed up, an overview of the changed Petrochemicals environment and technologies since 2000 may be warranted. Since an ethane extraction specific study, to be encouraged, would need pipeline gas with ethane content in excess of 3.5-4% C₂; likely over 6% ethane for initial pipeline volumes, ethane extraction still does not appear prospective. Refining in the NWT should not be studied; Fischer-Tropsch liquids and/or methanol from NWT feed stocks may warrant future scoping study, especially if it appears that the Northwest Passage may become open for shipping.*
- *Two other potential synergistic opportunities exist with local natural gas or extracted liquids-fueled Microturbine cogeneration. They are: 1) A hothouse operation near a community/transportation infrastructure and 2) A lumber mill powered by local Microturbine cogeneration with the power to run the sawmill and the heat used in space heating and kiln drying of the lumber product.* Neither of these, however, are large potential opportunities.
- *A Northern Energy Research Test Centre should continue to be examined, jointly with NRCan and potential industry partners. New fuel cell technologies from natural gas/NGL's, conversion of diesel engines to natural gas / NGL operation, various microturbine fuels and cogeneration schemes, natural gas from gas hydrates as well as permafrost-related R&D could be field tested in a new jointly funded NRCan/DIAND/GNWT/Industry Northern Energy Research Test Centre. This would be ideally located near Inuvik, could be managed by the Aurora Research Institute jointly with NRCan, and use Mackenzie Delta gas/NGL's as the source of fuels and the Arctic environment for its distinguishing tests.* SSHRC has recently increased their budget for Northern Research. All sources of Northern Research funding could coordinate with such a Northern Research Test Centre, which should be broadened beyond Northern Energy Research, e.g. environmental, geotechnical, arctic shelf/polar geomatics, high atmosphere research, etc.

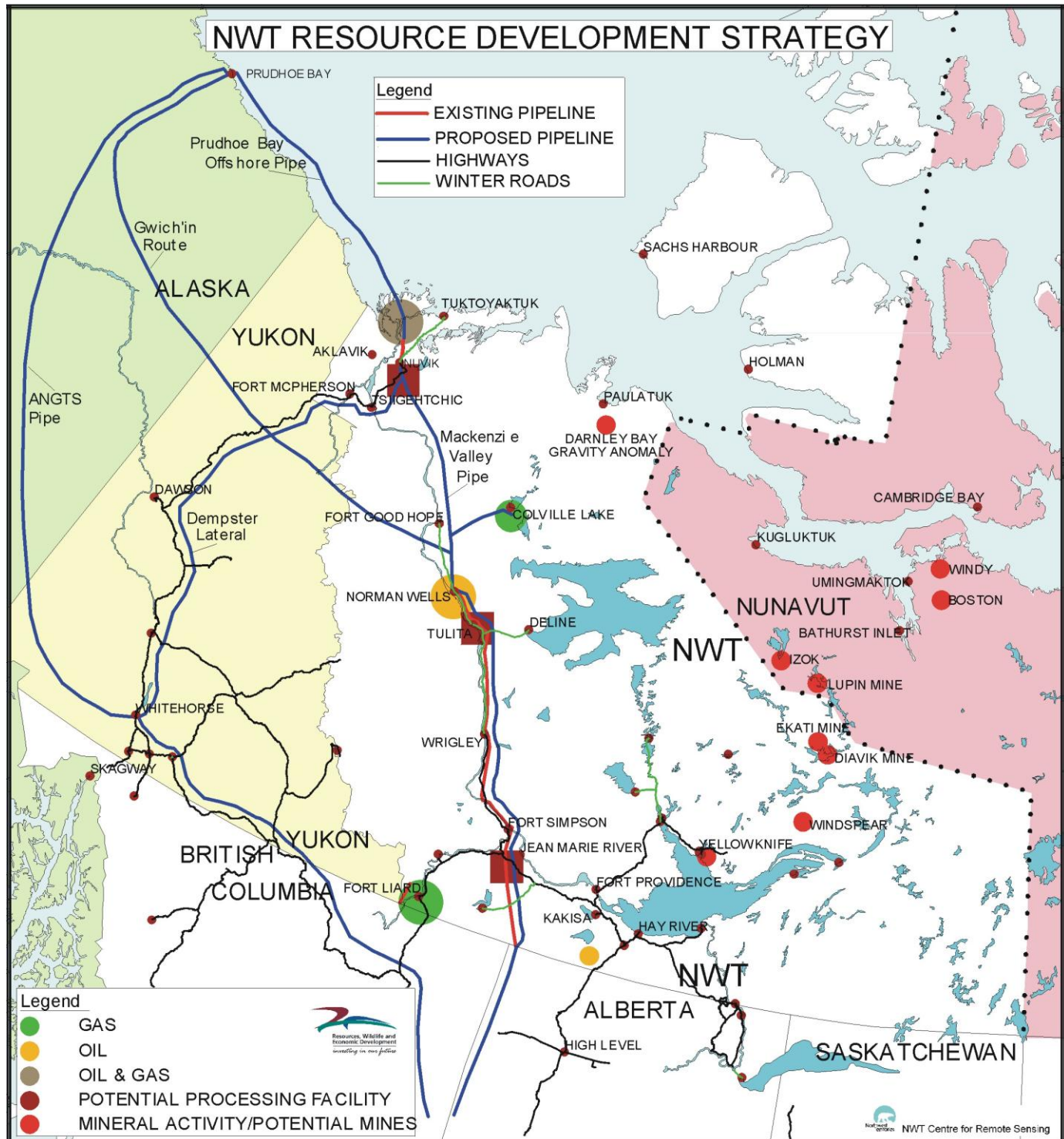
As is noted above, much of the 2000 Report assisted the GNWT and key stakeholders in establishing a list of priority areas and taking opportunistic action, where indicated.

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K.W. Putt

2008-06

Area Map



Source: Government of the Northwest Territories, Resources, Wildlife and Economic Development

1.0 Context

1.1 Report Context

The Mackenzie Valley Development Planning Committee of the Government of the Northwest Territories (GNWT) requested The Aurora Research Institute to undertake the 2000 study, conducted by K.W. Putt Consulting Inc. and endorsed by the Secondary Industries and Value Added Activities Subcommittee, by mutual agreement of the parties. In 2008, the Mackenzie Valley Pipeline Office requested K.W. Putt to provide an overview update his original study

This is the update of the original "Putt report" which is intended to re-look at the preliminary assessment of natural gas based value added and secondary industries. This study is intended to re-examine the preliminary evaluation of which of these secondary and value-added industries is most promising for establishment in the NWT, and which are believed to be the least promising. This evaluation will be based on the opinion of various experts in the field, and will provide a brief discussion of the reasons supporting the conclusions drawn.'

The methodology consisted of utilizing an advisor, generally knowledgeable in the petroleum sector, in research and development, as well as in new product development and commercialization to seek input from those with specific expertise and current hands-on experience. K.W. Putt performed that function.

The Mackenzie Valley Pipeline Office intention was that this updated report would further assist the key stakeholders in assessing areas that are felt to be worthy of implementation, investigation or more detailed feasibility assessments.

The 2000 guiding context is unchanged and was as follows:

"To assist in the establishment of Government of the Northwest Territories policies and development strategies related to 'Secondary Industries and Value Added Activities' with respect to NWT natural resource extraction and processing in concert with agreed support from and interaction with community, environment, business development, fiscal and human resource development planning"...to ensure the resource base is managed in an economic, legal and ethical framework beneficial to the people of the Northwest Territories and Canada."

1.2 Assumptions

- While environmental, community and human resource development are important ingredients in sustainable development, the most economically promising ideas and strategies would be pursued first. It's better for the GNWT to take it's royalty stream and other pipeline-related tax revenue and re-invest the funds in the "Agenda for the New North" Vision rather than using Government clout to push patently uneconomic ventures, i.e. economic 'pull' rather than government 'push' will be pursued.

- While advice and guidance from K.W. Putt is presented in this study, he takes no moral or legal responsibilities for the ideas or pursuit thereof expressed in this study. Specific scoping, feasibility, pre-development and economic/technical screening studies and contracts will be required with specialists in each of the most-promising target areas to provide a basis for informed decision making, for more detailed viability/feasibility confirmation, and support of policy development.
- The GNWT will provide a written or electronic review to those conducting future studies arising from this report of the relevant existing GNWT resource development, royalty, environmental, community, economic development, human resources and training policies and practises of the GNWT to ensure the future feasibility study(s) are done with due recognition of the equitable, ethical and regulatory policies that are currently in place and functioning, consistent with the GNWT's vision, strategies and legal requirements, if appropriate.
- The Mackenzie Gas Pipeline and Mackenzie Gathering System gas field and liquids extraction plant development will only proceed if all the key stakeholders are in agreement with respect to the approval and decision-making processes, the fiscal terms, the risk-sharing, the project's economic viability, and all necessary approvals/permits can be obtained.

1.3 Historical Context

In 1977, Mr. Justice Thomas R. Berger, Commissioner of the Mackenzie Valley Pipeline Inquiry, concluded an extensive consultative process with stakeholders of the day to examine issues surrounding various proposals to transport natural gas from the Prudhoe Bay oil and gas production area of Alaska across the Yukon Territories to connect with gas from the Mackenzie Delta of the Northwest Territories and from there, via a transportation corridor, to markets in the South. In The Report of the Mackenzie Valley Pipeline Inquiry entitled, "Northern Frontier, Northern Homeland" Berger concluded:

"The Mackenzie Valley is a natural transportation route that has already seen several decades of industrial development...I have concluded that it is feasible, from an environmental point of view, to build a pipeline and to establish an energy corridor along the Mackenzie Valley running south from the Mackenzie Delta to the Alberta border... However, to keep the environmental impacts of a pipeline to an acceptable level, its construction, and operation should proceed only under careful planning and strict regulation. The corridor should be based on a comprehensive plan that takes into account the many land use conflicts apparent in the region even today."

"Comprehensive land use planning in the Mackenzie Valley can emerge only from a settlement of native claims..."

1.4 Current Context

These land claims are largely settled today.

Increased powers have been devolved from The Government of Canada to the Government of the new Northwest Territories (GNWT), covering the Western Arctic region bounded by Nunavut to the East and the Yukon Territory to the West. While the capital and largest population centre of the new Northwest Territories (NWT) is Yellowknife, the geographical axis is the Mackenzie Valley from Inuvik in the Mackenzie Delta, Liard to the West, Slave to the East and Hay River railhead/barge terminus south-centrally. The GNWT is in the process of further devolving local powers to the major treaty claimants / settlement areas for Aboriginal self-governance.

A vision of the relationship between the GNWT and its inhabitants was proposed in the 1999 document entitled, "Agenda for the New North: Achieving our Potential in the 21st Century."

The Vision contemplated:

- A system of government that respects the collective rights of Aboriginal peoples and the individual rights of all Northerners.
- Northerners taking greater control of their future and becoming more responsible for their own well being.
- Modern healthcare, education, housing and social programs that are provided by and for Northerners.
- Sustainable development of the north's economic potential in a way that benefits all Northerners.
- Greater Aboriginal representation in the workforce and economy.
- Healthier, more self-reliant individuals, families and communities.
- Less dependence on federal transfer payments.
- A strong unified territory, taking its place in the federation and contributing to the prosperity of Canada.

There were five key elements that set the framework for reaching this Vision of the NWT. Together, these formed the basis of the GNWT legislative and fiscal agenda of 2000 and beyond, as follows:

:

1. Getting Governance Right
2. Sharing Control of Northern Resources
3. Restructuring the Fiscal Relationship with the Government of Canada
4. Harnessing the Northwest Territories' Economic Potential
5. Improving the Social Well Being of all inhabitants

It is in the context of the "Agenda for the New North" that this study was conducted.

The Premier of the Northwest Territories, the Honourable Stephen Kakfwi, put the current context in explicit perspective in his May 10, 2000 remarks to the annual general meeting of the Canadian Energy Pipeline Association, abridged as follows:

Today, in contrast to the 1970's, northern Aboriginal leaders favour non-renewable resource development. On January 19th this year (2000), the Dene, Metis and Inuvialuit leaders announced their unanimous support for the construction of a Mackenzie Valley Gas Pipeline, provided that Aboriginal equity in and management of the pipeline can be worked out. Their position is fully supported by the GNWT.

We support development of northern resources that brings lasting benefits to Northerners and is carried out in ways that protects the northern environment.

In the past quarter century, circumstances have changed. Together we, the Dene, Metis, Inuvialuit and other northern people, are confident we have the ability, knowledge and capacity to ensure benefits for ourselves from resource development in the NWT. We are taking the necessary steps to educate and equip ourselves to participate actively in developing our economy and securing our future.

You should take this agreement among Aboriginal leaders, to enter into a partnership to maximize benefits from a Mackenzie Valley gas pipeline, as an indicator of the confidence of northern Aboriginal people in their abilities to benefit from development.

It is truly in the national interest to build the pipeline down the Mackenzie Valley.

The Mackenzie Valley is already a well-established pipeline corridor. The only section through which there is no pipeline is between Norman Wells and Inuvik - and part of that is already a highway corridor.

A stable political regime and a clear regulatory system are important prerequisites to improving the investment climate in the NWT.

- Land claims agreements down the Mackenzie Valley set out who owns which lands, identifying to developers who to deal with when planning development.
- Within the decade, we expect all the NWT land claim rights to be settled. The increasing role of Aboriginal peoples in resource management, development decision-making, and regulatory control brings stability and certainty for investors and developers. That has been clearly demonstrated in the Inuvialuit settlement region.
- The settlement of land claims has given our Aboriginal leaders the political authority to decide the extent, scale and pace of development on their lands and to ensure that benefits flow to beneficiaries. Northern Aboriginal people need the jobs, the benefits and soon they will need a share of resource revenues to run their local and regional

governments. So in the Northwest Territories today, Aboriginal leaders overwhelmingly support non-renewable resource development.

We have seen changes in the industry practices in the North. Most companies recognize that doing business in the NWT means doing business with Aboriginal people and working to make sure that the development benefits local communities.

- Industry has demonstrated a willingness to work with the GNWT and with Aboriginal communities to help us achieve shared goals.

We applaud these initiatives. They represent the realities of doing business successfully in the North today. We look forward to working with the pipeline industry in similar ways and to seeing your industry make mutually beneficial agreements with northern people.

- We realize that pipeline construction in the North is difficult, and requires highly skilled workers.
- We want to make sure that as many of the available jobs as possible go to northerners. That will require investment by both the GNWT and private industries. The GNWT will work with pipeline companies to ensure that northerners are adequately trained to take and succeed in those jobs.

Industry has already shown leadership in this effort. The GNWT and certain pipeline companies have worked together to develop the Pipeline Internship Program.

- This program will provide to individuals from each of the Aboriginal land claim organizations training in all aspects of the pipeline industry. Trainees will then act as expert resource persons, to help their communities to plan how they can best benefit from the pipeline project.

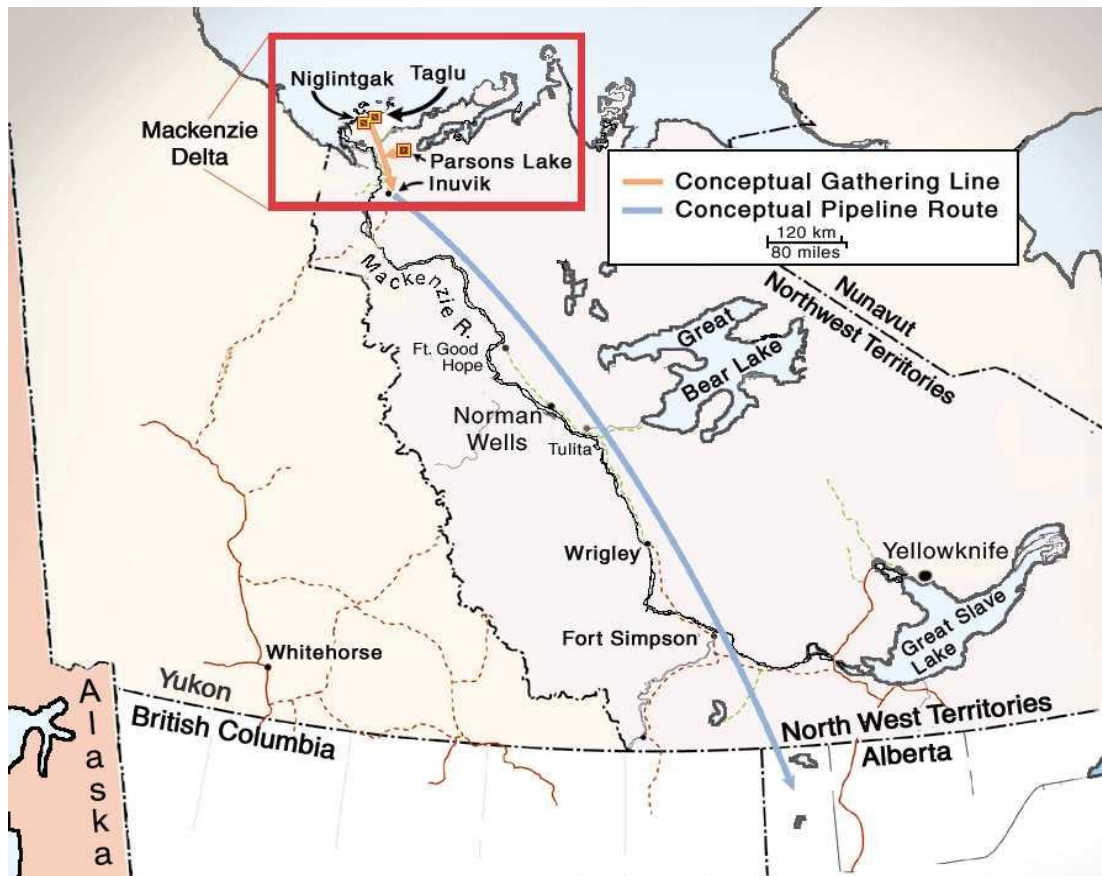
Employment is a crucial benefit we in the North can derive from pipeline development. But we know that most pipeline employment is short term.

- Aboriginal groups are therefore pursuing other, longer-term benefits now, including the gaining of partial ownership in pipelines.
- As development plans for the Mackenzie Valley are clarified, the GNWT and Aboriginal Governments will be looking at various models to determine how northerners can best benefit from the Mackenzie Valley pipeline.

The people of the Northwest Territories have spoken. They say to us: "We are now ready for the development of northern oil and gas resources." To represent their best interests as they have expressed them, we are aggressively courting a Mackenzie Valley gas pipeline to act as a corner stone in our economic development plans to create a robust northern economy.

- We think the Mackenzie Valley route is best for everyone because it is shorter and cheaper than any of the proposed alternatives.
- We know the Mackenzie Valley route is also more attractive environmentally.
- We in the NWT realize we cannot develop our oil and gas resources without the participation of both the producers and the pipeline companies.
 - So we look forward to working with the pipeline industry to make sure that the pipeline is built down the Mackenzie Valley, a route that goes through lands with enormous oil and gas potential.
 - We are confident that the GNWT and Aboriginal governments can work with you, the pipeline companies, to plan a pipeline to the Mackenzie Delta that provides benefits for all the key stakeholders—producers, pipeline operators, industry investors, and the people of the Northwest Territories."

1.5 Proposed Mackenzie Delta & Pipeline Development Area (Map)



Source: Imperial Oil Limited, The Reporter, April 2000

2.0 Key Stakeholders

There are many stakeholders that will need to be involved for the proposed Mackenzie Valley Natural Gas Pipeline to proceed successfully and for there to be opportunities for secondary industry and value added activities spin-off benefits. Identifying the legitimate players and organizing their input, involvement and potential investment in an effective way will be a challenge to the GNWT, Aboriginal leadership as well as the resource producers, pipeline companies and pipeline construction contractors alike.

At this early stage, any attempt to list all the key stakeholders will be fraught with difficulty. A generic list of key stakeholders would include, in no particular order or priority:

- Government of Canada (DIAND, Fisheries, Environment, NRCan, etc.)
- National Energy Board
- Government of the Northwest Territories (Industry, Tourism and Investment, etc.)
- Treaty First Nations (Inuvialuit, Gwich'in, Sahtu, Deh Cho, and individual settlement area local governments related to Pipeline routing, and their land development and business development corporate subsidiaries)
- Communities that the Pipeline passes through
- Mackenzie Gas Pipeline Applicant(s) (Imperial Oil Ventures Limited (Operator on behalf of the Applicants), Shell Canada Energy, ConocoPhillips (North) Limited, ExxonMobil Canada Properties. Since the Application was filed and been under review, another Delta petroleum resource developer, MGM Energy Corp. has signed contractual commitments seeking processing access to the Mackenzie Gathering System Inuvik gas liquids extraction plant and shipper's access to the Pipeline(s).
- Mainline Pipeline Operating Companies (TransCanada PipeLines Limited, Mackenzie Valley Aboriginal Pipeline Corporation (The Aboriginal Pipeline Group), Enbridge Inc.)
- Pipeline Financing Investors and Insurers (whether or not done through the above stakeholders)
- Mainline Pipeline construction contractor companies (Bannister, Ledcor, MAC, Marine Pipeline, O.J., etc.). Note that a major consortium has been formed to bid on infrastructure and pipeline construction – Mackenzie Aboriginal Corporation (MAC) composed of 51% Aboriginal treaty business development corporations (Gwich'in MAC, Denendeh Investments Inc., with other regional business development corporations invited to join in the 51% Aboriginal equity share) and 49% made up equally of Flint Energy, Kiewit & Sons, Ledcor and North American Construction)
- Construction Subcontractors, Infrastructure Subcontractors and Supply Companies (Trimac Trucking, Beaver Construction, Lafarge Cement, Ackland's, etc.

There are other upstream and downstream stakeholders, such as:

- Drilling and Well Servicing Subcontractors (Akita Equitak and four other Akita – Aboriginal development corporation Joint Ventures, Arctic Ensign Drilling, Savanna, Shehtah Nabors, D.S., Halliburton, Veri-Ililiq, Trace Sahtu, Inuvialuit Oilfield Services, Inukshuk Geomatics, etc.
- Secondary Industries and 3rd Party Resource Upgraders (natural gas liquids fractionators, processors and petrochemical feedstock upgraders; TransCanada Midstream, Dow, Nova Chemicals, Alberta Envirofuels, etc.
- Gas Distributors (End-user distribution subsidiaries of mainline pipeline companies, e.g. Union Gas, Consumer's Gas; Alta Gas, Northwest Utilities, Inuvik Gas, etc., marketing aggregators, etc.)

From the Applicants' standpoint, early, pre-development interactions with all Key Stakeholders are necessary in order to:

- 1) Confirm Northern Support (and Expectations)

This area would include Northern Benefits and issues emergent re secondary industries and value-added activities that could arise

- 2) Ensure broad participation in Regulatory Approval Process (including Land Administration)
- 3) Establish Principles for Pipeline Ownership and Risk Sharing
- 4) Determine Fiscal Terms

3.0 Policy Issues

The proposed Mackenzie Valley Pipeline project itself will surface many policy issues that will need to be addressed and resolved prior to the substantial human, financial and time commitments necessary to successfully implement a project of the contemplated size and scope.

Similarly, in order to promote meaningful and lasting benefits from potential secondary industries and value-added activities that could be made possible with the advent of a Mackenzie Valley Natural Gas Pipeline, other policy issues need to be identified early on in the planning and development process and dealt with expeditiously in order that potential benefits can be captured, opportunities seized, and Northern and Aboriginal business development and entrepreneurship fostered.

Examples of Policy issues relevant to the Secondary Industry and Value Added Activities Subcommittee and the GNWT in general would include, but not be limited to:

- Land Use Plans - These need to be promptly formulated for all the land claims agreement areas as contemplated in the settlements, so that secondary industries and value-added activities (not only the main pipeline) locations can be congruent with highest and best use considerations.
- Environmental assessment and review frameworks that have been established need to integrate their review and assessment of environmental impact for their respective land claim settlement areas as well as endorse land use plans. The Mackenzie Valley Environmental Impact Review Board (MVEIRB) was established to coordinate and integrate such reviews. In the Inuvialuit treaty area, the Inuvialuit Game Council has similar obligations.

Since the 2000 Study, the federal Ministry of the Environment, the Mackenzie Valley Environmental Impact Review Board and the Inuvialuit Game Council signed the joint *“Agreement for an Environmental Impact Review of the Mackenzie Gas Project (the Agreement)”* and issued the finalized *Terms of Reference for the Environmental Impact Statement for the Mackenzie Gas Project. The Agreement outlines how the environmental assessment processes for the Mackenzie Gas Project may be harmonized by establishing a joint review panel process that meets the requirements of both the Canadian Environmental Assessment Act and the Mackenzie Valley Resource Management Act. It also ensures the joint review will encompass certain unique measures related to wildlife impact assessment as contained in the Inuvialuit Final Agreement.”* In parallel, the National Energy Board (NEB) has held hearings and established pre-conditions for approval.

- The availability and access to river-sourced placer sand and gravel as well as surface deposits of sand and gravel that may be dredged, dug or surface mined as a source of pit-run sand and gravel or sized aggregates for use in concrete or direct aggregate use for Northwest Territories well lease preparation and oil and gas production facilities, future exploration and development well leases, camps and temporary or permanent infrastructure, and pipeline laying and right of way applications as well as industrial and public roads and community facilities needs to

be clear. A second issue is the aggregate resource revenue sharing. Is this a potential revenue source for treaty beneficiaries or is it covered under the Federal/GNWT mining regulations and part of the crown sub-surface rights?

Subsequently, the Applicant, in its filings to the NEB and Joint Review Panel has identified the sand and gravel "borrow pits" it intends on using for the MGP, with community consultation. Under the SEA, the Applicant will make aggregate resource information available.

- The assurance of provision of natural gas to Northwest Territories communities and industries along the pipeline right of way on a wellhead netback, plus pro-rata cost-of-service basis (with 50% credit for Producers'/Shippers' demand charges), with Pipeline "access point valves" to designated communities or major industrial terminals.

Since the original study, agreement has been reached for the provision of natural gas "access point valves" from the MGP mainline for natural gas supply to Fort Good Hope, Fort Simpson and Tulita in the Agreements and Applicant(s) commitments.

However, I have seen no agreements on access in the NWT to any of the NGL's., or "access point valves" for designated locations along the NGL liquids pipeline between Inuvik and Norman Wells, where the NGL's are blended into the existing Enbridge crude oil pipeline for shipment to Alberta.

A Policy for NGL "access point valves" for designated major industrial sites, mines or communities within economic small diameter NGL liquids pipeline distance or trucking access is needed. NGL liquids pipeline "access point valves" and provision for such facilities, not including local distribution, should be included in the NGL pipeline capital "rate base" and an agreed upon NGL pricing formula determined.

- Ensure that the natural gas production royalty regime fosters, to the extent possible under NAFTA and the WTO, the encouragement to extract natural gas liquids (NGL's) and petrochemical feedstocks, now and in the future, in the NWT.
- Examine the option of the GNWT taking the Federal Government royalty gas and/or NGL's "in-kind" to permit them to be used for the "highest and best use" within the Northwest Territories or beyond. This would give the GNWT more flexibility to act in its best interests. Potentially, the GNWT could take such in-kind royalty as "in stream components" or NGL's. Either way, an extraction/processing fee would need to be paid to the gas processor/transporter, much like the Government of Alberta's "Gas Cost Allowance."
- Review Northwest Territories Power / Electric Utilities Board policies and regulations to ensure that power and heat cogeneration is not discouraged by the rate/regulatory structure. Ensure that excess power generated by industrial, commercial or community users, who install their own gas-fired cogeneration units to take advantage of MGP natural gas or NGL availability from the proposed pipeline(s) aren't prevented from or at an economic disadvantage from selling such local surplus power generated back into the NT Power electrical grid (where one exists). Also look at the concept of special off-peak-time power consumption rates.

Currently, this is 'enabled' in Alberta and Ontario. For example, the economics of the Inuvik Midnight Sun Rec. Centre microturbine power/heat cogeneration demonstration are disadvantaged, since they are using natural gas at the retail consumer rate rather than being able to utilize the wholesale rate NT Power negotiated to convert its main diesel electricity generators in Inuvik to gas-fired electrical generators.

- Pursue with the Federal Government a financial program to encourage Aboriginal and Northern business development, such as the original Western Economic Diversification provisions, to permit greater access to financing for new secondary industry businesses and to fund major growth of successful existing businesses. An existing Northern model, the Arctic Cooperatives Federation of the Northwest Territories and Nunavut's financing vehicle, the Arctic Co-operative Development Fund, is an example that could be replicated beyond Co-operatives to support new Northern and Aboriginal business development and startup investment opportunities.

Subsequent to the 2000 Study, the Northwest Territories Business Development Investment Corporation (BDIC), was established on April 1, 2005 by the *Northwest Territories Business Development and Investment Corporation Act*. BDIC is a Crown Corporation of the Government of the Northwest Territories. The BDIC provides a range of programs and services to help northern business succeed.

The BDIC supports the economic objectives of the Government of the Northwest Territories by:

- ✓ Encouraging the creation and development of businesses;
- ✓ Providing information and financial assistance to businesses; and
- ✓ Making investments in business enterprises.

The BDIC promotes financial independence, assists communities in capturing economic development opportunities, and helps develop a diverse and viable northern economy. The BDIC's role is promoting and maintaining economic development and employment. This role has both economic and social aspects.

The BDIC is funded to a cap of \$50 million. With in excess of \$43million committed by early 2008, the BDIC does not have much remaining budget to leverage Northern and Aboriginal entrepreneurial activities and new businesses emergent from MGP opportunities.

Ideally, the cap should be raised with the participation of the Federal Government, such as is done by Western Economic Diversification Canada (WD), where a majority of WD's grants and contributions are delivered in partnership with other levels of government. These partnerships allow cost sharing initiatives that respond to regional needs and opportunities. Currently, Western Economic Partnership Agreements (WEPA's) are multi-year funding commitments to strengthen economic activity and improve quality of life in

western communities. WEPA's are cost-shared equally with each of the four western provinces, with a total of \$200 million allocated to initiatives identified as federal and western provincial priorities. For example, a WEPA with Saskatchewan, signed in 2007, committed \$50 million in WD funds over 5 years.

- If Benefit Agreements are to be negotiated and signed with the Applicant that include Aboriginal and Northern target employee content, then provision and credit may need to be provided for Applicant and mainline pipeline contractor(s) for pre-training to trades journeyman, operator, pipeline and corrosion control technician levels in their existing operations elsewhere, prior to pipeline construction, startup and operation. Further, a proposed plan for Northern secondary industry and value-added initiatives should be required as part of the Applicant's Socio Economic Impact Statements, as is often done elsewhere in the world; some equity ownership in the gathering system, processing, and/or mainline pipeline would also fit in that category.

These were spelled out in the Mackenzie Gas Project Socio Economic Agreement (SEA) signed by the Applicant(s) and GNWT in January 2007.

- In the past (Norman Wells to Zama oil pipeline) construction camps were located in order to not put undue social, infrastructure and economic pressure on existing communities. Now, twenty years later, the Territorial and Aboriginal self-governments and communities are more mature and may be able to better cope with and benefit from location of Construction camps and/or natural gas pipeline compressor stations near existing communities. The infrastructure, rather than be built temporarily, could be built more permanently to leave a lasting legacy of housing, community facilities and infrastructure such as roads, docks, airstrips, water and sewage treatment. An example is the infrastructure legacy left by the '88 Winter Olympics in Calgary. This must be managed carefully and selectively so as not to put too much of a social burden on the communities or an unreasonable economic burden on the Applicant, so as to not render the proposed project uneconomic, considering the risks involved. An approach with merit is for the NWT treaty beneficiaries to own the camps and lease them back to the developers; that way they can be re-deployed to maximum community benefit following construction. In any event, location of construction camps and long-lived compressor stations will need to be the subject of collaborative discussions between the treaty regional or land corporations and the developers and contractors for optimum mutual benefit/acceptable community impact.

These were covered under the SEA and in community consultations by the Applicants during the Joint Review Panel for the MGP process.

4.0 Role Models / Examples

There are a number of successful role models that industrial developers, operator's producers, and First Nations can learn from.

4.1 Syncrude Canada Ltd. (This is unchanged from the 2000 Study)

Syncrude began their formal Native Development Program in 1974 and established an action plan for Native Training and Counseling Programs. They established a Native Affairs Department and built a staff of more than a dozen administrators, trainers, job and family counselors and native business specialists. In 1982 they reorganized around a "philosophy that 'normal process' was necessary to ensure that, in the future, Aboriginal people in the region require preferential consideration for employment and business opportunities. Instead, they would be able to compete on a level playing field with the larger population." In place of the Native Affairs Department there is a Aboriginal Development Steering Committee made up of leaders from throughout the organization who ensure Syncrude's commitments to Aboriginal development are achieved. Syncrude's objective is to reflect the community demographics. The published goals for Aboriginal employment are:

- to attain 10% Aboriginal employees in direct workforce
- to attain 13% Aboriginal employees in overall workforce including contractors

According to R.K. (Bob) Loader, Chair of the Aboriginal Development Steering Committee and Manager of Aboriginal and Regional Affairs, Syncrude has attained their target of 10% Aboriginal content in their direct workforce and are at 13% overall onsite, including contractors. In addition they are now up to \$60 million contracts and subcontracts to Aboriginal firms, doubling their target of \$30 million.

Recognizing that Syncrude is a large, complex 'point source' of high employment, the following observations and learnings from Syncrude's point of view may be useful with respect to the development of secondary industries and value added activities deriving from a Mackenzie Valley Pipeline development.

- An Athabasca Tribal Council Industry Working Group (ATC/IWG) (5 First Nations from 'local' region, 2 levels of government, oil sands industry) has been useful in coordinating efforts, getting clarity on issues; Membership in the Council for the Advancement of Native Development Officers (CANDO) Roundtable provides a forum to share experiences in providing business and employment for Aboriginal Canadians
- Hiring policy is to hire the best, that is a grade 12 graduation or equivalent is required, although there is some 'grandfathering' for those without grade 12 but with trades and/or certified skills; some jobs have been made available to those without grade 12 certification, if those individuals made a commitment to upgrade to grade 12 over a 4 or 5 year period. The same shift times, attendance, and safety/training requirements apply uniformly to all employees.

- Will carve up contracts into smaller pieces so that Band-owned businesses can compete and bid on the work.
- Occasionally contracts are sole-sourced to Aboriginal companies to achieve objectives or have negotiated prices; in those cases there is a specified time-frame for the subcontractor to become competitive, with competitive bidding on contract expiry.
- Early in the process, before some companies had a successful track record, selective complementary financial consulting and maintenance management advice was provided, to help ensure firms were on a sound management footing at the outset. Most of the success stories started small and grew as they built on their experiences, knowledge and growing expertise from doing the work, staff and upgrading capabilities.
- There is no room in business for politics; the two must be kept separate. Nepotism must be avoided with employee selection based on merit and qualifications. Companies that are separated from Band politics are the most successful.
- Long term contracts, typically five years, are desirable.
- Groups of First Nations and Bands have captured economies of scale and more efficient use of resources by sharing their heavy and/or specialized equipment and labour supplies.
- "Blanket Contracts" are often used where the rates, terms and conditions are set for a multi-year period and then requests are made to have work done under the contract, as required by operational considerations, over time, as the needs arise and their expertise grows.
- Contracts are typically not exclusive, often with several companies (Aboriginal and non-Aboriginal) having smaller contracts doing similar work, rather than one large, exclusive contract.
- Support by the most senior executives of the company and its Board of Directors is critical to successfully supporting Aboriginal employment and business development.
- Needed Aboriginal peer support initially, now self-supporting with turnover about the same as the total workforce.
- It's important to have a set of Consultation Principles agreed with the key affected stakeholders as the basis for discussion; It's important to talk to people early and also discuss long term gains.
- They have become cautious of joint ventures; they need to be carefully structured to ensure they are really Aboriginal-owned, that there are transitions designed to progress Aboriginals into skilled positions and management, and that there are real benefits accruing to the Aboriginal joint-venturers.
- Labour supply is a good place to start as a business, as it's less capital intensive.

- Availability of Capital is a big issue for all startup companies; Aboriginal companies access to capital is an issue.
- Will provide contracts and documentation that can "be taken to the bank" to aid in financing Aboriginal working capital.
- No 'loan guarantees' are provided, however, some flexibility exists on timing of invoicing, etc. to assist in working capital timing squeezes.
- A Tribal Council Business Development Officer can be a key facilitator in making progress with respect to Aboriginal employment and support for and understanding/meeting needs for new business initiatives.
- Self-audits of Aboriginal businesses by people with appropriate experience can help reduce overhead, improve financial controls, streamline operations and identify improvement opportunities.

The Syncrude Aboriginal Contractor Listing 2000, as at March 31, 2000 includes 36 companies, of which completed their contracts earlier in the year. The Service and/or area of work were:

- ✓ General labour services
- ✓ Technical services
- ✓ Air Service
- ✓ CADD Drafting trainees
- ✓ High pressure water jetting and cleaning
- ✓ Janitorial services
- ✓ Provision and management of pallets
- ✓ Welding & fabricating service and maintenance
- ✓ Scrap yard management
- ✓ Tailings and field R&D support
- ✓ Steambay operators
- ✓ Electronic & electrical services
- ✓ Safety & security services
- ✓ Land reclamation, fencing, big game farming on reclaimed lands
- ✓ Mine janitorial & labour services
- ✓ Vehicle transportation services, shuttle bus, onsite fuel & lube management; mail room
- ✓ Fuel delivery
- ✓ General contracting services (Mine); formerly heavy equipment services
- ✓ Glass supply & service
- ✓ Design/build general contractor
- ✓ Consulting services - Report writing
- ✓ Consulting Services
- ✓ Overhead power line work & maintenance
- ✓ Supply of manufactured "wristolets"
- ✓ Drilling services
- ✓ Steel fabrication
- ✓ Truck driver and heavy equipment operator supply
- ✓ Protective clothing repair

- ✓ Sandblasting, painting, coatings
- ✓ Equipment services, conveyor maintenance, grading
- ✓ Painting
- ✓ Moving services
- ✓ Protective clothing supply (and manufacturing)
- ✓ Welding services
- ✓ Sewage, vacuum trucks, potable water provision
- ✓ Ground transportation

Many of these Aboriginal contract services would be similarly applicable, on a different scale, to Mackenzie Delta gas development and Mackenzie River and Liard Valley Pipeline developments by NWT First Nations' companies.

4.2 Suncor Energy - Oil Sands Plant (This is unchanged from the 2000 Study)

Some comments from Greg Quirk, Suncor's Manager of Aboriginal Affairs seem relevant to development of secondary industries and value added activities.

- Try to focus in issues affecting small business rather than "Aboriginal" as the issues are ones any small or startup business has.
- Do a lot of brainstorming with key stakeholders; get interested business development people to look up equipment and services needs of operators and major contractors and do business analysis of most promising prospects.
- Prior to starting a new project, commitments are needed from the engineering design, project management and contracting firms to maximize Northern content; that way subcontracts can be split off to be done by Aboriginal and/or Northern businesses. For example, even if the major process modules are built in the South, things that can be bid separately and fabricated/installed by Northerners, such as steel access ladders, can be provided for.
- The developers and major general contractors need to provide specific plans to utilize Aboriginal and Northern firms before contract award, as once contracts are awarded, they're less motivated.
- Brainstorming and development of a list of things that Suncor used a lot of identified "wristolets" as a potential business opportunity; The Fort Chipewyan band worked, with Suncor involvement, to develop this opportunity, now a separately incorporated company owned by the Fort Chipewyan First Nations that manufactures "wristolets" and sells large quantities to Suncor, Syncrude, Acklands, and is even now exporting them to the U.S. (see later learnings from Ft. Chipewyan perspective in more detail)

4.3 Ekati Mine (this is unchanged from the 2000 Study)

John Bekale of the BHP-operated Ekati Diamond Mine in the NWT manages Aboriginal issues and opportunities there. Many of his comments were similar to those from Syncrude and Suncor; however, he brought a more NWT-specific point of view and described some approaches by BHP, such as hiring standards that were different.

- BHP hire Aboriginal employees who don't have grade 12 certification on hiring, as they hire more on prior work experience, such as heavy equipment operating. They feature computer-added and on-the-job training.
- BHP completed an employee survey and there was interest in educational upgrading. Sometimes, up to 1 hour per day of on-the-job schooling is provided, with the balance on the individual's personal time.
- A more complete education and appropriate work and leadership attitudes are required for promotion to Foreman.
- An inventory of all Aboriginal-owned heavy equipment and/or specialized equipment in the NWT, as suggested by Harry Deneron, would be useful to First Nations and Developers alike for pooling and bidding on larger contracts.
- A number of First Nations have had trouble with Joint Ventures with Southern companies. They don't mind paying for the expertise, management, training and provision of specialized equipment, however, there are often excessive administration charges and hidden costs that drain away the financial benefits and, in some instances, Aboriginal partners hadn't been able to use the equipment they already owned.
- A model of a Joint Venture where the Southern co-venturer loans the Northern Aboriginal firm 50% for the Northern shareholders' equity and capital requirements, to be paid back from the Aboriginal company's share of the Joint Venture's cash flow is a desirable model.
- The Land Claims Treaty structures of separating the business side, Land Development Corporation(s) from the governance side seems to be a good model.
- In the case of the successful secondary industry of diamond polishing set up by two Aboriginal companies to take local advantage of Ekati Mine output, it was understood that a certain percent of production was set aside in the Benefits Agreement for further value added upgrading in the Northwest Territories. Also, it is understood that the GNWT backstopped the loans or provided loan guarantees for the capital investment in the polishing facilities and initial working capital.
- Splitting contracts into smaller elements helped create more opportunities for smaller companies. For example, BHP separated the Kitchen/Catering contract from camp Housekeeping and Cleaning.

4.4 Alliance Pipeline Ltd. (This is unchanged from the 2000 Study)

The Alliance Pipeline from Northern B.C. to Chicago is currently under construction and is scheduled to startup in October 2000. Learnings from Francis Erasmus, the Alliance Manager, Community and Aboriginal Affairs are current and germane to the proposed Mackenzie Valley Pipeline; however, all First Nations were in the Provinces of B.C., Alberta and Saskatchewan.

- A key success factor was establishment of a management focal point for Aboriginal and community priorities and issues within the Developer at the very first stage of planning.

- Real senior executive commitment to a consultation and involvement process and the role of Aboriginal and community affairs specialists was key to surfacing issues early and dealing with them successfully before, during and following the NEB and Provincial approval processes; The Aboriginal and Community Affairs Team meet weekly, as an Aboriginal Affairs Steering Committee, with the Alliance CEO, Chief Operating Officer, Vice President Regulatory Affairs, Manager Environmental Affairs and a Vice President of the Construction Project Manager.
- First Nations leadership is equally important in supporting the consultative and business development activities.
- The pipeline contractor will do anything the owner/developer wants that makes technical and/or business sense, eg., breaking up subcontract packages into smaller parcels that can be bid on by the local Bands/communities that the Alliance Pipeline passed through; having the developer break out clearing, stumping and grubbing well in advance with non-union Aboriginal firms, so as to not interfere with the union-shop mainline construction, having the developer provide all skids from an Aboriginal Lumber firm, etc.; Lateral pipeline feeders were done entirely as non-union jobs with different pipeline contractors, who also subcontracted to Aboriginal firms.
- A contract was developed for the Alexander First Nations' sawmill company, Alexander Wood Products to provide all the surveyor's lathes and stakes and all the pipeline constructions skids. Some 70,000 4"x6"x5' timber skids were delivered to the three pipeline contractors for construction startup. Alexander Wood Products has since obtained additional contracts from Alliance's mainline pipeline contractors on other projects.
- Some clearing and salvage contracts were customized so that the First Nation contractor could salvage the timber, reclaim it, use Band sawmill facilities, and use the lumber to add to the Band housing stock. Work experience in sawmilling and house construction was added skill development benefits.
- First Nations were active in the selection of archaeological consultants for archaeological studies; First Nations contracted for the traditional use studies, with extensive input and fieldwork with/by elders.
- The earlier the archaeological and traditional use studies can be conducted and completed the better, since permit to construct couldn't be received until they were completed and, on occasion the study results and discussions resulted in local re-routing to resolve land use conflicts.
- All employees who are Alliance direct hires must meet Alliance educational standards and be trained for safety, WHIMS, H2S protection, safe vehicle operation, etc.
- There is a very low ongoing operating staff requirement, as all compressor stations are electronically remote-operated (like they would be for a Mackenzie Valley Pipeline).
- A master agreement was reached between the developer, pipeline mainline contractors and the four craft trade unions; Welders, Teamsters, Operating Engineers, and the Labour union. In Saskatchewan, 150 Aboriginals were "permit

hired", since they were not union members or union certified to begin with. Since then some 70% of the 200 or so trained under the "permit hire" system have since become union members.

- The welders (United Association of Plumbers and Pipefitters) have a welder training school in Edmonton. Because of inadequate lead-time, Aboriginals from outside the trade could only be trained up to the welders' helper level during the project.
- The Operating Engineers Training Institute of Saskatchewan teamed up with the Aboriginal Ochapowase Human Resource Inc. for an intensive 'hands on' operator training for pipeline construction heavy equipment. Some 200 were nominated by the Federation of Saskatchewan Indian Nations (FSIN). FSIN provided selection and pre-employment training of candidates who had some previous pipeline and/or construction experience. They were then further trained to provide a roster of qualified candidates for 48 positions.
- Alliance is a company created to construct and operate the Alliance pipeline. There hasn't been sufficient lead time to apprentice new Aboriginal employees to the fully-qualified journeyman level.
- Since the number of employees is so low for permanent operation and maintenance of an automated natural gas pipeline, it would be desirable to pre-hire some Aboriginal employees and have them complete their training in existing facilities of the developers or their business partners/expected contractors. Pre-training in existing facilities in advance of pipeline construction and operation would be a significant opportunity for Aboriginals. An example would be pipeline inspectors, electrical, instrument and mechanical technicians, etc.
- Alliance recently contributed funding to assist the Alexis First Nation in the creation and development of a permanent training facility.

4.5 Akita Drilling Ltd. (Revised)

Akita Drilling Ltd. has been active throughout the Northwest Territories, having drilled approximately 90% of the wells in the Territory outside of the Cameron Hills region since the resurgence of activity in the area in the late 1990's. Since its first joint venture with the Inuvialuit in 1983, Akita's joint ventures now number eight and include 10 rigs. These are:

- Akita Equetak – Inuvialuit Development Corporation
- Doyon Akita – Doyon Inc. (Alaska)
- Akita Trailbreaker – Gwich'in Beneficiary
- Akita Sahtu – Sahtu Oil (Dene and Metis Land Corporations)
- Akita Sahcho – Acho Dene Ko (Fort Liard)
- Akita Kaska – Five member nations of the Kaska Nation
- Akita Wood Buffalo – Chipewyan Prairie First Nation, Fort McMurray First Nation, and four Metis Locals
- Akita Coastal – Naut'sa Mawt Tribal Council

Each joint venture is a 50/50 business enterprise with partner ownership of up to 50% of the rigs within the partnership. There is meaningful participation with equal board representation and the Chair is always represented by the partner. Akita has approximately \$40 million of Aboriginal, Inuvialuit and Metis investment within the companies and boasts approximately 15% (self identified) partner employment within the company, from entry level to executive.

Occasionally, training for rig hands is undertaken at Enform in Alberta (formerly known as the Petroleum Industry Training Service, PITS). However, necessary certifications are often available in the North and the vast majority of training for a rig hand is provided on the job, on the rig itself. As there is almost no summer drilling activity in the Arctic, rig hands have sometimes been able to continue work in Alberta during the summer months, although, without training funding, this has often proven to be cost prohibitive.

4.6 Fort Chipewyan (This is unchanged from the 2000 Study)

"Fort Chip" is an isolated community of some 1,200 residents on the NE shore of Lake Athabasca with no all weather road access. With a winter road and barge access in summer it's much like the communities of the Northern Mackenzie Valley, only larger, with the Mikisew Cree First Nation and the Athabasca Chipewyan First Nation as well as the Fort Chipewyan Metis Local located there.

Tony Punko, the Fort Chipewyan Business Development Officer responsible for the 'wristolet project' provided important insights on how they went about creating a successful "wristolet" manufacturing business that is one of the secondary industry success stories arising from the oilsands developments.

- They found that if they waited for industry to suggest business opportunities, they'd still be waiting; however, joint brainstorming and First Nations' opportunity to review and access Developers' business site and review their requirements let to prospective ideas for followup.
- They were provided lists of the things that Suncor bought in the greatest quantities and they brainstormed that, however, they got the wristolet idea when they were on a joint industry tour of the plant and Suncor's warehouse, looking for business development ideas by seeing the items and applications first hand. They found out where the items were manufactured and what they cost. Then they set out to answer fundamental business questions such as:
 - What were the raw materials and could they transport them to Ft. Chip economically?
 - What specialized equipment was required (knitting machines to knit Kelvar™ tubes), their cost and capacity; what was the market size (units per month) if Syncrude and Suncor would agree in advance to buy them, if a satisfactory product could be produced comparable to the existing one?

- Could they ship the product out in a timely and economically competitive way to the key customers?
- All economics were done on a "worst case scenario" basis, e.g. air transport in and out, minimum quantities, etc.
- By way of business development assistance, Suncor accompanied the Aboriginal Development staff to see the specialized knitting equipment; a knitting machine that could use other raw materials and do other things was desirable.
- A formal business approach was used; a add was place seeking interested community members to submit a resume or fill in a job application (for employment culture acclimatization) of education and prior work experience if they were interested in working in the new business.
- A small selection committee was used to select candidates for employment in the new venture; selection was totally business-focused on skills, work and interpersonal attitudes for business success, personal need and benefit; the selection was not politically-based.
- A separate company, Chip Manufacturing Co. Ltd. was formed; they sell to Syncrude through an integrated supply company (Acklands Granger).
- Specific purpose companies are desirable and easier to manage and keep effective control of; they now have six separate companies for different business purposes, products and services. They ensure a project is close to a company's mandate before locating the project in that corporate entity.
- All the training and manufacturing test runs were conducted before shipping the first product to customers to remove all the "bugs" typically associated with startups.
- On the job employment standards, hours of work, safety, etc. were enforced with coaching; if an employee started slipping into bad habits, they were counselled about the importance of their role to the whole team's success and the benefits that brought their work mates, and the hardship on others from unscheduled, un-notified lack of attendance. If improvement in commitment was lacking employees were terminated, as there were other qualified candidates seeking employment.
- The benefits of working in the community with such a manufacturing operation was that there was considerable flexibility to schedule around most personal personnel problems, as long as sufficient notice was provided.
- The enterprise provided a good training ground for those who had not been in an formal employment situation before to get used to the rigour of regular hours of work, start times, etc.
- Each new business enterprise needs to be looked at from not only a benefits standpoint, but also a liabilities point of view.

With respect to a proposed pipeline, tree clearing, stumping and grubbing right-of-way would be obvious subcontract areas. On an ongoing basis, re-vegetation, chipping and covering exposed permafrost with wood chips, site remediation and re-vegetation with naturally occurring and rapidly-covering species to avoid permafrost melting.

Perhaps more importantly, the project developers, pipeline operator and mainline contractors need to be asked for lists of products and services they'll need for construction and operation of the Delta gas production facility and pipeline. Then opportunities need to be brainstormed jointly and separately for provision of things on the lists and idea generation for things not on the list that can be envisioned.

4.7 Imperial Oil / Shehtah Drilling / Shehtah Nabors LP (Revised)

- Shehtah Drilling, originally set up at the start of the Imperial Oil Limited's Norman Wells project in 1982, was a good example of a positive joint venture experience. A long term contract, drilling and well servicing assets, management and senior skilled drillers were provided with a training plan to transition to full Aboriginal management and operation. Originally, it began with about 50 employees, 85% of whom were Northerners, almost all Aboriginal. Imperial's 50% interest was bought out under terms of the original Agreement whereby the Aboriginal shareholders could match any purchase offer. Following acquisition of the entire company, Shehtah revitalized management and did major maintenance on the equipment to upgrade it to then-current standards in order to take advantage of increased drilling activity in the North.
- Shehtah Nabors LP was subsequently formed as a partnership between Shehtah Drilling LP and Nabors Canada. The partnership was formed to enable technologically-advanced expansion, focused on work in Northern Canada. Shehtah Nabors LP presently operates four drilling rigs and four service rigs. Three of the conventional triple drilling rigs are equipped for work in extreme weather conditions. One drilling rig is a complete AC unit rigged up to move quickly and capable of drilling with coil tubing or a top drive with jointed pipe. Shehtah Nabors LP also operate two free standing single tubing double rod service rigs and two free standing double tubing double rod services rigs. The service rigs have been remanufactured and are also fully equipped to work under extreme weather conditions. The management Shehtah team has over 30 seasons of northern experience. The partnership has the capacity, expertise, and equipment to build remote access and leases, drill complete wells and tie them in for production in any NWT area and in all weather conditions.
- Mackenzie House staff accommodation/hotel at Norman Wells was another good example of a long term need of Imperial's being met by a new business owned by a local Northerner.
- Imperial observed that it was amazing what could be accomplished with a lot of small initiatives. The key was to break up services into a number of smaller discreet packages that could be met by different entrepreneurs, rather than large packages that lumped all support services together.

4.8 Savanna Energy Services Corp.

In 2006, Savanna merged with Western Lakota Energy Services Inc., who had previously established a number of drilling rig partnerships with Aboriginal First Nations and tribal groups for drilling operations in the Western Sedimentary Basin. At the time of the merger, nine such partnerships existed with eleven drilling and

service rigs. Fifteen rigs are now covered by these partnerships. The Savanna view on these partnerships is as follows.

“What separates a relationship from a genuine partnership? The difference lies in the depth and strength of the commitment involved. Over the years, Savanna has forged lasting partnerships with many Aboriginal communities. These relationships have been built on mutual trust, with Aboriginal communities participating both as investors and as valued employees. These partnerships are a key element of our business success and we’re proud of the benefits they bring to all parties involved.”

Since 2001, Savanna has worked closely with many key Aboriginal communities to develop and maintain strong business relationships. These relationships are genuine business partnerships that benefit Aboriginal communities, Savanna and their oil and gas exploration and production customers.

Savanna is currently partnered with nine First Nations communities as follows:

Partner	Number of Drilling Rigs in Partnership	Number of Service Rigs in Partnership
Alexander First Nation	1	-
Alexis Nakota Sioux Nation	-	4
Blood Tribe	1	-
Cold Lake First Nation	-	2*
Dene Tha' First Nation	2	-
Duncan's First Nation	1	-
Heart Lake First Nation	1**	-
Saddle Lake First Nation	2	-
Sturgeon Lake First Nation	1	-
	9	6

* One owned 50/50 by partnership, the second leased

** Leased in partnership

“This model brings Aboriginal communities into the Western Canadian energy industry as meaningful players, not just financial participants.”

One of the benefits of such partnerships are a window on employment in the well drilling and servicing sector, where Savanna’s view is as follows.

“Working with these communities also provides Savanna with access to a large and capable labour force. Hiring of Aboriginal personnel is based on need, skills and merit, as with all Savanna employees. Savanna offers a training program that helps

to develop skills in all prospective employees, with a personal empowerment component for those individuals from our partner communities.

Our customers benefit by building productive relationships with communities on whose land they might be active, today or in the future, though co-owned rigs seldom operate on a partner community's land.

Several Aboriginal communities have also participated in Savanna on a corporate level. To date, Dene Tha' First Nation, Samson Cree Nation, Saddle Lake First Nation, Horse Lake First Nation, and the Metis Nation of Alberta have had significant shareholdings in Savanna through the Toronto Stock Exchange. In addition, the former Chief of the Samson Cree Nation is a director of Savanna.

It is gratifying that many Aboriginal communities choose to meet with Savanna to discuss the availability of future partnerships. Based on shared interest and oil and gas customers' support, we see considerable opportunity to expand this model and extend its benefits over other service lines in the coming years."

4.9 MGM Energy Corp.

Formed in 2007 as a spin-out from Paramount Resources, MGM Energy Corp. (MGM) is the largest landholder in the onshore NWT and has been the leading driller in the two seasons since its inception. MGM's holdings are concentrated in three areas:

- The Umiak Significant Discovery License and EL 434.
- The West Delta Joint Venture, a farm-in from Chevron and BP on EL 427 and the Inuvialuit Inuvik Block 1 & 2.
- The Nogha discovery on Sahtu lands in the central Mackenzie Valley and associated exploration licenses including EL 424, 440 and 442.

MGM Energy drilled two wells in the 2007 drilling season and three wells in the 2008 season. MGM also shot over \$30,000,000 of seismic in the Mackenzie Delta and central Mackenzie.

MGM is committed to work with the local communities to build capacity in suppliers. MGM contracts preferentially with local suppliers as set out in local benefits and access agreements.

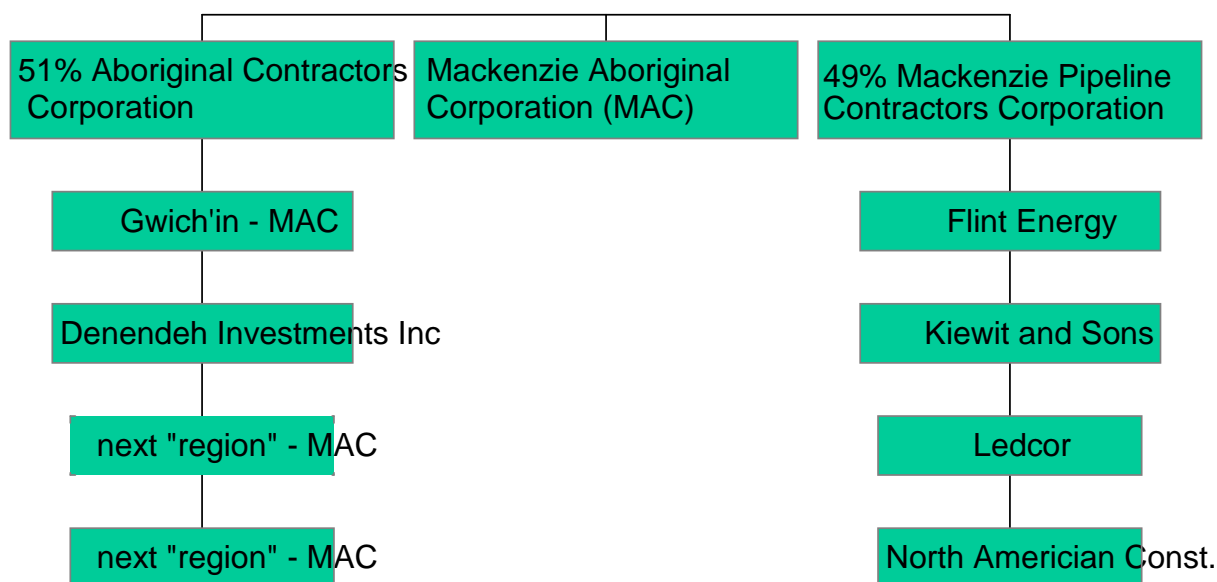
4.10 Mackenzie Aboriginal Corporation

Formed in 2007 under the leadership of Fred Carmichael of the Aboriginal Pipeline group (among his other Aboriginal business leadership involvements), the Mackenzie Aboriginal Corporation (MAC) was formed with 51% Aboriginal equity ownership, currently 34% held by the Gwich'in MAC and 17% by Denendeh Investment Inc. with the intention to share in the 51% Aboriginal equity opportunity with all the regions through which the MGP passes south of Inuvik. Participation in the Aboriginal equity component is currently under discussion in 2008 with the Deh Cho and Sahtu development

organizations. The remaining 49% equity share brings major heavy infrastructure, mining, energy and pipeline construction experience to the MAC corporate entity through equal share ownerships by Flint Energy, Kiewit and Sons, Ledcor, and North American Construction.

MAC indicates that the Applicant would view MAC as a qualified bidder for mainline MGP construction. MAC is currently proposing to bid on building an all weather road from Wrigley down the Mackenzie Valley transportation corridor to the Dempster Highway at Inuvik and thence on to Tuktoyaktuk.

While the all weather highway is, strictly speaking, not absolutely needed to build the MGP, MAC proponents estimate for every \$1M spent on the highway it could reduce MGP costs by \$0.6 M to \$1.0 M, or likely \$0.8M, which would make this a very viable undertaking to give MAC pre-MGP “on the ground” major construction, logistics and employment training with field experience.



5.0 Business Development / Funding Issues

One of the factors inhibiting creation of new secondary industries and new value added services businesses in the NWT, as elsewhere, is access to investment and working capital at competitive rates.

Other factors are: quality management, a skilled workforce, access to raw materials, energy, transportation, and appropriate technology. Access to, distance to, size and growth rate of market are also determining factors for success of new ventures.

5.1 Banker's View

With respect to the provision of investment capital and working capital lines of credit, what do Bankers look for? Here's the perspective of the Western Vice President of a bank that does traditional lending and equity investing in small and medium-sized enterprises. When asked what their criteria would be for lending to firms involved in secondary industries and value-added activities related to a proposed Mackenzie Valley Pipeline, he replied,

"Speaking from (my Bank's) perspective we would want to be satisfied on the following criteria, in the order presented:

- a) **Management** - we must feel the shareholders (owners) have the moxie to run the business - some history of increasing responsibility in related field, etc.
- b) **Debt serviceability** - normally we would expect to have 2 to 3 years historical cash flow coverage to support a forecast (which, strangely enough, always seems to show good profits and repayment ability!)
- c) **Security / Debt to Equity ratio / Working Capital** - these 3 elements are also important in assessing the deal, however, even if they're well satisfied, **Management** and **Cash Flow** still rule!

As a "for-profit" lender, we're not particularly interested in "social aspects" (i.e. job creation, native employment, etc.). If good things happen that are socially desirable, great - but that does not drive our decision.

Given the location of these investments, we would want the loan size to be at least \$1,000,000 and preferably higher to justify the additional travel/time involved in authorizing/monitoring a remote investment.

And finally, I suspect a lot of these applications will be for start-up enterprises which are very difficult to finance, even in Calgary or Vancouver. In these instances, the borrower should expect to be asked for additional comfort in the form of a long term lease, partial corporate/government guarantee, etc."

Another (and widely held) view was that many secondary industry ideas will be uneconomic because there's an inadequate local Northern market or the secondary

industry would be at a competitive disadvantage by being too far away from major markets, e.g. Refining, Petrochemicals, Portland Cement, Fertilizer manufacture.

5.2 Venture Capitalists' General Views (for all early stage businesses)

The top four axioms of a successful Venture Capitalist (VC):

- ◆ There are many Venture Capitalists, but only a few are great at what they do;
- ◆ Great Venture Capitalists are great psychologists, coaches, and sales people... financial and technical skills aren't the key success factors;
- ◆ Great entrepreneurs are superhuman or crazy...the best are both;
- ◆ In the Venture Capital world, money and ideas are commodities. **Great management is rare but is the critical success factor.** (this reiterates the banker's view above).

Further, there are a number of myths that seekers of Venture capital funding should be aware of, according to the President of a different Venture Capital Fund, as follows:

- ◆ Myth: The Internet changes everything -
Reality: It touches everything, but doesn't necessarily change it; (It does permit remote Northern businesses to market and sell over the Internet, provided transportation to the point of purchase still permits the product to be competitive)
- ◆ Myth: Venture Capitalists fund startups -
Reality: Venture Capitalists fund existing established companies; "Angels" fund startups; (Who are the 'Angels' for new NWT businesses?)
- ◆ Myth: 'I've got to perfect my Business Plan' -
Reality: No one is going to read it; you've only got a few seconds (the time of an elevator ride or a few minutes) to attract the attention of an investor (some VC's use a 12 slide template); Traditional Bank lenders want a more formal Business Plan, as do Venture Capitalists, once they're "hooked" on the idea
- ◆ Myth: Venture Capitalists backs Teams -
Reality: Venture Capitalists back expected future return on their investment; (It's the economic viability of the Business and the quality of its management that counts)
- ◆ Myth: There is more money out there than good ideas -
Reality: There are more good ideas than money. Lot's of good entrepreneurs with good ideas can't get funded; (There's even less money available in the North)
- ◆ Myth: (Success is assured if you) Find a need and fill it -
Reality: Anticipate a need and invent a market;
- ◆ Myth: If you build it they will come -

Reality: Anyone can build, but can you execute and sell? ('White Elephants abound; everyone has their own list)

- ◆ Myth: Someone will steal my ideas -
Reality: Someone already has your idea, and the next one; (The competitive advantages are in effective execution)
- ◆ Myth: Venture Capitalists 'don't get it' (don't understand the concept/plan) –
Reality: Unfortunately, they do get it. Listen to them and understand their feedback;
- ◆ Myth: Our projections are conservative -
Reality: Business Plan projections never are conservative enough, the risks can't all be understood fully (Murphy's Law - what can go wrong, will). Focus on the fundamentals of the business and how the business is going to be successful.

5.3 Federal and GNWT Business Development Funding Initiatives Needed

Once the Banker's and the Venture Capitalist's realities are understood, it becomes apparent new business development funding initiatives and/or ideas will be needed if Northerners are to gain the maximum economic benefit by creating Northern businesses to capture new business opportunities.

This needs to be pursued with the Federal Government to develop a financial program to encourage Aboriginal and Northern business development, such as the original Western Economic Diversification Canada (WD), to permit greater access to financing on new secondary industry businesses and fund major growth of successful existing businesses. If such a fund exists, its policies and regulations should be reviewed and updated; such funds should be re-capitalized. The WD, as a consequence of the entrepreneurial maturity of the Western Provinces, generally doesn't provide economic development grants, rather it provides carefully-analyzed legally binding, repayable backstopping for loans granted by traditional Banks, where the applicant wouldn't otherwise be eligible for a loan. Currently, WD "loan" application and approval process is just as rigorous as that of a traditional Bank.

In parallel with access to new / reinvigorated sources of capital, additional management and entrepreneurial development training programs need to be created and provided by Aurora College and/or others to enhance Northerner's management skills to successfully create and operate new businesses to capture the expected opportunities.

Subsequent to the 2000 Study, the Northwest Territories Business Development Investment Corporation (BDIC) was established on April 1, 2005 by the "*Northwest Territories Business Development and Investment Corporation Act*." BDIC, a Crown Corporation of the Government of the Northwest Territories, provides a range of programs and services to help northern business succeed.

"The BDIC supports the economic objectives of the Government of the Northwest Territories by:

- ✓ Encouraging the creation and development of businesses;
- ✓ Providing information and financial assistance to businesses; and
- ✓ Making investments in business enterprises.

The BDIC promotes financial independence, assists communities in capturing economic development opportunities, and helps develop a diverse and viable northern economy. The BDIC's role is promoting and maintaining economic development and employment. This role has both economic and social aspects."

The BDIC is currently funded to a cap of \$50 million. Since in excess of \$43 million had been committed by early 2008, the BDIC does not have much remaining capital to leverage Northern and Aboriginal entrepreneurial activities and new businesses emergent from MGP opportunities.

Ideally, the cap should be raised with the participation of the Federal Government, such as is done by Western Economic Diversification Canada (WD), where a majority of WD's grants and contributions are delivered in partnership with other levels of government. These partnerships allow cost sharing initiatives that respond to regional needs and opportunities.

5.4 Arctic Co-Operative Development Fund

An existing Northern model, the Arctic Cooperatives Federation of the Northwest Territories and Nunavut financing vehicle, the Arctic Co-operative Development Fund is an example that could be replicated beyond Co-op's to support new Northern and Aboriginal business development and startup investment and should be investigated further. Its initiatives are highly valued by Northern Co-operative firms and communities; however, the Fund won't have sufficient capital to meet all the demands on it during the development of the Mackenzie Gas Project.

5.5 Joint Ventures

Joint Venture partners from outside the NWT can bring capital assets, specialized equipment and working capital to enable Treaty development and land corporations and Aboriginal and other NWT residents to enter new businesses compatible with a Mackenzie Gas Project development. For Joint Ventures entered into with non-NWT companies by Aboriginal and Northern firms to obtain a long term source of cash flow and employment, there needs to be provision for the NWT partner to buyout the other partner on predetermined terms, ideally using the Northern share of cash flow to acquire additional equity interest. Such JV agreements need to contain a right to match any bona fide purchase offer by an arms-length third party to buy the partner's share.

One possible joint venture model is where there is the 'outplacement' of services to a joint venture between the Applicant and the local NWT company for specific services

needed by the operator from these JV companies. They have more chance for success because:

- ✓ The service is needed and wanted
- ✓ The service can be provided in a collaborative client/client relationship
- ✓ Guaranteed uptake of services for an extended period can be 'bankable' or a major ingredient in the NWT JV partner obtaining financing
- ✓ Only companies are formed that are needed by the Applicant and/or major MGP contractors
- ✓ Applicant JV partner's can assist in training, technology, and expertise in setting up and managing Northern-owned support and services companies
- ✓ It's better to have Applicant 'pull' rather than Government 'push'

5.6 Special Purpose Corporate Entities - APG and MAC

The Aboriginal Pipeline Group (APG), and its legal corporate entity and partnerships with Aboriginal Treaty areas' business development corporations through which the MGP passes, was created to own a significant equity interest in the MGP mainline. The APG is the initial successful example of this model developed by the affected Aboriginal groups that sought a material influence over and benefits from the MGP. The Mackenzie Aboriginal Corporation (MAC) promises to be a successful Aboriginal-controlled joint interest corporation with major multi-national infrastructure construction firms, created to bid on major portions of the MGP construction (and other major NWT infrastructure projects, such as a Mackenzie Valley all weather road).

6.0 Business Development / Training Issues

Numerous training issues and current practitioners' training responses are listed in the previous Role Models / Examples section. For Joint Ventures undertaken to obtain access to technology, equipment, capital or markets, there needs to be a clear plan and commitment by the partner bringing the existing business expertise to the Joint Venture to not only train first line workers but also train supervisors, managers and business specialists. Where the Joint Venture is identified as one of the benefits in the SEA, the full scope of pre-training, on-the-job and external training for all staff and management succession plans needs will be spelled out as committed to SEA as discussed with the contemplated Socio-economic Advisory Board and/or Regional Working Group.

It was noted earlier that two of the four pipeline trade unions run training programs, for welders in Edmonton and for operating engineers in Saskatchewan (in partnership with an Aboriginal training firm). Also, Enform in Alberta (formerly known as the Petroleum Industry Training Service, PITS) conducts training in important pre-employment, safety, drilling and well services training, as does Aurora College in the NWT.

In some instances, specialized equipment and facilities are required for top quality training. In other cases, much can be done with computer-aided and remote training. It will be important for the GNWT Department of Education, Culture and Employment (ECE) and Aurora College to continue current initiatives and the new ones contemplated, such as the "on-the-job" training project for Northerners as proposed by the Liard Valley Producers Group.

Further, it will be important to work with the MGP Applicant and potential mainline pipeline operators to identify likely total staffing needs during construction and for subsequent operation, by trade/skill type, so that skills with long lead-time for acquisition, e.g. needing 2-year technical institute diploma plus apprenticeship (part school, part on-the-job) can be identified early enough to access potential interested, committed Northern candidates in the near term for a 2010 construction start and 2013 operation start. The same will be true of any secondary industries and value-added activities that emerge. The Human Resource Development Group has identified a listing of potential training providers.

Virtually all of the direct employment estimated requirements by trade were spelled out by the Applicant in its filings with the Joint Review Panel and the NEB. The Applicant, by spreading the mainline construction over three years rather than the originally proposed two years has taken considerable pressure off of the peak workforce requirements and provided for a longer period of employment for construction workers.

7.0 Opportunities Arising Before and During Construction of Pipeline

7.1 Exploration

The resolution of major Treaties has brought about a land tenure environment that lends itself to the creation of oil and gas exploration companies owned by the Treaty area's land or development corporation to undertake exploration and development initiatives for their own account and to joint venture with major oil & gas exploration and production (E&P) companies. The Inuvialuit Petroleum Corporation (IPC) has been particularly successful at this, both on their own lands and further afield. IPC led formation of a joint venture with Enbridge and Alta Gas to complete two sweet, dry natural gas wells at Ikhlil, provide a 50 km, 6-inch chilled natural gas pipeline to Inuvik for power generation, and development of a local residential and commercial gas distribution network. Engineering was done by North of 60 Engineering, with Jim MacDougall as Project Manager. The Inuvialuit Regional Corporation (IRC) has a number of other successful subsidiaries, often held through the Inuvialuit Development Corporation (IDC), in Northern airline, distribution, property development, insurance brokerage, retail, projects and construction and communications.

Such Northern initiatives have been complemented by joint ventures with Southern drilling companies, particularly Akita Drilling, who has formed joint corporations with five Treaty settlement business corporations and, earlier, Shehtah Drilling, originally with Imperial Oil's affiliate as a joint equity owner, now an Aboriginal-owned joint venture with Nabors Canada. Besides having drilling rig capability, Shehtah Nabors LP has provided well servicing rigs from its inception to support Imperial's Norman Wells oilfield operations, since the mid-1980's.

Exploration is supported in the Ft. Liard area by Joint ventures like Deh Cho Helicopter and Aboriginally-owned major construction companies like Beaver Enterprises (Construction) Ltd.

In Alberta, a Saddle Lake and Whitefish Lake First Nations - owned exploration company, Keyano Pimee Exploration Company Ltd. is an example of a model that joint ventures with non-aboriginal E&P companies to explore their lands. Aboriginal-owned Pimee Drilling has been very successful commercially and with a meritorious safety record as the major recent driller at Imperial's Cold Lake heavy oil operations.

Western Lakota Energy Services Limited developed joint venture rig ownership entities with nine Aboriginal Bands and First Nations in Western Canada, since acquired by Savanna Energy Services Corp., who continue to support and grow their model, mentioned in more detail in Section 4.8 above. Savanna has grown this Aboriginal joint venture rig fleet from 11 in 2006 to 15 rigs in 2008.

Oil & gas exploration interest and activity is heating up in the Mackenzie Delta, offshore Beaufort Sea and along the Liard and Mackenzie Valley's with the end of the Federal land sale moratorium and renewed interest that a pipeline corridor up the Mackenzie

River valley will bring the access to Southern markets in a timely way that such exploration pre-investment requires to be economic.

7.1.1 Seismic Data Acquisition

After land exploration and production (E&P) rights acquisition, the next exploration activity is acquiring geological information through seismic data acquisition, processing and interpretation. The seismic data acquisition process, done in the winter for ease of access and to avoid environmental damage to the sensitive permafrost, is manpower-intensive. Seismic data acquisition lends itself to joint ventures with Aboriginal land corporations or development corporations, where the seismic exploration is being done. Some examples that have been created since the 2000 Study are Trace Energy Services (Inuvialuit) Ltd., Delta Trace Ltd., Trace Energy Services (Sahtu) Ltd. (J.V.'s with Trace Energy Services Ltd.) Yamoria Geophysical Ltd., Veri-Illuq Geophysical Ltd., Veritas Mackenzie Delta Ltd., (J.V.'s with Veritas Dcg Inc.), etc.

Early in the planning, before the seismic survey grid layout is finalized, there is an opportunity for participation in environmental impact and traditional land use surveys by Aboriginal firms and elders. Detailed surveying and geomatics work is needed to accurately locate shot points and facilities. An example on a Northern company doing geomatics work would be Inukshuk Geomatics and Gwich'in Geomatics. Inuvialuit Environmental and Geotechnical Inc. is another example of an environmental impact and geotechnical consulting Aboriginal business.

Seismic data acquisition is labour intensive and requires camps with catering and cleaning, transportation, fuel, and below the treeline, line clearing requiring heavy equipment and labour. As well, labour is required for shallow shothole drilling, loading, and geophone placement. Most seismic data acquisition companies want to own their won geophones, cable arrays and computer data acquisition, however, if multi-year data seismic data acquisition programs could be negotiated with major exploration leaseholders, business opportunities could exist for Aboriginally-owned seismic data acquisition businesses or purchase and lease-back of infrastructure facilities and equipment with Southern seismic contractors who have been awarded major contracts.

The Inuvialuit Oilfield Services, Mackenzie Valley Construction Ltd., and Gwich'in Ensign Oilfield Services Inc. are typical of Aboriginal or jointly-owned corporate entities created to provide many of the services needed to support exploration and drilling activities.

Offshore seismic in open water does not lend itself to the same level Northern business involvement in the field work because of the specialized ship and data acquisition requirements for offshore. On-ice acquisition is more analogous to land-based data acquisition in terms of business opportunities.

7.1.2 Seismic Data Ownership Opportunity

A thriving business has arisen in seismic two dimensional (2-D) and three dimensional (3-D) seismic data ownership, brokerage and trading. Seismic data, once acquired, becomes an asset that can be interpreted by the original E&P funder and then resold and reinterpreted as new technology, new geophysical algorithms emerge and new interested parties emerge over time. It is recommended that Treaty land corporations or development corporations take an equity interest in ownership of seismic data acquired on lands within their jurisdiction, so that they have a valuable residual asset that could be brought to the table to support their future oil and gas development priorities. Treaty beneficiaries' interest in seismic data ownership must be negotiated at the time of the exploration lease agreement and, ideally, in any signed Benefits Agreements.

Prior to entering into a seismic acquisition, processing and ownership business, an Aboriginal firm would be well advised to partner or joint venture with an established seismic firm. Such examples were with Trace Energy Services (Sahtu) Ltd. ("Trace Sahtu"), Delta Trace Ltd ("Delta") and Trace Energy Services (Inuvialuit) Ltd., ("Trace Inuvialuit"). Trace Energy Services has been subsequently acquired by Geokinetics Inc. who assumed the Trace rights and obligations in these business entities. Another example is Veri-Illuq Geophysical, and Veritas Mackenzie Delta Ltd. working in the Mackenzie Delta.

Besides knowledge of the technical side of seismic data acquisition and processing there are separate and different written and unwritten business practise knowledge that would need to be acquired in such a new seismic business. Business aspects unique to the seismic business would include:

- Data Quality Inspections
- Seismic Data Sales
- Seismic Licensing Agreements
- Partner Obligations and Responsibilities
- Data Archival Responsibilities
- Show & Tell Presentations
- Farm-Outs
- Seismic Review Options
- Corporate Mergers & Acquisitions
- Property Divestitures and Acquisitions
- Data Room Practices
- Poolings and Joint Ventures

Trace Energy Services (Inuvialuit) Ltd. sold certain of its interests in its proprietary seismic data base that it had acquired to a third party in 2004 and then sold its entire remaining interest in its seismic data library to a third party in 2005.

7.1.3 Drilling and Well Servicing

Besides the opportunity to wholly-own a drilling company (Shehtah Drilling Ltd., now Shehtah Nabors LP) or joint venture with Southern drilling companies, as has been done with Akita and others, there are a myriad of supporting well services, many provided by Inuvialuit Oilfield Services, encompassing everything from the drilling lease site preparation and access roads to the site, supply of aggregates and geotextile fabric for environmentally sensitive terrain, and mobilization transport of the drilling rig and ancillary power generation, drilling fluid handling equipment, drill pipe and casing and consumables such as drill bits and drilling mud. Camps, catering and janitorial, and general labour are required, as with seismic exploration.

Some well services require special technology, software algorithms and equipment such as wireline, perforating and logging, well testing, etc. All require special tools and techniques such as 'fishing' to remove tools stuck down hole, etc. In the 2000 Study, Denis Gaudet then consulting with the Winterhawk Group of Calgary provided specific information and insights regarding well and petroleum field services, as described more completely, below.

Secondary industries such as well servicing exist in areas where there is sufficient activity to keep equipment and personnel active most of the year. This, of course, requires sufficient number of wells in a geographically accessible area that require services such as cementing, wireline, perforating, logging, and remedial work etc. During the start up activity in a new area, the E&P company usually contracts with the service companies to mobilize the equipment to the prepared wellsite(s) and guarantees the service company a monthly payment or standby charge to have the equipment available in remote locations. The contracts are dependent on the activity level expected and the capital cost of the equipment.

CAPITAL COSTS* OF EQUIPMENT FOR MAJOR NECESSARY WELL SERVICES

Drill Rig Complete	\$ 3,000,000.00#	3000metre depth capacity
Service Rig Complete	\$ 950,000.00	3000metre depth capacity
Twin Cement Unit	\$ 1,000,000.00	
C & A Unit	\$ 650,000.00	
Wireline Unit	\$ 550,000.00	
Logging Unit	\$ 1,900,000.00	
Perforating Unit	\$ 1,400,000.00	
Production Testing	\$ 800,000.00	
Fracturing Equipment	\$ 10,000,00.00	

* Source: Winterhawk/Denis Gaudet, 2000

In 2008, a double drilling rig rated for 3000 metre depth capacity costs \$6-\$7,000000, depending upon how automated it is. This inflation factor could be applied to all the costs cited above, which have essentially doubled in cost since 2000.

Since the available Canadian land-based drilling fleet has experienced very low levels of utilization since spring break-up in the Western Canadian Sedimentary Basin in 2007

through to the spring break-up of 2008 and beyond, it makes much more sense to Joint Venture with an existing drilling operator that has surplus drilling rigs in its fleet rather than building new rigs in the current 2008 market.

The capital costs above typical for the standard equipment only, purchased in Alberta. Most services require additional support equipment such as lubricators, cement bins, rig tanks, sand storage, yard space, spare parts and storage, etc. which all need to be specified by people knowledgeable in the drilling and well servicing application the equipment is being purchased for.

The petroleum service companies utilize skilled, specialized personnel to carry out well servicing operations for the E&P companies. To complement these specialists, some support of the specialized well servicing work can utilize unskilled workers, who with pre-employment and prior safety training, can be trained on the job to carry out operations successfully. Enform in Alberta (formerly known as PITS) conducts training in important pre-employment, safety, drilling and well services training, as does Aurora College in the NWT. The training time required is dependent on the previous experience, the type of work and the activity levels for the different types of services.

Well servicing operations would be an area of considerable promise for local opportunities and employment. The drilling companies utilize the largest number of personnel per unit, followed by the service rig and then by the other services such as cementing and wireline etc. These are described in more detail, as follows.

Drilling Operations:

The drilling contractors usually operate the drilling rig on a 24-hour basis and therefore require a minimum of 2 crews per day (12 hours per shift) and require up to 7 or 8 personnel per shift depending on the size of the drilling rig. In some areas and cases they operate 3 crews per day (8 hours per shift). The drilling rigs can utilize unskilled labour for a portion of their crew, such as roughnecks. The Driller and Tool Push can train these personnel once they have taken the pre-employment safety and drilling rig preparatory course at Enform. Aurora College does pre-employment training for exploration and pipeline workers, which should be compared in more detail to the Enform program to ensure equivalency.

Service Rig:

The service rig contractors usually operate the service rig on a 12-hour basis. The rig utilizes up to 5 persons per crew, depending on the size and capability of the service rig. Similarly to the drilling rig, some of the unskilled labour can be trained from the local work force as roughnecks with suitable Enform/Aurora College pre-employment and safety pre-training, as for drilling. In both cases, progression up through higher skill and knowledge levels occurs through on-the-job training, supplemented by specialized courses, often complemented by training provided by supporting service companies and

experience. Roughneck to Driller to Tool Push supervisory positions would be the career path objectives.

Cementing and Acidizing Services:

Cementing and Acidizing (C&A) services usually operate with a 3-person crew on each C&A unit. The supervisor has an equipment operator and driver / equipment operator trainee. The operator and driver / operator can be supplied from the local work force after appropriate Enform/Aurora College pre-employment and safety training. The service company also requires some additional labour support such as mechanics, and labourers etc at an accessible base. Where possible, qualified personnel are hired from the local work force. Cementing operations occur at random times, depending on the needs of the rig's operations, and therefore the crews are almost always on 24-hour call. Longer-term training would permit progression to specialized and supervisory positions.

Wireline Services Perforating and Logging:

These services usually operate with 3 to 4 person crews depending on the size of the operation. The crews consist of mostly highly-skilled, specialized workers and Engineers, depending on the complexity of the job. Some local support is needed such as drivers and laborers, who can be hired locally after appropriate Enform/Aurora College pre-employment and safety training. These companies also require additional labour such as mechanics and labourers at the field base. Where possible, these mechanical personnel are hired locally to reduce the need for higher cost personnel from elsewhere. Well logging operations are driven by drilling operations and/or the well site Geologist and occur on-demand, similar to cementing, therefore crews are on 24-hour call.

Production Testing:

Production testing teams usually operate with 3 person crews up to 24 hours per day and often requires being on location for 3 to 10 days. The supervisor has 2 to 3 operators/helpers that are on location for the full 12 hour shift depending on the testing program. The skill level of these supporting operators is normally available from the local work force, with appropriate Enform/Aurora College pre-employment, safety training and on-the-job training. Additional field base support is also required as referred to in Wireline and Cementing and Acidizing services.

Fracturing Services:

Fracturing services require large crews due to the amount of equipment needed to perform one well fracturing operation. Up to 15 personnel are required for each operation depending on the size of the fracture treatment specifically designed for the target geological horizon. The Fracturing supervisor is a highly trained individual

with several years of experience similar to the Logging Engineer. The remainder of the crew consists of equipment operators with various levels of experience. The Fracturing operations are designed and planned closely with the E&P company representative and conducted during the daytime. Several positions would be initially available to a local work force. These would include drivers, laborers, mechanics and helpers. Longer-term training would permit progression to specialized and supervisory positions.

Capital Funding of Drilling and Well Servicing:

The capital required for integrated drilling and well servicing operations is in the millions of dollars, depending on the services provided. It is difficult to justify the required capital outlay for small projects or low, intermittent activity areas dependent on fluctuating world prices for oil and natural gas. For new areas of committed long term operations, the E&P Companies can work out some long term (3 to 5 years) contracts similar to what was done at the Norman Wells Project in the mid to late 1980's; where Imperial facilitated access to capital and equipment to start up a 50% Aboriginally-owned (Shehtah Drilling) company in drilling and service rig work. These programs have been successful in fostering entrepreneurial service opportunities and creating more local involvement, employment, enhanced skill development and progression as well as personal growth.

Non-technical Logistical Support during Construction and Operation:

There typically would be several areas of Logistical / Construction / Rental that would present good opportunities for local companies to take advantage of business requirements for the E&P companies as well as the Drilling and Petroleum Services sectors. Please refer to the sub-headings below for a sample of examples. Most of these would also be applicable to the mainline natural gas and NGL's pipelines and Mackenzie Gathering System construction and operations phase.

Materials / Transportation:

The transportation of materials is an area where planning and logistics will play a vital role since the transportation of material may have to occur in short periods of time. This will involve air, barge and truck receipts and distribution. The warehousing and storage of material could present significant opportunities for the local economy. Local trucking will also benefit from the handling of these materials both on the journey to the area for storage ahead of time; and then in the delivery of these materials to the well lease, compressor station or right-of way site.

Lease Preparation and Access Roads:

Construction of lease gravel pads, and gravel pads for processing facilities, camps, base stations, compressor stations and equipment laydown areas and access roads to potential drilling sites, processing facilities, river barge-landing sites, airstrips,

compressor stations, camps, base stations and materials stockpile areas will be an area of opportunity for the local contractors.

Schedules permitting, it is desirable to use local construction heavy equipment, to the extent available, for construction and, in all cases for ongoing long-term winter and all-weather road and site maintenance.

The provision of aggregate is a potential significant opportunity area for the Treaty land and/or development corporations that manage the land through which the pipelines pass. Because of recent weather changes, winter roads have experienced later start dates and shorter seasons and are becoming problematic. Increasingly, the most important winter roads will need to be replaced by all-weather gravel roads, with the Mackenzie Highway North of Wrigley a priority for a Mackenzie Valley transportation corridor. The Applicant's proposed "borrow pits" for construction aggregate and proposed road creation for MGP construction and operation have been spelled out in the Applicant's NEB submissions of 2004, as updated through 2008 with community consultation.

Hauling & Storage, Waste Treatment, Rentals:

Lay barges, tank trucks for potable and industrial-use water, hydrocarbon waste vacuum trucks, sewage treatment facilities, cranes and crane trucks and portable tanks and other rental items and storage would be another area of opportunity for local suppliers to provide to the E&P companies and pipeline operators. Water truck hauling also provides a local company with an opportunity to supply equipment that is readily accessible yet does not require high technical advancements and cost.

Camps, Catering, Administration, Safety and Security, Utilities:

Besides portable modular housing camps, catering, janitorial, and laundry as well as supporting administration and office services, telecommunications and internet connections, and conventional utilities (power, heat, water, sewage) will be required. Fuel and lubricant services and waste disposal will also be required. Safety and security services are also business opportunities that can be effectively supplied locally, in coordination with the developers' staff and standards. Some of these services, and the above listed infrastructure-related ones, lend themselves to being broken down into small, local contract bid packages, focused on each significant site of development or operational activity. Other services could, perhaps, best be met by aggregating over a larger number of small companies, such as payroll services, accounting, etc.

Reclamation:

Lease and right-of-way reclamation and environmental services is an area that local companies would be able to provide services to both the E&P Companies and pipeline operators. Locations that have been utilized for seismic, dry holes or for

exploration would have to be returned to near original state and of course will require services of reclamation and revegetation.

7.1.4 Oilfield & Industrial Supply Stores

Further opportunities may exist for joint ventures or franchise operations with the major oilfield and industrial supply stores, such as Acklands Granger. Acklands had a supply store in Norman Wells during that project and for a year following project completion in the mid 1980's and still operates a company-owned industrial supply store serving the Mackenzie Delta and Beaufort Sea from Inuvik.

Acklands worked with the Fort Chipewyan Chip Manufacturing Co. Ltd. to market the Aboriginally-manufactured Kelvar™ knitted "wristolet" safety product. Wristolets protect welders from hot metal sparks getting inside their gloves/sleeves and keep worker's sleeves from catching in rotating equipment. Safety vests, coveralls and parkas are also currently manufactured/repared by Aborigines for the tar sands companies and distributed by Acklands Granger, who have 'Northern status' based on their long duration in the North.

7.1.5 Mainline Pipeline Construction - Employment and Subcontract Opportunities

The mainline (and lateral) pipeline construction project will utilize and require virtually all of the same infrastructure-related support activities mentioned above in Drilling and Well Servicing. In the mainline pipeline case, however, a huge amount of work is spread over three winter work seasons. Therefore, everything is on a grand scale and "time is of the essence" in everything that is done to meet the tight schedule and narrow construction windows. Transportation to and support of people, heavy equipment and materials for the work site pipeline construction "spreads" becomes critical.

Civil Infrastructure, Processing Facilities, Pipeline and Compressor Stations

As mentioned above in Sections 4.10 and 5.6, The Mackenzie Aboriginal Corporation (MAC) promises to be a successful Aboriginal-controlled joint interest corporation with major multi-national infrastructure construction firms, created to bid on major portions of the MGP construction.

Road(s)

The mainline pipeline project is an opportunity to seek Federal Government co-funding of an extension of the all-weather Mackenzie highway from Wrigley to the Dempster Highway near Inuvik, and beyond to Tuktoyaktuk. The all-weather road will make transportation cheaper and permit raw materials to get in and products to get out for new secondary industries and value activities that will emerge. In addition, maintenance of the road will enhance the aggregate supply secondary industry. The Mackenzie Aboriginal Corporation (MAC) is pushing this proposal with GNWT and Federal officials as this 2008 update is being written, now that MAC has been created and there is a

better understanding of the economic and strategic justifications for such an all-weather access road.

Geotechnical and Permafrost Applications - Aggregate and Other Materials

According to Derick Nixon, a permafrost geotechnical specialist, "even in the expected situation of a pipeline transmitting chilled gas, some limited seasonal surface thaw would likely occur and be permitted anywhere south of Inuvik, resulting in some seasonal thaw to a meter below the pipeline. Thaw settlement and frost heave would both occur all the way down to Zama, depending on distance downstream of any given station. The main requirement for select aggregate fill would be in the backfill over the pipe, at any location where significant ice contents were observed in the top meter of soil. This would be a high percentage of the route north of about Wrigley." At the time of the 2000 study, prior to the detailed design being done, it was assumed that "typically, placement in the excavated pipeline trench of anywhere up to 0.3 to 0.5 metre of clean sand and/or gravel might be required along the route, to offset the thaw settlement and ponding that would occur in the backfill trench over the pipe.

This will amount to a very significant volume of relatively good grade of fill. This material would have to be 1" minus or so, and therefore may require screening. This fill over the pipe may also be required to resist buoyancy of the empty pipeline (could be up to 25% of route in Mackenzie Valley). In this case, the select fill mentioned above would be wrapped in a geotextile to make a "bag" over the pipe. Alternatively, screw anchors would be used in areas of icy permafrost or thick organics in N. Alberta to provide buoyancy control. Concrete coating is the more traditional, but expensive form of buoyancy control." Concrete swamp weights may also be used in regions of discontinuous permafrost South of Norman Wells and in areas of muskeg. "The frost bulb at unfrozen river crossings when traversed by a chilled pipe would not be mitigated by over-excavation and replacement by gravel. Rather, the pipe would be insulated and concrete coated, likely pre-fabricated in the South, and shipped to site for the short lengths involved. This would not be well-suited to local involvement." The detailed designs for drilling river crossings and frost bulb calculations were provided by the Applicant in their submissions to the Joint Review Panel and NEB.

"Wood chips are viable for slope protection; however, harvested or imported peat moss can do the same or better job. (Wood chips suffer from potential self-heating, and peat moss does not)." Placement and ongoing maintenance of such slope protection would be ideally suited to local businesses located along the route.

For compressor stations, up to 1.2 metres of gravel fill would be required in permafrost areas, underlain by geotextile and possibly some styrofoam board insulation depending on the site.

Environmental and Land Use/Traditional Use Studies

In addition to planning for the massive infrastructure effort, the Applicants will need to conduct environmental and geotechnical monitoring as well as traditional use studies along the proposed and actual pipeline right-of-way. Aboriginal companies and elders are ideally suited to participate in these activities, as has been done recently in the Alliance Pipeline development. Much of this and follow up monitoring is covered in the Joint Review Panel and NEB submissions by the Applicant and in the SEA.

The Mackenzie pipeline corridor, where river landing sites are established and new all-weather roads established, will open up the Mackenzie Valley to general tourism and, in particular, eco-tourism. For example, the Japanese seem particularly interested in viewing the Northern Lights; however, they expect four-star accommodation, which isn't currently available. As a tourism initiative, the Inuvialuit Development Corporation purchased Arctic Nature Tours to work with tour operators in the region and to attract and expand tourism opportunities in the Western Arctic.

Wood Products

Once the pipeline route has been finalized, opportunities exist for supply of wood products from Northern sawmills, like Alexander Wood Products supplied for the Alliance Pipeline, namely surveyors lathes and survey stakes and the 100,000 or so 4"x6"x5' timber pipeline skids used for supporting the pipeline during welding and laying. These can be supplied by a large regional sawmill or local portable 'mini-mills' near the pipeline construction spread locations to minimize transportation of the wood to the pipeline construction sites. These products do not need to be kiln-dried. Building construction lumber must be kiln dried for project construction, domestic use or export. A wood byproduct, wood chips, were used successfully during construction of the Enbridge Inc. oil pipeline from Norman Wells NWT to Zama, Alberta, in order to protect slopes and exposed permafrost. Although some short term repair was initially required, the vast majority of the wood chips placed worked effectively to protect permafrost and remain in place.

Cement and Concrete

No similar opportunity exists to manufacture Portland Cement in the Northwest Territories, even though there now will be natural gas and there may be limestone of suitable quality. Portland cement is a commodity business with million ton plants costing hundreds of millions of dollars now the norm to be 'world scale'. Lafarge Canada has two million-ton plants, one at Exshaw, Alberta and one at Richmond, B.C. tidewater, with Exshaw serving all of the Prairies and into the U.S. and Richmond serving the Pacific Northwest and offshore Pacific Rim. Options for cement distribution would be a bulk terminal at the Hay River railhead/barge terminus. Alternatively, two ton polyethylene-insert/ polypropylene outer layer bags that are rail, truck, barge, and heli-portable may obviate the need for cement distribution terminals altogether.

The possibility does exist for joint ventures with a cement supplier, such as Lafarge, and local entrepreneurs for concrete Redi-mix plants, to serve high demand areas or produce

concrete products that will be needed in large volumes from the pipeline contractor. For the Joint Venture to be desirable from the cement supplier's standpoint, the Northern joint venture partner would need to own or have rights to the supply the sand and aggregate, since the cement manufacturers normally prefer to own their own sources of sand and gravel aggregate. Access to housing, utilities and fuel, trucking and a Building Materials Store for access to lumber and tools is normally required to complement provision of concrete services. Open steel mesh and reinforcing steel is also needed for related concrete products.

Pipeline Construction Trades

The four fundamental trades used in pipeline construction are:

- Welding
- Operating Engineers
- Teamsters
- Labour

Most large diameter mainline pipeline projects in Canada are constructed with union trades people. Laterals and smaller pipeline construction projects are typically built as non-union jobs, although the same trade skill sets and competencies are required.

As noted earlier, the welders (United Association of Plumbers and Pipefitters) have a welder training school in Edmonton. Also, the Operating Engineers Training Institute of Saskatchewan has teamed up with the Aboriginal Ochapowase Human Resource Inc. for an intensive 'hands on' operator training for pipeline construction heavy equipment, which doesn't require such a long lead time for training prior to the start of pipeline construction

Because of long lead-time for training pipeline pressure welders, some provision will need to be pursued to utilize the major project developers/contractors to work together with the treaty area organizations and the GNWT Department of Education, Culture and Employment, and Aurora College to develop and implement appropriate trades and skills pre-training.

Since the welding activity peaks during the three winter pipeline construction periods, it would be desirable to cross-train welders with equipment mechanics, as mechanics will be required over the long term for facility maintenance. Other trades with long lead-time training requirements are process operators of Mackenzie Delta gas well and liquids processing facilities and instrument/electrical trade's people. Since the pipeline compressor stations will be automated and remote-operated, some specialized computer control instrumentation and telecommunications personnel will be required long-term. A small number of experienced pipeline technical inspectors will be required during construction. Not as many corrosion technicians will be needed for the natural gas pipeline as will be needed for an NGL pipeline to maintain the pipeline anti-corrosion

measures. SCADA systems installed to monitor and control the pipeline system will require a small number of specialists, typically employees of the operator. These people have long lead-time training requirements as well.

8.0 Opportunities Arising As A Result of Natural Gas Pipeline

Besides the ongoing well servicing, infrastructure support and the relatively small number of process operating, maintenance and electronic instrument people required to support the natural gas production, primary processing and pipelining, there are other business and secondary industry opportunities that arise from access to the natural gas for local use in the Northwest Territories.

A major opportunity area is substitution of gas for expensive diesel fuel oil for local power generation and space heat for communities and businesses along the pipeline route. This would involve power cogeneration and local gas utility distribution.

- The Inuvik Gas Ltd. local natural gas distribution system serving Inuvik, designed by North of 60 Engineering, and owned jointly 1/3 by the Inuvialuit Petroleum Corporation; a subsidiary of the Inuvialuit Regional Corporation, 1/3 by Enbridge Inc. through IPL Holdings Inc., and 1/3 by AltaGas Utilities Inc., through AltaGas Marketing Inc., is a promising model. In that instance, NT Power Corp. replaced their old diesel-powered generation with two new natural gas powered reciprocating engines in the station, while retaining some diesel capacity as standby backup. While it was not a cogeneration installation, some waste heat is captured and utilized in Inuvik's water supply intake system. Subsequent to the 2000 Study, a commercial prototype project was completed by Northwest Territories Power Corporation with the installation of two Capstone 60.30 "Heat Plus Power" microturbine cogeneration units at the Inuvik Recreation Centre in 2002.
- Three communities are to be provided with "access point valves" for MGP natural gas access under the SEA.

Significant new drilling for and discovery of natural gas has already occurred in the Liard River valley area. As of 2000, Fort Liard's electrical power was still generated by diesel-powered gen-sets. Because of the terrain and separation of residences, local natural gas distribution may not be as economic as it is at Inuvik. It may be economically-limited to more centrally-located major energy consumers in Ft. Liard proper.

Local Natural Gas Distribution Opportunities along Route

Since, other than Fort Good Hope (K'asho Got'ine), Tulita (Fort Norman) and Fort Simpson, identified for mainline MGP "access point valves" in the SEA, it is likely uneconomic to run a smaller-diameter spur line lateral from the mainline natural gas pipeline to "town gate" custody transfer points for other designated communities within 50 miles of the proposed Mackenzie Valley natural gas pipeline route. Other communities within a ~ 50 mile (<85 km) radius of the likely mainline pipeline route would be: Aklavik, Deline, Arctic Red River (Tsiigetichic), Jean Marie River, Trout Lake (Sambaa K'ee) and Wrigley. Inuvik, Norman Wells and Ft. Liard are special cases that have local access to indigenous natural gas. Tuktoyaktuk and Fort McPherson would require laterals of 130 km and 100 km respectively and may warrant further examination. Also, further study should be given to potential use of

MGP NGL's, possibly truck transported via winter or all weather roads, for those communities noted above within economic access of the NGL pipeline.

In each community, the gas would feed firstly the Northwest Territories Power Corporation (NTPC), the GNWT Crown Corporation with the mandate to generate community power in the Northwest Territories, and secondly a distribution company which would distribute and sell the gas to individuals and business within the community. A number of alternative marketing options exist, but several that should be looked into would be a local community Co-Operative or a broader common distribution franchisee which would level the cost of gas for all similarly-served communities, using a "postage stamp" model.

Small scale distributed microturbine power generation, which is able to effectively generate electrical power from natural gas or can be specially designed for liquid byproducts of natural gas production (NGL's) may help solve this dilemma.

For example, the Canadian distributor for Capstone microturbines participated in a test run of a Capstone unit on naphtha, which would have application in the Northwest Territories, as the fuel trial was similar to MGP NGL's.

Distributed generation based on natural gas or liquid byproducts of natural gas production (NGL's) and in particular, small scale on-site power generation may assist Northern communities and local commercial enterprises to lower their energy costs significantly. This can be done by reducing the need for duplication of infrastructure. Instead of gas pipelines and electrical transmission and distribution systems being built, one infrastructure network, a gas pipeline, combined with small scale and readily transportable, scalable microturbine electrical generation equipment, ideally cogeneration units generating power and utilizing heat, can effectively serve both functions.

Gas microturbine power generation and cogeneration represent a significant opportunity for small communities. This opportunity is fleshed out below in more detail, based on consultations with Mercury Electric Corporation of Calgary. The economics and specific case studies cited were provided by them in 2000, with permission. Since 2000, Mercury's exclusive microturbine manufacturer, Honeywell, shut down its microturbine business, which has caused the business focus of Mercury Electric to change from microturbines.

Currently, Capstone Turbine Corporation microturbines are the dominant microturbines in widespread use, with over 16 million hours of operational experience as at 2008. The Canadian sales and service distributor for Capstone microturbines is Tarpon Energy Services Ltd. of Edmonton. The Capstone installation at the Midnight Sun Recreation Centre in Inuvik was a custom designed cogeneration configuration by Mariah Energy Corporation, which has since gone bankrupt. The Inuvik Capstone microturbines are operated and maintained by NTPC with a service contract to Ruhnke Consulting Inc.

8.1 Microturbine Power Generation and Cogeneration in the Northwest Territories:

"Utilization of Natural Gas from the Mackenzie River Delta and Liard River Valley to Lower Energy Costs in Northern Communities"

8.1.1 Microturbine Technology

The recent commercialization of industrial microturbine technology has opened up numerous opportunities for distributed power generation, with particular advantages in remote locations, such as Canada's North.

Microturbines offer numerous technical advantages over reciprocating engine-based generators. These advantages include: lower maintenance costs; fuel flexibility; quiet operation with little vibration; small footprint; weatherproof enclosure; automated, remote sensing and control capability for monitoring and operation; and scalability through parallel operation of multiple units.

Microturbines are small integrated power generators, which have outputs ranging from approximately 30 kW to >100 kW, use a high speed combustion turbine as the prime mover and a solid state electrical power inverter for the electrical output. They are capable of operating either in stand-alone mode without an electrical utility, or in parallel with the electrical utility grid. Microturbines have the benefit of being fuel-flexible with only minor hardware and software modifications to adjust for a wide variety of hydrocarbon fuels. They can operate on liquid fuels including natural gas liquids, diesel, kerosene, naphtha or burn gaseous fuels ranging from low-btu landfill and digester gas to high btu fuels such as propane and raw solution gas. Natural gas fired units produce significantly lower emissions than other fossil fuel fired electrical generators.

The Capstone C30 has been test run on Naphtha which is similar to MGP NGL's, although test runs would be required to certify the Capstone units on the specific NGL design composition.

These easily transportable generators are designed to be "plug and play". Installation consists of little more than hooking up the gas or liquid fuel supply and wiring the power into a suitable power connection point. The engine is a high-speed turbine, operating at speeds in the 50, 000 - 120,000 rpm range. The construction is a single shaft with the compressor, expander turbine and a generator rotor supported by journal and thrust air bearings. Two of the microturbine product lines utilize air bearings thus eliminating the need for oil lubrication, which is an added benefit in cold climates. Microturbines achieve a relatively high electrical conversion efficiency of close to 30% by employing recuperation. This entails feeding the hot exhaust gases through a heat exchanger and passing this energy on to the compressed combustion air. Although efficiencies of up to 80% have been cited for cogeneration units, some 60-65% efficiency is more typical.

The whole turbine engine core is an easily field removable single sealed unit. Field servicing consists of removing the old core and exchanging it for a factory rebuilt unit. The combustor is external with a replaceable liner to reduce maintenance costs. The turbine engine is operated by a dedicated computer that can start the turbine, monitor and protect it. The onboard computer also matches the power output load to the most efficient engine speed.

8.1.2 Redundancy versus Cost

The Microturbines are designed to be operated in parallel for scalability. When set up in a multi-unit configuration, they can operate either in conjunction with an existing electrical grid or independently. By having multiple smaller generators at a remote site, base-load or emergency power can be reliably supplied with less redundancy than would be required with one or two larger units. When compared with standard reciprocating engine-based generators, microturbines typically have a higher first cost. However, for grid parallel installations, the lower capital cost of the reciprocating generating set may be somewhat offset by the need for more expensive switchgear, synchronization, protection equipment and less liquid to gaseous fuel flexibility.

When evaluating remote generation costs, the opportunity for savings occurs when the need for redundancy is taken into account. Assuming a typical load of 300 kilowatts at peak, a facility which depends on on-site generation would normally have two complete 350kW or 400 kilowatt generating units. With microturbines, that same facility could place five or six units totaling 375 – 450 kilowatts and maintain the level of reliability and redundancy of the two larger units. This is because the statistical likelihood of more than two microturbines being out of service at any given time is less likely. As well, even having three units down would still allow the facility to maintain a basic level of service until one or more of the downed units was brought back into service. However, due to the remote nature of the proposed installations, access to spare parts and service support from southern manufacturers may be limited and may result in lengthy down time and/or repair times. A thorough analysis of spare parts requirements, maintenance training and committed service support needs to be determined as part of any microturbine acquisition economic evaluation and acquisition decision. This same argument can be made for routine maintenance.

Finally, multiple microturbine units can be programmed to optimize operation based on load demands. Specifically, they can be set up to always run near their peak level of efficiency, by turning additional units on and off in response to load demands. With a larger reciprocating engine, a smaller load demand will be met by reducing the power of the engine. Below about 60 – 70 % of full output, however, reciprocating engines begin to lose efficiency, and below 50% the efficiency loss is significant. Although they may have a higher rated level of efficiency, unless they are

operated in their prime power band at all times, the actual efficiency can be quite poor for typical commercial loads which tend to have a variable load factor.

8.1.3 Fuel Flexibility

In general, turbines have robust combustion capabilities. Because the fuel - air mixture is combusted in a “combustor can”, turbines can burn a wide variety of gaseous and liquid fuel substances. Microturbines share these robust combustion capabilities. Although early production models were set up for natural gas operation, diesel and propane units are now being produced. With minor fuel mapping (software) and nozzle design (hardware) changes, microturbines can also operate effectively on naphtha, # 2 fuel oil, kerosene, and natural gasoline (C5+condensate).

Another benefit of the adjustable control of the fuel mapping which is designed to obtain the most effective fuel air ratio depending on elevation, ambient temperature, and heat content, is that microturbines can also operate on both low and high BTU fuels such vent gases and raw solution gas from oil and gas production facilities (gas rich in NGL's with heating values >1200 BTU/ft3).

The limitations on this fuel flexibility are that microturbines are not designed to operate on dual-phase flow. Therefore, the fuel must be liquid or gaseous but not a combination of the two. This limitation can pose a problem when operating the unit on raw solution gas which contains higher boiling point hydrocarbons that are liquid at fuel feed temperatures and pressures. As long as the fuel remains in a gaseous state, the turbine will effectively combust the fuel. However, if liquids condense out in the fuel feed valves or at the nozzle tips, the combustion process will be inhibited. This necessitates the introduction of some low grade fuel scrubbing system to drop out any liquids ahead of the fuel valves or preheating to maintain the liquid in the gaseous state.

Gas Compression

Microturbines which use gaseous fuels have a minimum fuel supply pressure of 50 - 75 psig depending on the manufacturer. Where supply pressures in a natural gas distribution system are below this threshold, a fuel gas compressor must be used to boost the pressure. These small scale compressors normally add about 15% to the cost of an installation and have a parasitic load of between 2 – 3 kW. In raw gas or low BTU gas applications, a more robust compressor which incorporates inlet and discharge scrubbers as well as discharge cooling is better suited to the job.

If fuel supply is being taken from a pressure regulating station for local distribution from the mainline pipeline, the fuel supply for the microturbines can be taken off ahead of the final pressure reduction valve to eliminate the need for microturbine fuel compression, such as is done at Inuvik, where the gas is taken off at the meter station ahead of pressure reduction.

8.1.4 Cogeneration

Cogeneration or combined heat and power refer to the process of obtaining both power and thermal energy from a single fuel source. In the case of combustion turbines, this is accomplished by burning the fuel to spin the electrical power generator and also capturing waste heat from the exhaust to create a hot fluid or steam.

Microturbines vent a large volume of flue gas or exhaust. Because microturbines use a component called a recuperator, which is an air-to-air heat exchanger to preheat combustion air for added electrical conversion efficiency, the exhaust stream is not as hot as in a conventional combustion turbine. With exhaust gas temperature ranging from 450 – 525 Degrees Fahrenheit, microturbines are only capable of creating low grade thermal energy.

Cogeneration Efficiency

Although there is insufficient energy in the exhaust stream to make high grade heat for process steam, the hot fluid derived can be effectively used for smaller scale thermal requirements. By capturing waste heat with a relatively simple and inexpensive shell in tube heat exchanger, the overall efficiency of the microturbine can be increased from close to 30% to over 70%, making them a cost effective power and thermal energy source for many commercial, institutional and light industrial applications.

Cogeneration Applications

The most suitable applications for cogeneration are those facilities which have a relatively constant power and heat requirement, and particularly where those requirements coincide. However, where more heat is required during off-peak electrical hours, fuel use can be balanced out using hot water storage during peak energy production and distribution of that heat when it is required during high thermal demand periods. Typical microturbine cogeneration applications include public buildings such as hospitals, recreational centres which incorporate hockey rinks and swimming pools, hotels with laundry and spa facilities, large multi-family residential buildings, and small industrial facilities such as micro-breweries, greenhouses, and large grocery stores. The use of cogeneration waste heat has been used for kiln drying lumber at Socco Forest Products in Washington State. Use of the heat has also been studied for drying feed to reduce the heat load of combustion kilns.

Cogeneration Advantages and Limitations

The primary advantage of a microturbine-based cogeneration facility over a similar scale reciprocating engine facility is cost of heat recovery and ease of installation. All the inherent electrical interconnect and electrical power conditioning, quiet operation,

low maintenance and low vibration benefits discussed above still apply, but the microturbine cogeneration package is less expensive because it utilizes a simpler heat recovery exchanger system with exhaust bypass duct and does not need heat dissipation ventilation fans to expel heat from the cooling loop when the thermal energy is not required.

The primary limitation of microturbine cogeneration systems is the lack of steam-generation capability. This limitation restricts the type of use to lower grade heating (and potentially absorption chilling) applications.

8.1.5 Cost of Power

Power costs vary widely throughout the North, depending on the location of the community or industry and in some cases on the policy environment. The 2008 data points to power costs ranging from under ten cents per kilowatt hour for hydro-sourced power (\$.0871/kwH at Fort Smith) to \$0.2683/kwH for third party power supplied at Norman Wells from natural gas and \$0.3221/kwH from natural gas at Inuvik, with diesel-sourced electricity costing \$0.552/kwH at Fort Good Hope up to a staggering \$2.3736kw/H at Colville Lake. The normal range for the larger diesel-fueled communities would appear to be more in the \$0.50 - \$0.60/kwH range in 2008 rather than the \$0.12/kwH – \$0.20kwH experienced in 2000. Where the primary fuel source is diesel or its low pour heating oil equivalent, power prices are typically above 50 cents per kilowatt hour and will rise dramatically as fuel costs rise. In 2008, diesel and heating oil are increasingly in short supply and diesel motive fuel now commands a higher price than motor gasoline elsewhere in North America.

Cost of Fuel

Diesel and heating oil fuel costs in the Mackenzie Delta and Mackenzie Valley ranged from \$0.82 - \$0.85 per litre for the 1999/2000 purchase period. This cost was in the order of \$1.55 - \$1.65 per litre or higher in 2008, with prices expected to be substantially higher the coming year as crude oil and petroleum product prices are now at an all-time high and transportation costs to the North have risen accordingly. Fuel oil prices for larger communities such as Whitehorse or Yellowknife are somewhat lower. Other fuel sources such as condensate, propane and natural gas are available to varying degrees in the North, depending on the location of the community in relation to oil and gas production facilities. In Norman Wells for example, condensate can be obtained. With increasing natural gas production in the Fort Liard Valley area, although some of the gas is "dry", this will likely be the fuel of choice for power generation given its relatively low cost in relation to fuel oil and diesel. As Mackenzie Delta gas starts to come on stream, small distribution networks in the vicinity of the main pipeline corridor could result in significant savings in fuel costs for power generation and thermal energy from an indigenous product.

Microturbines have been designed in a modular fashion with low maintenance in mind. Typically, they have three primary components, the core microturbine engine,

the recuperator, and the power electronics. The core engine is designed to be replaced on a regular cycle with a remanufactured core. The work is done on-site by one or two technicians and can be done in with regular tools in less than half a day. The recuperator is a bolt on heat exchanger which, in 2000, required replacement every 40,000 hours. The power electronics consist of printed circuit boards and electronic switches which are long-lasting and low maintenance if housed so as not to overheat. These parts are designed to be easily replaced in the event of a failure. Training for maintenance can be provided to local residents who display a mechanical inclination in a week or two. Diagnostics are built in to the unit through the local control software, and can also be provided through remote monitoring in the event that problems cannot be readily diagnosed on-site. Due to the remote nature of the proposed installations, access to spare parts and service support from southern manufacturers may be limited and may result in lengthy down time and/or repair times. A thorough analysis of spare parts requirements, maintenance training and committed service support needs to be determined as part of any microturbine acquisition economic evaluation and acquisition decision.

Climate Issues and Concerns

Microturbines are designed to operate outdoors without any special containment. However, none of the manufacturers have designed the product to operate in the extreme climate of the Arctic. With temperatures occasionally dipping down below minus 60 degrees Fahrenheit, some additional sheltering is advisable. Mercury's Honeywell microturbine has been rated to minus 20 Fahrenheit, so the shelter does not need to be extensively insulated or heated, but must provide adequate air circulation for the turbine inlet combustion and cooling air. Capstone units are similarly installed in Alaska.

8.1.6 Economics

Given the wide range of possible applications and needs in the North, it is difficult to make blanket generalizations about the economics of microturbines for power generation. It is fair to say that under a variety of conditions, microturbines offer numerous advantages over conventional reciprocating generators, and some of these advantages can be stated in economic terms. For example, in 2000 microturbines could be installed in Southern locations for as little as \$1000 - \$1200 per kilowatt or around \$75,000 - \$90,000 per 75 kW unit. Due to higher transportation costs, it is assumed that this cost could be 15 –20% higher for remote Northern locations. In addition to the premium for installation, it is necessary to assume higher maintenance expenses to take higher shipping and handling expenses and more spare parts for remote locations. For the purposes of the sample economics below, in 2000 a maintenance cost of \$0.035/kWh vs. a typical cost in the South of \$0.014/kWh was assumed.

Remote Power Generation

In 2000, at remote sites where no utility generation and distribution grid system was present, the cost of power from a single unit, using diesel fuel at a 2000 price of approximately \$0.81 per litre, and a load factor of 50%, would have been about \$0.42/kWh. If two units were installed to ensure full redundancy, that cost would increase to \$0.46/kWh (in 2000).

That same project, using 2000 natural gas price of \$5.00/GJ would generate power at \$0.17/kWh with a single unit and about \$0.20/kWh with two units. The use of wellhead natural gas prices or the Government of the Northwest Territories' "in-kind" royalty gas would substantially lower electrical power costs from microturbine power generation further. For comparative purposes, the 2008 price set by Inuvik Gas Ltd. that would apply to the Midnight Sun Capstone two microturbine cogeneration installation was set April 25, 2008 at \$18.77/GJ.

Grid Connected Power/Peak Shaving

In a grid-connected application, the likely use of an on-site power system would be for standby or emergency use. In this situation, the primary benefit of a microturbine over a reciprocating engine generator is the smaller footprint, quiet operation and lower maintenance. In addition, because the microturbine does not use oil lubrication, it does not need to be kept warm all the time to ensure reliable starting. Where and if tariff design allows for it, energy management can be regularly employed to generate a portion of the site needs to reduce costly peak power costs, where natural gas or less expensive byproduct liquid fuels were available.

Cogeneration Power Costs

In the standalone application for 2000 evaluated above, the addition of cogeneration to meet some or all of the heat needs of the facility can greatly enhance the economic viability of the microturbine. Using the same 2000 \$0.81 per litre diesel assumption, and adding a heat exchanger to capture thermal energy, assuming a similar 50% thermal load factor, the cost of the power can be reduced to \$0.25/kWh for a single unit and \$0.28/kWh when two units are installed.

For purposes of illustrating the benefit of lower cost natural gas, Inuvik Gas Limited was providing wholesale gas to NTPC at a flat rate of \$11.35/GJ in 2000. Based on this fuel price, power costs with cogeneration would be \$0.18/kWh (single unit) and \$0.21/kWh (two units). Unfortunately, the Midnight Sun Rec Centre is unable to obtain the NTPC bulk rate and is paying some \$18.77/GJ in 2008. As can be seen from this 2000 example, even at the low wholesale natural gas rate assumption, the benefits of cogeneration are substantial and are magnified in a high fuel cost environment. Where thermal storage can be employed, allowing a higher overall thermal utilization than the 50% used in this example, the economics are further enhanced.

Alternative Fuels (NGL's)

With the development of the Liard River Valley and Mackenzie Delta gas reserves, it is possible that other fuel sources from separated heavier hydrocarbons, such as NGL's containing propane, butane and C5+ condensate could become available. However, with higher values being paid to producers who ship their sweet, light condensate for bitumen diluent's markets and refinery/petrochemical feedstock's, following fractionation, it is not a given that NGL's and higher-end hydrocarbons will be available for local use in the Northwest Territories. In the SEA document and the Applicant's submissions, there doesn't appear to be any provision for NGL's from the Inuvik area Gathering System liquids extraction plant to be made available for sale in the NWT via strategically-located "access point valves." Propane, butane, pentane and other condensates such as pentane+ condensate and C7+ condensate command higher values than natural gas in the South. Direct use of the MGP NGL's should logically be significantly less expensive than imported refined fuels such as low pour point heating diesel oil. As such, it is expected that costs for power generated from these fuels could be closer to that stated above for natural gas (2000 basis). If these MGP NGL's could be locally shipped by truck or barge over economic hauls or even pipelined via new "access point valves", another benefit would be reduced storage needs, and correspondingly lower costs due to less annual upfront purchasing and payment requirements for southern-sourced liquid fuels currently imported seasonally.

8.1.7 Specific Applications

There are numerous opportunities for small-scale remote power generation in the North. They range from powering entire small communities down to providing prime power and standby systems for individual buildings and electrical power consumers.

Commercial/Industrial Opportunities

The high cost of power in the North leads some to believe that new, efficient technologies can result in cost savings, even using expensive liquid fuels. One such opportunity evaluated by Mercury Electric was a large airport hangar, which had a 60 kW electrical load, an adjacent office building with a smaller lighting and computer load; both using fuel oil for space heating. By incorporating cogeneration, the opportunity for immediate savings could be recognized. If less expensive natural gas became available, the potential exists for this facility to reduce energy costs by half or more.

Another opportunity examined by Mercury was the use of microturbines to power a chain of retail stores, which stretch across the North. Since redundant generation is put in place for all the stores, whether they are grid connected or not, a certain sunk cost was assumed. Reciprocating generators are considered very labour intensive

from a maintenance perspective. With a connected load of some 350 kW, the newer stores in the chain require approximately 800 kW of installed reciprocating power generation to operate independently of the grid. The same level of reliability can be provided with as few as 6 microturbines at a capacity of 450 kW, at a lower capital and operating cost. Service would be conducted by one or two trained individuals, with spare parts that could be stored on-site, if required. With increasing demand for fresh produce and more meat and dairy products, additional refrigeration is being installed, which adds to the electrical requirements. In addition, some franchise-oriented fast food services are now being offered which adds additional load. Evaluating the installation of a single microturbine unit into one such large grocery store with warehouse facilities in Inuvik, which was assumed to utilize natural gas at 2000 cost of \$11.35/GJ and using cogeneration to offset a portion of the current fuel oil based heating, a potential savings of over \$60,000 per year could be realized, on a base of less than \$325,000, a reduction of more than 18%. In 2008, both power cost assumptions and natural gas costs are substantially higher, necessitating updating of any detailed investment evaluations.

Individual Institutional Facilities

The potential to apply cogeneration to larger institutional infrastructure and, perhaps recreational complexes, bears further evaluation. Numerous hospitals and federal buildings currently utilize base load cogeneration systems in Southern Canada. Where smaller buildings with high occupancy rates or year round heating needs are available, microturbine based cogeneration systems might be the most efficient and cost-effective energy solution. With the expectation that an affordable absorption chilling option may become available, a higher load factor on heat recovery will make commercial office building and small hospital use more economic.

Multi-facility Power

On a community level, multiple small units which operate at or near peak efficiencies and provide a high degree of redundancy could be more cost effective than using diesel fired reciprocating engines. If Mackenzie Delta or Liard Valley natural gas becomes available to communities in the vicinity of the pipeline, the microturbine option should be evaluated before the decision is made to replace a diesel fleet with similar natural gas units.

Cost of Power - Fuel Oil vs. Gas

In summary it would appear by converting natural gas into power locally at sites accessible to the new natural gas pipeline(s), the cost of electricity can be cut substantially. Where cogeneration opportunities exist, the benefit is even greater.

In summary, the operating characteristics of microturbines would appear to fit the profile of Northern on-site power generation. Where cogeneration opportunities are available to use the waste heat, the potential exists for significant savings and emission reductions.

8.2 Liquids Extracted from the Natural Gas Pipeline/Petrochemical Feedstocks

Since the Applicant has proposed to extract NGL's in an Inuvik area Gathering System plant, then pipeline the NGL's south to Norman Wells and there blend the NGL's into the Norman Well crude oil and ship the blend south via the existing Enbridge pipeline, any utilization of NGL's, if economic and provided for by the Applicants, must be done in Inuvik, Norman Wells or somewhere in between. The Producers and Pipeline Operators have made no provision for "midstream" petrochemical feedstock fractionators or direct extraction and shipping of liquids to market end-users.

NGL Extraction

Based on the gas compositions filed with the NEB, Gulf 's Parsons Lake and Imperial Oil's Taglu gas field analyses indicated the expected gas production contained considerable quantities of NGL's and some C7 plus condensate, whereas Shell's Niglintgak gas field composition indicated a virtually 'dry' gas. The three streams from the Applicant's three "anchor fields" will be blended and processed in the Inuvik area Gathering System plant and then shipped south via a market quality natural gas pipeline to Alberta and a separate NGL liquid pipeline to Norman Wells. Subsequent to the Applicant's original filings with the regulators, MGM Energy has applied to have their Mackenzie delta raw gas processed through the Applicant's Gathering System NGL extraction plant and for shipping volumes in the MGP.

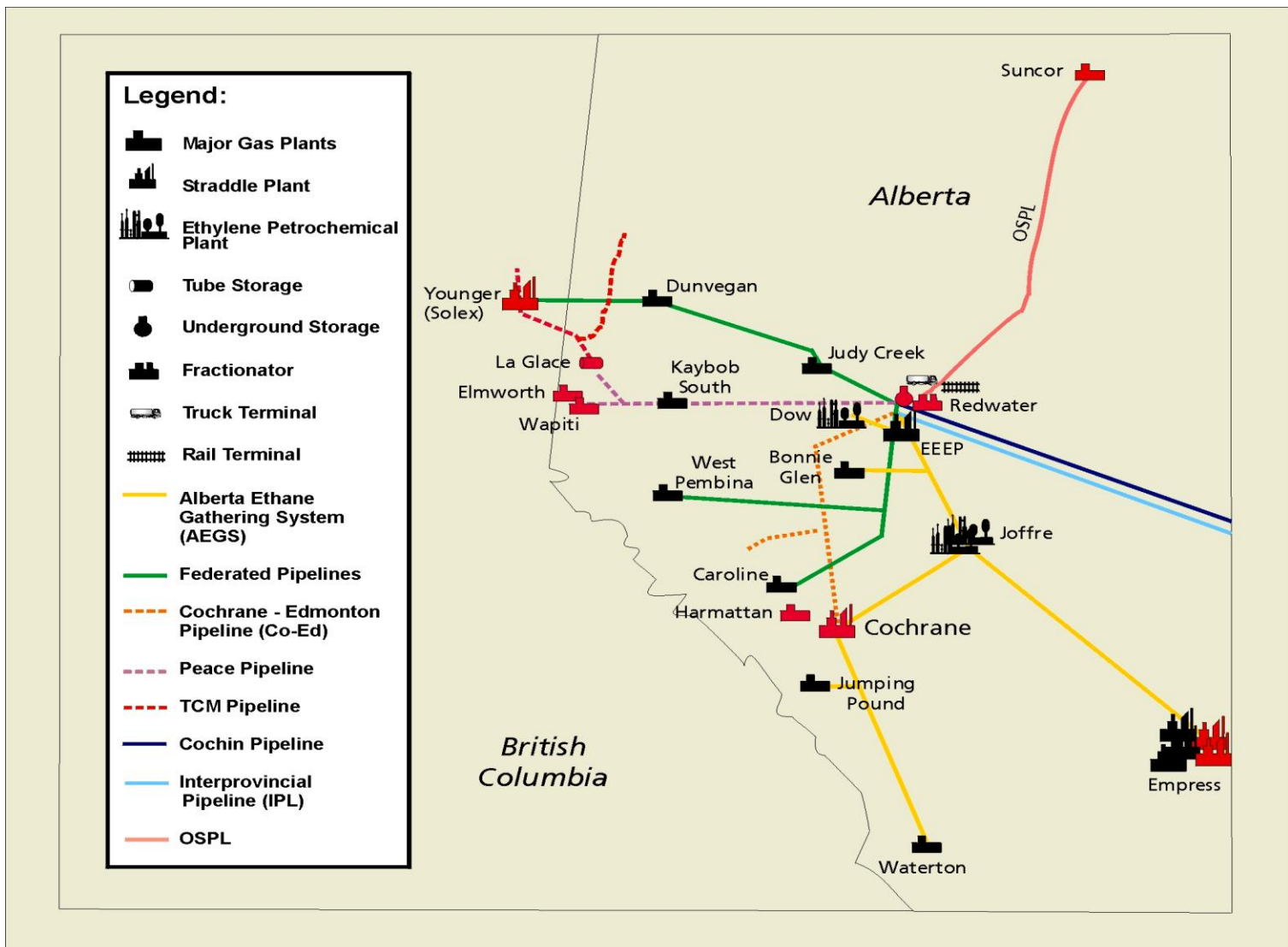
Small volumes of the sweet NGL's could be used in the Mackenzie Delta to fuel microturbines and larger turbines for local oilfield and infrastructure power generation. Sweet condensate is in high demand for use as a diluent to flux bitumen for pipelining from the Cold Lake heavy oil extraction area and Ft. McMurray oilsands areas of Northern Alberta. Also, NGL condensate is a premium feedstock for Parkland's Bowden (condensate feed) Refinery, that was shut down because of the high cost and unavailability of condensate. The Bowden Refinery was converted in 2007 to make organic drilling fluids, largely to take advantage of the Bowden infrastructure and tank farm. A recent study was conducted by Corillo Energy LP, Parkland Income Fund and Gibson Energy Ltd to look at a condensate processing facility on the Gibson terminal lands in Edmonton's refinery row, however, access to condensates and economics may be problematic, especially if the Mackenzie Gas Project NGL's are simply blended into Norman Wells crude oil at the Norman Wells Enbridge pipeline terminal, as proposed by the Applicant, rather than the more capital intensive batching of NGL's south.

The 2000 Study suggested the NGL stream could utilize a new small diameter pipeline to transport Parsons Lake/Taglu liquids removed at gas conditioning plant(s) in the Mackenzie Delta to tie-in to the Enbridge liquids line at Norman Wells. As mentioned elsewhere, the C2 content in the gas is expected to be below the cut-off for efficient ethane extraction, so it's not expected that this would be a "deep cut" plant.

The extraction and fractionation case would need substantially more storage to keep each of the streams separate for fractionator feed and product pipeline batching, however, Imperial may have some available proprietary C3/C4 and naphtha storage in Norman Wells. In any case, the NGL extraction plant products would need to be pumped South as liquids, using spare capacity in the Enbridge Norman Wells to Zama oil pipeline (or a separate NGL / condensate line). The NGL's and condensate would have to be kept separate and batched, with Southern breakout of previously fractionated or mixed NGL's in the Redwater / Fort Saskatchewan NGL complex.

The Edmonton area Fractionators have strategic subterranean cavern storage for the large volumes of C2, C3, C4's and mixed NGL's. These Fractionators and the Taylor NGL LP Plant at Taylor B.C., tied into the Ft. Liard Westcoast Energy, now Spectra Transmission (pipeline system from Fort Liard via Spectra Energy's large Fort Nelson plant), also have the advantage of connection to all the major NGL pipelines lines to existing fuel, refinery, and petrochemical markets in Alberta and onward to Ontario, via the Cochin pipeline, which can also ship petrochemical grade ethylene from the Alberta plants. It makes economic sense to use the incremental capacity of existing NGL extraction and Fractionation plants, however, equity could be sought to accommodate expansion for MGP NGL's.

NGL "Midstream" Industry Overview: Ethane Infrastructure



Source: TransCanada Midstream

The Redwater/Fort Saskatchewan area is one of the four existing North American NGL hubs.

The Redwater/Ft. Saskatchewan NGL hub has the following strategic advantages:

- Fractionation Capacity – 274 MBPD
- Storage – 18.6 million barrels
- Pipeline access – inbound and outbound
- Rail/Truck access
- Proximity to Petrochemical/Refinery demand
- Specification ethane, propane, butane and condensate terminals

Fractionators

The Redwater / Fort Saskatchewan area is dominated by four fractionators which are capable of processing 274 MBPD.

	Fort Saskatchewan Area Capacity (MBPD)						
Facility	C ₂	C ₃	C ₄	C ₃ /C ₄	C ₅	Total	%
Williams-Redwater	25	20	12		8	65	24
BP Amoco		20		62	23	105	38
Chevron		13	9		7	29	11
Dow	45	14	13		3	75	27
TOTAL	70	67	34	62	41	274	100

Williams-Redwater and Dow facilities are the only two Fort Saskatchewan area fractionators capable of receiving ethane-plus streams and of producing specification ethane as a feedstock for the growing petrochemical market.

In addition, Williams Redwater is one of only 2 Fort Saskatchewan area fractionators capable of accepting high sulphur NGL's and treating the finished products to meet the required standards, although this is not an issue for low sulphur Mackenzie Delta NGL's

Storage

Each of the current Redwater / Fort Saskatchewan area fractionators has associated storage which is critical to their effective operation.

Facility	Caverns	MM BBLs	Capacity %
Williams - Redwater	9	4.7	25
BP Amoco	9	5.3	29
Chevron	10	5.0	27
Dow	5	3.6	19
TOTAL	33	18.6	100

Pipeline Access

The Redwater / Fort Saskatchewan area is a hub for several feeder pipelines from all over Alberta, which connect to the following fractionation facilities:

In-Bound Pipeline	Williams	BP Amoco	Chevron	Dow
Peace	C ₂ +/C ₃ +	C ₃ +	C ₃ +	C ₂ +/C ₃ +
Federated North	C ₂ +			C ₂ +
Federated South	C ₂ +			C ₂ +
Co-Ed		C ₃ +		

These fractionators are also connected to outbound pipelines:

Out-Bound Pipeline	Williams	BP Amoco	Chevron	DOW
Cochin	+	+	+	+
Enbridge / LPL		+		
Alberta Ethane Gathering System	+	+		+
Fort Saskatchewan Pipeline System	+	+	+	+
Alberta Butane System	+	+	+	+
Fort Saskatchewan Storage Joint Venture	+	+		+

Williams Redwater has the only Olefins Fractionator and has the ability to deliver propane directly to the Cochin pipeline, thereby bypassing the Cochin high pressure injection charge of 25¢/bbl or \$1.57/m³.

Rail Tank Car / Tank Truck Transport Access

In addition to the capability of moving specification products through the connected pipeline systems, rail tank car and tank truck access remains essential to the acquisition of supplemental volumes or to re-deliver volumes.

Rail / Trucks	TCM	BP AMOCO	CHEVRON	DOW
Rail Tank Car	1 Switch 30 cars/d	At Edmonton	At Edmonton	At Edmonton
Trucks – C ₃ Loading	+	At Edmonton	At Edmonton	At Edmonton
Trucks – C ₃ Unloading	+	At Edmonton	At Edmonton	At Edmonton
Trucks – FC ₄ Unloading	+			

Trucks Unloading*	– C ₃ +			+	
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* Not a regularly scheduled service.

The Williams Redwater rail rack is a proprietary rack serviced by CN Rail. Volumes from all other fractionator facilities must be loaded through the Williams-Redwater rack or the Gibson's loading rack in Edmonton. The Gibson's loading rack is connected to the Chevron facilities via the Fort Saskatchewan Pipeline System owned by the Chevron Fort Saskatchewan owners.

The Williams Redwater facility is the only Fort Saskatchewan area fractionator that can offer a fully integrated rail NGL tank car service.

Proximity to Petrochemical / Refinery Demand

In 2000, the largest single consumer of field grade butane in the Edmonton area is Alberta Envirofuels Ltd., which purchased of some 20% of Alberta production, approximately 20,000 barrels/day (BPD) field butane, for the manufacture of MTBE, prior to the banning of MTBE in motor gasoline. The next largest consumers in the Edmonton area in 2000 were the Imperial Oil and PetroCanada refineries, consuming some 25,000 BPD of butane in aggregate. Imperial fractionates the field butane and uses the iC₄ in their Hydrofluoric Acid Alkylation unit for making high octane motor gasoline blending components. The refineries also utilize butane on a seasonal basis, largely from September through March of each year, to blend into motor gasoline, within RVP specifications, for improved winter properties.

In 2002, Alberta Enviro-Fuels Inc., owned 50% by Neste Canada Inc. (owned by Neste Oil Oyj of Finland) and 50% by Chevron Standard Limited, was converted to produce iso-octane, a 100 Octane motor Gasoline blending component.

Transportation within this market is provided by:

- Alberta Butane System, which originates in Redwater;
- Fort Saskatchewan Pipeline System, from Chevron Fractionator;
- Rimbey Pipeline System.

The other major petrochemical feedstock requirement is ethane, which is discussed further under Petrochemical Development, below. TCM Redwater and Dow Fort Saskatchewan fractionate this "deep cut" product and transport it through connections into the Alberta Ethane Gathering System.

NWT Greenfields Site

A new natural gas liquids Fractionator facility in the NWT at the Southern end of the Applicant's Mackenzie Valley NGL liquids pipeline at Norman Wells would suffer economically from lack of large volume cavern storage, spare fractionating capacity, and the economic debit of batching facilities in Norman Wells for the fractionated NGL's for batching into the Enbridge crude oil pipeline as well as the cost of incremental break out facilities in the Edmonton area. A further debit would be that Norman Wells has no all weather road or rail connections.

To my knowledge, no salt domes suitable for NGL storage caverns have been identified from the Inuvik area along the Mackenzie Valley liquids pipeline route to Norman Wells to facilitate any "greenfield" sites that could potentially benefit an NGL Fractionation, cavern storage and batch shipment potential, which would be a requirement for any future natural gas liquids-based value-added processing.

The gas being gathered in the Fort Liard region feeding the Fort Nelson gas processing plant, in 2000, was relatively "dry" and, as such, C2 could not be economically removed there. Depending on the C2 content of the resulting mixed gas stream further downstream in the Fort St. John area, the possibility may exist to remove some future, non-MGP, NWT-originating C2 component from gas at the Taylor NGL LP deep cut plant at Taylor, B.C.

Straddle Plant for Ethane Not Immediately Promising

Petrochemical Development

The primary petrochemical building block that is generated from feedstocks extracted from field quality natural gas is ethylene. It is the building block from which a myriad of products are manufactured including: polyethylene, polystyrene, polyvinyl chloride (PVC) and ethylene glycol, to mention a few. Ethane, when fed to an Ethylene Plant is cracked to produce ethylene as well as minor amounts of C3, C4 and C5 olefinic byproducts. Propane and butane, as well as higher molecular weight paraffinic hydrocarbons, can also be cracked to produce ethylene, however, the volume of byproduct olefins produced from such processes would be proportionately much greater. Fischer-Tropsch naphtha, which is entirely paraffinic, has been identified as a desirable feedstock for liquid cracking to ethylene.

A world-scale ethylene plant, in 2000, would produce approximately 1.5 billion pounds of ethylene per year and require approximately 41,000 barrels per day of ethane feedstock. If the C2 content of the mainline blended gas from the three Mackenzie Delta fields initially contemplated for development were in the upper range of reported concentrations, some 18-21,000 barrels of ethane might be recoverable, or half the amount required for a competitive plant, at recovery efficiencies of 60-70%, assuming the 1.2 billion cubic feet per day ultimate pipeline capacity.

In 2000, the capital cost of a 1.5 billion pound ethylene per year facility, including offsites and utilities was in the order of \$700 million. To construct ethylene consuming derivative plants would cost at least that much again (in year 2000 dollars), however, there are a number of logistical issues that must be addressed with respect to pipeline connection to feedstocks and product access/proximity to markets.

The derivatives from the consuming plants are either solids such as polyethylene, or liquids such as ethylene glycol, which must be shipped out by rail. This is a severe disadvantage for the NWT, simply because of the distances involved to get those derivatives to market, and the fact that there's no rail connections past Hay River. If there were rich enough natural gas streams with high enough ethane content to extract C2 in the NWT and it was economic to crack it there, it would be better to pipeline the ethylene to existing users or new ones close to markets. However, shipping ethylene has its own set of problems, because it is a high purity product and easily contaminated. The Cochin Pipeline is the only pipeline that is able to successfully ship petrochemical grade ethylene to Ontario. They accomplish this task by batching the ethylene between buffers of ethane and only permitting batches of clean NGL's to use the pipeline. Note that TransCanada Pipelines Ltd. sold its TransCanada Midstream assets to Williams Energy Canada Inc. in 2000. Williams also bought a 32.5% interest in the Cochin gas liquids and ethylene pipeline from Dow Chemical Co. BP Amoco is the operator of the Cochin pipeline.

This would be an option for a "clean products" pipeline out of the Northwest Territories, if batches could be conveniently and economically stored at the point of ethane and ethylene production. At Fort Saskatchewan, this is done using salt caverns. If there were salt dome deposits accessible to the Mackenzie Valley pipeline corridor in the Southern NWT, this same storage method could be used in the Northwest Territories; in fact it would be a necessity. In that case, C2 and/or ethylene batching becomes a potentially viable option. It is possible that the salt formations in Alberta do extend into the southern portions of the NWT, making the development of salt caverns worthy of further study if large quantities of natural gas sufficiently rich in ethane were discovered and available, which is not currently the case (in 2008).

At the time of earlier NEB submissions, with the blending ratio's being contemplated between the three gas fields, the C2 content was expected to be closer to 2.6% - 3.2% ethane, more likely at the low end of the range; even lower with the introduction of MGM Energy gas into the Mackenzie Gathering System. Two sources, knowledgeable in C2 extraction design queried for this report, cited 4% ethane as close to the dilute end of the range for viable ethane extraction. A third suggested 3.5% ethane content in the gas stream was the minimum for viable ethane extraction. At 4% C2 the ethane extraction efficiency is some 70%; at 3.5% some 65%, and at 3.2% some 60% recovery. The recovery efficiency declines rapidly as the ethane concentration in the gas being processed gets leaner than

these levels. For the lower startup volumes contemplated, some 6% C2 content would likely be required for economic ethane extraction from the mainline gas, if there was a viable site in the NWT. With the addition of MGM Energy gas from Mackenzie Delta sources west of the Applicant's anchor fields, the composite gas stream will likely be even leaner in C2, as the ethane content decreases to the west of the anchor fields.

Since the current expectations are for Mackenzie Delta natural gas to be at ethane compositions well below 4% ethane, a deep cut Straddle Plant to extract ethane does not appear viable at this time. If the ethane component was present in rich enough concentrations in the natural gas pipeline in the future, through additional fields coming on stream to the east or changing concentrations from the Mackenzie Delta producers to make C2 economically extractable, pipeline economics would likely warrant an extraction location as close to the southern infrastructure in Alberta as possible and certainly adjacent to salt cavern storage. In that instance, owners of equity in ethane-rich natural gas could still seek an interest in extraction facilities. The small number of jobs created for the large capital investment would not likely offset the adverse location debits of a NWT-sited C2 extraction straddle plant.

For reference to ethane used as a petrochemical feedstock, the Alberta Petrochemical infrastructure is shown in the Appendix.

Natural gas based ammonia, ammonium nitrate, and urea-based fertilizer production does not appear prospective for some of the same reasons as those noted above. As with Portland cement manufacture, distance from markets, lack of rail connections and transportation cost debits for phosphate rock and sulphur / sulphuric acid supply, in the case of ammonium phosphate and ammonium sulphate fertilizers, also renders economic operation unlikely.

As the extent of the hydrocarbon development progresses, so does the degree of technology. As was the case for the growth of the Oil Sands and Upgrading to synthetic crude oil at Ft McMurray and the petrochemical development in central Alberta, the need for skilled technology teachers, trainers, and graduates is imperative. Technically-trained operational staff, with a grade 12 education and post-secondary education is required for most production, process, and petrochemical operations jobs as well as for skilled electrical and mechanical trade's jobs. Success can only be achieved with good technical leadership and qualified, trained operations staff.

Methanol Plant Not Promising

Methanol, to be economically viable, has to have low cost natural gas and access to world markets. Right now there is a surplus of available methanol plant capacity, with smaller, more costly plants being shut down or "mothballed" in Canada, Europe, and around the world. The recent growth phase of methanol consumption that drove the massive world-wide expansion in methanol plant capacity in the early-mid 1990's

has contracted with the banning of MTBE from motor gasoline in California and elsewhere, which had been the main driver for methanol consumption and capacity growth. The drive to eliminate the use of MTBE in gasoline was because of concern of potential harm to humans. Leaking gasoline storage tanks had resulted in MTBE showing up in aquifers in levels sufficiently high to give concern. The ban may be an overreaction, but it is real.

MTBE production is a complex process involving a reaction between methanol and butylene. This has put a severe damper on the MTBE market. For example, the Alberta EnviroFuels Plant, jointly owned by Neste Canada Inc. and Chevron, was built in Edmonton to manufacture MTBE for the California and export market for use as an octane extender in motor gasoline. They used some 20 percent of the Alberta field butane (nC4/iC4), which they isomerized. The plant has since been converted to manufacture iso-octane, a high octane blending component, and alkylate feed for use low sulphur motor gasoline.

Natural gas to methanol has traditionally been the most viable gas-to-liquids option, where adequate methanol markets existed. As mentioned above, methanol is currently in such a surplus that plants are being shut down, such as the closure of Methanex's 500,000 ton/year Kitimat, B.C. methanol plant, idling 145 workers. The plant, British Columbia's largest industrial user of natural gas, cost \$330 million in early 1980's dollars to construct.

In Europe, the remaining natural gas based, first generation, low-pressure plant, Methanor, had closed its two plants by 2006, blaming continually high European natural gas prices. Interestingly, BMCN have converted the Methanor facility, utilizing new technology, for the production of biomethanol. Small amount of methanol, usually bio-methanol, are also used in automotive fuel blends

The majority of new low cost, high capacity methanol manufacturing additions from natural gas feed stocks is occurring in regions that have supplies of "stranded gas" where there is no alternative fuel value for this gas. For stranded gas with no natural gas pipelines to large markets, the utilization of natural gas to produce methanol is a viable alternative method to exploit this resource by converting it to a ship-transportable liquid, competing with LNG. This is occurring in gas rich areas without sufficient indigenous markets for the natural gas such as the Middle East (Saudi Arabia, Oman, Iraq and, under study, Egypt), South East Asia (Malaysia, Brunei) and Latin America (Venezuela, Argentina, and Trinidad). Australia and Africa are also prospective for stranded gas based methanol plants in the near-future, further glutting the methanol market with excess capacity.

Fischer-Tropsch Technology Garnering Renewed Interest

In special cases, use of Fischer-Tropsch (FT) technology or gas-to-liquids (GTL) technology, such as pioneered by Sasol in South Africa, Shell at their Bintulu Plant

in Malaysia, and Exxon at their process demonstration plant in Baton Rouge, has been pursued. In the past, Fischer-Tropsch GTL plants had only been viable if the "associated gas" from crude oil production would otherwise be flared and had a very low raw materials cost versus the price of the liquids that would be produced, there was an embargo on liquids which couldn't otherwise be obtained, or other special conditions prevailed. The other application was if there is no gaseous transportation infrastructure ("stranded gas") or the liquified natural gas transportation costs would be too high and/or the LNG transportation infrastructure was lacking. In the late 1990's, prior to the renewed interest in a natural gas pipeline from Alaska via the TransCanada Pipeline route endorsed by the Governor of Alaska through Canada, Fischer-Tropsch GTL was studied as a way of transporting Alaska North Slope "stranded gas" via the Trans Alaska crude oil pipeline route.

The Shell Bintulu, Malaysia Plant, for example, cost some U.S. \$850 million to build; starting up in 1993, using 100 million cubic feet of natural gas per day to produce 12,500 barrels per day of paraffinic liquids using their Shell Middle Distillate Synthesis (SMDS) process.

Exxon has developed proprietary GTL technology they call "Advanced Gas Conversion for the 21st Century (AGC-21)" supported by some 1500 patents developed through over U.S. \$300 million in Fischer-Tropsch related GTL R&D, which they studied for possible Alaskan application. Exxon/Mobil have also just announced a technology breakthrough which would permit "on-board" reforming of gasoline to hydrogen for automotive fuel cells. General Motors and Exxon/Mobil will be testing this in GM's experimental vehicles in the immediate future.

Two other small companies with Fischer-Tropsch based technology are U.S. companies Syntroleum Corporation and Rentech Inc. Syntroleum and ARCO announced plans in 1997 to build a GTL pilot plant at ARCO's Bellingham Washington Refinery to consider possible GTL technology for processing their Alaskan stranded gas. Alaska has some 30-35 trillion cubic feet of stranded gas that a study group was comparing for LNG versus GTL transportation alternatives. ARCO (now BP Amoco) has licensed to use the Syntroleum Process® in broad geographic areas, including Alaska.

Common with many of the Fischer-Tropsch based GTL schemes is Texaco's partial oxidation process for the manufacture of the necessary synthesis gas (hydrogen and carbon monoxide) to create the paraffinic liquids. Other approaches for syngas creation are steam reforming of natural gas and autothermal reforming with air. The other main processing variables are iron versus cobalt catalysts and the type of FT reactor design.

In 2000, Syntroleum, Catalytica Advanced Technologies, Mitsubishi, and Petro-Canada had been pursuing a 3-year R&D program to study a single-stage process to directly produce liquids via a new class of direct oxidation catalysts.

Of emerging interest is the fact that the FT liquids are a potential blending stock to meet new cetane and sulphur specifications for transportation diesel fuels, since FT middle distillates have a high cetane number, no detectable sulphur at the parts-per-million level, and no aromatics.

All NGL Cavern Storage is in Edmonton Area

In general, the location of the NGL extraction from the gas stream would be dictated by pipeline economics and pipeline-interconnect NGL storage considerations.

The U.S. market sets the price for C3/C4, netted back to Edmonton, just as the price of West Texas intermediate (WTI) sets the price for light, sweet crude oil. Condensate sells at a slight premium to crude in Edmonton. For example, in the summer of 1999 sweet condensate commanded a premium of some \$50/m³ over crude because of the shortage of sweet condensate to dilute bitumen to meet pipeline viscosity specifications during the high-demand summer asphalt season in North America. Bitumen diluent can't contain propane or too much butane because of crude oil and pipeline RVP restrictions. Use of NGL's as motive fuel in automotive engines designed to run on motor gasoline is similarly restricted in allowable C3 and C4 content by RVP restrictions.

Refining Not Promising

This study relates to opportunities arising from a Mackenzie Gas Project, with a natural gas pipeline from the Mackenzie Delta to the Alberta border and a NGL liquids pipeline from the Inuvik area Gathering System liquids extraction plant to Norman Wells, where it is blended into the Enbridge crude oil pipeline. The question has been raised, however, "What about refining as a secondary value added industry?"

In the course of the 2000 study, discussions were held with large Multinational, and National refiners as well as small Interprovincial geographic and tiny Provincial niche refiners. They all realized the same imperatives of the business ...the importance of economies of scale, the significant capital replacement costs, the importance of transportation costs to make certain niche markets viable and concerns about how they were going to make the major capital investments to achieve 30 ppm sulphur in motor gasoline and low sulphur diesel as the then new regulations went into effect.

The following points have relevance:

- Imperial's small refineries in Alberta, Saskatchewan and Manitoba were not economic to operate versus one 140,000 Barrel/day refinery at Strathcona (which has been since expanded several times). Their 30,000 +/- Barrel per day loco Refinery on tidewater in Burrard inlet wasn't economic versus pipeline product supply from Strathcona; Imperial's Dartmouth Refinery, much larger than loco, is only marginally economic. The old, largely-depreciated niche refinery at Norman Wells that benefited from its crude oil feed permitting incremental crude

production over the capacity of the Enbridge Norman Wells to Zama pipeline capacity could not afford to be repaired after a fire caused extensive damage.

- Petro-Canada, who have an 80,000+ barrels/day refinery in Edmonton (since expanded), reiterated in 2000 that there was surplus capacity in Edmonton refineries and that product could be moved into the NWT from Edmonton cheaper than building refinery capacity in the NWT. There was an insufficient market and what market there was in Yellowknife was away from the Mackenzie Valley transportation corridor. There were no economies of scale identifiable for a NWT-based facility.
- The Husky Refinery in Prince George, B.C. at 10,000 Barrels/day crude oil feed rate is a small refinery that is an anachronism, which would not be economic to build today; The cost of new facilities to produce 30 ppm sulphur motor gasoline and 15 ppm sulphur in diesel fuel has likely cost as much again as the refinery was worth. Innovative solutions have been required to survive the upgrades to meet government-mandated motor fuel specifications. The Husky Refinery only survived this long because it was in a niche market, with pulp mills and 80,000 people, twice the population of the entire NWT, at its gate. Transportation costs provided some shielding from Edmonton and Vancouver, however, since being on the B.C. Rail line permitted them to access Ft. St. John to Ft. Nelson from Prince George. Competitors' pipelined products from Edmonton need to be "broken out" at Kamloops and trucked to the Northern Interior of B.C. Clearly, the alternative cost of petroleum products is the key.
- The 6,500 barrels/day condensate refinery at Bowden, Alberta bought from Shell by Parkland Industries is another niche special case. Because its feed is so light, Bowden primarily produced motor gasoline, with some regular sulphur diesel. Bowden is plagued by lack of economies of scale and sulphur specifications in mogas and diesel transportation fuels. At a replacement cost of some \$110 million, according to a study referenced by Parkland, conducted by Purvin & Gertz Inc. before 2000, it would not be economic to build today. The economies of scale are evident when one compares that to the \$280 million Imperial spent to build its 140,000 barrels/day refinery in Edmonton in 1975, even when the time value of money is taken into account. Borden's original saving grace was a former surplus of condensate and its location half way between Edmonton and Calgary, which had some transportation benefits. Because of the surplus of condensates at the time it was originally built, the low cost of condensate feed stocks helped the economics of the day. It now has several challenges; it needs sweet condensate as a feedstock, which is increasingly in short supply (as what ever is available commands a premium price as a bitumen blending component to produce diluted bitumen or "Dil-bit" to meet pipeline quality specifications), and it would require significant capital investment to meet the Federal sulphur specification of 30 ppm S by 2002 and benzene content limitations. The zero sulphur condensate from the Mackenzie Delta would be a premium feedstock for this little condensate refinery and could obviate its need to add sulphur removal technology, however, the C3 and C4 would have to be stripped out first. Process

operators at Bowden needed grade 12 graduation certificates, a 2-year diploma course at SAIT or NAIT, or equivalent and a 4th Class steam ticket.

- The Bowden Refinery was shut down and “mothballed” in 2001. In 2007 the Bowden Refinery was reconfigured to use its infrastructure and tank farm by INEOS Canada Partnership to manufacture and store synthetic drilling fluids. The INEOS drilling fluid operation shut down early in 2008 because of the high cost of condensate and decline in drilling activity when natural gas prices declined. It is now an environmental liability.
- Use of condensate feedstock in the North would primarily produce motor gasoline (if the C3 and much of the C4 were removed), whereas the market is primarily diesel for motive fuel and fuel oil.
- Sweet C5+ condensate sells at a premium to crude oil, especially during the summer when demand for bitumen is strong for asphalt manufacture in North America and the needs for condensate high to dilute the increased bitumen volumes to meet pipeline quality viscosity and RVP specifications. Premiums in excess of \$50 per cubic meter of sweet condensate have been paid. This is the “best and highest use”, as judged by market forces.

For all the above reasons, refining is not prospective for the Northwest Territories.

8.3 Secondary Industries that can benefit from Natural Gas Availability

In general, any industry with cost-effective raw materials that can benefit from affordable, available natural gas will be encouraged by the availability of natural gas in the Mackenzie Valley transportation corridor, assuming right of access (and nearness to access point valves) and pricing per the SEA agreement.

The major limiting factors for manufacturing and secondary industry, besides obtaining cost-effective raw materials, labour and energy, is the small local market and high transportation cost and distance from major markets/centres of consumption. This rules out high volume basic commodities such as Portland cement manufacture, as mentioned earlier in the Pipeline Construction section, Fertilizer, and other value-added activities such as Petrochemical manufacture and refining mentioned above because of lack of cost effective feedstock and distance from infrastructure and markets.

New commodity businesses such as sand and gravel / aggregates provision which can benefit from the pipeline construction and expected Mackenzie Valley transportation corridor exploration and development activity and all weather road building to resources should prosper. Although aggregate plants, where possible, should take advantage of access to less expensive river transportation, the commodity is inexpensive enough to be stockpiled seasonally. As well, new roads are expected to open up longer term road maintenance business opportunities for Northerners, especially if an all weather highway is extended down the Mackenzie River valley from Wrigley to Inuvik and on to Tuktoyaktuk.

8.3.1 Lumber Mills

Lumber from the NWT is typically either spruce or pine. For North America, spruce must be kiln-dried. For Japan, all dimensional lumber must be kiln dried.

There is an opportunity for utilization of natural gas cogeneration powered saw mills, which should be located a short pipeline lateral from the main line and have transportation access for the wood products. The electrical power from gas turbine power generation would power the sawmill and office/shop infrastructure and the cogenerated heat would provide space heat and heat the lumber drying kiln(s). This is currently done with gas-fired steam in the Sacco Forest Products re-manufacturing mill in Sumas Washington. That mill has been successful as a re-manufacturing mill because it is centrally-located to remanufacture wood from the myriad of lumber mills in Southwestern B.C. and the Pacific Northwest and is energy efficient. Most mills in B.C. that have power from steam boiler cogeneration have used waste wood hog fuel to fire a boiler for power from a steam turbine and then used the waste heat from the steam to heat their lumber drying kilns. In the North, circulating glycol or hot oil would be preferable to the use of steam as the heat transfer fluid in lumber-drying kilns. Hog fuel fired cogeneration could complement natural gas-fired cogen in lumber mills with kiln drying capability, however, capital cost will need to be watched carefully, as the wood products are still a long way from large markets.

Mill operators report kiln-drying dimensional spruce/pine/fir (SPF) is a higher heat load than drying remanufactured lumber, with 200-210 degrees Fahrenheit for air dried wood and 280-300 degrees for green SPF dimensional lumber, as it must be dried fast and excessive moisture evolution must be accommodated.

As a consequence of the Softwood Lumber Agreement between Canada and the U.S. for dimensional lumber and as a result of the depression in U.S. house building, many Western Canadian lumber mills have been shut down since 2007, so remaining lumber mills must be high productivity/low cost, have a unique location with respect to a major market or be in a special high value niche market to remain economic (e.g. like cedar mills).

8.4.1 Greenhouse/Hothouse Operations

A small greenhouse has begun in Inuvik, operated by The Community Gardening Society of Inuvik. It is not a cogen hothouse and does not yet have high volume, automated hydroponic production. Currently it's designed for summer seasonal operation and is in conjunction with a community garden. RWED has supported it from the outset, as has Aurora College, who provided the location and other support.

Large scale commercial hothouse operations also have potential, particularly where waste heat from cogeneration can be utilized. It is noteworthy, however, that the greenhouse cogeneration "experiments" by Nova Chemical have been terminated. The one associated with the Southern Alberta methanol plant has been discontinued and

dismantled. The one Nova owned, purchased K & C Silviculture, next to Nova Chemical's Joffre Petrochemical complex has had their waste heat steam shut off by Nova. According to K & C, Nova Chemicals apparently don't see enough benefit in it for them for the operational issues their operators say it causes in managing the Chemical Plant's steam system. K & C Silviculture specializes in growing seedlings for reforestation. Because seedlings are small, light weight and sturdy enough to be bundled up in large numbers, they've been shipped as far as Alaska for reforestation projects.

K & C has experimented with hothouse vegetables but found it more difficult to penetrate the market in the Pacific Northwest and California, which the B.C. Hothouse Cooperative dominates.

There is one hothouse in B.C. that gets waste heat from combustion of garbage disposal land-fill waste low-b.t.u. methane. Otherwise, typically they burn natural gas directly and store the heat in hot water. Typically 1000 ppm - 1500 ppm CO₂ is added to the hothouse atmosphere to enhance growth. In a cogen operation, there may be an opportunity to source this CO₂ from fully combusted, sweet flue gas, however, presently bottled CO₂ is used. A large commercial hothouse operator in the U.S., apparently uses cogeneration waste heat, however, the practice is reported to be more wide spread in The Netherlands and England.

In Finland, the technique depends more on using low cost "off peak" power to heat and light hothouses there. Their power generation produces 20-30% of their heat load. This doesn't work in B.C. because deregulation policies haven't been established yet to encourage use of "off peak" power and the base power rates are already low.

One European cogeneration model is where the power utility company builds the cogeneration plant and then buys back the electrical power and the hothouse operator buys the heat and the power it needs.

It is recommended that any new commercial NWT hothouse operation using cogen power for light and waste heat for temperature control be done in a Joint Venture with an experienced commercial hothouse operator, who understands the hydroponic technology and plant growth science and who has access to the target markets. The most prospective vegetables are hydroponic tomatoes, cucumbers and bell peppers. Nutrients will need to be shipped in seasonally. It will be difficult to compete with B.C. growers, unless there is some transportation back-haul opportunity. Seasonally, in the summer, where there are 24 hours/day daylight and barge/truck back haul possibilities. At that time, the hothouse operations would be lowest cost and most productive, however, demand is limited by natural farm produce and prices are squeezed when seasonal vegetables are widely available in Southern markets. In winter the power consumption for grow lights will be higher than anywhere else and heat loads will be excessive. Ornamental flowers that have high enough sale value to warrant air transportation may also have merit.

With these issues noted, hothouse applications in the NWT using Mackenzie Valley gas for cogeneration warrants for further, more definitive, study.

9.0 Other Possibilities

There are other opportunities for value-added activities that don't fit conventional thinking.

9.1 Extended Health / Palliative Care Facilities

There will be extensive temporary modular housing and camps mobilized into the Mackenzie Valley and Delta to house construction workers for the Mackenzie Gas Gathering System and the NGL liquids and mainline MGP pipeline construction. While these could obviously be left for the benefit of the Treaty members that the pipeline passes through as part of a benefit Agreement, the modular housing could be located on Mackenzie River Valley viewpoints, near existing community or construction infrastructure such as barge docks, air strips, power, water and sewage treatment and converted following construction to extended care health facilities, old age and palliative care facilities. Although it may not be an obvious fit to the Aboriginal cultural norms of looking after their elders and infirmed, it would provide a quality setting that could provide for relative's stay and care-giving as well, near their traditional lands. This may warrant further discussion with political and Aboriginal leaders. A potential model could be for the Treaty settlement area development corporation to own the modular housing/camp facilities and rent them to the developers/contractors for the duration of the project. Then, following construction completion, the modular housing and camp facilities could be re-deployed for the "highest and best use" of the Treaty beneficiaries. The camp locations have been agreed upon following consultations with Aboriginal governments and communities as described before the Joint Review Panel and in NEB submissions. The Applicant(s)' commitments are also discussed in the SEA.

9.2 Northern Energy Research Test Centre

All new and emerging technologies that utilize natural gas and NGL's, to be designed to stand up to the rigours of Canadian winters or relate to the Arctic environment could be field tested in a new jointly funded NRCan/DIAND/GNWT/Industry Northern Energy Research Test Centre. This would be ideally located near Inuvik, could be managed by the Aurora Research Institute jointly with NRCan, and use Mackenzie Delta gas (and NGL liquids) as the source of fuels and the Arctic climate as its test of rigour. Data could be readily transmitted to the test centre client companies, wherever they may be located, via the Internet. Such a Research Centre could attract NRCan, SSHRC, Environment Canada, Industry Canada and PERD funding for projects congruent with their identified Northern research priorities. Technologies of potential interest that have arisen in this study include:

9.2.1 Alternative Fuel Systems Inc. of Calgary is producing natural gas engine control systems primarily for vehicular use (trucks, buses, taxis, etc.). Most sales are to Europe and Asia, where the natural gas refuelling infrastructure is well developed. The company

has also been involved in projects involving conversion of diesel generator sets to run on natural gas.

9.2.2 Westport Innovations Inc. of Vancouver is converting new Cummins diesel engines and a suite of other heavy-duty to smaller engines to run on natural gas and liquefied natural gas.

While Westport Innovations Inc. developed a Cummins engine conversion to natural gas to generate 1.5 MWe at 1800 RPM or 1.0 MWe at 1200 RPM for peak shaving or base load applications, since 2000, Westport Innovations have since gotten out of the stationary gas-fired diesel electric power generating set business, which has been assumed by Cummins.

Although Westport Innovations has vacated the natural gas-fired gen-set space, natural gas as a fuel for heavy duty mine and Class 8 transport trucks , as well as medium and light duty alternative fuel vehicles remains strong as evidenced by the statement below from their June 2008 quarterly financial statement press release, as follows:

"Although we saw continued strong growth around the world in fiscal 2008, the rapid rise in oil prices late in the fiscal year has moved natural gas vehicles from being primarily an environmental story to now being both environmentally sound and a very good business decision. Early deliveries of Kenworth trucks, Sterling's recent product announcement, and Peterbilt's recent LNG announcement have all helped raise the credibility and momentum of this idea as a viable transportation fuel. Although we have been focused on bus and refuse fleets for our ISL G engine, and the San Pedro Bay Ports Clean Truck Program for our larger ISX program, demand is now appearing very broadly from truck fleets all over the world concerned about rising diesel fuel prices. Fuel has become the number one expense for many fleets and has risen by 300% to 500% over just the past few years."

9.2.3 Microturbine Power Generation.

While Mercury Electric Corporation of Calgary had the Honeywell franchise for gas-fired and liquid-fired Microturbines that could be used for a cogeneration-heated hydroponic experimental hothouse that could power and be an integral program in such a test centre, Mercury Electric changed the focus of their business when Honeywell got out of manufacturing Microturbines. The microturbine commercial applications are now dominated by Capstone Turbine Corporation, although Ingersoll-Rand, Powerworks, and Elliott Microturbines also have developed units. Capstone is represented in Canada by ONPOWER in the East and by Tarpon Energy of Calgary and Edmonton in the West. Capstone has a microturbine unit operating in an outdoor Alaskan oilfield application as well as the Inuvik Recreation Centre indoor power and heat co-generation application.

9.2.4 Geological Research

Production methods of methane from natural gas hydrates in permafrost to minimize greenhouse gas emissions and permafrost subsidence.

9.2.7 Geotechnical Research

Permafrost management techniques; protection, restoration, low-cost development responses.

9.3 Geotextile Manufacture

Extensive use of geotextiles will be likely during mainline pipeline and compressor station construction. Since the Fort Chip people showed selective woven/knitted products could be economic to manufacture in the North, this should be looked at closer. Since the route and design are close to finalization, the yardage of product required by the proposed project could be estimated by those knowledgeable in the application. For manufacture to be viable, it would have to be able to supply other markets on completion of the Mackenzie Gas Project. Depending on the timing of a natural gas pipeline out of Prudhoe Bay, Alaska, these two projects could provide both the markets and the extended time of production for a potentially viable business in the NWT.

9.4 Cottage Crafts with High Energy Demands

Cottage art crafts and larger scale pottery manufacture where low cost electricity and natural gas fuel were available, e.g. fired ceramics, might be viable if there were indigenous sources of appropriate pottery clays available in the Mackenzie Valley or it could be seasonally barged/trucked in economically.

9.5 Mines near the Pipeline Corridor

A potential opportunity would be to use gas or NGL hydrocarbon liquids as an energy source for some of the mining initiatives that are ongoing or planned in the NWT that are closest to the MGP route. The challenge is to get the gas and/or liquids to the mines in a cost efficient manner, such that they can compete with the alternative which is primarily diesel, either from the Edmonton area or back hauled from wherever the ore is shipped to. Alternatively, power for the mine could be generated in a power and heat cogeneration or combined cycle plant near the pipeline and the electrical power transmitted to the mine, for use of electric excavators, hoists, electric heat, etc. to reduce the use of high cost diesel, and the heat used in the community adjacent to the MGP access point valves. If the mine was close enough to the Mackenzie Valley pipeline corridor for a pipeline lateral, cogen power can be generated at the mine site and the heat used for space heating and to dry and preheat the ore, with natural gas used for ore sulphide roasting to oxides, if required by the minerals recovery process.

9.6 Use of Natural Gas Liquid Fuel in the North

A low sulphur NGL condensate stream is generated in the Mackenzie Gathering System Inuvik area gas processing plant as part of the gas gathering /gas conditioning of the raw gas prior to its transfer into the mainline natural gas pipeline.

The composition and volumes of natural gas condensate likely to be removed in the Mackenzie Delta to optimize mainline pipeline design and operation should be examined as a potential source of liquid fuels for local uses. The sulphur levels will need to be within the proposed Federal Government specifications for transportation fuels (expected to be 30 ppm Sulphur going to 10 ppm S in motor gasoline and 15 ppm S in Diesel) if considered in the Mackenzie Delta for natural gasoline and diesel transportation fuel substitutions for local use. The substitution of Mackenzie Gathering System NGL's liquids for space heating or motive fuel may need to have the C4's partially stripped out for safety to maintain sufficiently low vapour pressures for alternative fuel use where perhaps cost-effective versus imported diesel. Such applications will have to be examined very carefully from a safety standpoint and certified safe before use in existing facilities.

10.0 Current 2008 Situation – Much Has Been Accomplished since 2000

Much progress has been made on the Mackenzie Gas Pipeline (MGP) project in the eight years since I wrote a confidential report to the Government of the Northwest Territories, via the Aurora Research Institute, entitled, “Secondary industries and Value Added Activities Study.”

While the mega MGP project feasibility development, environmental and socio economic baseline studies, design basis development and engineering have taken extensive time and the “one window” approval process reviews have been complicated and of considerable duration, the elapsed time and community and stakeholder consultations have resulted in considerable progress in Aboriginal business development and creation of new and extensive partnerships between Aboriginal and Treaty Settlement business development corporations and prominent non-Aboriginal businesses.

The Mackenzie Valley Aboriginal Pipeline LP (APG) with their Funding and Participation Agreements with TransCanada Pipelines Limited and the agreed one third equity interest in the mainline Mackenzie Gas Pipeline with the proponent and each of the Producer Group led by Imperial Oil Resources Ventures Limited have been the most noteworthy Aboriginal business development opportunity captured to date.

While the original APG equity interest was apportioned as: Sahtu 34%, Gwich'in 20%, Inuvialuit 4%, the proposed 34% for the Deh Cho was held in abeyance, since the Deh Cho had not signed the incorporating and partnership agreements. A further 8% was held for other “North of 60” Northwest Territories Aboriginal groups whose lands were not traversed by the MGP. The good news is that the Deh Cho have just laid the groundwork for joining the APG by creating a legal entity, the Deh Cho Pipeline Management LP, a structure that individual Deh Cho communities can utilize to join, pro-rata in the 34% share that the Aboriginal Pipeline Group has set aside for the Deh Cho.

Another significant recent development, of major potential importance for the MGP construction through the various Treaty Settlement Regions and potential all weather road construction phase, is the Mackenzie Aboriginal Corporation. The Gwich'in Development Corporation has created a new joint venture model. Its design features a jointly-owned company, the Mackenzie Aboriginal Corporation (MAC), which is 51% Aboriginal-owned and 49% owned by four Southern major infrastructure engineering, procurement and construction (EPC) firms. MAC has since been joined by Denendeh Investments Inc., reducing the founding Gwich'in MAC interest. Encouragingly, the Deh Cho has recently signed a Letter of Intent to also join the Gwich'in-initiated MAC. Discussions are ongoing with the Sahtu and Dene Tha to include all the Aboriginal business development corporations from the regions through which the pipeline passes as shareholders in the 51% Aboriginal tranche. The four firms each equally sharing the remaining 49% equity non-Aboriginal interest

in MAC are Flint Energy Services, Peter Kiewit Sons Co., The Ledcor Group of Companies and North American Construction Group.

The Denendeh implemented one of the original Putt Report's recommendations by hosting an Aboriginal business development event and workshop in Yellowknife and creating the NWT Aboriginal Business Development Association to foster development and partnering with existing and emerging Aboriginal businesses. As have the Inuvialuit and Denendeh, the Gwich'in and Deh Cho are developing business entity profiles and equipment lists for each Aboriginal-owned business in their respective regions. The Inuvialuit Regional Corporation has published such a list for some time.

Some of the business development opportunities described in the original Putt Report are now up and running, particularly in the drilling and well servicing sectors, some have been created and are in the bid development stage with jointly funded overhead and project development costs, and some Aboriginal groups are still contemplating joining consortia.

As well, increased exploration and development drilling activity along the MGP route and in the Mackenzie Delta in the interim has confirmed sufficient potential commercial production to encourage one third party natural gas producer (MGM Energy) to apply for access to the Mackenzie Gathering System and for conveyance on the Mackenzie Gas Pipeline. MGM Energy has executed a Capacity Request Agreement for 200 MM c.f./day capacity in the Mackenzie Gathering System, dated October 12, 2007.

Since the Putt report was issued in 2000, noteworthy exploration, drilling, and oilfield services joint ventures have been expanded or created.

Examples are:

➤ Akita Drilling Ltd.

Akita's joint ventures now number eight and include 10 rigs. Four Northwest Territories examples are:

- Akita Equetak Drilling Ltd – Inuvialuit Development Corporation (IDC)
- Akita Trailbreaker – Gwich'in Beneficiary
- Akita Sahtu – Sahtu Oil (Dene and Metis Land Corporations)
- Akita Sahcho – Acho Dene Ko (Fort Liard)

Each joint venture is a 50/50 business enterprise with partner ownership of up to 50% of the rigs within the partnership. There is meaningful participation with equal board representation and the Chair is always represented by the Aboriginal partner. Akita has approximately \$40 million of Aboriginal, Inuvialuit and Metis investment within its eight Aboriginal JV companies and boasts approximately

15% (self identified) partner employment within the company, from entry level to executive.

- Savanna Energy Services Corp. (owns Western Lakota Energy Services Inc.) Savanna is currently partnered with nine First Nations Communities; however, currently none are “North of 60” entities.
- Shehtah Drilling LP (owned by Denendeh Investment Incorporated (DII)) Shehtah Nabors LP is a partnership between Shehtah Drilling LP and Nabors Canada. The partnership was formed to focus on work “North of 60”. Shehtah Nabors LP presently operates four Drilling Rigs and four Service Rigs. Three drilling rigs are Conventional Triple Drilling Rigs are equipped for work in extreme weather conditions and the fourth drilling rig is an AC unit rigged up to move quickly and capable of drilling with coil tubing or a top drive with jointed pipe. Shehtah Nabors also operate two Free Standing Single Tubing Double Rod Service Rigs and two Free Standing Double Tubing Double Rod Services Rigs. All service rigs have been remanufactured and are fully equipped to work under extreme weather conditions. The management team has over 30 seasons of Northern experience. The partnership has the capacity, expertise, and equipment to build access roads and leases, drill and complete wells and tie them in for production with any area and all weather conditions.

Seismic Joint Ventures

On a typical land seismic survey, the seismic recording crew is supported by a surveying crew and a drilling crew. The surveying crew lays out the line locations to be recorded and identifies the sites for shot-hole placement. The shot hole drilling crew creates the shallow holes for the explosive charges that produce the necessary acoustical impulse. A mechanical vibrating unit is used in areas where explosives are not utilized. The seismic crew lays out the geophones and recording instruments, directs shooting operations and records the acoustical reflection signals.

There are business opportunities in the contracting of the field work necessary for seismic data acquisition and in bearing a share of the complete costs of the seismic data acquisition and processing and thus acquiring an equity interest in the knowledge-based seismic product.

- Inuvialuit Oilfield Services – IDC with Schlumberger From seismic exploration to well completion, Inuvialuit Oilfield Services Ltd. (IOS) supports all phases of oil and gas projects. Jointly held by the Inuvialuit Development Corporation (IDC) 51% and Schlumberger 49% the company specializes in geological & geophysical consulting, cementing services, drilling measurement services (DD/MWD/LWD), drill bits and drilling fluids, marine seismic data acquisition, seismic data processing,

well completion services, well logging – cased and open hole; electric and slick line, well stimulation, and well testing.

- Veri-Illuq Geophysical Ltd.
Veri-Illuq is a business entity owned 51% by the Inuvialuit Regional Corporation and 49% by Veritas Dgc Inc. that was created to conduct seismic data acquisition, both land-based and marine data acquisition, seismic data processing and seismic data sales.
- With Trace Energy Services Inc. (49%)
 - Delta Trace Ltd.
 - Trace Energy Services (Sahtu) Ltd.
 - Trace Energy Services (Inuvialuit) Ltd

Trace Energy Services (Inuvialuit) Ltd. sold its interest in certain seismic data library surveys to third parties in 2004 and 2005

Environmental and Geotechnical

- Inuvialuit Environmental & Geotechnical Inc. (IEG)
IEG is an engineering, project management and environmental science company owned by the Inuvialuit Development Corporation that will do the described work directly or in partnership with non-Aboriginal firms having specific expertise that is complementary.

Geomatics

- Inukshuk Geomatics – IDC with Challenger Geomatics Inc.
Inukshuk Geomatics is a geomatics-driven engineering services corporation controlled by IDC with Challenger Geomatics Ltd. that provides logistical and Arctic knowledge of IDC with Challenger's operational and technical expertise in precise mapping and location control for exploration, drilling and infrastructure projects. Besides Geomatics consulting & services, Inukshuk provides Civil Engineering consulting, ice profiling, navigation guidance as well as land development & management.

Natural Gas Power Generation

In terms of using locally available natural gas, the Northwest Territories Power Corporation (NT Power) spent some \$5 million to convert their Inuvik diesel power generation to natural gas powered generators. Additionally, in the fall of 2002 NT Power has installed a demonstration microturbine power and heat co-generation pilot project at the Inuvik Community Centre to demonstrate the concept's feasibility using two Capstone microturbines fueled by commercially-available gas from Inuvik Gas Ltd. from the Inuvialuit Petroleum Corporation's Ikhil natural gas field. Experience on these applications in terms of run-life experience and integration engineering for turnkey installations was mixed, at best with poor process integration

and load balancing, however, the experience continues to improve with more heat load added. Capstone is the leading producer of microturbines for gas-fired electric power and cogeneration, where heat can also be utilized, with over 15 million hours of service run life as at mid-2007. Capstone has recently developed turnkey cogeneration applications with single microturbines with capacity up to 200 K.W. per unit.

The Mackenzie Valley Gas Conversion Project will provide more clarity on the economic viability of using microturbine power and cogeneration for those sites along the MGP that will be initially designated as having access to mainline natural gas.

The objective of the contract due March 31, 2008, is to update and supplement existing work of the Ch-4 Report and Technical / Economical and Engineering Feasibility Study of supplying natural gas or gas-generated electricity to Tulita, Fort Good Hope, and Fort Simpson communities. The business case for the conversion of northern communities to natural gas is to be further refined by fully reviewing input costs and revenue assumptions, and undertaking a pre-feasibility level on-site examination of potential facility and distribution system locations in the three communities currently being considered by the MGP proponents for designated tie-ins for mainline gas access. The purpose for the high-level on-site review is to identify any local conditions that could potentially have a substantial impact on project costs.

A secondary objective is to identify other opportunities that may be available for communities to take advantage of access to natural gas for heating and power purposes. The technical issues, economics and engineering considerations, as well as pricing feasibility study of constructing a lateral pipeline to the communities to provide gas to these three communities will guide policy in this regard.

Petrochemicals

It is understood that the blended gas composition is expected to be leaner than 2.6% - 3.2% ethane, more likely at the low end of the range. The MGM gas from Umiak gas looks like Taglu gas composition, which is drier than Parsons Lake and the MGM west side gas looks like Niglintgak, the driest in gas liquids and ethane of the three core gas fields. The gas in the delta tertiary gets leaner as the reservoirs move from East to West. Since a gas stream composition of about 4% ethane is close to the dilute end of the range for viable ethane extraction. At 4% C₂ the ethane extraction efficiency is some 70%; at 3.5% some 65%, and at 3.2% likely less than 60% recovery. The recovery efficiency declines rapidly as the ethane concentration in the gas being processed gets leaner than these levels. For the lower startup volumes contemplated, some 6% C₂ content would likely be required for economic ethane extraction from the mainline gas, if there was a viable site in the NWT.

Since the current expectations are for Mackenzie Delta natural gas to be at ethane compositions well below 4% ethane, a Straddle Plant to extract ethane does not

appear viable at this time. If the ethane component was present in rich enough concentrations in the natural gas pipeline in the future, through additional fields coming on stream or changing concentrations from the Mackenzie Delta producers East of Parsons Lake to make C2 economically extractable, pipeline economics would likely warrant an extraction location as close to the southern infrastructure in Alberta as possible and certainly adjacent to salt cavern storage. In that instance, owners of equity in ethane-rich natural gas could still seek an interest in extraction facilities.

In any event, the Petro-Chemicals section of the Putt Report would need a significant amount of updating to reflect the change in situation over the last 8 years and perhaps more importantly, will need a thorough re-assessment of the petrochemical opportunities (in context of the global picture) based on the feedstocks, current and expected future pricing of feedstocks, and global forces impacting where petrochemicals are produced.

KemeX Engineering Services Ltd., a leading Canadian company with world-wide Petro-chemical feasibility and design from Alberta are best positioned to do such a study update.

Policy

With the signing of the Mackenzie Valley Gas Project Socio-Economic Agreement (SEA) between the Government of the Northwest Territories (GNWT) and Imperial Oil Resources Ventures Limited, ConocoPhillips Canada (North) Limited and Shell Canada Energy in late 2007, many of the socio-economic policy issues became codified and set out in the SEA.

Several other policy issues remain outstanding, namely

- Agreement between GNWT and the Federal government on GNWT obtaining Royalties from the NWT production of petroleum (natural gas, natural gas liquids and oil). This prevents the GNWT taking royalty gas (and gas liquids) “in-kind” and encouraging further value added processing in the NWT or by NWT companies “South of 60.”
- Provision for identified liquid off take points to remove bulk natural gas liquids from selected points along the natural gas liquids line for fuel uses where trucking of the liquids would be an economic alternative to diesel fuel from southern sources.
- An early-stage Western Economic Development model for the North that recognizes that small and start-up businesses normally don’t qualify for bank financing or mezzanine financing. The Arctic Cooperatives Development Fund and other mechanisms need to be developed jointly with the Federal Government and small and medium-sized enterprise (SME) support groups such as NRC’s Industrial Research Assistance Program (IRAP) for all business ventures, not just technology-driven ones.

11.0 Summary /Areas for Further Developmental Study

It has been observed that "the more remote the industry, the more power is put in the hands of the transporter." This has resonance for the proposed Mackenzie Valley natural gas pipeline, as well, since the potential benefits from secondary industries, value-added activities and the usefulness of community access to affordable natural gas in the region cannot be achieved if the Producer/Developer doesn't have an adequate risk-adjusted economic return. Hence, any additional economic burdens suggested to the Producer/Developer and pipeline contractors, owners and operator, to more evenly balance the power, risks and benefits, must not preclude the economic viability of the overall proposed project. The Socio Economic Agreement (SEA) has codified much of the Applicant's and the GNWT's responsibilities with respect to local, regional and Territories-wide benefits.

That said, there are a number of potential opportunity areas for subsidiary benefits of incremental secondary industries and value-added economic activities that can be achieved by considering the feasibility and scoping the opportunities early in the planning and approval processes.

Some of the areas warranting further studies will require additional clarity of proposed intent from the Producers/Developers to be most useful, others can be done somewhat independently.

The suggested priority areas for further study, pre-feasibility examination and/or funding involvement by the GNWT are as follows, along with suggestions of some possible participants.

- Ongoing sponsorship support of the NWT Aboriginal Business Development Association to foster development and partnering with existing and emerging Aboriginal businesses. The Aboriginal Business Development Association could be funded to organize this annually with consulting and event management assistance, for its members, along with the Applicants, their contractors and invited guests, to share best practices and flesh out business opportunities.
- Study the application of natural gas and NGL-fired Microturbine power generation and cogeneration versus conversion of existing P-50 fueled power generation for the three designated communities with designated MGP pipeline access valves. Also compare costs of power generated at compressor stations and/or access valve take-off points from the mainline pipeline and high voltage power distribution to the communities versus natural gas laterals and local distribution from the "town gate." A microturbine consultant and the Northwest Territories Power Corporation, who could best provide the HVAC transmission and diesel P-50 to natural gas power conversion costs. North of 60 Engineering Ltd. or the consultant used for "The Mackenzie Valley Gas Conversion Project" would be well placed to update and cost

the gas laterals, pressure letdown, metering and distribution costs from earlier studies and scope the natural gas distribution in named communities.

- Conduct a study to determine the safety and economic viability of using Mackenzie Gathering System (MGS) NGL's for microturbines, motive fuel and space heating fuel. For example, since 50% of the raw gas C4's are recovered in the MGS NGL's at the Inuvik processing plant for shipment south via a separate NGL liquids pipeline to Norman Wells, the liquid condensate may have too high a C4 content and RVP for safe direct use as motor gasoline substitution. Conversely there may be too many heavy ends. Alberta Research Council or the Applicant's could provide guidance in this area.
- Conduct a "paper" scoping geological reconnaissance study of salt cavern resources potentially suitable for NGL storage in the Mackenzie Valley pipeline/transportation corridor from the Mackenzie Delta South to the Alberta border. This would involve integrating all past isolated sources of information with regional and local mapping and knowledge from past exploration and seismic work, where accessible to inquiry. The engineering requirements for use of suitable salt caverns for C2, C3 C4 and mixed NGL storage would not be done as they need to be related to the identified available cavern resource(s) mated with an optimum location for NGL processing/fractionation and clean product pipelining. The subsurface ownership and land use approval requirements would need to be spelled out for each major resource identified. Henday Frontier is familiar with this geological issue and could be contracted to put together a detailed proposal for such a preliminary investigation.
- An overview review of the world-wide Petrochemicals environment and developments since 2000 should be conducted. Now that the mainline pipeline gas composition has been firmed up, such a sector overview would confirm that a more detailed ethane extraction study should not be encouraged at this time. Such an overview study would surface the options for "stranded gas" such as methanol manufacture and confirm or refute options via screening-level economics. Kemex Engineering Services Ltd. would be well suited to do such a Petrochemicals study.
- Two other potential synergistic opportunities exist with local natural gas or extracted liquids-fueled Microturbine cogeneration. They are: 1) A hothouse operation near a community/transportation infrastructure and 2) A lumber mill powered by local Microturbine cogeneration with the power to run the sawmill and the heat used in space heating and kiln drying of the lumber product. The hothouse needs access to affordable nutrients and high-enough value products to absorb the product shipment costs. The lumber mill must be close to a supply of suitable timber, labour, and transportation. The Community Gardening Society of Inuvik and a consultant may make viable recommendations following discussions with the B.C. Hothouse Growers' Association and the B.C. Ministry of Agriculture. In the case of the lumber mill cogeneration/kiln drying application, Tarpon Energy could explore any power/kiln drying heat cogeneration application using Capstone microturbines with Salton Fabrication of Vancouver, who specialize in lumber drying kilns and have done a wood waste heat recovery project in Fort Nelson, near the Liard Valley.

- A Northern Energy Research Test Centre should be examined. New fuel cell technologies, conversion of diesel engines to natural gas/NGL operation, various microturbine fuels and cogeneration schemes, natural gas from gas hydrates and permafrost-related R&D could be field tested in a new jointly funded NRCan/DIAND/Environment Canada/GNWT/Industry Northern Energy Research Test Centre. This would be ideally located near Inuvik, could be managed by the Aurora Research Institute jointly with NRCan, and use Mackenzie Delta gas as the source of fuels and the Arctic climate as its test of rigour. Data could be readily transmitted to the test centre client companies, wherever they may be located, via the Internet. Such a Research Centre could attract PERD and other government and industrial funding for projects congruent with their identified Northern research priorities. Aurora Research Institute with assistance from consultants and CANMET could do this study. K. R. Croasdale and Associates Ltd. could be a useful resource in pursuing this concept, as he has had long involvement with PERD..
- The opportunity to manufacture geotextiles in the Northwest Territories was been identified because of a large expected ramp up in demand and potential ongoing need if Northern exploration is expected to persist. This might be best pursued by a Treaty settlement area economic development organization, such as the Inuvialuit Development Corporation, with consulting assistance, with reference to the Fort Chipewyan "wristolet" experience and a scoping estimate from the Producers/Developers and or pipeline designers of the expected geotextile requirements.
- An Economic Development Capital Availability/Financing Study needs to be conducted to examine existing funding mechanisms for Northern businesses and recommend creation of new mechanisms and increased availability of Capital for indigenous NWT business creation and growth. Capital infusion into the Arctic Cooperatives Federation of the Northwest Territories and Nunavut's financing vehicle, the Arctic Co-operative Development Fund, may be an example that could be replicated beyond Co-operatives to support new Northern and Aboriginal business development and startup investment opportunities, as could creation of a micro-business economic development fund. Industry, The GNWT Industry, Tourism and Investment Department should pursue with the Federal Government's Western Economic Diversification crown corporation an infusion of \$50 million of WED funds, as has been done across the western provinces, with rules tailored to encourage Aboriginal and Northern business development, to replenish the original \$50 million fund which is mostly committed. This would to permit greater access to financing for new secondary industry businesses and to fund major growth of successful existing businesses, where banks would be otherwise disinterested.
- Refining should not be studied for Northwest Territories locations because of lack of markets and absence of economies of scale. There may be same opportunities for local processing of MGS NGL's for use in the Inuvik area or elsewhere between Inuvik and Norman Wells, if agreement can be reached with the Applicant to provide designated NGL pipeline access valves and a pricing mechanism can be agreed upon. North of 60 could evaluate this.

- Study of the creation of Fischer-Tropsch liquids from NWT feedstocks may warrant further review as the technology advances and becomes demonstrated and economic at current high crude oil prices (and lower natural gas prices on a BTU equivalency basis). Low sulphur regulations for transportation gasoline and diesel and less aromatics/higher cetane requirements in diesel may make Fischer-Tropsch zero sulphur paraffinic liquids attractive as a high value blending stock for Southern refineries and fuel pools. Any work in this area could best be done by and/or with the Applicants, several of which have access to the proprietary Fischer-Tropsch technology of their international parent companies.

The Mackenzie Valley Pipeline Office maintains frequent contact with the Applicants and the Mackenzie Valley regional leadership / stakeholders' group. This frequent exchange of information, status, requests for data needs and clarification of intentions will facilitate a timelier, collaborative approach to the planning, approval and development processes.

I trust 'this report will assist the GNWT in its ongoing development.

K.W. Putt

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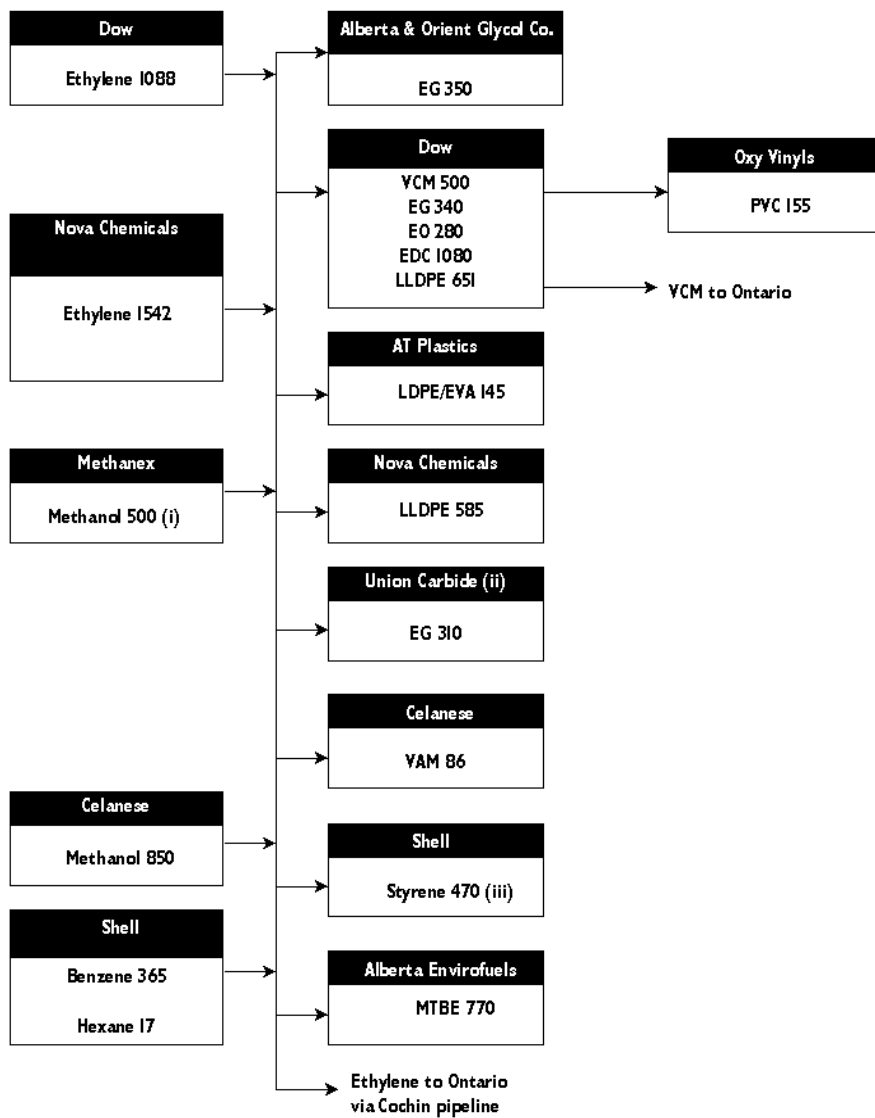
K.W. Putt Consulting Inc.

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Appendix

Source: CCPA

Alberta Petrochemical Plants Nameplate Capacity (as at January 1, 2000)



- (i) site also contains mothballed units totalling 600 kt
- (ii) Dow merging with Union Carbide
- (iii) Shell starting up new 440 kt EG plant in July 2000